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# RECEIVING TUBE MANUAL





# RADIO CORPORATION OF AMERICA

ELECTRONIC COMPONENTS AND DEVICES
HARRISON, NEW JERSEY

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# RCA Receiving Tube Manual

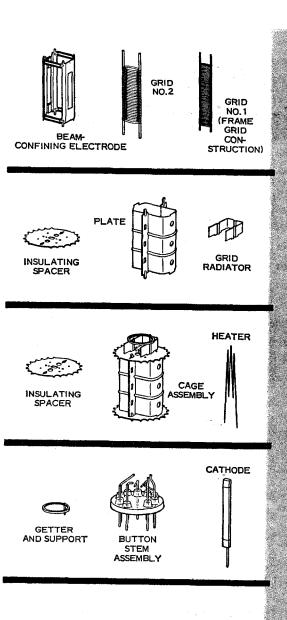
THIS MANUAL, like its preceding editions, has been prepared to assist those who work or experiment with home-entertainment-type electron tubes and circuits. It will be found valuable by engineers, service technicians, educators, experimenters, radio amateurs, hobbyists, students, and many others technically interested in electron tubes.

This up-dated edition features an all-inclusive Index to RCA Receiving Tubes, a comprehensive listing which will greatly facilitate the location of specific tube types in the manual. In addition, for more convenient referencing of latest tube types, the Technical Data Section has been restricted to coverage of active RCA types; basic data for replacement and discontinued RCA tubes are given in the RCA Types for Replacement Use table.

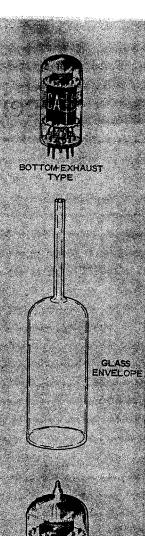
### RADIO CORPORATION OF AMERICA

ELECTRONIC COMPONENTS AND DEVICES

HARRISON, N. J.



Parts of a Typical Receiving Tube





# Electrons, Electrodes and Electron Tubes

THE electron tube is a marvelous device. It makes possible the performing of operations, amazing in conception, with a precision and a certainty that are astounding. It is an exceedingly sensitive and accurate instrument—the product of coordinated efforts of engineers and craftsmen. Its construction requires materials from every corner of the earth. Its use is world-wide. Its future possibilities, even in the light of present-day accomplishments, are but dimly foreseen, for each development opens new fields of design and application.

The importance of the electron tube lies in its ability to control almost instantly the flight of the millions of electrons supplied by the cathode. It accomplishes this control with a minimum of energy. Because it is almost instantaneous in its action, the electron tube can operate efficiently and accurately at electrical frequencies much higher than those attainable with rotating machines.

#### Electrons

All matter exists in the solid, liquid, or gaseous state. These three forms consist entirely of minute divisions known as molecules, which, in turn, are composed of atoms. Atoms have a nucleus which is a positive charge of electricity, around which revolve tiny charges of negative electricity known as electrons. Scientists have estimated that electrons weigh only 1/30-billion, billion, billion, billion, billion that of an ounce, and that they may travel at speeds of thousands of miles per second.

Electron movement may be accelerated by the addition of energy. Heat is

one form of energy which can be conveniently used to speed up the electron. For example, if the temperature of a metal is gradually raised, the electrons in the metal gain velocity. When the metal becomes hot enough, some electrons may acquire sufficient speed to break away from the surface of the metal. This action, which is accelerated when the metal is heated in a vacuum, is utilized in most electron tubes to produce the necessary electron supply.

An electron tube consists of a cathode, which supplies electrons, and one or more additional electrodes, which control and collect these electrons, mounted in an evacuated envelope. The envelope may be made of glass, metal, ceramic, or a combination of these materials.

### Cathodes

A cathode is an essential part of an electron tube because it supplies the electrons necessary for tube operation. When energy in some form is applied to the cathode, electrons are released. Heat is the form of energy generally used. The method of heating the cathode may be used to distinguish between the different forms of cathodes. For example, a directly heated cathode, or filament-cathode, is a wire heated by the passage of an electric current. An indirectly heated cathode, or heatercathode, consists of a filament, or heater, enclosed in a metal sleeve. The sleeve carries the electron-emitting material on its outside surface and is heated by radiation and conduction from the heater.

A filament, or directly heated cathode, such as that shown in Fig. 1 may be further classified by identifying the filament or electron-emitting material. The materials in regular use are tungsten, thoriated tungsten, and metals which have been coated with alkaline-earth oxides. Tungsten filaments are made from the pure metal. Because they must operate at high temperatures (a dazzling white) to emit sufficient electrons, a relatively large amount of filament power is required.

Thoriated-tungsten filaments are made from tungsten impregnated with thorium oxide. Due to the presence of thorium, these filaments liberate electrons at a more moderate temperature of about 1700°C (a bright yellow) and are, therefore, much more economical of filament power than are pure tungsten filaments.

Alkaline earths are usually applied as a coating on a nickel-alloy wire or ribbon. This coating, which is dried in a relatively thick layer on the filament, requires only a relatively low temperature of about 700-750°C (a dull red) to produce a copious supply of electrons. Coated filaments operate very efficiently and require relatively little filament power. However, each of these cathode materials has special advantages which determine the choice for a particular application.

Directly heated filament-cathodes require comparatively little heating power. They are used in tube types designed for battery operation because it is, of course, desirable to impose as small a drain as possible on the batteries. They are also used in rectifiers such as the 1G3GT/1B3GT and the 5Y3GT.

An indirectly heated cathode, or heater-cathode, consists of a thin metal sleeve coated with electron-emitting material such as alkaline-earth oxides. The emissive surface of the cathode is maintained at the required temperature (approximately 1050°K) by resistance-heating of a tungsten or tungsten-alloy wire which is placed inside the cathode sleeve and electrically insulated from it, as shown in Fig. 2. The heater is used only for the purpose of heating the cathode sleeve and sleeve coating to an electron-emitting temperature.

Useful emission does not take place from the heater wire.

A new dark heater insulating coating developed by RCA has better heat transfer than earlier aluminum-oxide coatings, and makes it possible to operate heaters at lower temperatures for given power inputs. Because the tensile strength of the heater wire increases at the lower operating temperatures, tubes using dark heaters have increased reliability, stability, and life.

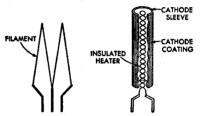


Fig. 1—Filament or directly heated cathode.

Fig. 2—Indirectly heated cathode or heater-cathode

The heater-cathode construction is well adapted for use in electron tubes intended for operation from ac power lines and from storage batteries. The use of separate parts for emitter and heater functions, the electrical insulation of the heater from the emitter, and the shielding effect of the sleeve may all be utilized in the design of the tube to minimize the introduction of hum from the ac heater supply and to minimize electrical interference which might enter the tube circuit through the heater-supply line. From the viewpoint of circuit design, the heater-cathode construction offers advantages in connection flexibility because of the electrical separation of the heater from the cathode.

Another advantage of the heatercathode construction is that it makes practical the design of a rectifier tube having close spacing between its cathode and plate, and of an amplifier tube having close spacing between its cathode and grid. In a close-spaced rectifier tube, the voltage drop in the tube is low, and, therefore, the regulation is improved. In an amplifier tube, the close spacing increases the gain obtainable from the tube. Because of the advantages of the heater-cathode construction, almost all present-day receiving tubes designed for ac operation have heater-cathodes.

### **Generic Tube Types**

Electrons are of no value in an electron tube unless they can be put to work. Therefore, a tube is designed with the parts necessary to utilize electrons as well as those required to produce them. These parts consist of a cathode and one or more supplementary electrodes. The electrodes are enclosed in an evacuated envelope having the necessary connections brought out through air-tight seals. The air is removed from the envelope to allow free movement of the electrons and to prevent injury to the emitting surface of the cathode.

When the cathode is heated, electrons leave the cathode surface and form an invisible cloud in the space around it. Any positive electric potential within the evacuated envelope offers a strong attraction to the electrons (unlike electric charges attract; like charges repel). Such a positive electric potential can be supplied by an anode (positive electrode) located within the tube in proximity to the cathode.

### Diodes

The simplest form of electron tube contains two electrodes, a cathode and an anode (plate), and is often called a diode, the family name for a two-electrode tube. In a diode, the positive potential is supplied by a suitable electrical source connected between the plate terminal and a cathode terminal, as shown in Fig. 3. Under the influence of the positive plate potential, electrons

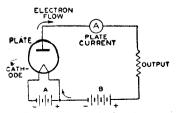


Fig. 3-Basic diode circult.

flow from the cathode to the plate and return through the external plate-battery circuit to the cathode, thus completing the circuit. This flow of electrons is known as the plate current.

If a negative potential is applied to the plate, the free electrons in the space surrounding the cathode will be forced back to the cathode and no plate current will flow. If an alternating voltage is applied to the plate, the plate is alternately made positive and negative. Because plate current flows only during the time when the plate is positive, current flows through the tube in only one direction and is said to be rectified. Fig. 4 shows the rectified output current produced by an alternating input voltage.

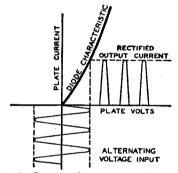


Fig. 4—Current characteristics of rectifier circuit.

Diode rectifiers are used in ac receivers to convert the ac supply voltage to de voltage for the electrodes of the other tubes in the receiver. Rectifier tubes having only one plate and one cathode, such as the 35W4, are called half-wave rectifiers, because current can flow only during one-half of the alternating-current cycle. When two plates and one or more cathodes are used in the same tube, current may be obtained on both halves of the ac cycle. The 6X4, 5Y3GT, and 5U4GB are examples of this type and are called full-wave rectifiers.

Not all of the electrons emitted by the cathode reach the plate. Some return to the cathode, while others remain in the space between the cathode and plate for a brief period to produce an effect known as space charge. This charge has a repelling action on other electrons which leave the cathode surface and impedes their passage to the plate. The extent of this action and the amount of space charge depend on the cathode temperature, the distance between the cathode and the plate, and the plate potential. The higher the plate potential, the less is the tendency for electrons to remain in the space-charge region and repel other electrons. This effect may be noted by applying increasingly higher plate voltages to a tube operating at a fixed heater or filament voltage. Under these conditions, the maximum number of available electrons is fixed, but increasingly higher plate voltages will succeed in attracting a greater proportion of the free electrons.

Beyond a certain plate voltage, however, additional plate voltage has little effect in increasing the plate current because all of the electrons emitted by the cathode are already being drawn to the plate. This maximum current, illustrated in Fig. 5, is called saturation current. Because it is an indication of the total number of electrons emitted, it is also known as emission current or simply emission.

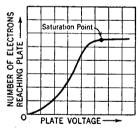


Fig. 5—Current characteristic of diode tube.

Although tubes are sometimes tested by measurement of their emission current, it is generally not advisable to measure the full value of emission because this value would be sufficiently large to cause change in the tube characteristics or even to damage the tube. Consequently, while the test value of emission current is somewhat larger than the maximum current which will be required from the cathode in the

use of the tube, it is ordinarily less than the full emission current. The emission test, therefore, is used to indicate whether the cathode can supply a sufficient number of electrons for satisfactory operation of the tube.

If space charge were not present to repel electrons coming from the cathode, the same plate current could be produced at a lower plate voltage. One way to make the effect of space charge small is to make the distance between plate and cathode small. This method is used in rectifier types having heatercathodes, such as the 5V4GA and the 6AX5GT. In these types the radial distance between cathode and plate is only about two hundredths of an inch.

Another method of reducing spacecharge effect is utilized in mercuryvapor rectifier tubes. When such tubes are operated, a small amount of mercury contained in the tube is partially vaporized, filling the space inside the bulb with mercury atoms. These atoms are bombarded by electrons on their way to the plate. If the electrons are moving at a sufficiently high speed, the collisions tear off electrons from the mercury atoms. The mercury atom is then said to be "ionized," i.e., it has lost one or more electrons and, therefore, has a positive charge. Ionization is evidenced by a bluish-green glow between the cathode and plate. When ionization occurs, the space charge is neutralized by the positive mercury atoms so that increased numbers of electrons are made available. Mercury-vapor tubes are used primarily for power rectifiers.

Ionic-heated-cathode rectifiers depend on gas ionization for their operation. These tubes are of the full-wave design and contain two anodes and a coated cathode sealed in a bulb containing a reduced pressure of inert gas. The cathode becomes hot during tube operation, but the heating effect is caused by bombardment of the cathode by ions within the tube rather than by heater or filament current from an external source.

The internal structure of an ionicheated-cathode tube is designed so that when sufficient voltage is applied to the tube, ionization of the gas occurs between the anode which is instantaneously positive and the cathode. Under normal operating voltages, ionization does not take place between the anode that is negative and the cathode, so that the requirements for rectification are satisfied. The initial small flow of current through the tube is sufficient to raise the cathode temperature quickly to incandescence, whereupon the cathode emits electrons. The voltage drop in such tubes is slightly higher than that of the usual hot-cathode gas rectifiers because energy is taken from the ionization discharge to keep the cathode at operating temperature. Proper operation of these rectifiers requires a minimum flow of load current at all times to maintain the cathode at the temperature required to supply sufficient emission.

### Triodes

When a third electrode, called the grid, is placed between the cathode and plate, the tube is known as a triode, the family name for a three-electrode tube. The grid usually consists of relatively fine wire wound on two support rods (siderods) and extending the length of the cathode. The spacing between turns of wire is large compared with the size of the wire so that the passage of electrons from cathode to plate is practically unobstructed by the grid. In some types, a frame grid is used. The frame consists of two siderods supported by four metal straps. Extremely fine lateral wire (diameter of 0.5 mil or less) is wound under tension around the frame. This type of grid permits the use of closer spacings between grid wires and between tube electrodes, and thus improves tube performance.

The purpose of the grid is to control the flow of plate current. When a tube is used as an amplifier, a negative dc voltage is usually applied to the grid. Under this condition the grid does not draw appreciable current.

The number of electrons attracted to the plate depends on the combined effect of the grid and plate polarities, as shown in Fig. 6. When the plate is positive, as is normal, and the dc grid voltage is made more and more negative, the plate is less able to attract electrons to it and plate current decreases. When the grid is made less and less negative (more and more positive), the plate more readily attracts electrons to it and plate current increases. Hence, when the voltage on the grid is varied in accordance with a signal, the plate current varies with the signal. Because a small voltage applied to the grid can control a comparatively large amount of plate current, the signal is amplified by the tube. Typical three-electrode tube types are the 6C4 and 6AF4A.

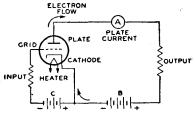


Fig. 6-Basic triode circuit.

The grid, plate, and cathode of a triode form an electrostatic system, each electrode acting as one plate of a small capacitor. The capacitances are those existing between grid and plate, plate and cathode, and grid and cathode. These capacitances are known as interelectrode capacitances. Generally, the capacitance between grid and plate is of the most importance. In high-gain radio-frequency amplifier circuits, this capacitance may act to produce undesired coupling between the input circuit, the circuit between grid and cathode, and the output circuit, the circuit between plate and cathode. This coupling is undesirable in an amplifier because it may cause instability and unsatisfactory performance.

#### **Tetrodes**

The capacitance between grid and plate can be made small by mounting an additional electrode, called the screen grid (grid No. 2), in the tube. With the addition of the grid No. 2, the tube has four electrodes and is, accordingly, called a tetrode. The screen

grid or grid No. 2 is mounted between the grid No. 1 (control grid) and the plate, as shown in Fig. 7, and acts as an electrostatic shield between them, thus reducing the grid-to-plate capacitance. The effectiveness of this shielding action is increased by a bypass

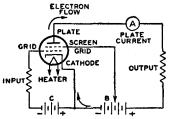


Fig. 7—Basic tetrode circuit.

capacitor connected between screen grid and cathode. By means of the screen grid and this bypass capacitor, the grid-plate capacitance of a tetrode is made very small. In practice, the grid-plate capacitance is reduced from several picofarads (pF) for a triode to 0.01 pF or less for a screen-grid tube.

The screen grid has another desirable effect in that it makes plate current practically independent of plate voltage over a certain range. The screen grid is operated at a positive voltage and, therefore, attracts electrons from the cathode. However, because of the comparatively large space between wires of the screen grid, most of the electrons drawn to the screen grid pass through it to the plate. Hence the screen grid supplies an electrostatic force pulling electrons from the cathode to the plate. At the same time the screen grid shields the electrons between cathode and screen grid from the plate so that the plate exerts very little electrostatic force on electrons near the cathode.

So long as the plate voltage is higher than the screen-grid voltage, plate current in a screen-grid tube depends to a great degree on the screengrid voltage and very little on the plate voltage. The fact that plate current in a screen-grid tube is largely independent of plate voltage makes it possible to obtain much higher amplification with a tetrode than with a triode. The

low grid-plate capacitance makes it possible to obtain this high amplification without plate-to-grid feedback and resultant instability. In receiving-tube applications, the tetrode has been replaced to a considerable degree by the pentode.

### **Pentodes**

In all electron tubes, electrons striking the plate may, if moving at sufficient speed, dislodge other electrons. In two- and three-electrode types, these dislodged electrons usually do not cause trouble because no positive electrode other than the plate itself is present to attract them. These electrons, therefore, are drawn back to the plate. Emission caused by bombardment of an electrode by electrons from the cathode is called secondary emission because the effect is secondary to the original cathode emission.

In the case of screen-grid tubes, the proximity of the positive screen grid to the plate offers a strong attraction to these secondary electrons, and particularly so if the plate voltage swings lower than the screen-grid voltage. This effect reduces the plate current and limits the useful plate-voltage swing for tetrodes.

The effects of secondary emission are minimized when a fifth electrode is placed within the tube between the screen grid and plate. This fifth electrode is known as the suppressor grid (grid No. 3) and is usually connected to the cathode, as shown in Fig. 8. Because of its negative potential with respect to the plate, the suppressor grid retards the flight of secondary electrons and diverts them back to the plate.

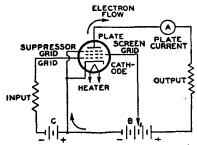


Fig. 8-Basic pentode circuit.

The family name for a five-electrode tube is "pentode," In power-output pentodes, the suppressor grid makes possible higher power output with lower grid-driving voltage: in radio-frequency amplifier pentodes, the suppressor grid makes possible high voltage amplification at moderate values of plate voltage. These desirable features result from the fact that the plate-voltage swing can be made very large. In fact, the plate voltage may be as low as. or lower than, the screen-grid voltage without serious loss in signal-gain capability. Representative pentodes used for power amplification are the 6CL6 and 6K6GT: representative pentodes used for voltage amplification are the 6AU6A, 6BA6, and 5879,

### **Beam Power Tubes**

A beam power tube is a tetrode or pentode in which directed electron beams are used to increase substantially the power-handling capability of the tube. Such a tube contains a cathode, a control grid (grid No. 1), a screen grid (grid No. 2), a plate, and, optionally, a suppressor grid (grid No. 3). When a beam power tube is designed without an actual suppressor grid, the electrodes are so spaced that secondary emission from the plate is suppressed by space-charge effects between screen grid and plate. The space charge is produced by the slowing up of electrons traveling from a high-potential screen grid to a lower-potential plate. In this low-velocity region, the space charge produced is sufficient to repel secondary electrons emitted from the plate and to cause them to return to the plate.

Beam power tubes of this design employ beam-confining electrodes at cathode potential to assist in producing the desired beam effects and to prevent stray electrons from the plate from returning to the screen grid outside of the beam. A feature of a beam power tube is its low screen-grid current. The screen grid and the control grid are spiral wires wound so that each turn of the screen grid is shaded from the cathode by a grid turn. This alignment of the screen

grid and control grid causes the electrons to travel in sheets between the turns of the screen grid so that very few of them strike the screen grid. Because of the effective suppressor action provided by space charge and because of the low current drawn by the screen grid, the beam power tube has the advantages of high power output, high power sensitivity, and high efficiency.

Fig. 9 shows the structure of a beam power tube employing spacecharge suppression and illustrates how

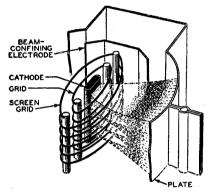


Fig. 9—Structure of beam power tube showing beam-confining action.

the electrons are confined to beams. The beam condition illustrated is that for a plate potential less than the screen-grid potential. The high-density space-charge region is indicated by the heavily dashed lines in the beam. Note that the edges of the beam-confining electrodes coincide with the dashed portion of the beam. In this way the space-charge potential region is extended beyond the beam boundaries and stray secondary electrons are prevented from returning to the screen grid outside of the beam. The spacecharge effect may also be obtained by use of an actual suppressor grid. Examples of beam power tubes are 6AQ5A, 6L6GC, 6V6GTA, and 50C5.

### Multi-Electrode and Multi-Unit Tubes

Early in the history of tube devel-

opment and application, tubes were designed for a general service; that is, a single tube type—a triode—was used as a radio-frequency amplifier, an intermediate-frequency amplifier, an audio-frequency amplifier, an oscillator, or a detector. Obviously, with this diversity of application, one tube did not meet all requirements to the best advantage.

Later and present trends of tube design are the development of "specialty" types. These types are intended either to give optimum performance in a particular application or to combine in one bulb functions which formerly required two or more tubes. The first class of tubes includes such examples of specialty types as the 6CB6A and 6BY6. Types of this class generally require more than three electrodes to obtain the desired special characteristics and may be broadly classed as multielectrode types. The 6BY6 is an especially interesting type in this class. This tube has an unusually large number of electrodes, namely seven, exclusive of the heater. Plate current in the tube is varied at two different frequencies at the same time. The tube is designed primarily for use as a combined sync separator and sync clipper in television receivers.

The second class includes multiunit tubes such as the twin-diode triodes 6CN7 and 6AV6, as well as triode-pentodes such as the 6U8A and 6X8. This class also includes class A twin triodes such as the 6CG7 and 12AX7A, and types such as the 6CM7 containing dissimilar triode units used primarily as combined vertical oscillators and vertical deflection amplifiers in television receivers. Full-wave rectifiers are also multi-unit types.

A third class of tubes combines features of each of the other two classes. Typical of this third class are the pentagrid-converter types 6BE6 and 6SA7. These tubes are similar to the multi-electrode types in that they have seven electrodes, all of which affect the electron stream; and they are similar to the multi-unit tubes in that they perform simultaneously the double function of oscillator and mixer in superheterodyne receivers.

### **Receiving Tube Structure**

Receiving tubes generally utilize a glass or metal envelope and a base. Originally, the base was made of metal or molded phenolic material. Types having a glass envelope and a molded phenolic base include the "octal" types such as the 5U4GB and the 6SN7GTB. Types having a metal envelope and molded phenolic octal base include the 6F6 and the 6L6. Many modern types utilize integral glass bases. Present-day conventional tube designs utilizing glass envelopes and integral glass bases include the seven-pin and nine-pin miniature types, the nine-pin novar and neonoval types, and the twelve-pin duodecar types. Examples of the seven-pin miniature types are the 6AU6A and 6BN6. Examples of the nine-pin miniature types are the 12AU7A and 6EA8. Examples of the novar types are the 6BH3 and 7868. The nine-pin base for the novar types has a relatively large pin-circle diameter and long pins to insure firm retention of the tube in its socket.

The **nuvistor** concept provided a new approach to electron tube design. Nuvistor tubes utilize a light-weight cantilever-supported cyclindrical electrode structure housed in a ceramic-metal envelope. These tubes combine new materials, processes, and fabrication techniques. Examples of the nuvistor are the 6CW4 and the 6DV4.

### **Television Picture Tubes**

The picture tube, or kinescope, is a multi-electrode tube used principally in television receivers for picture display. It consists essentially of an electron gun, a glass or metal-and-glass envelope and face-plate combination, and a fluorescent screen.

The electron gun includes a cathode for the production of free electrons, one or more control electrodes for accelerating the electrons in the beam, and, optionally, a device for "trapping" unwanted ions out of the electron beam.

Focusing of the beam is accomplished either electromagnetically by

means of a focusing coil placed on the neck of the tube, or electrostatically, as shown in Fig. 10, by means of a focusing electrode (grid No. 4) within the envelope of the tube. The screen is a white-fluorescing phosphor P4 of either the silicate or the sulfide type.

Deflection of the beam is accomplished either electrostatically by means of deflecting electrodes within the envelope of the tube, or electromagnetically by means of a deflecting voke placed on the neck of the tube. Fig. 10 shows the structure of the gun section of a picture tube and illustrates how the electron beam is formed and how the beam is deflected by means of an electromagnetic deflecting yoke. In this type of tube, ions in the beam are prevented from damaging the fluorescent screen by an aluminum film on the gun side of the screen. This film not only "traps" unwanted ions, but also improves picture contrast. In many types of non-aluminized tubes, ions are separated from the electron beam by means of a tilted-gun and ion-trapmagnet arrangement.

Color television picture tubes are similar to black-and-white picture tubes, but differ in three major ways: (1) The light-emitting screen is made up of trios of phosphor dots deposited in an interlaced pattern. Each dot of a trio is capable of emitting light in one of the three primary colors (red, green, or blue). (2) A shadow mask mounted near the screen of the tube contains over 300,-000 apertures, one for each of the phosphor dot trios. This mask provides color separation by shadowing two of the three phosphor dots of each trio. (3) Three closely spaced electron guns, built as a unit, provide separate beams for excitation of the three different color-phosphor-dot arrays. Thus it is possible to control the brightness of each of the three colors independently of the other two. Fig. 11 shows a cutaway view of a color television picture tube.

The three electron guns are mounted with their axes tilted toward the central axis of the envelope, and are spaced 120 degrees with respect to each other. The focusing electrodes of the three guns are interconnected internally, and their potential is adjusted to cause the separate beams to focus at the phosphor-dot screen. All three beams must be made to converge at the screen while they are simultaneously being deflected. Convergence is accomplished by the action of static and

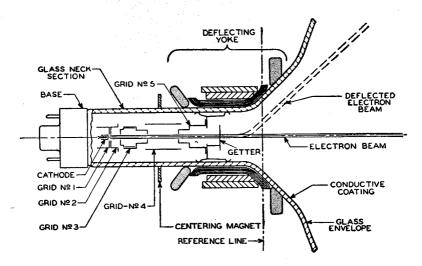


Fig. 10-Structure of television-picture-tube electron gun.

dynamic magnetic fields set up by the radial-converging magnet assembly mounted on the neck of the tube. These fields are coupled into the radial-converging pole pieces within the tube. Another pair of pole pieces in the tube is activated by the lateral-converging magnet also mounted on the neck of the tube. These pole pieces permit lateral shift in position of the blue beam in opposition to the lateral shift of the green and red beams.

A purifying magnet is used with color picture tubes to provide a magnetic field, adjustable in magnitude and direction, to effect register over the entire area of the screen. A magnetic shield is used to minimize the effects of the earth's magnetic field.

Deflection of the three beams is accomplished simultaneously by a deflecting yoke using four electromagnetic coils similar to the deflecing yoke used for black-and-white picture tubes.

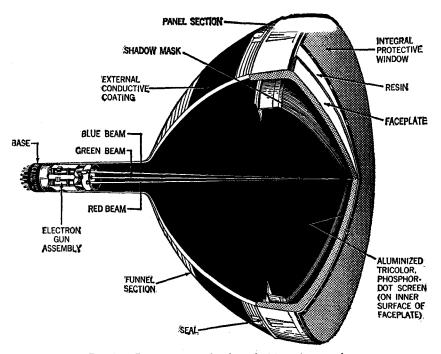


Fig. 11—Cutaway view of color television picture tube.

### Electron Tube Characteristics

THE term "characteristics" is used to identify the distinguishing electrical features and values of an electron tube. These values may be shown in curve form or they may be tabulated. When the characteristics values are given in curve form, the curves may be used for the determination of tube performance and the calculation of additional tube factors.

Tube characteristics are obtained from electrical measurements of a tube in various circuits under certain definite conditions of voltages. Characteristics may be further described by denoting the conditions of measurements. For example, Static Characteristics are the values obtained with different dc potentials applied to the tube electrodes. while Dynamic Characteristics are the values obtained with an ac voltage on a control grid under various conditions of dc potentials on the electrodes. The dynamic characteristics, therefore, are indicative of the performance capabilities of a tube under actual working conditions.

Static characteristics may be shown by plate characteristics curves and transfer (mutual) characteristics curves. These curves present the same information, but in two different forms to increase its usefulness. The plate characteristic curve is obtained by varying plate voltage and measuring plate current for different grid-bias voltages. while the transfer-characteristic curve is obtained by varying grid-bias voltage and measuring plate current for different plate voltages. A plate-characteristic family of curves is shown in Fig. 12. Fig. 13 gives the transfer-characteristic family of curves for the same tube.

Dynamic characteristics include amplification factor, plate resistance, control-grid—plate transconductance, and certain detector characteristics, and may be shown in curve form for variations in tube operating conditions.

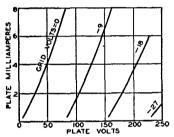


Fig. 12—Family of plate-characteristics curves.

The amplification factor, or  $\mu$ , is the ratio of the change in plate voltage to a change in control-electrode voltage in the opposite direction, under the condition that the plate current remains

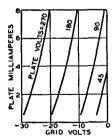


Fig. 13—Family of transfer-characteristics curves.

unchanged and that all other electrode voltages are maintained constant. For example, if, when the plate voltage is made 1 volt more positive, the control-electrode (grid-No. 1) voltage must be made 0.1 volt more negative to hold plate current unchanged, the amplification factor is 1 divided by 0.1, or 10. In other words, a small voltage variation in the grid circuit of a tube has the same effect on the plate current as a large plate-voltage change—the latter equal to the product of the grid-voltage change and amplification factor. The  $\mu$  of a tube is often useful for calculating stage gain. This use is discussed in the **Electron Tube Applications** section.

Plate resistance (r<sub>p</sub>) of an electron tube is the resistance of the path between cathode and plate to the flow of alternating current. It is the quotient of a small change in plate voltage divided by the corresponding change in plate current and is expressed in ohms, the unit of resistance. Thus, if a change of 0.1 milliampere (0.0001 ampere) is produced by a plate-voltage variation of 1 volt, the plate resistance is 1 divided by 0.0001, or 10000 ohms.

Control-grid—plate transconductance, or simply transconductance (gm), is a factor which combines in one term the amplification factor and the plate resistance, and is the quotient of the first divided by the second. This term has also been known as mutual conductance. Transconductance may be more strictly defined as the quotient of a small change in plate current (amperes) divided by the small change in the control-grid voltage producing it, under the condition that all other voltages remain unchanged. Thus, if a grid-

voltage change of 0.5 volt causes a plate-current change of 1 milliampere (0.001 ampere), with all other voltages constant, the transconductance is 0.001 divided by 0.5, or 0.002 mho. A "mho" is the unit of conductance and was named by spelling ohm backwards. For convenience, a millionth of a mho, or a micromho (µmho), is used to express transconductance. Thus, in the example, 0.002 mho is 2000 micromhos.

Conversion transconductance (g.) is a characteristic associated with the mixer (first detector) function of tubes and may be defined as the quotient of the intermediate-frequency (if) current in the primary of the if transformer divided by the applied radio-frequency (rf) voltage producing it; more precisely, it is the limiting value of this quotient as the rf voltage and if current approach zero. When the performance of a frequency converter is determined, conversion transconductance is used in the same way as control-grid-plate transconductance is used in single-frequency amplifier computations.

The plate efficiency of a power amplifier tube is the ratio of the ac power output  $(P_o)$  to the product of the average dc plate voltage  $(E_b)$  and dc plate current  $(I_b)$  at full signal, or

$$\frac{Plate \; efficiency}{\%} = \frac{P_o \; watts}{E_b \; volts \times I_b \; amperes} \; \times 100$$

The power sensitivity of a tube is the ratio of the power output to the square of the input signal voltage (E<sub>1n</sub>), and is expressed in mhos as follows:

Power sensitivity (mhos) = 
$$\frac{P_o \text{ watts}}{(E_{in}, \text{ rms})^2}$$

# Electron Tube Applications

THE diversified applications of an electron receiving tube have, within the scope of this section, been treated under seven headings. These are: Amplification, Rectification, Detection, Automatic Volume or Gain Control, Oscillation, Frequency Conversion, and Automatic Frequency Control. Although these operations may take place at either radio or audio frequencies and may involve the use of different circuits and different supplemental parts, the general considerations of each kind of operation are basic.

### **Amplification**

The amplifying action of an electron tube was mentioned under Triodes in the section on Electrons, Electrodes, and Electron Tubes. This action can be utilized in electronic circuits in a number of ways, depending upon the results desired. Four classes of amplifier service recognized by engineers are covered by definitions standardized by the Institute of Radio Engineers (now the Institute of Electrical and Electronics Engineers). This classification depends primarily on the fraction of input cycle during which plate current is expected to flow under rated full-load conditions. The classes are class A, class AB, class B, and class C. The term "cutoff bias" used in these definitions is the value of grid bias at which plate current is very small.

### Classes of Service

A class A amplifier is an amplifier in which the grid bias and alternating grid voltages are such that plate current in a specific tube flows at all times.

A class AB amplifier is an amplifier in which the grid bias and alternating grid voltages are such that plate current in a specific tube flows for appreciably more than half but less than the entire electrical cycle.

A class B amplifier is an amplifier in which the grid bias is approximately equal to the cutoff value, so that the plate current is approximately zero when no exciting grid voltage is applied, and so that plate current in a specific tube flows for approximately one-half of each cycle when an alternating grid voltage is applied.

A class C amplifier is an amplifier in which the grid bias is appreciably greater than the cutoff value, so that the plate current in each tube is zero when no alternating grid voltage is applied, and so that plate current flows in a specific tube for appreciably less than one-half of each cycle when an alternating grid voltage is applied.

The suffix 1 may be added to the letter or letters of the class identification to denote that grid current does not flow during any part of the input cycle. The suffix 2 may be used to denote that grid current flows during part of the cycle.

For radio-frequency (rf) amplifiers which operate into a selective tuned circuit, as in radio transmitter applications, or under requirements where distortion is not an important factor, any of the above classes of amplifiers may be used, either with a single tube or with a push-pull stage. For audio-frequency (af) amplifiers in which distortion is an important factor, only class A amplifiers permit single-tube operation. In this case, operating con-

ditions are usually chosen so that distortion is kept below the conventional 5 per cent for triodes and the conventional 7 to 10 per cent for tetrodes or pentodes. Distortion can be reduced below these figures by means of special circuit arrangements such as that discussed under inverse feedback. With class A amplifiers, reduced distortion with improved power performance can be obtained by using a push-pull stage for audio service. With class AB and class B amplifiers, a balanced stage using two tubes is required for audio service.

### Class A Voltage Amplifiers

As a class A voltage amplifier, an electron tube is used to reproduce gridvoltage variations across an impedance or a resistance in the plate circuit. These variations are essentially of the same form as the input signal voltage impressed on the grid, but their amplitude is increased. This increase is accomplished by operation of the tube at a suitable grid bias so that the applied grid input voltage produces plate-current variations proportional to the signal swings. Because the voltage variation obtained in the plate circuit is much larger than that required to swing the grid, amplification of the signal is obtained.

Fig. 14 gives a graphical illustration of this method of amplication and shows, by means of the grid-voltage vs. plate-current characteristics curve, the effect of an input signal (S) applied to the grid of a tube. The output signal (O)

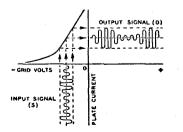


Fig. 14—Current characteristics of class A amplifier.

is the resulting amplified plate-current variation.

The plate current flowing through the load resistance (R) of Fig. 15 causes a voltage drop which varies directly with the plate current. The ratio of this voltage variation produced in the load resistance to the input signal voltage is

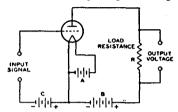


Fig. 15-Triode amplifier circuit.

the voltage amplification, or gain, provided by the tube. The voltage amplification due to the tube is expressed by the following convenient formulas:

Voltage amplification = 
$$\frac{\mu \times R_L}{R_L + r_p}$$
  
or  $\frac{g_m \times r_p \times R_L}{1000000 \times (r_p + R_L)}$ 

where  $\mu$  is the amplification factor of the tube,  $R_L$  is the load resistance in ohms,  $r_p$  is the plate resistance in ohms, and  $g_m$  is the transconductance in micromhos.

From the first formula, it can be seen that the gain actually obtainable from the tube is less than the tube amplification factor, but that the gain approaches the amplification factor when the load resistance is large compared to the tube plate resistance. Fig. 16 shows graphically how the gain approaches the amplification factor of the tube as the load resistance is increased. From the curve it can be seen that a high value of load resistance should be used to obtain high gain in a voltage amplifier.

In a resistance-coupled amplifier, the load resistance of the tube is approximately equal to the resistance of the plate resistor in parallel with the grid resistor of the following stage. Hence, to obtain a large value of load resistance, it is necessary to use a plate resistor and a grid resistor of large

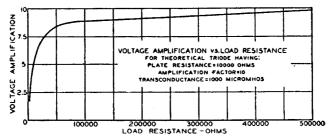


Fig. 16-Gain curve for triode amplifier circuit.

resistance. However, the plate resistor should not be too large because the flow of plate current through the plate resistor produces a voltage drop which reduces the plate voltage applied to the tube. If the plate resistor is too large, this drop will be too large, the plate voltage on the tube will be too small, and the voltage output of the tube will be too small. Also, the grid resistor of the following stage should not be too large, the actual maximum value being dependent on the particular tube type. This precaution is necessary because all tubes contain minute amounts of residual gas which cause a minute flow of current through the grid resistor. If the grid resistor is too large, the positive bias developed by the flow of this current through the resistor decreases the normal negative bias and produces an increase in the plate current. This increased current may overheat the tube and cause liberation of more gas which. in turn, will cause further decrease in bias. The action is cumulative and results in a runaway condition which can destroy the tube.

A higher value of grid resistance is permissible when cathode-resistor bias is used than when fixed bias is used. When cathode-resistor bias is used, a loss in bias due to gas or grid-emission effects is almost completely offset by an increase in bias due to the voltage drop across the cathode resistor. Typical values of plate resistor and grid resistor for tube types used in resistance-coupled circuits, and the values of gain obtainable, are shown in the Resistance-Coupled Amplifier section.

The input impedance of an electron tube (that is, the impedance between grid and cathode) consists of (1) a reactive component due to the capacitance between grid and cathode, (2) a resistive component resulting from the time of transit of electrons between cathode and grid, and (3) a resistive component developed by the part of the cathode lead inductance which is common to both the input and output circuits. Components (2) and (3) are dependent on the frequency of the incoming signal. The input impedance is very high at audio frequencies when a tube is operated with its grid biased negative. In a class A<sub>1</sub> or AB<sub>1</sub> transformer-coupled audio amplifier, therefore, the loading imposed by the grid on the input transformer is negligible. As a result, the secondary impedance of a class A<sub>1</sub> or class AB<sub>1</sub> input transformer can be made very high because the choice is not limited by the input impedance of the tube; however, transformer design considerations may limit the choice.

At the higher radio frequencies, the input impedance may become very low even when the grid is negative, due to the finite time of passage of electrons between cathode and grid and to the appreciable lead reactance. This impedance drops very rapidly as the frequency is raised, and increases input-circuit loading. In fact, the input impedance may become low enough at very high radio frequencies to affect the gain and selectivity of a preceding stage appreciably. Tubes such as the "acorn" and "pencil" types and the high-frequency miniatures have been

developed to have low input capacitances, low electron-transit time, and low lead inductance so that their input impedance is high even at the ultrahigh radio frequencies. Input admittance is the reciprocal of input impedance.

A remote-cutoff amplifier tube is a modified construction of a pentode or a tetrode type designed to reduce modulation-distortion and cross-modulation in radio-frequency stages. Crossmodulation is the effect produced in a radio or television receiver by an interfering station "riding through" on the carrier of the station to which the receiver is tuned. Modulation-distortion is a distortion of the modulated carrier and appears as audio-frequency distortion in the output. This effect is produced by a radio-frequency amplifier stage operating on an excessively curved characteristic when the grid bias has been increased to reduce volume. The offending stage for cross-modulation is usually the first radio-frequency amplifier, while for modulation-distortion the cause is usually the last intermediate-frequency stage. The characteristics of remote-cutoff types are such as to enable them to handle both large and small input signals with minimum distortion over a wide range of signal strength.

Fig. 17 illustrates the construction of the grid No. 1 (control grid) in a remote-cutoff tube. The remote-cutoff

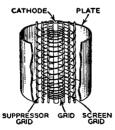


Fig. 17-Structure of remote-cutoff grid.

action is due to the structure of the grid which provides a variation in amplification factor with change in grid bias. The grid No. 1 is wound with open spacing at the middle and with close spacing at the ends. When weak signals and low grid bias are applied to the tube, the effect of the non-uniform turn spacing of the grid on cathode emission and tube characteristics is essentially the same as for uniform spacing. As the grid bias is made more negative to handle larger input signals, the electron flow from the sections of the cathode enclosed by the ends of the grid is cut off. The plate current and other tube characteristics are then dependent on the electron flow through the open section of the grid. This action changes the gain of the tube so that large signals may be handled with minimum distortion due to cross-modulation and modulation-distortion.

Fig. 18 shows a typical plate-current vs. grid-voltage curve for a remotecutoff type compared with the curve

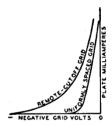


Fig. 18—Plate-current curves for triodes having remote-cutoff and uniformly spaced grids.

for a type having a uniformly spaced grid. It will be noted that while the curves are similar at small grid-bias voltages, the plate current of the remote-cutoff tube drops quite slowly with large values of bias voltage. This slow change makes it possible for the tube to handle large signals satisfactorily. Because remote-cutoff types can accommodate large and small signals, they are particularly suitable for use in sets having automatic volume control. Remote-cutoff tubes also are known as variable-mu types.

### Class A Power Amplifiers

As a class A power amplifier, an electron tube is used in the output stage of a radio or television receiver to supply a relatively large amount of power

to the loudspeaker. For this application, large power output is of more importance than high voltage amplification; therefore, gain possibilities are sacrificed in the design of power tubes to obtain power-handling capability.

Triodes, pentodes, and beam power tubes designed for power amplifier service have certain inherent features for each structure. Power tubes of the triode type for class A service are characterized by low power sensitivity, low plate-power efficiency, and low distortion. Power tubes of the pentode type are characterized by high power sensitivity, high plate-power efficiency and, usually, somewhat higher distortion than class A triodes. Beam power tubes have higher power sensitivity and efficiency than triode or conventional pentode types.

A class A power amplifier is also used as a driver to supply power to a class  $AB_2$  or a class B stage. It is usually advisable to use a triode, rather than a pentode, in a driver stage because of the lower plate impedance of the triode.

Power tubes connected in either parallel or push-pull may be employed as class A amplifiers to obtain increased output. The parallel connection (Fig. 19 provides twice the output of a single tube with the same value of grid-signal voltage. With this connection,

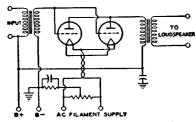


Fig. 19—Power amplifier with tubes connected in parallel.

the effective transconductance of the stage is doubled, and the effective plate resistance and the load resistance required are halved as compared with single-tube values.

The push-pull connection (Fig. 20), although it requires twice the grid-

signal voltage, provides increased power and has other important advantages

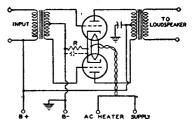


Fig. 20—Power amplifier with tubes connected in push-pull.

over single-tube operation. Distortion caused by even-order harmonics and hum caused by plate-voltage-supply fluctuations are either eliminated or decidedly reduced through cancellation. Because distortion for push-pull operation is less than for single-tube operation, appreciably more than twice single-tube output can be obtained with triodes by decreasing the load resistance for the stage to a value approaching the load resistance for a single tube.

For either parallel or push-pull class A operation of two tubes, all electrode currents are doubled while all de electrode voltages remain the same as for single-tube operation. If a cathode resistor is used, its value should be about one-half that for a single tube. If oscillations occur with either type of connection, they can often be eliminated by the use of a non-inductive resistor of approximately 100 ohms connected in series with each grid at the socket terminal.

Operation of power tubes so that the grids run positive is inadvisable except under conditions such as those discussed in this section for class AB and class B amplifiers.

### Power-Output Calculations

Calculation of the power output of a triode used as a class A amplifier with either an output transformer or a choke having low de resistance can be made without serious error from the plate family of curves by assuming a resistance load. The proper plate current, grid bias, optimum load resistance, and per-cent second-harmonic distortion can also be determined. The calculations are made graphically and are illustrated in Fig. 21 for given conditions. The procedure is as follows:

(1) Locate the zero-signal bias point P by determining the zero-signal bias Ec<sub>o</sub> from the formula:

Zero-signal bias (Ec<sub>0</sub>) =  $-(0.68 \times E_b)/\mu$ 

where  $E_b$  is the chosen value in volts of dc plate voltage at which the tube is to be operated, and  $\mu$  is the amplification factor of the tube. This quantity is shown as negative to indicate that a negative bias is used.

- (2) Locate the value of zero-signal plate current, I<sub>0</sub>, corresponding to point P.
- (3) Locate the point  $2I_o$ , which is twice the value of  $I_o$  and corresponds to the value of the maximum-signal plate current  $I_{max}$ .
- (4) Locate the point X on the dc bias curve at zero volts,  $E_c = 0$ , corresponding to the value of  $I_{max}$ .
- (5) Draw a straight line XY through X and P.

Line XY is known as the load resistance line. Its slope corresponds to the value of the load resistance. The load resistance in ohms is equal to  $(E_{max} - E_{min})$  divided by  $(I_{max} - I_{min})$ , where E is in volts and I is in amperes.

It should be noted that in the case of filament types of tubes, the calculations are given on the basis of a dcoperated filament. When the filament is ac-operated, the calculated value of dc bias should be increased by approximately one-half the filament voltage rating of the tube.

The value of zero-signal plate current I<sub>o</sub> should be used to determine the plate dissipation, an important factor influencing tube life. In a class A amplifier under zero-signal conditions, the plate dissipation is equal to the power input, i.e., the product of the dc plate voltage E<sub>o</sub> and the zero-signal dc plate current I<sub>0</sub>. If it is found that the platedissipation rating of the tube is exceeded with the zero-signal bias Ec<sub>o</sub> calculated above, it will be necessary to increase the bias by a sufficient amount so that the actual plate dissipation does not exceed the rating before proceeding further with the remaining calculations.

For power-output calculations, it is assumed that the peak alternating grid voltage is sufficient (1) to swing the grid from the zero-signal bias value  $E_{\rm o}$  to zero bias ( $E_{\rm c}=0$ ) on the positive swing and (2) to swing the grid to a value twice the zero-signal bias value on the negative swing. During the negative swing, the plate voltage and plate current reach values of  $E_{\rm max}$  and  $I_{\rm min}$ ; during the positive swing, they reach values of  $E_{\rm min}$  and  $I_{\rm max}$ . Because power is the product of voltage and current, the power output  $P_{\rm o}$  as shown by a watt-meter is given by

$$P_{o} = \frac{(I_{max}-I_{min}) \times (E_{max}-E_{min})}{8}$$

where E is in volts, I is in amperes, and P<sub>o</sub> is in watts.

In the output of power-amplifier triodes, some distortion is present. This distortion is due predominantly to second harmonics in single-tube amplifiers. The percentage of second-harmonic distortion may be calculated by the following formula:

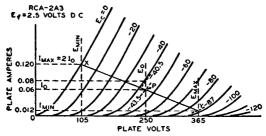


Fig. 21—Graphic calculations for class A amplifier using the 2A3 power triode.

% distortion = 
$$\frac{\frac{I_{\text{max}} + I_{\text{min}}}{2} - I_0}{I_{\text{max}} - I_{\text{min}}} \times 100$$

where I<sub>0</sub> is the zero-signal plate current in amperes. If the distortion is excessive, the load resistance should be increased or, occasionally, decreased slightly and the calculations repeated.

Example: Determine the load resistance, power output, and distortion of a triode having an amplification factor of 4.2, a plate-dissipation rating of 15 watts, and plate-characteristics curves as shown in Fig. 21. The tube is to be operated at 250 volts on the plate.

Procedure: For a first approximation, determine the operating point P from the zero-signal bias formula, Ec.  $= -(0.68 \times 250) / 4.2 = -40.5$  volts. From the curve for this voltage, it is found that the zero-signal plate current is 0.08 ampere and, therefore, the platedissipation rating is exceeded  $(0.08 \times$ 250 = 20 watts). Consequently, it is necessary to reduce the zero-signal plate current to 0.06 ampere at 250 volts. The grid bias is then -43.5 volts. Note that the curve was taken with a dc filament supply; if the filament is to be operated on an ac supply, the bias must be increased by about onehalf the filament voltage, or to -45 volts, and the circuit returns made to the mid-point of the filament circuit.

Point X can then be determined. Point X is at the intersection of the dc bias curve at zero volts with  $I_{max}$ , where  $I_{max} = 2I_0 = 2 \times 0.06 = 0.12$  ampere. Line XY is drawn through points P and X.  $E_{max}$ ,  $E_{min}$ , and  $I_{min}$  are then found from the curves. When these values are substituted in the power-output formula, the following result is obtained:

$$P_0 = \frac{(0.12 - 0.012) \times (365 - 105)}{8} = 3.52 \text{ watts}$$

The resistance represented by load line XY is

$$\frac{(365 - 105)}{(0.12 - 0.012)} = 2410 \text{ ohms}$$

When the values from the curves are substituted in the distortion formula, the following result is obtained:

% distortion = 
$$\frac{\frac{0.12 + 0.012}{2} - 0.06}{0.12 - 0.012} \times 100 = 5.5\%$$

It is customary to select the load resistance so that the distortion does not exceed five per cent. When the method shown is used to determine the slope of the load-resistance line, the second-harmonic distortion generally does not exceed five per cent. In the example, however, the distortion is excessive and it is desirable, therefore, to use a slightly higher load resistance. A load resistance of 2500 ohms will provide a distortion of about 4.9 per cent. The power output is reduced only slightly to 3.5 watts.

Operating conditions for triodes in push-pull depend on the type of operation desired. Under class A conditions, distortion, power output, and efficiency are all relatively low. The operating bias can be anywhere between that specified for single-tube operation and that equal to one-half the grid-bias voltage required to produce plate-current cutoff at a plate voltage of 1.4E<sub>o</sub>, where E<sub>o</sub> is the operating plate voltage. Higher bias than this value requires higher grid-signal voltage and results in class AB<sub>1</sub> operation, which is discussed later.

The method for calculating maximum power output for triodes in pushpull class A operation is as follows: Erect a vertical line at  $0.6~E_{\rm o}$  (see Fig. 22, intersecting the  $E_{\rm c}=0$  curve at the point  $I_{\rm max}$ . Then,  $I_{\rm max}$  is determined from the curve for use in the formula

$$P_0 = (I_{max} \times E_0)/5$$

If I<sub>max</sub> is expressed in amperes and E<sub>0</sub> in volts, power output is in watts.

The method for determining the proper load resistance for triodes in push-pull is as follows: Draw a load line through I<sub>max</sub> on the zero-bias curve and through the E<sub>o</sub> point on the zero-current axis. Four times the resistance represented by this load line is the plate-to-plate load (R<sub>pp</sub>) for two triodes in a class A push-pull amplifier. Expressed as a formula,

$$R_{pp} = 4 \times (E_o - 0.6E_o)/I_{max}$$

where  $E_0$  is expressed in volts,  $I_{max}$  in amperes, and  $R_{pp}$  in ohms.

**Example:** Assume that the plate voltage (E<sub>0</sub>) is to be 300 volts, and the plate-dissipation rating of the tube is 15

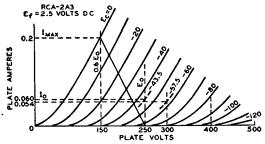


Fig. 22—Graphic calculations for push-pull class A amplifier using the 2A3 power triode.

watts. Then, for class A operation, the operating bias can be equal to, but not more than, one-half the grid bias for cutoff with a plate voltage of  $1.4 \times 300$ = 420 volts. (Since cutoff bias is approximately -115 volts at a plate voltage of 420 volts, one-half of this value is -57.5 volts bias.) At this bias, the plate current is found from the plate family to be 0.054 ampere and, therefore, the plate dissipation is  $0.054 \times$ 300 or 16.2 watts. Since -57.5 volts is the limit of bias for class A operation of these tubes at a plate voltage of 300 volts, the dissipation cannot be reduced by increasing the bias and it becomes necessary to reduce the plate voltage.

If the plate voltage is reduced to 250 volts, the bias will be found to be -43.5 volts. For this value, the plate current is 0.06 ampere, and the plate dissipation is 15 watts. Then, following

the method for calculating power output, erect a vertical line at  $0.6E_o = 150$  volts. The intersection of the line with the curve  $E_c = 0$  is  $I_{max}$  or 0.2 ampere. When this value is substituted in the power formula, the power output is  $(0.2 \times 250)/5 = 10$  watts. The load resistance is determined from the load formula: Plate-to-plate load  $(R_{pp}) = 4 \times (250 - 150)/0.2 = 2000$  ohms.

Power output for a pentode or a beam power tube as a class A amplifier can be calculated in much the same way as for triodes. The calculations can be made graphically from a special plate family of curves, as illustrated in Fig. 23

From a point A at or just below the knee of the zero-bias curve, draw arbitrarily selected load lines to intersect the zero-plate-current axis. These lines should be on both sides of the operating point P, whose position is

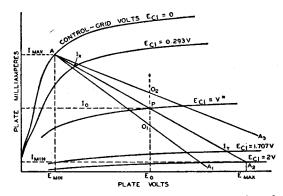


Fig. 23—Graphic calculations for class A amplifier using a pentode or beam power tube.

determined by the desired operating plate voltage, E<sub>o</sub>, and one-half the maximum-signal plate current. Along any load line, say AA<sub>1</sub>, measure the distance AO<sub>1</sub>. On the same line, lay off an equal distance, O<sub>1</sub>A<sub>1</sub>. For optimum operation, the change in bias from A to O<sub>1</sub> should be nearly equal to the change in bias from O<sub>1</sub> to A<sub>1</sub>. If this condition can not be met with one line, as is the case for the line first chosen, then another should be chosen. When the most satisfactory line has been selected, its resistance may be determined by the following formula:

Load resistance (R<sub>L</sub>) = 
$$\frac{E_{max} - E_{min}}{I_{max} - I_{min}}$$

The value of  $R_L$  may then be substituted in the following formula for calculating power output.

$$P_{o} = \frac{[I_{max} - I_{min} + 1.41 (I_{x} - I_{y})]^{2} R_{L}}{32}$$

In both of these formulas, I is in amperes, E is in volts,  $R_L$  is in ohms, and  $P_o$  is in watts.  $I_r$  and  $I_y$  are the current values on the load line at bias voltages of  $Ec_1 = V - 0.707V = 0.293V$  and  $E_{c1} = V + 0.707V = 1.707V$ , respectively.

Calculations for distortion may be made by means of the following formulas. The terms used have already been defined.

% 2nd-harmonic distortion = 
$$\frac{I_{max} + I_{min} - 2 I_0}{I_{max} - I_{min} + 1.41 (I_x - I_y)} \times 100$$
% 3rd-harmonic distortion = 
$$\frac{I_{max} - I_{min} - 1.41 (I_x - I_y)}{I_{max} - I_{min} + 1.41 (I_x - I_y)} \times 100$$
% total (2nd and 3rd) harmonic distortion =

## $\sqrt{(\% \text{ 2nd})^2 + (\% \text{ 3rd})^2}$ Conversion Factors

Operating conditions for voltage values other than those shown in the published data can be obtained by use of the nomograph shown in Fig. 24 when all electrode voltages are changed simultaneously in the same ratio. The nomograph includes conversion factors for current (F<sub>1</sub>), power output (F<sub>p</sub>), plate resistance or load resistance (F<sub>1</sub>),

and transconductance  $(F_{gm})$  for voltage ratios between 0.5 and 2.0. These factors are expressed as functions of the ratio between the desired or new voltage for any electrode  $(E_{des})$  and the published or original value of that voltage  $(E_{pub})$ . The relations shown are applicable to triodes and multigrid tubes in all classes of service.

To use the nomograph, simply place a straight-edge across the page so that it intersects the scales for  $E_{des}$  and  $E_{pub}$  at the desired values. The desired conversion factor may then be read directly or estimated at the point where the straight-edge intersects the  $F_1$ ,  $F_p$ , or  $F_{gm}$  scale.

For example, suppose it is desired to operate two 6L6GC's in class A<sub>1</sub> push-pull, fixed bias, with a plate voltage of 200 volts. The nearest published operating conditions for this class of service are for a plate voltage of 250 volts. The operating conditions for the new plate voltage can be determined as follows:

The voltage conversion factor,  $F_e$ , is equal to 200/250 or 0.8. The dashed lines on the nomograph of Fig. 24 indicate that for this voltage ratio  $F_i$  is approximately 0.72,  $F_p$  is approximately 0.57,  $F_r$  is 1.12, and  $F_{gm}$  is approximately 0.892. These factors may be applied directly to operating values shown in the tube data, or to values calculated by the methods described previously.

Because this method for conversion of characteristics is necessarily an approximation, the accuracy of the nomograph decreases progressively as the ratio E<sub>des</sub>/E<sub>pub</sub> departs from unity. In general, results are substantially correct when the value of the ratio E<sub>des</sub>/E<sub>pub</sub> is between 0.7 and 1.5. Beyond these limits, the accuracy decreases rapidly, and the results obtained must be considered rough approximations.

The nomograph does not take into consideration the effects of contact potential or secondary emission in tubes. Because contact-potential effects become noticeable only at very small dc grid-No. 1 (bias) voltages, they are generally negligible in power tubes.

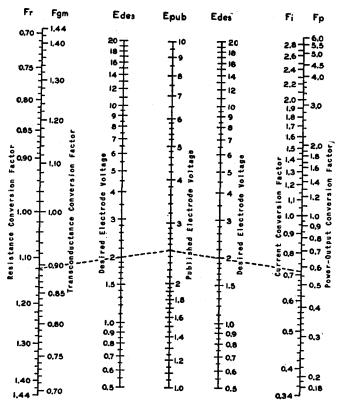


Fig. 24—Nomograph of tube conversion factors.

Secondary emission may occur in conventional tetrodes, however, if the plate voltage swings below the grid-No. 2 voltage. Consequently, the conversion factors shown in the nomograph apply to such tubes only when the plate voltage is greater than the grid-No. 2 voltage. Because secondary emission may also occur in certain beam power tubes at very low values of plate current and plate voltage, the conversion factors shown in the nomograph do not apply when these tubes are operated under such conditions.

### Class AB Power Amplifiers

A class AB power amplifier employs two tubes connected in push-pull with a higher negative grid bias than is used in a class A stage. With this higher negative bias, the plate and screen-

grid voltages can usually be made higher than for class A amplifiers because the increased negative bias holds plate current within the limit of the tube plate-dissipation rating. As a result of these higher voltages, more power output can be obtained from class AB operation.

Class AB amplifiers are subdivided into class AB<sub>1</sub> and class AB<sub>2</sub>. In class AB<sub>1</sub>, there is no flow of grid current. That is, the peak signal voltage applied to each grid is not greater than the negative grid-bias voltage. The grids therefore are not driven to a positive potential and do not draw current. In class AB<sub>2</sub>, the peak signal voltage is greater than the bias so that the grids are driven positive and draw current.

Because of the flow of grid current in a class AB<sub>2</sub> stage, there is a loss of power in the grid circuit. The sum of this loss and the loss in the input transformer is the total driving power required by the grid circuit. The driver stage should be capable of a power output considerably larger than this required power in order that distortion introduced in the grid circuit be kept low. The input transformer used in a class AB<sub>2</sub> amplifier usually has a stepdown turns ratio.

Because of the large fluctuations of plate current in a class AB<sub>2</sub> stage, it is important that the plate power supply have good regulation. Otherwise the fluctuations in plate current cause fluctuations in the voltage output of the power supply, with the result that power output is decreased and distortion is increased. To obtain satisfactory regulation, it is usually advisable to use a low-drop rectifier, such as the 5V4GA, with a choke-input filter. In all cases, the resistance of the choke and transformers should be as low as possible.

### Class AB, Power Amplifiers

In class  $AB_1$  push-pull amplifier service using triodes, the operating conditions may be determined graphically by means of the plate family if  $E_0$ , the desired operating plate voltage, is given. In this service, the dynamic load line does not pass through the operating point P as in the case of the single-tube amplifier, but through the

point D in Fig. 25. Its position is not affected by the operating grid bias provided the plate-to-plate load resistance remains constant.

Under these conditions, grid bias has no appreciable effect on the power output. Grid bias cannot be neglected, however, since it is used to find the zero-signal plate current and, from it, the zero-signal plate dissipation. Because the grid bias is higher in class AB<sub>1</sub> than in class A service for the same plate voltage, a higher signal voltage may be used without grid current being drawn and, therefore, higher power output is obtained.

In general, for any load line through point D, Fig. 25, the plate-toplate load resistance in ohms of a pushpull amplifier is  $R_{pp} = 4E_0/I'$ , where I' is the plate-current value in amperes at which the load line as projected intersects the plate-current axis. and Eo is in volts. This formula is another form of the one given under pushpull class A amplifiers,  $R_{pp} = 4(E_o -$ 0.6E<sub>0</sub>)/I<sub>max</sub>, but is more general. Power output =  $(I_{max}/\sqrt{2})^2 \times R_{pp}/4$ , where Imax is the peak plate current at zero grid volts for the load chosen. This formula simplified is  $(I_{max})^2 \times R_{pp}/8$ . The maximum-signal average plate current is 2I<sub>max</sub>/π or 0.636 I<sub>max</sub>; the maximum-signal average power input is  $0.636 I_{max} \times E_o$ 

It is desirable to simplify these

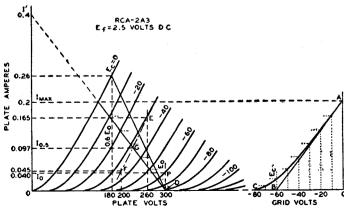


Fig. 25—Graphic calculations for class AB<sub>1</sub> amplifier using the 2A3 power triode.

Fig. 26—Instantaneous curve for class AB<sub>1</sub> amplifier.

formulas for a first approximation. This simplification can be made if it is assumed that the peak plate current, Imax, occurs at the point of the zero-bias curve corresponding approximately to 0.6 E<sub>o</sub>, the condition for maximum power output. The simplified formulas are:

Po (for two tubes) = 
$$(I_{max} \times E_0)/5$$
  
 $R_{pp} = 1.6E_0/I_{max}$ 

where  $E_0$  is in volts,  $I_{max}$  is in amperes,  $R_{pp}$  is in ohms, and  $P_0$  is in watts.

It may be found during subsequent calculations that the distortion or the plate dissipation is excessive for this approximation; in that case, a different load resistance must be selected, using the first approximation as a guide, and the process repeated to obtain satisfactory operating conditions.

**Example:** Fig. 25 illustrates the application of this method to a pair of 2A3's operated at  $E_o = 300$  volts. Each tube has a plate-dissipation rating of 15 watts. The method is to erect a vertical line at  $0.6E_o$ , or at 180 volts, which intersects the  $E_o = 0$  curve at the point  $I_{max} = 0.26$  ampere. Using the simplified formulas, the following values are obtained:

$$R_{pp} = (1.6 \times 300)/0.26 = 1845$$
 ohms  
 $P_0 = (0.26 \times 300)/5 = 15.6$  watts

At this point, it is well to determine the plate dissipation and to compare it with the maximum rated value. From the average-plate-current formula (0.636 I<sub>max</sub>) mentioned previously, the maximum-signal average plate current is 0.166 ampere. The product of this current and the operating plate voltage is 49.8 watts, the average input to the two tubes. From this value, subtract the power output of 15.6 watts to obtain the total dissipation for both tubes, which is 34.2 watts. Half of this value, 17 watts, is in excess of the 15-watt rating of the tube and it is necessary, therefore, to assume another and higher load resistance so that the plate-dissipation rating will not be exceeded.

It will be found that at an operating plate voltage of 300 volts the 2A3's require a plate-to-plate load resistance of 3000 ohms. From the formula for  $R_{pp}$ , the value of I' is found to be 0.4

ampere. The load line for the 3000-ohm load resistance is then represented by a straight line from the point I' = 0.4 ampere on the plate-current ordinate to the point  $E_o = 300$  volts on the plate-voltage abscissa. At the intersection of the load line with the zerobias curve, the peak plate current,  $I_{max}$ , can be read at 0.2 ampere. Then

$$P_0 = (I_{max}/\sqrt{2})^2 \times R_{pp}/4$$
  
=  $(0.2/1.41)^2 \times 3000/4$   
= 15 watts

Proceeding as in the first approximation, it is found that the maximum-signal average plate current,  $0.636I_{max}$ , is 0.127 ampere, and the maximum-signal average power input is 38.1 watts. This input minus the power output is 38.1 - 15 = 23.1 watts. This value is the dissipation for two tubes; the value per tube is 11.6 watts, a value well within the rating of this tube type.

The operating bias and the zerosignal plate current may then be found by use of a curve which is derived from the plate family and the load line. Fig. 26 is a curve of instantaneous values of plate current and dc grid-bias voltages taken from Fig. 25. Values of grid bias are read from each of the grid-bias curves of Fig. 25 along the load line and are transferred to Fig. 26 to produce the curved line from A to C. A tangent to this curve, starting at A, is drawn to intersect the grid-voltage abscissa. The point of intersection, B, is the operating grid bias for fixed-bias operation. In the example, the bias is -60 volts. Refer back to the plate family at the operating conditions of plate volts = 300 and grid bias = -60volts; the zero-signal plate current per tube is seen to be 0.04 ampere.

This procedure locates the operating point for each tube at P. The plate current must be doubled, of course, to obtain the zero-signal plate current for both tubes. Under maximum-signal conditions, the signal voltage swings from zero-signal bias voltage to zero bias for each tube on alternate half cycles. Hence, in the example, the peak of signal voltage per tube is 60 volts, or the grid-to-grid value is 120 volts.

As in the case of the push-pull class A amplifier, the second-harmonic dis-

tortion in a class AB, amplifier using triodes is very small and is largely canceled by virtue of the push-pull connection. Third-harmonic distortion, however, which may be larger than permissible, can be found by means of composite characteristic curves. A complete family of curves can be plotted. but for the present purpose only the one corresponding to a grid bias of one-half the peak grid-voltage swing is needed. In the example, the peak grid voltage per tube is 60 volts, and the half value is 30 volts. The composite curve, since it is nearly a straight line, can be constructed with only two points (see Fig. 25. These two points are obtained from deviations above and below the operating grid and plate voltages.

In order to find the curve for a bias of -30 volts, a deviation of 30 volts from the operating grid voltage of -60 volts is assumed. Next assume a deviation from the operating plate voltage of, say, 40 volts. Then at 300 -40 = 260 volts, erect a vertical line to intersect the (-60) - (-30) = -30volt bias curve and read the plate current at this intersection, which is 0.167 ampere; likewise, at the intersection of a vertical line at 300 + 40 = 340volts and the (-60) + (-30) = -90volt bias curve, read the plate current. In this example, the plate current is estimated to be 0.002 ampere. The difference of 0.165 ampere between these two currents determines the point E on the 300 - 40 = 260-volt vertical. Similarly, another point F on the same composite curve is found by assuming the same grid-bias deviation but a larger plate-voltage deviation, say, 100 volts.

These steps provide points at 260 volts and 0.165 ampere (E), and at 200 volts and 0.045 ampere (F). A straight line through these points is the composite curve for a bias of -30 volts, shown as a long-short dash line in Fig. 25. At the intersection of the composite curve and the load line, G, the instantaneous composite plate current at the point of one-half the peak signal swing is determined. This current value, designated I<sub>0.5</sub> and the peak plate current, I<sub>max</sub>, are used in the following formula

to find the peak value of the thirdharmonic component of the plate current.

$$Ih_3 = (2I_{0.5} - I_{max})/3$$

In the example, where  $I_{0.5}$  is 0.097 ampere and  $I_{max}$  is 0.2 ampere,  $I_{hs} = (2 \times 0.097 - 0.2)/3 = (0.194 - 0.2)/3 = -0.006/3 = -0.002$  ampere. (The fact that  $I_{hs}$  is negative indicates that the phase relation of the fundamental (first-harmonic) and third-harmonic components of the plate current is such as to result in a slightly peaked wave form.  $I_{hs}$  is positive in some cases, indicating a flattening of the wave form.)

The peak value of the fundamental or first-harmonic component of the plate current is found by the following formula:

$$Ih_1 = 2/3 \times (I_{max} + I_{0.5})$$

In the example,  $I_{h1}=2/3\times(0.2+0.097)=0.198$  ampere. Thus, the percentage of third-harmonic distortion is  $(I_{h3}/I_{h1})\times100=(0.002/0.198)\times100=1$  per cent approx.

### Class AB2 Power Amplifiers

A class AB<sub>2</sub> amplifier employs two tubes connected in push-pull as in the case of class AB<sub>1</sub> amplifiers. It differs in that it is biased so that plate current flows for somewhat more than half the electrical cycle but less than the full cycle, the peak signal voltage is greater than the dc bias voltage, grid current is drawn, and, consequently, power is consumed in the grid circuit. These conditions permit high power output to be obtained without excessive plate dissipation.

The sum of the power used in the grid circuit and the losses in the input transformer is the total driving power required by the grid circuit. The driver stage should be capable of a power output considerably larger than this required power in order that distortion introduced in the grid circuit be kept low. In addition, the internal impedance of the driver stage as reflected into or as effective in the grid circuit of the power stage should always be as low as possible in order that distortion may be kept low. The input transformer used

in a class AB<sub>2</sub> stage usually has a stepdown ratio adjusted for this condition.

Load resistance, plate dissipation, power output, and distortion determinations are similar to those for class AB. These quantities are interdependent with peak grid-voltage swing and driving power; a satisfactory set of operating conditions involves a series of approximations. The load resistance and signal swing are limited by the permissible grid current and power and the distortion. If the load resistance is too high or the signal swing is excessive, the plate-dissipation rating will be exceeded, distortion will be high, and the driving power will be unnecessarily high.

### Class B Power Amplifiers

A class B amplifier employs two tubes connected in push-pull, so biased that plate current is almost zero when no signal voltage is applied to the grids. Because of this low value of no-signal plate current, class B amplification has the same advantage as class AB<sub>2</sub>, i.e., large power output can be obtained without excessive plate dissipation. Class B operation differs from class AB<sub>2</sub> in that plate current is cut off for a larger portion of the negative grid swing, and the signal swing is usually larger than in class AB<sub>2</sub> operation.

Because certain triodes used as class B amplifiers are designed to operate very close to zero bias, the grid of each tube is at a positive potential during all or most of the positive halfcycle of its signal swing. In this type of triode operation, considerable grid current is drawn and there is a loss of power in the grid circuit. This condition imposes the same requirement in the driver stage as in a class AB<sub>2</sub> stage: i.e., the driver should be capable of delivering considerably more power output than the power required for the grid circuit of the class B amplifier so that distortion will be low. Similarly. the interstage transformer between the driver and the class B stage usually has a step-down turns ratio. Because of the high dissipations involved in class B operation at zero bias, it is not feasible to use tetrodes or pentodes in this type of class B operation.

Determination of load resistance, plate dissipation, power output, and distortion is similar to that for a class AB<sub>a</sub> stage.

Power amplifier tubes designed for class A operation can be used in class AB<sub>2</sub> and class B service under suitable operating conditions. There are several tube types designed especially for class B service. The characteristic common to all of these types is a high amplification factor. With a high amplification factor, plate current is small even when the grid bias is zero. These tubes, therefore, can be operated in class B service at a bias of zero volts so that no bias supply is required. A number of class B amplifier tubes consist of two triode units mounted in one tube. The two units can be connected in push-pull so that only one tube is required for a class B stage.

### High-Fidelity Amplifiers

Several high-fidelity amplifiers are shown in the Circuits section. The performance capabilities of such amplifiers are usually given in terms of frequency response, total harmonic distortion, maximum power output, and noise level.

To provide high-fidelity reproduction of audio program material, an amplifier should have a frequency response which does not vary more than 1 db over the entire audio spectrum. General practice is to design the amplifier so that its frequency response is flat within 1 db from a frequency below the lowest to be reproduced to one well above the upper limit of the audible region.

Harmonic distortion and intermodulation distortion produce changes in program material which may have adverse effects on the quality of the reproduced sound. Harmonic distortion causes a change in the character of an individual tone by the introduction of harmonics which were not originally present in the program material. For high-fidelity reproduction, total harmonic distortion (expressed as a percentage of the output power) should not be greater than about 1 per cent at the

desired listening level. Types such as the 6973, 7027A and 7868 are designed to provide extremely low harmonic distortion in suitably designed push-pull amplifier circuits.

Intermodulation distortion is a change in the waveform of an individual tone as a result of interaction with another tone present at the same time in the program material. This type of distortion not only alters the character of the modulated tone, but may also result in the generation of spurious signals at frequencies equal to the sum and difference of the interacting frequencies. Intermodulation distortion should be less than 2 per cent at the desired listening level. In general, any amplifier which has low intermodulation distortion will have very low harmonic distortion.

The maximum power output which a high-fidelity amplifier should deliver depends upon a complex relation of several factors, including the size and acoustical characteristics of the listening area, the desired listening level, and the efficiency of the loudspeaker system. Practically, however, it is possible to determine amplifier requirements in terms of room size and loudspeaker efficiency.

The acoustic power required to reproduce the loudest passages of orchestral music at concert-hall level in the average-size living room is about 0.4 watt. Because high-fidelity loudspeakers of the type generally available for home use have an efficiency of only about 5 per cent, the output stage of the amplifier should therefore be able to deliver a power output of at least 8 watts. Because many wide-range loudspeaker systems, particularly those using frequencydivider networks, have efficiencies of less than 5 per cent, output tubes used with such systems must have correspondingly larger power outputs. The 6973, 7027A, 7189, and 7868 can provide ample output for most systems when used in suitable push-pull circuits.

The noise level of a high-fidelity amplifier determines the range of volume the amplifier is able to reproduce, *i.e.*, the difference (usually expressed in decibels) between the loudest

and softest sounds in program material. Because the greatest volume range utilized in electrical program material at the present time is about 60 dB, the noise level of a high-fidelity amplifier should be at least 60 dB below the signal level at the desired listening level.

### Cathode-Drive Circuits

The preceding text has discussed the use of tubes in the conventional grid-drive type of amplifier—that is, where the cathode is common to both the input and output circuits. Tubes may also be employed as amplifiers in circuit arrangements which utilize the grid or plate as the common terminal. Probably the most important of these amplifiers are the cathode-drive circuit, which is discussed below, and the cathode-follower circuit, which will be discussed later in connection with inverse feedback.

A typical cathode-drive circuit is shown in Fig. 27. The load is placed in

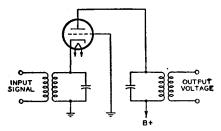


Fig. 27-Cathode-drive circuit.

the plate circuit and the output voltage is taken off between the plate and ground as in the grid-drive method of operation. The grid is grounded, and the input voltage is applied across an appropriate impedance in the cathode circuit. The cathode-drive circuit is particularly useful for vhf and uhf applications, in which it is necessary to obtain the low-noise performance usually associated with a triode, but where a conventional grid-drive circuit would be unstable because of feedback through the grid-to-plate capacitance of the tube. In the cathode-drive circuit, the grounded grid serves as a capacitive shield between plate and cathode and permits stable operation at frequencies higher than those in which conventional circuits can be used.

The input impedance of a cathodedrive circuit is approximately equal to  $1/g_m$  when the load resistance is small compared to the  $r_p$  of the tube. A certain amount of power is required, therefore, to drive such a circuit. However, in the type of service in which cathodedrive circuits are normally used, the advantages of the grounded-grid connection usually outweigh this disadvantage.

### Inverse Feedback

An inverse-feedback circuit, sometimes called a degenerative circuit, is one in which a portion of the output voltage of a tube is applied to the input of the same or a preceding tube in opposite phase to the signal applied to the tube. Two important advantages of feedback are (1) reduced distortion from each stage included in the feedback circuit and (2) reduction in the variations in gain due to changes in line voltage, possible differences between tubes of the same type, or variations in the values of circuit constants included in the feedback circuit.

Inverse feedback is used in audio amplifiers to reduce distortion in the output stage where the load impedance on the tube is a loudspeaker. Because the impedance of a loudspeaker is not constant for all audio frequencies, the load impedance on the output tube varies with frequency. When the output tube is a pentode or beam power tube having high plate resistance, this variation in plate load impedance can, if not corrected, produce considerable frequency distortion. Such frequency distortion can be reduced by means of inverse feedback. Inverse-feedback circuits are of the constant-voltage type and the constant-current type.

The application of the constant-voltage type of inverse feedback to a power-output stage using a single beam power tube is illustrated in Fig. 28. In this circuit, R<sub>1</sub>, R<sub>2</sub>, and C are connected as a voltage divider across the output of the tube. The secondary winding of the grid-input transformer is returned to a

point on this voltage divider. Capacitor C blocks the dc plate voltage from the grid. However, a portion of the tube af output voltage, approximately equal to the output voltage multiplied by the

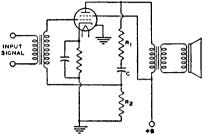


Fig. 28—Power-output stage using constantvoltage inverse feedback.

fraction  $R_2/(R_1 + R_2)$ , is applied to the grid. This voltage reduces the source impedance of the circuit and a decrease in distortion results which is explained in the curves of Fig. 29.

Consider first the amplifier without the use of inverse feedback. Suppose that when a signal voltage e. is applied to the grid the af plate current i', has an irregularity in its positive half-cycle. This irregularity represents a departure from the waveform of the input signal and is, therefore, distortion. For this plate-current waveform, the af plate voltage has a waveform shown by e'p. The plate-voltage waveform is inverted compared to the plate-current waveform because a plate-current increase produces an increase in the drop across the plate load. The voltage at the plate is the difference between the drop across the load and the supply voltage; thus, when plate current goes up, plate voltage goes down; when plate current goes down, plate voltage goes up.

Now suppose that inverse feedback is applied to the amplifier. The voltage fed back to the grid has the same waveform and phase as the plate voltage, but is smaller in magnitude. Hence, with a plate voltage of waveform shown by e'p, the feedback voltage appearing on the grid is as shown by e'gt. This voltage applied to the grid produces a component of plate current i'pt. It is evident that the irregularity in the waveform of

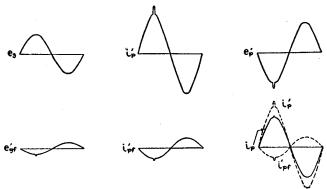


Fig. 29-Voltage and current waveforms showing effect of inverse feedback.

this component of plate current would act to cancel the original irregularity and thus reduce distortion.

After inverse feedback has been applied, the relations are as shown in the curve for i<sub>p</sub>. The dotted curve shown by i'pt is the component of plate current due to the feedback voltage on the grid. The dotted curve shown by i'p is the component of plate current due to the signal voltage on the grid. The algebraic sum of these two components gives the resultant plate current shown by the solid curve of ip. Since i'p is the plate current that would flow without inverse feedback, it can be seen that the application of inverse feedback has reduced the irregularity in the output current. In this manner inverse feedback acts to correct any component of plate current that does not correspond to the input signal voltage, and thus reduces distortion.

From the curve for i<sub>p</sub>, it can be seen that, besides reducing distortion, inverse feedback also reduces the amplitude of the output current. Consequently, when inverse feedback is applied to an amplifier there is a decrease in gain or power sensitivity as well as a decrease in distortion. Hence, the application of inverse feedback to an amplifier requires that more driving voltage be applied to obtain full power output, but this output is obtained with less distortion.

Inverse feedback may also be applied to resistance-coupled stages, as

shown in Fig. 30. The circuit is conventional except that a feedback resistor,  $R_s$ , is connected between the plates of tubes  $T_1$  and  $T_2$ . The output signal voltage of  $T_1$  and a portion of the output signal voltage of  $T_2$  appear across  $R_2$ . Because the distortion generated in the plate circuit of  $T_2$  is applied to its grid out of phase with the input signal, the distortion in the output of  $T_2$  is comparatively low. With sufficient inverse feedback of the constant-voltage type

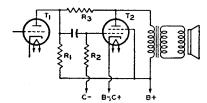


Fig. 30—Resistance-coupled stages using feedback resistor.

in a power-output stage, it is not necessary to employ a network of resistance and capacitance in the output circuit to reduce response at high audio frequencies. Inverse-feedback circuits can also be applied to push-pull class A and class AB<sub>1</sub> amplifiers.

Constant-current inverse feedback is usually obtained by omitting the bypass capacitor across a cathode resistor. This method decreases the gain and the distortion but increases the source impedance of the circuit. Consequently, the output voltage rises at the resonant

frequency of the loudspeaker and accentuates hangover effects.

Inverse feedback is not generally applied to a triode power amplifier, such as the 2A3, because the variation in speaker impedance with frequency does not produce much distortion in a triode stage having low plate resistance. It is sometimes applied in a pentode stage, but is not always convenient. As has been shown, when inverse feedback is used in an amplifier, the driving voltage must be increased in order to provide full power output. When inverse feedback is used with a pentode, the total driving voltage required for full power output may be inconveniently large, although still less than that required for a triode. Because a beam power tube gives full power output on a comparatively small driving voltage, inverse feedback is especially applicable to beam power tubes. By means of inverse feedback, the high efficiency and high power output of beam power tubes can be combined with freedom from the effects of varying speaker impedance.

### Cathode-Follower Circuits

Another important application of inverse feedback is in the cathode-follower circuit, an example of which is shown in Fig. 31. In this application, the load has been transferred from the plate circuit to the cathode circuit of the tube.

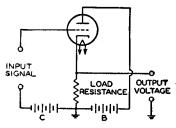


Fig. 31—Cathode-follower circuit,

The input voltage is applied between the grid and ground, and the output voltage is obtained between the cathode and ground. The voltage amplification (V.A.) of this circuit is always less than unity and may be expressed by the following convenient formulas. For a triode:

$$V. A. = \frac{\mu \times R_L}{r_p + [R_L \times (\mu + 1)]}$$

For a pentode:

$$V. A. = \frac{g_m \times R_L}{1 + (g_m \times R_L)}$$

In these formulas,  $\mu$  is the amplification factor,  $R_L$  is the load resistance in ohms,  $r_P$  is the plate resistance in ohms, and  $g_m$  is the transconductance in mhos.

The use of the cathode follower permits the design of circuits which have high input resistance and high output voltage. The output impedance is quite low and very low distortion may be obtained. Cathode-follower circuits may be used for power amplifiers or as impedance transformers designed either to match a transmission line or to produce a relatively high output voltage at a low impedance level.

In a power amplifier which is transformer coupled to the load, the same output power can be obtained from the tube as would be obtained in a conventional grid-drive type of amplifier. The output impedance is very low and provides excellent damping to the load, with the result that very low distortion can be obtained. The peak-to-peak signal voltage, however, approaches 11/2 times the plate supply voltage if maximum power output is required from the tube. Some problems may be encountered, therefore, in the design of an adequate driver stage for a cathodefollower output system.

When a cathode-follower circuit is used as an impedance transformer, the load is usually a simple resistance in the cathode circuit of the tube. With relatively low values of cathode resistor, the circuit may be designed to supply significant amounts of power and to match the impedance of the device to a transmission line. With somewhat higher values of cathode resistor, the circuit may be used to decrease the output impedance sufficiently to permit the transmission of audio signals along a line in which appreciable capacitance is present.

The cathode follower may also be used as an isolation device to provide extremely high input resistance and low

input capacitance as might be required in the probe of an oscilloscope or vacuum-tube voltmeter. Such circuits can be designed to provide effective impedance transformation with no significant loss of voltage.

Selection of a suitable tube and its operating conditions for use in a cathode-follower circuit having a specified output impedance (Z<sub>0</sub>) can be made, in most practical cases, by the use of the following formula to determine the approximate value of the required tube transconductance.

Required 
$$g_m (\mu mhos) = \frac{1,000,000}{Z_0 \text{ (ohms)}}$$

Once the required transconductance is obtained, a suitable tube and its operating conditions may be determined from the technical data given in the Technical Data section. The tube selected should have a value of transconslightly lower than that ductance obtained from the above expression to allow for the shunting effect of the cathode load resistance. The conversion nomograph given in Fig. 24 may be used for calculation of operating conditions for values of transconductance not included in the tabulated data. After the operating conditions have been determined, the approximate value of the required cathode load resistance may be calculated from the following formulas. For a triode:

$$\begin{array}{l} \text{Cathode} \ \ R_L = \frac{Z_o \times r_p}{r_p - [Z_o \times (1+\mu)]} \\ \text{For a pentode:} \\ \text{Cathode} \ R_L = \frac{Z_o}{1 - (g_m \times Z_o)} \end{array}$$

Resistance and impedance values are in ohms; transconductance values are in mhos.

If the value of the cathode load resistance calculated to provide the required output impedance does not provide the required operating bias, the basic cathode-follower circuit can be modified in a number of ways. Two of the more common modifications are shown in Figs. 32 and 33.

In Fig. 32 the bias is increased by adding a bypassed resistance between the cathode and the unbypassed load resistance and returning the grid to the low end of the load resistance. In Fig.

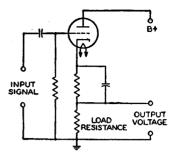


Fig. 32—Cathode-follower circuit modified for increased bias.

33 the bias is reduced by adding a bypassed resistance between the cathode and the unbypassed load resistance but, in this case, the grid is returned to the junction of the two cathode resistors so that the bias voltage is only the do voltage drop across the added resistance. The size of the bypass capacitor should be large enough so that it has negligible reactance at the lowest frequency to be handled. In both cases the B-supply should be increased to make up for the voltage taken for biasing.

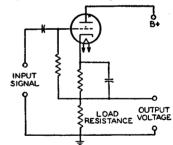


Fig. 33—Cathode-follower circuit modified for reduced bias.

**Example:** Select a suitable tube and determine the operating conditions and circuit components for a cathode-follower circuit having an output impedance that will match a 500-ohm transmission line.

**Procedure:** First, determine the approximate transconductance required.

Required 
$$g_m = \frac{1,000,000}{500} = 2000 \ \mu \text{mhos}$$

A survey of the tubes that have a transconductance in this order of magnitude shows that type 12AX7A is among the tubes to be considered. Referring to the characteristics given in the technical data section for one triode unit of highmu twin triode 12AX7, we find that for a plate voltage of 250 volts and a bias of -2 volts, the transconductance is 1600 micromhos, the plate resistance is 62500 ohms, the amplification factor is 100, and the plate current is 0.0012 ampere. When these values are used in the expression for determining the cathode load resistance, the following result is obtained:

Cathode 
$$R_L = \frac{500 \times 62500}{62500 - 500 \times (100 + 1)} = 2600$$
 ohms

The voltage across this resistor for a plate current of 0.0012 ampere is  $2600 \times 0.0012 = 3.12$  volts. Because the required bias voltage is only -2volts, the circuit arrangement given in Fig. 33 is employed. The bias is furnished by a resistance that will have a voltage drop of 2 volts when it carries a current of 0.0012 ampere. The required bias resistance, therefore, is 2/0.0012 = 1670 ohms. If 60 cycles per second is the lowest frequency to be passed, 20 microfarads is a suitable value for the bypass capacitor. The Bsupply, of course, is increased by the voltage drop across the cathode resistance which, in this example, is approximately 5 volts. The B-supply, therefore, is 250 + 5 = 255 volts.

Because it is desirable to eliminate. if possible, the bias resistor and bypass capacitor, it is worthwhile to try other tubes and other operating conditions to obtain a value of cathode load resistance which will also provide the reguired bias. If the triode section of twin diode—high-mu triode 6AT6 is operated under the conditions given in the technical data section with a plate voltage of 100 volts and a bias of -1 volt, it will have an amplification factor of 70, a plate resistance of 54000 ohms, a transconductance of 1300 micromhos, and a plate current of 0.0008 ampere. Then,

Cathode 
$$R_L = \frac{500 \times 54000}{54000 - 500 \times (70 + 1)} = 1460 \text{ ohms}$$

The bias voltage obtained across this resistance is  $1460 \times 0.0008 = 1.17$  volts. Since this value is for all practical purposes close enough to the required bias, no addition bias resistance will be required and the grid may be returned directly to ground. There is no need to adjust the B-supply voltage to make up for the drop in the cathode resistor. The voltage amplification (V.A.) for the cathode-follower circuit utilizing the triode section of type 6AT6 is

V.A. 
$$=\frac{70 \times 1460}{54000 + 1460 \times (70 + 1)} = 0.65$$

For applications in which the cathode follower is used to isolate two circuits-for example, when it is used between a circuit being tested and the input stage of an oscilloscope or a vacuum-tube voltmeter—voltage output and not impedance matching is the primary consideration. In such applications it is desirable to use a relatively high value of cathode load resistance. such as 50,000 ohms, in order to get the maximum voltage output. In order to obtain proper bias, a circuit such as that of Fig. 33 should be used. With a high value of cathode resistance, the voltage amplification will approximate unity.

#### Corrective Filters

A corrective filter can be used to improve the frequency characteristic of an output stage using a beam power tube or a pentode when inverse feedback is not applicable. The filter consists of a resistor and a capacitor connected in series across the primary of the output transformer. Connected in this way, the filter is in parallel with the plate load impedance reflected from the voicecoil by the output transformer. The magnitude of this reflected impedance increases with increasing frequency in the middle and upper audio range. The impedance of the filter, however, decreases with increasing frequency. It follows that, by use of the proper values for the resistance and the capacitance in the filter, the effective load impedance on the output tubes can be made practically constant for all frequencies in the middle and upper audio range. The result is an improvement in the frequency characteristic of the output stage.

The resistance to be used in the filter for a push-pull stage is 1.3 times the recommended plate-to-plate load resistance; or, for a single-tube stage, is 1.3 times the recommended plate load resistance. The capacitance in the filter should have a value such that the voltage gain of the output stage at a frequency of 1000 cycles or higher is equal to the voltage gain at 400 cycles.

A method of determining the proper value of capacitance for the filter is to make two measurements of the output voltage across the primary of the output transformer: first, when a 400-cycle signal is applied to the input, and second, when a 1000-cycle signal of the same voltage as the 400-cycle signal is applied to the input. The correct value of capacitance is the one which gives equal output voltages for the two signal inputs. In practice, this value is usually found to be in the order of 0.05 microfarad.

Volume Compressors and Expanders

Volume compression and expansion are used in FM transmitters and receivers and in recording devices and amplifiers to make more natural the reproduction of music which has a very large volume range. For example, in the music of a symphony orchestra the sound intensity of the soft passages is very much lower than that of the loud passages. When this low volume level is raised above the background noise for transmitting or recording, the peak level of the program material may be raised to an excessively high volume level. It is often necessary, therefore, to compress the volume range of the program content within the maximum capabilities of the FM transmitter or the recording device. Exceeding a maximum peak volume level for FM modulation corresponds to exceeding the allowed bandwidth for transmission. In some recording devices, excessive peak volume levels may cause overloading and distortion.

Volume compression may be accomplished by either manual or automatic control. The types of compression used include peak limiters, volume limiters, and volume compressors. A peak limiter limits the peak power to some predetermined level. A volume limiter provides gain reduction based on an average signal level above a predetermined level. A volume compressor provides gain reduction for only the sustained loud portions of the sound level. Only volume compressors can be correctly compensated for with volume expanders.

For faithful reproduction of the original sound, the volume expander used in the FM receiver or audio amplifier should have the reverse characteristic of the volume compressor used in the FM transmitter or recording device. In general, the basic requirements for either a volume compressor or expander are shown in the block diagram of Fig. 34. In a volume compressor, the

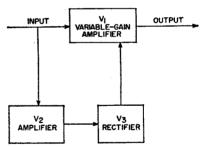


Fig. 34—Block diagram of volume compressor or expander circuit.

variable-gain amplifier V<sub>1</sub> has greater gain for a low-amplitude signal than for a high-amplitude signal; therefore, soft passages are amplified more than loud ones. In an expander, the gain is greater for high-amplitude signals than for low-amplitude signals; therefore, loud passages are amplified more than soft ones and the original amplitude ratio is restored.

In the diagram shown in Fig. 34, the signal to be amplified is applied to  $V_1$ , and a portion of the signal is also applied to  $V_2$ . The amplified output

from  $V_2$  is then rectified by  $V_3$ , and applied as a negative (for compressors) or positive (for expanders) bias voltage to  $V_1$ . As this bias voltage varies with variations in signal amplitude, the gain of  $V_1$  also varies to produce the desired compression or expansion of the signal.

Tubes having a large dynamic range provide the best results in volume compressor or expander applications. Examples of such types are the 6BJ6 and 6BE6. Push-pull operation is generally desired for the variable-gain amplifier to prevent high distortion and other undesirable effects which may occur in volume compressors and expanders.

#### Phase Inverters

A phase inverter is a circuit used to provide resistance coupling between the output of a signal-tube stage and the input of a push-pull stage. The necessity for a phase inverter arises because the signal-voltage inputs to the grids of a push-pull stage must be 180 degrees out of phase and approximately equal in amplitude with respect to each other. Thus, when the signal voltage input to a push-pull stage swings the grid of one tube in a positive direction, it should swing the grid of the other tube in a negative direction by a similar amount. With transformer coupling between stages, the out-of-phase input voltage to the push-pull stage is supplied by means of the center-tapped secondary. With resistance coupling, the out-of-phase input voltage is obtained by means of the inverter action of a tube.

Fig. 35 shows a push-pull power amplifier, resistance-coupled by means of a phase-inverter circuit to a single-stage triode  $T_1$ . Phase inversion in this circuit is provided by triode  $T_2$ . The output voltage of  $T_1$  is applied to the grid of triode  $T_3$ . A portion of the output voltage of  $T_1$  is also applied through the resistors  $R_2$  and  $R_3$  to the grid of  $T_2$ . The output voltage of  $T_2$  is applied to the grid of triode  $T_4$ .

When the output voltage of T<sub>1</sub> swings in the positive direction, the

plate current of  $T_2$  increases. This action increases the voltage drop across the plate resistor  $R_2$  and swings the plate of  $T_2$  in the negative direction. Thus, when the output voltage of  $T_1$  swings positive, the output voltage of  $T_2$  swings negative and is, therefore, 180 degrees out of phase with the output voltage of  $T_1$ .

In order to obtain equal voltages at  $E_a$  and  $E_b$ ,  $(R_3 + R_5)/R_5$  should equal the voltage gain of T<sub>2</sub>. Under the condition where a twin-type tube or two tubes having the same characteristics are used as T1 and T2, R4 should be equal to the sum of R<sub>5</sub> and R<sub>5</sub>. The ratio of R<sub>5</sub> + R<sub>5</sub> to R<sub>5</sub> should be the same as the voltage gain ratio of T<sub>2</sub> in order to apply the correct value of signal voltage to T<sub>2</sub>. The value of R<sub>5</sub> is, therefore, equal to R4 divided by the voltage gain of T<sub>2</sub>: R<sub>3</sub> is equal to R<sub>4</sub> minus R<sub>5</sub>. Values of R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> plus R<sub>5</sub>, and R<sub>4</sub> may be taken from the chart in the Resistance-Coupled Amplifiers section. In the practical application of this circuit, it is convenient to use a twin-triode tube combining T1 and T2.

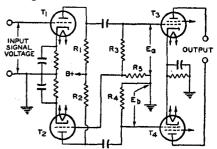


Fig. 35—Push-pull power amplifier resistance-coupled to triode by means of phase inverter.

#### Tone Controls

A tone control is a variable filter (or one in which at least one element is adjustable) by means of which the user may vary the frequency response of an amplifier to suit his own taste. In radio receivers and home amplifiers, the tone control usually consists of a resistance-capacitance network in which the resistance is the variable element.

The simplest form of tone control

is a fixed tone-compensating or "equalizing" network such as that shown in Fig. 36. This type of network is often used to equalize the low- and high-frequency response of a crystal phonograph pickup. At low frequencies the attenuation of this network is 20.8 dB. As the frequency is increased, the 100-picofarad capacitor serves as a bypass for the 5-megohm resistor, and the combined impedance of the resistor-capacitor network is reduced. Thus.

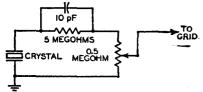


Fig. 36—Tone-control circuit for fixed tone compensation or "equalizing".

more of the crystal output appears across the 0.5-megohm resistor at high frequencies than at low frequencies, and the frequency response at the grid is reasonably flat over a wide frequency range. Fig. 37 shows a comparison between the output of the crystal (curve A) and the output of the equalizing network (curve B). The response curve can be "flattened" still more if the attenuation at low frequencies is increased by changing the 0.5-megohm resistor to 0.125 megohm.

The tone-control network shown in Fig. 38 has two stages with completely separate bass and treble controls. Fig. 39 shows simplified representations of

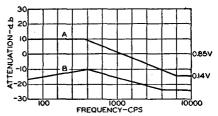


Fig. 37—Curve showing output from crystal phonograph pickup (A) and from equalizing network (B).

the bass control of this circuit when the potentiometer is turned to its extreme variations (usually labeled "Boost" and "Cut"). In this network, as in the crystal-equalizing network shown in Fig. 36, the parallel RC combination is the controlling factor. For bass "boost," the capacitor C<sub>2</sub> bypasses resistor R<sub>3</sub> so that less impedance is placed across the output to grid B at high frequencies than

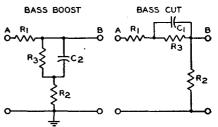


Fig. 39—Simplified representations of basscontrol circuit at extreme ends of potentiometer.

at low frequencies. For bass "cut," the parallel combination is shifted so that  $C_1$  bypasses  $R_0$ , causing more high-

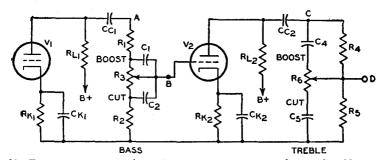


Fig. 38—Two-stage tone-control circuit incorporating separate bass and treble controls.

frequency than low-frequency output. Essentially, the network is a variable-frequency voltage divider. With proper values for the components, it may be made to respond to changes in the R<sub>2</sub> potentiometer setting for only low frequencies (below 1000 cycles).

Fig 40 shows extreme positions of the treble control. The attenuation of the two circuits is approximately the same at 1000 cycles. The treble "boost" circuit is similar to the crystal-equalizing network shown in Fig. 36. In the treble "cut" circuit, the parallel RC elements serve to attenuate the signal voltage further because the capacitor by passes the resistance across the output.

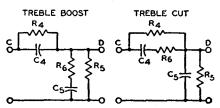


Fig. 40—Simplified representations of treble-control circuit at extreme ends of potentiometer.

The effect of the capacitor is negligible at low frequencies; beyond 1000 cycles, the signal voltage is attenuated at a maximum rate of 6 dB per octave.

The location of a tone-control network is of considerable importance. In a typical radio receiver, it may be inserted in the plate circuit of the power tube, the coupling circuit between the first af amplifier tube and the power tube, or the grid circuit of the first tube. In an amplifier using a beam power tube or pentode power amplifier without negative feedback, it is desirable to connect a resistancecapacitance filter across the primary of the output transformer. This filter may be fixed, with a supplementary tone control elsewhere, or it may form the tone control itself. If the amplifier incorporates negative feedback, the tone control may be inserted in the feedback network or else should be connected to a part of the amplifier which is external to the feedback loop. The overall gain of a well designed tone-control network should be approximately unity.

## Phonograph and Tape Preamplifiers

The frequency range and dynamic range which can be recorded on a phonograph record or on magnetic tape depend on several factors, including the composition, mechanical characteristics, and speed of the record or tape, and the electrical and mechanical characteristics of the recording equipment. To achieve wide frequency and dynamic ranges, manufacturers of commercial recordings use equipment which introduces a nonuniform relationship between amplitude and frequency. This relationship is known as a "recording characteristic." To assure proper reproduction of a high-fidelity recording. therefore, some part of the reproducing system must have a frequency-response characteristic which is the inverse of the recording characteristic. Most manufacturers of high-fidelity recordings use the RCA "New Orthophonic" (RIAA) characteristic for discs and the NARTB characteristic for magnetic tape.

Some typical preamplifier stages are shown in the Circuits section. The location of the frequency-compensating network or "equalizer" in the reproducing system will depend on the types of recordings which are to be reproduced and on the pickup devices used.

A ceramic high-fidelity phonograph pickup is usually designed to provide proper compensation for the RIAA recording characteristic when the pickup is operated into the load resistance specified by its manufacturer. Because this type of pickup also has relatively high output (0.5 to 1.5 volts), it does not require the use of either an equalizer network or a preamplifier, and can be connected directly to the input of a tone-control amplifier and/or power amplifier.

A magnetic high-fidelity phonograph pickup, on the other hand, usually has an essentially flat frequencyresponse characteristic and very low output (1 to 10 millivolts). Because a pickup of this type merely reproduces the recording characteristic, it must be

followed by an equalizer network, as well as by a preamplifier having sufficient voltage gain to provide the input voltage required by the tone-control amplifier and/or power amplifier. Many designs include both the equalizing and amplifying circuits in a single unit.

A high-fidelity magnetic-tape pickup head, like a magnetic phonograph pickup, reproduces the recording characteristic and has an output of only a few millivolts. This type of pickup device, therefore, must also be followed by an equalizing network and preamplifier, or by a preamplifier which provides "built-in" equalization for the NARTB characteristic.

#### Limiters

An amplifier may also be used as a limiter. One use of a limiter is in receivers designed for the reception of frequency-modulated signals. The limiter in FM receivers has the function of eliminating amplitude variations from the input to the detector. Because in an FM system amplitude variations are primarily the result of noise disturbances, the use of a limiter prevents such disturbances from being reproduced in the audio output. The limiter usually follows the last if stage so that it can minimize the effects of disturbances coming in on the rf carrier and those produced locally.

The limiter is essentially an if voltage amplifier designed for saturated operation. Saturated operation means that an increase in signal voltage above a certain value produces very little increase in plate current. A signal voltage which is never less than sufficient to cause saturation of the limiter, even on weak signals, is supplied to the limiter input by the preceding stages. Any change in amplitude, therefore, such as might be produced by noise voltage fluctuation, is not reproduced in the limiter output. The limiting action, of course, does not interfere with the reproduction of frequency variations.

Plate-current saturation of the limiter may be obtained by the use of grid-No. 1-resistor-and-capicitor bias with plate and grid-No. 2 voltages which are low compared with customary if-amplifier operating conditions.

As a result of these design features, the limiter is able to maintain its output voltage at a constant amplitude over a wide range of input-signal voltage variations. The output of the limiter is frequency-modulated if voltage, the mean frequency of which is that of the if amplifier. This voltage is impressed on the input of the detector.

The reception of FM signals without serious distortion requires that the response of the receiver be such that satisfactory amplification of the signal is provided over the entire range of frequency deviation from the mean frequency. Since the frequency at any instant depends on the modulation at that instant, it follows that excessive attenuation toward the edges of the band, in the rf or if stages, will cause distortion. In a high-fidelity receiver. therefore, the amplifiers must be capable of amplifying, for the maximum permissible frequency deviation of 75 kilocycles, a band 150 kilocycles wide. Suitable tubes for this purpose are the 6BA6 and 6BJ6.

## **Television Tuners**

The vhf tuner of a television receiver selects the desired frequency channel in the range from 55 to 216 megacycles per second, amplifies it, and converts it to a lower intermediate frequency. These functions are accomplished in rf-amplifier, mixer, and localoscillator stages employing tube types that are designed specifically for these applications. The rf-amplifier stage uses a high-transconductance tube that has small dimensions to maintain low interelectrode capacitances, particularly between grid and plate. The mixer and oscillator stages usually employ a dualunit triode-pentode tube that has a hightransconductance pentode unit and a medium-mu triode unit.

Fig. 41 shows a simplified schematic diagram of a typical vhf television tuner. The balun converts the 300-ohm balanced antenna impedance to an unbalanced impedance of 75 ohms. The high-pass filter eliminates lower-frequency interference signals. The tuner is set to the desired frequency by simultaneous adjustment of the inductances

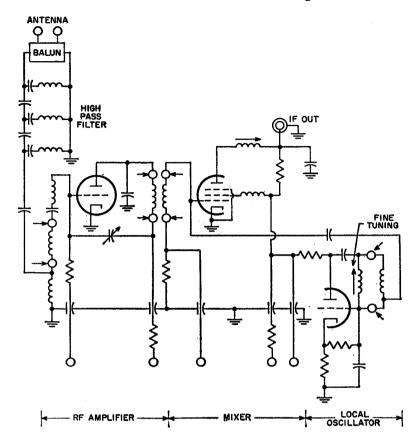


Fig. 41—Simplified schematic of typical vhf television tuner.

indicated by the several sets of arrows in Fig. 41. The inductances are either replaced completely or incremental amounts of inductance are added as the tuner is switched from high frequencies to lower frequencies. Some tuners use a combination of the two methods.

Because noise generated in the first amplifier stage is often the controlling factor in determining the over-all sensitivity of a radio or television receiver, the "front end" is designed with special attention to both gain and noise characteristics. The input circuit of an amplifier inherently contains some thermal noise contributed by the resistive elements in the input device. When an

input signal is amplified, therefore, the thermal noise generated in the input circuit is also amplified. If the ratio of signal power to noise power (signal-to-noise ratio, S/N) is the same in the output circuit as in the input circuit, the amplifier is considered to be "noiseless," and is said to have a noise figure of unity, or zero dB.

In practical circuits, however, all amplifier stages generate a certain amount of noise as a result of thermal agitation of electrons in resistors and other components, minute variations in the cathode emission of tubes (shot effect), and minute grid currents in the amplifier tubes. As a result, the ratio of signal power to noise power is in-

evitably impaired during amplification. A measure of the degree of impairment is called the **noise figure** (NF) of the amplifier, and is expressed as the ratio of signal power to noise power at the input  $(S_1/N_1)$  divided by the ratio of signal power to noise power at the output  $(S_0/N_0)$ , as follows:

$$NF = \frac{(S_1/N_1)}{(S_0/N_0)}$$

The noise figure in decibels (dB) is equal to ten times the logarithm of this power ratio. For example, a one-dB noise figure in an amplifier decreases the signal-to-noise ratio by a factor of 1.26, a 3-dB noise figure by a factor of 2, a 10-dB noise figure by a factor of 10, and a 20-dB noise figure by a factor of 10, and a 20-dB noise figure by a factor of 100.

The over-all noise figure of a receiver is affected by the total number of stages, as shown by the following relationship:

$$\begin{split} NF_{\text{recolver}} &= NF_1 + \frac{(NF_0 + 1)}{G_1} \\ &+ \frac{(NF_3 + 1)}{G_1G_3} \cdot \cdot \cdot \end{split}$$

where G represents power gain and the subscripts indicate the number of each stage. This relationship indicates that the contribution of the second-stage noise factor to that of the over-all receiver is reduced by the gain of the first stage. Therefore, it is important that the rf amplifier have enough gain to make the effect of the second stage negligible. The third stage will then have even less effect. The maximum available power gain G of an rf stage is given by

$$G = \frac{g_{m^3} R_{1n} R_{out}}{4}$$

For maximum gain, therefore, the rfamplifier tube should have high transconductance and high input and output impedances. At frequencies in the vhf television band, the input resistance is small enough to affect the gain. As mentioned previously, the rf tube is designed to have low interelectrode capacitances, small interelectrode spacings, and low lead inductances (particularly the cathode lead).

The gain of the rf stage must be

reduced as the incoming-signal amplitude changes to prevent overload distortion in the following stages. As the signal amplitude increases, an automatic-gain-control (agc) circuit biases the rf tube to decrease its gain. The rf tube usually employs a semiremotecutoff grid to reduce cross-modulation distortion.

Either a triode or a pentode can be used in the rf-amplifier stage of tuner input circuits of vhf television receivers. Such stages are required to amplify signals ranging from 55 to 216 megacycles per second and having a bandwidth of 4.5 megacycles per second (the tuner is usually aligned for a bandwidth of 6 megacycles per second to assure complete coverage of the band). In early rf tuners, pentodes rather than triodes were used because the grid-plate capacitance of triodes created stability problems. However, the use of twin triodes in direct-coupled cathode-drive circuits makes it possible to obtain stable operation along with the low-noise characteristics of triodes.

Pentodes or tetrodes do not provide the useful sensitivity of triodes because of the "partition noise" introduced by the screen grid. The directcoupled cathode-drive circuit provides both the gain and the stability capabilities of the pentode, as well as the advantages of a low-noise triode input stage. Because the cathode-drive stage provides a low-impedance load to the grounded-cathode stage, the gain of the latter stage is very low and there is no necessity for neutralizing the grid-plate capacitance. An interstage impedance, usually an inductance in series with the plate of the first stage and the cathode of the second stage, is often used at higher frequencies to provide a degree of impedance matching between the units. The cathode-drive portion of the circuit is matched to the input network and provides most of the stage gain. Because the feedback path of the cathode-drive circuit is the plate-cathode capacitance, which in most cases is very small, excellent isolation is provided between the antenna and the local oscillator.

Development of single triodes having low grid-plate capacitance, such as the 6BN4, has made possible the design of neutralized triode rf circuits. Tubes such as the 6GK5 and 6CW4 are specially designed to minimize gridplate capacitance to permit easier neutralization of a grounded-cathode circuit over the wide frequency band. Bridge-neutralized rf-amplifier stages are widely used in television tuners; in this arrangement, a portion of the output signal is returned to the grid out of phase with the feedback signal from the grid-plate capacitance. This circuit provides excellent gain and noise performance with stable operation across the band.

The mixer stage of a vhf tuner usually employs a pentode tube, or the pentode unit of a triode-pentode tube. Although triodes such as the 6J6 were used as mixers in early receivers, they have been replaced by pentodes because the higher output impedance of a pentode provides a higher mixer gain than can be obtained with a triode.

The amplified signal from the rf stage in Fig. 41 is applied to the mixer grid along with a local-oscillator signal of much larger amplitude. The localoscillator signal varies the mixer grid voltage from cutoff into the grid-current region. This signal develops a gridresistor bias, called the injection voltage, which is a measure of the local-oscillator voltage. Because the transfer curve of the mixer tube is nonlinear, mixing action between the rf signal and the local-oscillator signal produces sum and difference frequencies. The output circuit of the mixer is tuned to the difference frequency (about 44 megacycles per second) and rejects all other frequencies. This signal is then fed to the intermediate-frequency amplifier.

The mixer gain is a function of the amplitude of the local-oscillator signal. The gain has a broad maximum over a range of injection voltages from -2.5 to -5.0 volts for conventional-grid mixers and slightly lower for frame-grid mixers. Good impedance matching between the rf-amplifier plate and the mixer grid, consistent with

bandpass requirements, is important to achieve maximum signal power transfer. A slight amount of regeneration is provided by a small screen-grid inductance. This regeneration effectively increases the mixer-grid input impedance and thus improves power gain.

The local-oscillator stage shown in Fig. 41 is a Colpitts type in which the tuned circuit is located between the grid and plate and the feedback path is through the tube interelectrode capacitances. A large signal is developed in the local oscillator and coupled loosely to the mixer grid to minimize the effects of changes in the mixer input on the frequency of oscillation. The circuit is designed to keep frequency shift within a very narrow range with supply-voltage and temperature changes. Fine tuning is provided by a capacitance variable inductance or across the tuned circuit. Tubes commonly used in local-oscillator and mixer circuits are the 6EA8, 6KZ8, and 6KE8,

# **Television IF Amplifiers**

intermediate-frequency (if) amplifier stages in a television receiver provide the additional gain required to bring the signal level to an amplitude suitable for final detection. A constant peak signal of about three to five volts is required at the input to the detector. The mixer output signal is passed through two or three stages of amplification to attain this level. High-transconductance pentodes having low grid-No.1-to-plate capacitances are normally used in if amplifiers. The coupling circuits are usually tuned transformers which may be single- or double-tuned. The transformers are either synchronously (same frequency) tuned or stagger-tuned, depending on circuit requirements. The over-all bandwidth varies from a maximum of 3.58 megacycles per second at the 6-dB points for color receivers to values in the order of 2.0 to 2.5 megacycles per second for the most inexpensive receivers. An expression for the figure of merit for a singletuned if-amplifier tube is the gainbandwith product  $G \times B$ , which is

given by

$$G \times B = \frac{g_m}{2 \pi G}$$

where C is the total tuning capacitance. This relationship again demonstrates the need for high transconductance and low interelectrode capacitance.

The first stage (or first two stages in the case of a three-stage if) is gaincontrolled like the rf amplifier. However, the bias applied to the if-amplifier tube varies the input resistance and capacitance of the tube and thus detunes the circuit. It is important for proper reception to maintain the frequency response of the if stages constant, particularly in the case of the color receiver. Therefore, a small unbypassed cathode resistor is used which provides degenerative feedback to minimize the effect of bias changes. In addition, the effects on input impedance caused by the grid-plate capacitance are reduced by use of a partial bypass capacitor at the screen grid to provide neutralization of the grid-to-plate capacitance.

Tubes used in the gain-controlled stages of the if amplifier have remoteor semiremote-cutoff characteristics to reduce cross-modulation or intermodulation interference. Tube types commonly used in this application include the 6BZ6, 6GM6, 6JH6, and 6JD6.

The last if-amplifier stage is a relatively-large-signal amplifier. this reason, the tube must be biased so that it will operate over a region of linear operation for large voltage excursions. Because such a quiescent operating point provides a transconductance somewhat below the maximum value for the tube, the selection of the operating point involves a compromise between signal-handling capacity and gain. For purposes of linearity, the final if-amplifier stage is not gain-controlled, and operates with the cathode bypassed to ground. Because fixed bias is used, a sharp-cutoff tube is used to provide higher transconductance than could be obtained with an equivalent remote- or semiremote-cutoff tube. Examples of types used in this stage are the 6EW6 and 6JC6.

## Video Amplifiers

The video amplifier stage in a television receiver usually employs a pentode-type tube specially designed to amplify the wide band of frequencies contained in the video signal and, at the same time, to provide high gain per stage. Pentodes are more useful than triodes in such stages because they have high transconductance (to provide high gain) together with low input and output interelectrode capacitances (to permit the broadband requirements to be satisfied). An approximate "figure of merit" for a particular tube for this application can be determined from the ratio of its transconductance, gm, to the sum of its input and output capacitances. Cin and Cout. as follows:

Figure of Merit = 
$$\frac{g_m}{C_{in} + C_{out}}$$

Typical values for this figure are in the order of 500 x 10° or greater.

A typical video amplifier stage, such as that shown in Fig. 42, is connected between the second detector of the television receiver and the picture tube. The contrast control, R<sub>1</sub>, in this circuit controls the gain of the video amplifier tube. The inductance, L<sub>2</sub>, in series with the load resistor, R<sub>L</sub>, maintains the plate load impedance at a relatively constant value with increasing

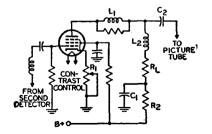


Fig. 42—Typical video amplifier stage.

frequency. The inductance L<sub>1</sub> isolates the output capacitance of the tube so that only stray capacitance is placed

across the load. As a result, a higher-value load resistor is used to provide higher gain without affecting frequency response or phase relations. The decoupling circuit, C<sub>1</sub>R<sub>2</sub>, is used to improve the low-frequency response. Tubes used as video amplifiers include types 6CL6 and 12BY7A, or the pentode sections of types 6AW8A and 6AN8A.

The luminance amplifier in a colortelevision receiver is a conventional video amplifier having a bandwidth of approximately 3.5 megacycles per second. In a color receiver, the portion of the output of the second detector which lies within the frequency band from approximately 2.4 to 4.5 megacycles per second is fed to a bandpass amplifier. as shown in the block diagram in Fig. 43. The color synchronizing signal, or "burst," contained in this signal may then be fed to a "burst-keyer" tube. At the same time, a delayed horizontal pulse may be applied to the keyer tube. The output of the kever tube is applied to the burst amplifier tube and the

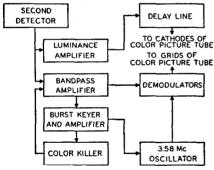


Fig. 43—Block diagram of video-amplifier section of color television receiver.

signal is then fed to the 3.58-megacycle oscillator and to the "color-killer" stage.

The color killer applies a bias voltage to the bandpass amplifier in the absence of burst so that the color section, or chrominance channel, of the receiver remains inoperative during black-andwhite broadcasts. A threshold control varies the bias and controls the burst level at which the killer stage operates.

The output of the 3.58-megacycle oscillator and the output of the bandpass amplifier are fed into phase and amplitude demodulator circuits. The output of each demodulator circuit is an electrical representation of a color-difference signal, i.e., an actual color signal minus the black-and-white, or luminance, signal. The two color-difference signals are combined to produce the third color-difference signal; each of the three signals then represents one of the primary colors.

The three color-difference signals are usually applied to the grids of the three electron guns of the color picture tube, in which case the black-and-white signal from the luminance amplifier may be applied simultaneously to the cathodes. The chrominance and luminance signals then combine to produce the color picture. In the absence of transmitted color information, the chrominance channel is cut off by the color killer, as described above, and only the luminance signal is applied to the picture tube, producing a black-and-white picture.

# Television Sync Circuits

In addition to picture information, the composite video signal supplied to a television receiver contains information to assure that the picture produced on the receiver is synchronized with the picture being viewed by the camera or pickup tube. The "sync" pulses, which have a greater amplitude than the video signal, trigger the scanning generators of the receiver when the electron beam of the pickup tube ends each trace.

The sync pulses in the composite video signal may be separated from the video information in the output of the second or video detector by means of the triode circuit shown in Fig. 44. In this circuit, the time constant of the network R<sub>1</sub>C<sub>1</sub> is long with respect to the interval between pulses. During each pulse, the grid is driven positive and draws current, thereby charging capacitor C<sub>1</sub>. Consequently, the grid develops a bias which is slightly greater

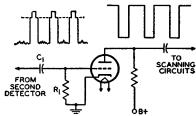


Fig. 44—Sync-separator circuit.

than the cutoff voltage of the tube. Because plate current flows only during the sync-pulse period, only the amplified pulse appears in the output. This sync-separator stage discriminates against the video information. Because the bias developed on the grid is proportional to the strength of the incoming signal, the circuit also has the advantage of being relatively independent of signal fluctuations.

Because the electron beam scans the face of the picture tube at different rates in the vertical and horizontal directions, the receiver incorporates two different scanning generators. The repetition rate of the vertical generator is 60 cycles per second, and the rate of the horizontal generator is approximately 15,750 cycles per second. The composite video signal includes information which enables each generator to derive its correct triggering. One horizontal sync pulse is supplied at the end of each horizontal line scan. At the end of each frame, several pulses of longer duration than the horizontal sync pulses are supplied to actuate the vertical generator. The vertical information is separated from the horizontal information by differentiating and integrating circuits.

In fringe areas, two conditions complicate the process of sync separation. First, the incoming signal available at the antenna is weak and susceptible to fading and other variations; second, the receiver is operating at or near maximum gain, which makes it extremely susceptible to interference from pulse-type noise generated by certain types of electrical equipment, ignition systems, switches, or the like. Some type of noise-immunity provision is

almost essential for acceptable performance. Noise may be reduced or eliminated from the sync and agc circuits by gating or by a combination of gating, inversion, and cancellation. An example, of the latter method is shown in Fig. 45. In this circuit the 6GY6, which has two independent control grids, serves the dual function of agc amplifier and noise inverter. Because the sync tips of the video signal at grid No. 1 of the 6GY6 drive the tube near its cutoff region, any noise signal

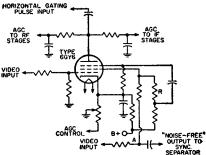


Fig. 45—Typical noise-cancellation circuit. extending above the tip level will appear inverted across the grid-No.2 load resistor R. This inverted noise signal is re-combined with the video signal and fed to the sync separator at point "A" in Fig. 45, where noise cancellation takes place. This process leaves the sync pulses relatively free of disturbing noise and results in a stable picture. To prevent reduction of receiver gain due to the effect of noise on the age amplifier, a portion of the inverted noise signal is fed to the second control grid, grid No.3, of the 6GY6 to cut off or gate the agc amplifier when a noise pulse occurs.

#### Rectification

The rectifying action of a diode finds important applications in supplying a receiver with dc power from an ac line and in supplying high dc voltage from a high-voltage pulse. A typical arrangement for converting ac to dc includes a rectifier tube, a filter, and a voltage divider. The rectifying action of the tube is explained briefly under Diodes, in the Electrons, Electrodes.

and Electron Tubes section. Highvoltage pulse rectification is described later under Horizontal Output Circuits.

The function of a filter is to smooth out the ripple of the tube output, as indicated in Fig. 46, and to increase rectifier efficiency. The action

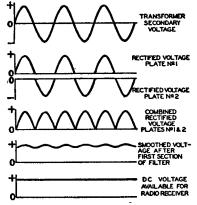


Fig. 46—Voltage waveforms of full-wave rectifier circuit.

of the filter is explained in the Electron Tube Installation section under Filters. The voltage divider is used to cut down the output voltage to the values required by the plates and the other electrodes of the tubes in the receiver.

A half-wave rectifier and a full-wave rectifier circuit are shown in Fig. 47. In the half-wave circuit, current flows through the rectifier tube to the filter on every other half-cycle of the ac input voltage when the plate is positive with respect to the cathode. In the full-wave circuit, current flows to the filter on every half-cycle, through plate No. 1 on one half-cycle when plate No. 1 is positive with respect to the cathode, and through plate No. 2 on the next half-cycle when plate No. 2 is positive with respect to the cathode.

Because the current flow to the filter is more uniform in the full-wave circuit than in the half-wave circuit, the output of the full-wave circuit requires less filtering. Rectifier operating information and circuits are given under each rectifier tube type and in the **Circuits** section, respectively.

Parallel operation of rectifier tubes furnishes an output current greater than that obtainable with the use of one tube. For example, when two full-wave rectifier tubes are connected in parallel, the plates of each tube are connected together and each tube acts as a half-wave rectifier. The permissible voltage and load conditions per tube are the same as for full-wave service but the total load-handling capability of the complete rectifier is approximately doubled.

When mercury-vapor rectifier tubes are connected in parallel, a stabilizing resistor of 50 to 100 ohms should be connected in series with each plate lead in order that each tube will carry an equal share of the load. The value of the resistor to be used will depend on the amount of plate current that passes through the rectifier. Low plate current requires a high value; high plate current, a low value. When the plates of mercury-vapor rectifier tubes are connected in parallel, the corresponding filament leads should be similarly connected. Otherwise, the tube drops will be considerably unbalanced and larger stabilizing resistors will be required.

Two or more vacuum rectifier tubes can also be connected in parallel

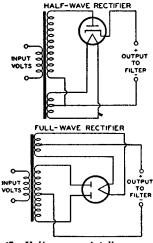


Fig. 47—Half-wave and full-wave rectifier circuits.

to give correspondingly higher output current and, as a result of paralleling their internal resistances, give somewhat increased voltage output. With vacuum types, stabilizing resistors may or may not be necessary depending on the tube type and the circuit.

A voltage-doubler circuit of simple form is shown in Fig. 48. The circuit derives its name from the fact that its

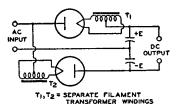
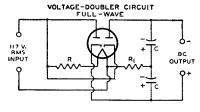


Fig. 48-Full-wave voltage-doubler circuit.

dc voltage output can be as high as twice the peak value of ac input. Basically, a voltage doubler is a rectifier circuit arranged so that the output voltages of two half-wave rectifiers are in series.

The action of a voltage doubler can be described briefly as follows. On the positive half-cycle of the ac input. that is, when the upper side of the ac input line is positive with respect to the lower side, the upper diode passes current and feeds a positive charge into the upper capacitor. As positive accumulates on the plate of the capacitor, a positive voltage builds up across the capacitor. On the next half-cycle of the ac input, when the upper side of the line is negative with respect to the lower side. the lower diode passes current so that



R = HEATERS OF OTHER TUBES IN SERIES WITH VOLTAGE-DROPPING RESISTOR

a negative voltage builds up across the lower capacitor.

So long as no current is drawn at the output terminals from the capacitor, each capacitor can charge up to a voltage of magnitude E, the peak value of the ac input. It can be seen from the diagram that with a voltage of +E on one capacitor and -E on the other, the total voltage across the capacitors is 2E. Thus the voltage doubler supplies a no-load dc output voltage twice as large as the peak ac input voltage. When current is drawn at the output terminals by the load, the output voltage drops below 2E by an amount that depends on the magnitude of the load current and the capacitance of the capacitors. The arrangement shown in Fig. 48 is called a full-wave voltage doubler because each rectifier passes current to the load on each halt of the ac input cycle.

Two rectifier types especially designed for use as voltage doublers are the 25Z6GT and 117Z6GT. These tubes combine two separate diodes in one tube. As voltage doublers, the tubes are used in "transformerless" receivers. In these receivers, the heaters of all tubes in the set are connected in series with a voltage-dropping resistor across the line. The connections for the heater supply and the voltage-doubling circuit are shown in Fig. 49.

With the full-wave voltage-doubler circuit in Fig. 49, it will be noted that the dc load circuit can not be connected to ground or to one side of the ac supply line. This circuit presents certain disadvantages when the heaters of all the tubes in the set are connected in series

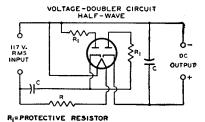


Fig. 49—Full-wave and half-wave voltage-doubler circuits showing heater-supply connections.

with a resistance across the ac line. Such a circuit arrangement may cause hum because of the high ac potential between the heaters and cathodes of the tubes.

The half-wave voltage-doubler circuit in Fig. 49 overcomes this difficulty by making one side of the ac line common with the negative side of the dc load circuit. In this circuit, one half of the tube is used to charge a capacitor which, on the following half cycle, discharges in series with the line voltage through the other half of the tube. This circuit is called a half-wave voltage doubler because rectified current flows to the load only on alternate halves of the ac input cycle. The voltage regulation of this arrangement is somewhat poorer than that of the fullwave voltage doubler.

## Detection

When speech, music, or video information is transmitted from a radio or television station, the station radiates a radio-frequency (rf) wave which is of either of two general types. In one type, the wave is said to be amplitude modulated when its frequency remains constant and the amplitude is varied. In the other type, the wave is said to be frequency modulated when its amplitude remains essentially constant but its frequency is varied.

The function of the receiver is to reproduce the original modulating wave from the modulated rf wave. The receiver stage in which this function is performed is called the **demodulator** or detector stage.

## AM Detection

The effect of amplitude modulation on the waveform of the rf wave is shown in Fig 50. There are three different basic circuits used for the detection of amplitude-modulated waves: the diode detector, the grid-bias detector, and the grid-resistor detector. These circuits are alike in that they eliminate, either partially or completely, alternate halfcycles of the rf wave. With alternate half-cycles removed, the audio variations of the other half-cycles can be amplified to drive headphones or a loudspeaker.

A diode-detector circuit is shown in Fig. 51. The action of this circuit when a modulated rf wave is applied is

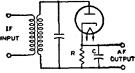


Fig. 51—Basic diode-detector circuit. illustrated by Fig. 52. The rf voltage applied to the circuit is shown in light line; the output voltage across capacitor C is shown in heavy line.

Between points (a) and (b) on the first positive half-cycle of the applied rf voltage, capacitor C charges up to the peak value of the rf voltage. Then as the applied rf voltage falls away from its peak value, the capacitor holds the cathode at a potential more positive than the voltage applied to the anode. The capacitor thus temporarily cuts off current through the diode. While the diode current is cut off, the capacitor discharges from (b) to (c) through the diode load resistor R.

When the rf voltage on the anode rises high enough to exceed the potential at which the capacitor holds the cathode, current flows again and the capacitor charges up to the peak value of the second positive half-cycle at (d). In this way, the voltage across the capacitor follows the peak value of the applied rf

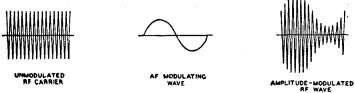


Fig. 50-Waveforms showing effect of amplitude modulation on an rj wave.



Fig. 52—Waveforms showing modulated rf input (light line) and output voltage (heavy line) of diode-detector circuit.

voltage and reproduces the af modulation.

The curve for voltage across the capacitor, as shown in Fig. 52, is somewhat jagged. However, this jaggedness, which represents an rf component in the voltage across the capacitor, is exaggerated in the drawing. In an actual circuit the rf component of the voltage across the capacitor is negligible. Hence, when the voltage across the capacitor is amplified, the output of the amplifier reproduces the speech or music originating at the transmitting station.

Another way to describe the action of a diode detector is to consider the circuit as a half-wave rectifier. When the rf signal on the plate swings positive, the tube conducts and the rectified current flows through the load resistance R. Because the dc output voltage of a rectifier depends on the voltage of the ac input, the dc voltage across C varies in accordance with the amplitude of the rf carrier and thus reproduces the af signal. Capacitor C should be large enough to smooth out rf or if variations, but should not be so large as to affect the audio variations. Two diodes can be connected in a circuit similar to a full-wave rectifier to provide full-wave detection. However, in practice, the advantages of this connection generally do not justify the extra circuit complication.

The diode method of detection produces less distortion than other methods because the dynamic characteristics of a diode can be made more linear than those of other detectors. The disadvantages of a diode are that it does not amplify the signal, and that it draws current from the input circuit and therefore reduces the selectivity of the input circuit. However, because the

diode method of detection produces less distortion and because it permits the use of simple ave circuits without the necessity for an additional voltage supply, the diode method of detection is most widely used in broadcast receivers.

A typical diode-detector circuit using a twin-diode—triode tube is shown in Fig. 53. Both diodes are connected

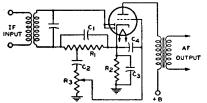


Fig. 53—Typical diode-detector circuit using a twin diode—triode tube.

together.  $R_1$  is the diode load resistor. A portion of the af voltage developed across this resistor is applied to the triode grid through the volume control  $R_8$ . In a typical circuit, resistor  $R_1$  may be tapped so that five-sixths of the total af voltage across  $R_1$  is applied to the volume control. This tapped connection reduces the af voltage output of the detector circuit slightly, but it reduces audio distortion and improves the rf filtering.

DC bias for the triode section is provided by the cathode-bias resistor  $R_2$  and the audio bypass capacitor  $C_2$ . The function of capacitor  $C_2$  is to block the dc bias of the cathode from the grid. The function of capacitor  $C_4$  is to bypass any rf voltage on the grid to cathode. A twin-diode—pentode may also be used in this circuit. With a pentode, the af output should be resistance-coupled rather than transformer-coupled.

Another diode-detector circuit, called a diode-biased circuit, is shown in Fig. 54. In this circuit, the triode grid

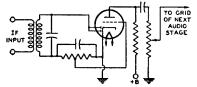


Fig. 54-Diode-biased detector circuit.

is connected directly to a tap on the diode load resistor. When an rf signal voltage is applied to the diode, the dc voltage at the tap supplies bias to the triode grid. When the rf signal is modulated, the af voltage at the tap is applied to the grid and is amplified by the triode.

The advantage of the circuit shown in Fig. 54 over the self-biased arrangement shown in Fig. 53 is that the diode-biased circuit does not employ a capacitor between the grid and the diode load resistor, and consequently does not produce as much distortion of a signal having a high percentage of modulation.

However, there are restrictions on the use of the diode-biased circuit. Because the bias voltage on the triode depends on the average amplitude of the rf voltage applied to the diode, the average amplitude of the voltage applied to the diode should be constant for all values of signal strength at the antenna. Otherwise there will be different values of bias on the triode grid for different signal strengths and the triode will produce distortion. Because there is no bias applied to the diodebiased triode when no rf voltage is applied to the diode, sufficient resistance should be included in the plate circuit of the triode to limit its zerobias plate current to a safe value.

These restrictions mean, in practice, that the receiver should have a separate-channel automatic-volume-control (avc) system. With such an avc system, the average amplitude of the signal voltage applied to the diode can be held within very close limits for all values of signal strength at the antenna.

The tube used in a diode-biased circuit should be one which operates at a fairly large value of bias voltage. The variations in bias voltage are then a small percentage of the total bias and hence produce small distortion. Tubes taking a fairly large bias voltage are types such as the 6BF6 or 6SR7 having a medium-mu triode. Tube types having a high-mu triode or a pentode should not be used in a diode-biased circuit.

A grid-bias detector circuit is

shown in Fig. 55. In this circuit, the grid is biased almost to cutoff, *i.e.*, operated so that the plate current with zero signal is practically zero. The bias voltage can be obtained from a cathode-bias resistor, a C-battery, or a bleeder

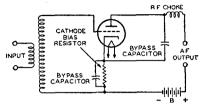


Fig. 55—Grid-bias detector circuit.

tap. Because of the high negative bias, only the positive half-cycles of the rf signal are amplified by the tube. The signal is, therefore, detected in the plate circuit. The advantages of this method of detection are that it amplifies the signal, besides detecting it, and that it does not draw current from the input circuit and therefore does not reduce the selectivity of the input circuit.

The grid-resistor-and-capacitor method, illustrated in Fig. 56, is somewhat more sensitive than the grid-bias method and gives its best results on weak signals. In this circuit, there is no negative dc bias voltage applied to the grid. Hence, on the positive half-cycles of the rf signal, current flows from grid to cathode. The grid and cathode thus

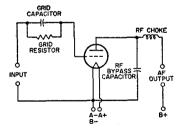


Fig. 56—Detector circuit using grid-resistorand-capacitor bias.

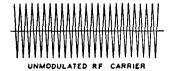
act as a diode detector, with the grid resistor as the diode load resistor and the grid capacitor as the rf bypass capacitor. The voltage across the capacitor then reproduces the af modulation in the same manner as has been explained for the diode detector. This voltage appears between the grid and cathode and is therefore amplified in the plate circuit. The output voltage thus reproduces the original af signal.

In this detector circuit, the use of a high-resistance grid resistor increases selectivity and sensitivity. However, improved af response and stability are obtained with lower values of grid-circuit resistance. This detector circuit amplifies the signal, but draws current from the input circuit and therefore reduces the selectivity of the input circuit.

## FM Detection

The effect of frequency modulation on the waveform of the rf wave is shown in Fig. 57. In this type of transmission, the frequency of the rf wave deviates from a mean value, at an rf rate depending on the modulation, by an amount that is determined in the transmitter and is proportional to the amplitude of the af modulation signal.

For this type of modulation, a detector is required to discriminate between deviations above and below the mean frequency and to translate those



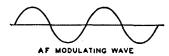




Fig. 57—Waveforms showing effect of frequency modulation on an rf wave.

deviations into a voltage whose amplitude varies at audio frequencies. Since the deviations occur at an audio frequency, the process is one of demodulation, and the degree of frequency deviation determines the amplitude of the demodulated (af) voltage.

A simple circuit for converting frequency variations to amplitude variations is a circuit which is tuned so that the mean radio frequency is on one slope of its resonance characteristic, as at A of Fig. 58. With modulation, the frequency swings between B and C, and the voltage developed across the circuit varies at the modulating rate. In order that no distortion will be introduced in this circuit, the frequency swing must be restricted to the portion of the slope which is effectively straight. Since this portion is very short, the voltage developed is low. Because of these limitations, this circuit is not commonly used but it serves to illustrate the principle.

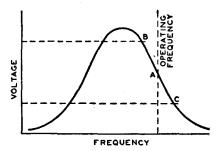


Fig. 58—Resonance curve showing desired operating range for frequency-modulation converter.

The faults of the simple circuit are overcome in a push-pull arrangement, sometimes called a discriminator circuit, such as that shown in Fig. 59. Because of the phase relationships between

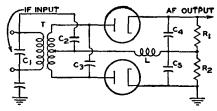


Fig. 59-Basic discriminator circuit.

the primary and each half of the secondary of the input transformer (each half of the secondary is connected in series with the primary through capacitor C<sub>2</sub>), the rf voltages applied to the diodes become unequal as the rf signal swings from the resonant frequency in each direction.

Because the swing occurs at audio frequencies (determined by the af modulation), the voltage developed across the diode load resistors, R<sub>1</sub> and R<sub>2</sub> connected in series, varies at audio frequencies. The output voltage depends on the difference in amplitude of the voltages developed across R<sub>1</sub> and R<sub>2</sub>. These voltages are equal and of opposite sign when the rf carrier is not modulated and the output is, therefore, zero. When modulation is applied, the output voltage varies as shown in Fig. 60.

Because this type of FM detector is sensitive to amplitude variations in the rf carrier, a limiter stage is frequently used to remove most of the amplitude modulation from the carrier. (See Limiters under Amplification.)

Another form of detector for frequency-modulated waves is called a ratio detector. This FM detector, unlike the previous one which responds to a difference in voltage, responds only to changes in the ratio of the voltage across two diodes and is, therefore, insensitive to changes in the differences in the voltages due to amplitude modulation of the rf carrier.

The basic ratio detector is given in Fig. 61. The plate load for the final if amplifier stage is the parallel resonant circuit consisting of C<sub>1</sub> and the primary transformer T. The tuning and coupling of the transformer are practically the

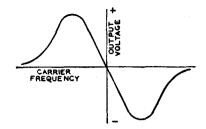


Fig. 60—Output waveform of discriminator circuit.

same as in the previous circuit and, therefore, the rf voltages applied to the diodes depend upon how much the rf signal swings from the resonant frequency in each direction. At this point the similarity ends.

Diode 1, R<sub>2</sub>, and diode 2 complete a series circuit fed by the secondary of the transformer T. The two diodes are connected in series so that they conduct on the same rf half-cycle. The rectified current through R<sub>2</sub> causes a negative voltage to appear at the plate of diode 1. Because C<sub>6</sub> is large, this negative voltage at the plate of diode 1 remains constant even at the lowest audio frequencies to be reproduced.

The rectified voltage across  $C_8$  is proportional to the voltage across diode 1, and the rectified voltage across  $C_4$  is proportional to the voltage across diode 2. Because the voltages across the two diodes differ according to the instantaneous frequency of the carrier, the voltages across  $C_8$  and  $C_4$  differ proportionately, the voltage across  $C_8$  being the larger of the two voltages at carrier frequencies below the intermediate frequency and the smaller at frequencies above the intermediate frequency.

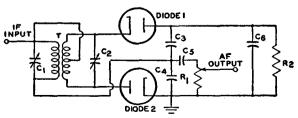


Fig. 61-Basic ratio-detector circuit.

These voltages across C<sub>8</sub> and C<sub>4</sub> are additive and their sum is fixed by the constant voltage across C<sub>6</sub>. Therefore, while the ratio of these voltages varies at an audio rate, their sum is always constant. The voltage across C<sub>4</sub> varies at an audio rate when a frequency-modulated rf carrier is applied to the ratio detector; this audio voltage is extracted and fed to the audio amplifier. For a complete circuit utilizing this type of detector, refer to the Circuits section.

## Color Demodulation

In the transmission of picture signals for color-television receivers, all the color information is contained in three signals, a luminance (black-andwhite) or monochrome signal and two chrominance signals. The luminance signal, which is called the Y signal, contains brightness information only. The voltage response of the Y signal is made similar to the brightness response of the human eve by use of a composite signal that contains definite proportions of the red, green, and blue signals from the color-television camera (30 per cent red, 59 per cent green, and 11 per cent blue). This Y signal, which includes sync and blanking pulses, provides a correct monochrome picture in a conventional black-and-white television receiver.

For the generation of color-television signals, the Y signal is subtracted from the red, green, and blue signals to provide a new set of color-difference signals, which are designated as R-Y, B-Y, and G-Y. All of the original picture information is contained in the Y

signal, the R-Y signal, and the B-Y signal. Therefore, the G-Y signal is not contained in the transmitted signal, but is synthesized in the receiver by proper combination of the R-Y and B-Y signals.

(Color signals transmitted under present color-television standards are not R-Y and B-Y, but a similar pair of signals designated as I and Q. In the color-television receiver, R-Y and B-Y signals are demodulated directly from the I and Q signals with negligible loss of color quality. For purposes of simplicity, only R-Y and B-Y signals are considered in this explanation. In addition, a 90-degree phase-shift network is shown; the phase-shift angle could be, and often is, some other value.)

Because the luminance signal and the two color-difference signals must be transmitted with a standard 6-megacycle channel, the two color signals are combined into one signal at the transmitter and are independently recovered at the receiver by proper detection techniques. A color subcarrier of approximately 3.58 megacycles per second is used for transmitting the color information within the 6-megacycle spectrum of the television station. As shown in Fig. 62, the 3.58-megacycle subcarrier and one of the color-difference signals are applied directly to a balanced AM modulator. The other color-difference signal is applied directly to a second balanced AM modulator. and the 3.58-megacycle subcarrier is applied to this second modulator through a 90-degree phase-shifting network. The balanced modulators effectively cancel both the individual color-

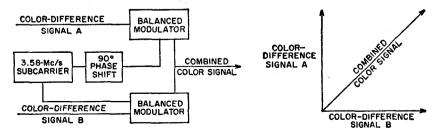


Fig. 62—Formation of combined color signal for transmission.

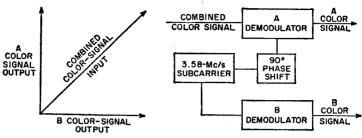


Fig. 63—Separation of combined color signal into two signals at the receiver.

difference signals and the subcarrier signal, and the output contains only the side-bands of the combined chrominance signal.

Recovery of the color information at the receiver involves a process called synchronous detection. In this process, two separate detectors are used to recover the separate color information, just as two separate modulators were used to combine the information at the transmitter. The 3.58-megacycle subcarrier, which was suppressed during transmission, must be reinserted at the receiver for recovery of the color information. The basis of synchronous detection is the phase relationship of this reinserted 3.58-megacycle subcarrier.

For example, the original color information is represented in Fig. 62 by the color-difference signals A and B. At the receiver, the combined color signal is fed to two demodulators A and B, as shown in Fig. 63. At the same time, a 3.58-megacycle subcarrier is also fed to the two demodulators, with the same phase relationship that was used in the modulators at the transmitter. This locally generated subcarrier essentially duplicates or replaces the original subcarrier, which was removed at the transmitter.

The local 3.58-megacycle oscillator in the color-television receiver is made to function at the proper frequency and phase by means of a synchronizing signal sent out by the transmitter. This synchronizing signal consists of a short burst of 3.58-megacycle signals transmitted during the horizontal blanking interval, immediately after the horizontal sync pulse, as shown in Fig. 64.

Fig. 65 shows a simplified diagram of a low-level color demodulator frequently used in color-television receivers. The locally generated 3.58-megacycle signal is applied to the grid No. 3

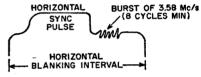


Fig. 64—Waveform for synchronizing signal.

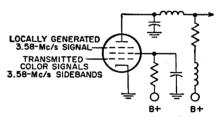


Fig. 65—Low-level color demodulator.

of the pentode. The transmitted color signal containing the 3.58-megacycle sidebands is applied to grid No. 1. The phase of the 3.58-megacycle color signal constantly changes in accordance with its color content. For example, the following table shows six variations in color (hue) as a function of subcarrier phase:

Subcarrier Phase-degrees (with respect to 3.58-megacycle local signal in phase with burst)	Hue
13	Yellow
77	Red
119	Magenta
193	Blue
257	Cyan
299	Green

55

The basic operating principle of the color demodulator shown in Fig. 65 is that plate current from the pentode is zero (or quite low) unless both grid No. 1 and grid No. 3 are simultaneously positive. For example, when the signals applied to the two grids are in phase, plate current can be expected to flow for 180 degrees of each -ac cycle. Conversely, when the signals are 180 degrees out of phase, plate current is cut off. The output signal from the detector, therefore, is a function of the phase relationship between the transmitted color signal and the locally generated subcarrier.

In a typical color-television receiver, two color demodulators of the type shown in Fig. 65 are required. In one demodulator, the 3.58-megacycle subcarrier signal is applied directly to the pentode grid No. 3 from the local "burst" oscillator. In the other demodulator, the 3.58-megacycle signal from the burst oscillator is shifted 90 degrees in phase before it is applied to the pentode grid No. 3. As shown previously in Fig. 63, the demodulator B produces R-Y signals. These B-Y and R-Y signals are then combined (matrixed) to produce the G-Y signal, as discussed earlier. The complete luminance signal is then amplified to the required level in a conventional videoamplifier circuit.

In some color-television receivers, the demodulators are designed so that the color output signals can be applied directly to the color picture tube. In the diagram shown in Fig. 66, for example, the 6JH8 sheet-beam demodula-

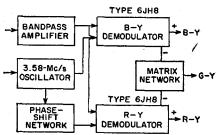


Fig. 66—Block diagram of demodulator circuit used to apply signals directly to color picture tube.

tors produce both positive and negative B-Y and R-Y signals. The positive signals are applied directly to the control grids (grid No. 1) of the blue and red guns of the color picture tube. At the same time, the negative color-difference signals are added (matrixed) in the correct proportions to produce the G-Y signal, which is applied to grid No. 1 of the green gun.

# Automatic Volume or Gain Control

The chief purpose of automatic volume control (avc) or automatic gain control (agc) in a radio or television receiver is to prevent fluctuations in loudspeaker volume or picture brightness when the audio or video signal at the antenna is fading in and out.

An automatic volume control circuit regulates the receiver rf and if gain so that this gain is less for a strong signal than for a weak signal. In this way, when the signal strength at the antenna changes, the avc circuit reduces the resultant change in the voltage output of the last if stage and consequently reduces the change in the speaker output volume.

The avc circuit reduces the rf and if gain for a strong signal usually by increasing the negative bias of the rf, if, and frequency-mixer stage when the signal increases. A simple avc circuit is shown in Fig. 67. On each positive half-cycle of the signal voltage, when the diode plate is positive with respect to the cathode, the diode passes current.

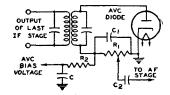


Fig. 67—Automatic-volume-control (avc) circuit.

Because of the flow of diode current through  $R_1$ , there is a voltage drop across  $R_1$  which makes the left end of  $R_1$  negative with respect to ground. This voltage drop across  $R_1$  is applied,

through the filter  $R_2$  and C, as negative bias on the grids of the preceding stages. When the signal strength at the antenna increases, therefore, the signal applied to the avc diode increases, the voltage drop across  $R_1$  increases, the negative bias voltage applied to the rf and if stages increases, and the gain of the rf and if stages is decreased. Thus the increase in signal strength at the antenna does not produce as much increase in the output of the last if stage as it would produce without avc.

When the signal strength at the antenna decreases from a previous steady value, the avc circuit acts, of course, in the reverse direction, applying less negative bias, permitting the rf and if gain to increase, and thus reducing the decrease in the signal output of the last if stage. In this way, when the signal strength at the antenna changes, the avc circuit acts to reduce change in the output of the last if stage, and thus acts to reduce change in loudspeaker volume.

The filter, C and R<sub>2</sub>, prevents the ave voltage from varying at audio frequency. The filter is necessary because the voltage drop across R<sub>1</sub> varies with the modulation of the carrier being received. If avc voltage were taken directly from R<sub>1</sub> without filtering, the audio variations in avc voltage would vary the receiver gain so as to smooth out the modulation of the carrier. To avoid this effect, the avc voltage is taken from the capacitor C. Because of the resistance R2 in series with C, the capacitor C can charge and discharge at only a comparatively slow rate. The avc voltage therefore cannot vary at frequencies as high as the audio range but can vary at frequencies high enough to compensate for most fading. Thus the filter permits the avc circuit to smooth out variations in signal due to fading, but prevents the circuit from smoothing out audio modulation.

It will be seen that an avc circuit and a diode-detector circuit are much alike. It is therefore convenient in a receiver to combine the detector and the avc diode in a single stage. Examples of how these functions are combined in receivers are shown in Circuits section.

In the circuit shown in Fig. 67, a certain amount of avc negative bias is applied to the preceding stages on a weak signal. Because it may be desirable to maintain the receiver rf and if gain at the maximum possible value for a weak signal, avc circuits are designed in some cases to apply no avc bias until the signal strength exceeds a certain value. These avc circuits are known as delayed avc or davc circuits.

A dave circuit is shown in Fig. 68. In this circuit, the diode section  $D_1$  of the 6H6 acts as detector and ave diode.

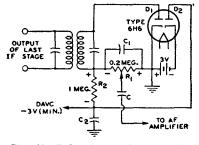


Fig. 68-Delayed avc (davc) circuit.

R<sub>1</sub> is the diode load resistor and R<sub>2</sub> and C2 are the avc filter. Because the cathode of diode D<sub>2</sub> is returned through a fixed supply of -3 volts to the cathode of D<sub>1</sub>, a dc current flows through R<sub>1</sub> and R2 in series with D2. The voltage drop caused by this current places the avc lead at approximately -3 volts (less the negligible drop through D2). When the average amplitude of the rectified signal developed across R<sub>1</sub> does not exceed 3 volts, the avc lead remains at -3 volts. Hence, for signals not strongh enough to develop 3 volts across R<sub>1</sub>, the bias applied to the controlled tubes stays constant at a value giving high sensitivity.

However, when the average amplitude of rectified signal voltage across  $R_1$  exceeds 3 volts, the plate of diode  $D_2$  becomes more negative than the cathode of  $D_2$  and current flow in diode  $D_2$  ceases. The potential of the avc lead is then controlled by the voltage developed across  $R_1$ . Therefore, with further increase in signal strength, the avc circuit applies an increasing avc

bias voltage to the controlled stages. In this way, the circuit regulates the receiver gain for strong signals, but permits the gain to stay constant at a maximum value for weak signals.

It can be seen in Fig. 68 that a portion of the -3 volts delay voltage is applied to the plate of the detector diode  $D_1$ , this portion being approximately equal to  $R_1/(R_1 + R_2)$  times -3 volts. Hence, with the circuit constants as shown, the detector plate is made negative with respect to its cathode by approximately one-half volt. However, this voltage does not interfere with detection because it is not large enough to prevent current flow in the tube.

Automatic gain control (agc) compensates for fluctuations in rf picture carrier amplitude. The peak carrier level rather than the average carrier level is controlled by the agc voltage because the peaks of the sync pulses are fixed when inserted on a fixed carrier level. The peak carrier level may be determined by measurement of the peaks of the sync pulses at the output of the video detector.

A conventional age circuit, such as that shown in Fig. 69, consists of a diode

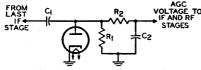


Fig. 69—Automatc-gain control (agc) circuit.

detector circuit and an RC filter. The time constant of the detector circuit is made large enough to prevent the picture content from influencing the magnitude of the age voltage. The output voltage (age voltage) is equal to the peak value of the incoming signal.

The diode detector receives the incoming signal from the last if stage of the television receiver through the capacitor C<sub>1</sub>. The resistor R<sub>1</sub> provides the load for the diode. The diode conducts only when its plate is driven positive with respect to its cathode. Electrons then flow from the cathode to the plate and thence into capacitor C<sub>1</sub>, where the negative charge is stored. Because of the

low impedance offered by the diode during conduction, C<sub>1</sub> charges up to the value of the peak applied voltage.

During the negative excursion of the signal, the diode does not conduct, and C1 discharges through resistor R1. Because of the large time constant of R<sub>1</sub>C<sub>1</sub>, however, only a small percentage of the voltage across C1 is lost during the interval between horizontal sync During succeeding positive pulses. cycles, the incoming signal must overcome the negative charge stored in C<sub>1</sub> before the diode conducts, and plate current flows only at the peak of each positive cycle. The voltage across C<sub>1</sub>, therefore, is determined by the level of the peaks of the positive cycles, or the sync pulses.

The negative voltage developed across resistor R<sub>1</sub> by the sync pulses is filtered by resistor R<sub>2</sub> and capacitor C<sub>3</sub> to remove the 15,750-cycle ripple of the horizontal sync pulse. The dc output is then fed to the if and rf amplifiers as an age voltage.

This agc system may be expanded to include amplification of the agc signal before detection of the peak level, or amplification of the dc output, or both. A direct-coupled amplifier must be used for amplification of the dc signal. The addition of amplification makes the system more sensitive to changes in carrier level.

A "keyed" agc system such as that shown in Fig. 70 is used to eliminate flutter and to improve noise immunity in weak signal areas. This system provides more rapid action than the conventional agc circuits because the filter circuit can employ lower capacitance and resistance values.

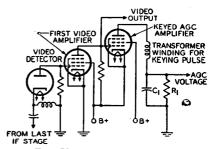


Fig. 70-"Keyed" agc circuit.

In the keyed agc system, the negative output of the video detector is fed directly to the grid No. 1 of the first video amplifier. The positive output of the video amplifier is, in turn, fed directly to the grid No. 1 of the keyed ago amplifier. The video stage increases the gain of the agc system and, in addition, provides noise clipping. The plate voltage for the age amplifier is a positive pulse obtained from a small winding on the horizontal output transformer which is in phase with the horizontal sync pulse obtained from the video amplifier. The polarity of this pulse is such that the plate of the age amplifier tube is positive during the retrace time. The tube is biased so that current flows only when the grid No. 1 and the plate are driven positive simultaneously. amount of current flow depends on the grid-No. 1 potential during the pulse. These pulses are smoothed out in the RC network in the plate circuit  $(R_1C_1)$ . Because the dc voltage developed across R<sub>1</sub> is negative, it is suitable for application to the grids of the rf and if tubes as an agc voltage.

> Tuning Indication With Electron-Ray Tubes

Electron-ray tubes are designed to indicate visually by means of a fluorescent target the effects of a change in controlling voltage. One application of them is as tuning indicators in radio receivers. Types such as the 6U5, 6E5, and the 6AB5/6N5 contain two main parts: (1) a triode which operates as a dc amplifier and (2) an electron-ray indicator which is located in the bulb as shown in Fig. 71. The target is operated at a positive voltage and, therefore, attracts electrons from the cathode. When the electrons strike the target they produce a glow on the fluorescent coating CATHODE

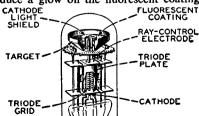


Fig. 71—Structure of electron-ray tube.

of the target. Under these conditions, the target appears as a ring of light.

A ray-control electrode is mounted between the cathode and target. When the potential of this electrode is less positive than the target, electrons flowing to the target are repelled by the electrostatic field of the electrode, and do not reach that portion of the target behind the electrode. Because the target does not glow where it is shielded from electrons, the control electrode casts a shadow on the glowing target. The extent of this shadow varies from approximately 100 degrees of the target when the control electrode is much more negative than the target to 0 degrees when the control electrode is at approximately the same potential as the target.

In the application of the electronray tube, the potential of the control electrode is determined by the voltage on the grid of the triode section, as can be seen in Fig. 72. The flow of the triode plate current through resistor R produces a voltage drop which determines

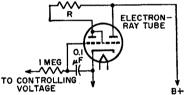


Fig. 72—Indicating circuit using an electron-ray tube.

the potential of the control electrode. When the voltage of the triode grid changes in the positive direction, plate current increases, the potential of the control electrode goes down because of the increased drop across R, and the shadow angle widens. When the potential of the triode grid changes in the negative direction, the shadow angle narrows.

Another type of indicator tube is the 6AF6G. This tube contains only an indicator unit but employs two ray-control electrodes mounted on opposite sides of the cathode and connected to individual base pins. It employs an external dc amplifier. (See Fig. 73.) Thus, two symmetrically opposite shadow angles may be obtained by connecting the two ray-control electrodes together;

or, two unlike patterns may be obtained by individual connection of each raycontrol electrode to its respective amplifier.

In radio receivers, ave voltage is applied to the grid of the de amplifier. Because ave voltage is at maximum when the set is tuned to give maximum response to a station, the shadow angle is at minimum when the receiver is tuned to resonance with the desired station.

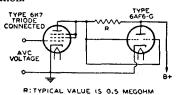


Fig. 73—Indicating circuit using 6AF6G electron-ray tube and external dc amplifier.

The choice between electron-ray tubes depends on the avc characteristic of the receiver. The 6E5 contains a sharp-cutoff triode which closes the shadow angle on a comparatively low value of avc voltage. The 6AB5/6N5 and 6U5 each have a remote-cutoff triode which closes the shadow on a larger value of avc voltage than the 6E5. The 6AF6G may be used in conjunction with dc amplifier tubes having either remote- or sharp-cutoff characteristics.

#### Oscillation

As an oscillator, an electron tube can be employed to generate a continuously alternating voltage. In presentday radio broadcast receivers, this application is limited practically to superheterodyne receivers for supplying the heterodyning frequency. Several circuits (represented in Figs. 74 and 75) may be utilized, but they all depend on feeding more energy from the plate circuit to the grid circuit than is required to equal the power loss in the grid circuit. Feedback may be produced by electrostatic or electromagnetic coupling between the grid and plate circuits. When sufficient energy is fed back to more than compensate for the loss in the grid circuit, the tube will oscillate. The action consists of regular surges of power between the plate and the grid circuit at a frequency dependent on the circuit constants of inductance and capacitance. By proper choice of these values, the frequency may be adjusted over a very wide range.

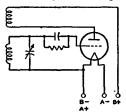


Fig. 74—Tuned-grid triode oscillator circuit using filament-type tube.

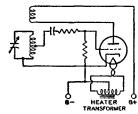


Fig. 75—Tuned-grid triode oscillator circuit using heater-cathode-type tube.

#### Multivibrators

Relaxation oscillators, which are widely used in present-day electronic equipment, are used to produce non-sinusoidal waveshapes such as rectangular and sawtooth pulses. Probably the most common relaxation oscillator is the multivibrator, which may be considered as a two-stage resistance-coupled amplifier in which the output of each tube is coupled into the input of the other tube.

Fig. 76 is a basic multivibrator circuit of the free-running type. In this circuit, oscillations are maintained by the alternate shifting of conduction from one tube to the other. The cycle usually starts with one tube,  $V_1$ , at zero bias, and the other,  $V_2$ , at cutoff or beyond. At this point, the capacitor  $C_1$  is charged sufficiently to cut off  $V_2$ .  $C_1$  then begins to discharge through the resistor  $R_4$ , and the voltage on the grid of  $V_2$  rises until  $V_2$  begins to conduct. The voltage on the plate of  $V_2$  then decreases, causing  $V_1$  to conduct less and less. At the same time,

the plate voltage of  $V_1$  begins to rise, causing  $V_2$  to conduct still more heavily. Because of the amplification, this cumulative effect builds up extremely fast, and conduction switches from  $V_1$  to  $V_2$  within a few microseconds, depending on the circuit components.

In this circuit, therefore, conduction switches from  $V_1$  to  $V_2$  over the interval during which  $C_1$  discharges from the voltage across  $R_4$  to the cutoff voltage for  $V_2$ . The actual transfer of conduction does not occur until cutoff is reached. Conduction switches back to  $V_1$  through a similar process to complete the cycle. The plate waveform is essentially rectangular in shape, and may be adjusted as to symmetry, frequency, and amplitude by proper choice of circuit constants, tubes, and voltages.

Although this type of multivibrator is free-running, it may be triggered by

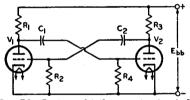


Fig. 76—Basic multivibrator circuit of the free-running type.

pulses of a given amplitude and frequency to provide a frequency-stabilized output. Multivibrator circuits may also be designed so that they are not freerunning, but must be triggered externally to shift conduction from one tube to the other. Depending on the type of circuit, conduction may shift back to the first tube after a given time interval, or the second tube may continue conducting until another trigger signal is applied.

## Synchroguide Circuits

The "synchroguide" is a controlled type of oscillator used in television receivers to generate and control the synchronized sawtooth voltage necessary for adequate line- or horizontal-frequency scanning. A simplified synchroguide circuit is shown in Fig. 77. This circuit provides stable, noise-free control

of a blocking oscillator which generates a horizontal-frequency signal. It permits comparison of the received sync pulses and the generated sawtooth voltages so

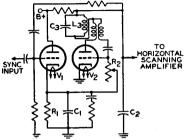


Fig. 77—Simplified synchroguide circuit. that properly locked-in horizontal scanning results.

The triode V<sub>2</sub> in Fig. 77 is a conventional blocking oscillator which enables a sawtooth voltage to be developed across the capacitor C2. A portion of this sawtooth is fed back to the grid of the control tube, V<sub>1</sub>. The positive sync pulses are also applied to the grid of V<sub>1</sub>. The waveforms shown in Fig. 78 illustrate the sawtooth and sync pulses (A and B) and their proper "in-sync" combination (C). The sync pulse occurs partly during the portion of the sawtooth voltage in which the triode V<sub>1</sub> draws current. Any shift in sync pulse as it is superimposed on the sawtooth, therefore, will affect the amount of conduction of the control tube. A change in control-tube conduction ultimately affects the bias on the oscillatortube grid by changing the voltage to which the capacitor C<sub>1</sub> in the cathode circuit may charge. An increase in the positive bias increases the frequency of oscillation.

For example, waveform D in Fig. 78 illustrates a condition in which the sawtooth voltage is advanced in phase

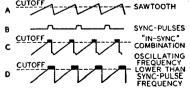


Fig. 78—Sawtooth and sync pulses in synchroguide circuit.

with respect to the sync pulses. The widening of the pulse which occurs at the corner of the sawtooth waveform allows the control tube to conduct more current and, consequently, allows the capacitor C<sub>1</sub> to charge to a higher voltage. This increased reference voltage also appears in the grid circuit of V<sub>2</sub> and makes the grid more positive. The increased grid voltage then speeds up the frequency of oscillations until proper synchronization results.

The blocking oscillator can be made more immune to changes in frequency and noise if  $V_2$  is brought out of cutoff very sharply. This effect is obtained by sine-wave stabilization. The tuned circuit  $L_8C_8$  in the plate circuit of Fig. 77 superimposes a shock-excited sine wave on the plate and grid waveforms, as shown in Fig. 79.

## **Deflection Circuits**

## Vertical Output Circuits

A modified multivibrator in which the vertical output tube is part of the oscillator circuit is used in the vertical deflection stage of many television receivers. This stage supplies the deflection energy required for vertical deflection of the picture-tube beam. A simplified combined vertical-oscillatoroutput stage is shown in Fig. 80. Waveshapes at critical points of the circuit are included to illustrate the development of the desired current through the vertical output transformer and deflecting yoke.

The current waveform through the deflecting yoke and output transformer

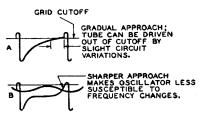


Fig. 79—Waveforms showing effect of tuned circuit  $L_8C_8$  in Fig. 77.

should be a sawtooth to provide the desired deflection. The grid and plate voltage waveforms of the output tube could also be sawtooth except for the effect of the inductive components in the yoke and transformer. The effect of these inductive components must be taken into consideration. however, particularly during retrace. The fast rate of current change during retrace time (which is approximately 1/15 as long as trace time) causes a high-voltage pulse at the plate which could give a trapezoidal waveshape to the plate voltage and cause increased plate current, excess damping, and lengthened retrace time. However, the grid voltage is made sufficiently negative during retrace to keep the tube close to cutoff, as described below.

The frequency, and the relative deviation of the positive and negative portions of each cycle, are dependent on the values of resistors  $R_1$  and  $R_3$  and the RC combination  $R_3C_2$ , as explained previously in the section on multivibrators. The desired trapezoidal waveshape at the grid of  $V_2$  is created by capacitor  $C_1$  and resistor  $R_2$ . If  $R_2$  were equal to

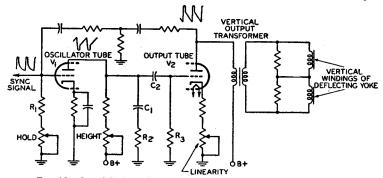


Fig. 80—Simplified combined vertical-oscillator-and-output stage.

zero, C<sub>1</sub> would cause the grid-voltage waveshape to take the form shown in Fig. 81(a). When R<sub>2</sub> is sufficiently large, C<sub>1</sub> does not discharge completely when V<sub>1</sub> conducts. When V<sub>1</sub> is cut off, therefore, the voltage on the grid of V<sub>2</sub> immediately rises to the voltage across C<sub>1</sub>. The resulting waveshape is shown in Fig. 81(b). The negative-going pulse of the grid-voltage waveshape prevents the high plate pulse from causing excess conductance, and thereby prevents overdamping.



Fig. 81—Waveforms showing effect of  $R_2$  in Fig. 80.

This vertical deflection stage utilizes twin-triode tubes such as the 6DR7 and 6EM7. The 6EM7 is particularly suitable for this application because it incorporates dissimilar units to provide for the different operating requirements of the oscillator and output sections.

# Horizontal Output Circuits

Fig. 82 shows a typical horizontaloutput-and-deflection circuit used in television receivers. In addition to supplying the deflection energy required for horizontal deflection of the picture-tube beam, this circuit provides the high dc voltage required for hte ultor (anode) of the picture tube and the "boosted" B voltage for other portions of the receiver. The horizontal-output tube is usually a beam power tube such as the 6DQ63, 6CD6-GA, or 6GW6.

In this circuit, a sawtooth voltage from the horizontal-oscillator tube is applied to the grid No. 1 of the horizontal-output tube. When this voltage rises above the cutoff point of the output tube, the tube conducts a sawtooth of plate current which is fed through the auto-transformer to the horizontal-deflecting yoke. At the end of the horizontal-scanning cycle, which lasts for 63.4 microseconds, the sawtooth voltage on the grid suddenly cuts off the output tube. This sudden change sets up an

oscillation of about 50 to 70 kilocycles in the output circuit, which may be considered as inductor shunted by the stray capacitance of the circuit. During the first half of this oscillation, a positive voltage appears across the transformer. In the second half of the cycle, the voltage swings below the plate supply voltage, and the damper diode conducts, damping out the oscillation. At the same time. the current through the deflecting yoke reverses and reaches its negative peak. As the damper-diode current decays exponentially to zero, the output tube begins to conduct again. The voke current, therefore, is composed of current resulting from damper-diode conduction followed by output-tube conduction.

When the output tube is suddenly cut off, the high-voltage pulse produced by shock excitation of the load circuit is increased by means of an extra winding on the transformer. This high-voltage pulse charges a high-voltage capacitor through the high-voltage rectifier. The output of this circuit is the dc high-voltage supply for the picture tube. The high-voltage rectifier also obtains its filament power through a separate wind-

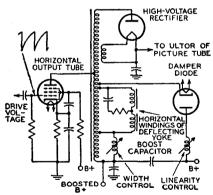


Fig. 82—Typical horizontal-deflection and high-voltage circuit.

ing on the horizontal-output transformer.

Current flowing through the damper diode charges the "boost" capacitor through the damper portion of the transformer winding. The polarity of the charge on the capacitor is such that the voltage at the low end of the winding is increased above the plate supply voltage, or B+. This higher voltage or "boost" is used for the output-tube plate supply, and may also supply the deflection oscillators and the vertical-output circuit provided the current drain is not excessive.

## High-Voltage Regulator Circuit

In color-television receivers, it is very important to regulate the high-voltage supply to the picture tube. A suitable circuit using the 6BK4 for regulation of the output of a high-voltage, high-impedance supply is shown in Fig. 83. In this circuit, the cathode is held at

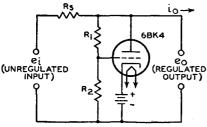


Fig. 83—High-voltage regulator circuit for color television.

a fixed positive potential with respect to ground. Because the grid potential is kept slightly less positive by the voltage drop across resistor R<sub>2</sub>, the tube operates in the negative grid region and no grid current is drawn.

When the output voltage, e<sub>0</sub>, rises as a result of a decrease in load current, a small fraction of the additional voltage is applied to the grid of the tube by the voltage-divider circuit consisting of R<sub>1</sub> and R<sub>2</sub>. This increased grid voltage causes the tube to draw an increased current from the unregulated supply. The increased current, in turn, causes a voltage drop across the high internal impedance of the unregulated supply, R<sub>s</sub>, which tends to counteract the original rise of the voltage. If desired, the grid may be connected to a variable point on the voltage divider to allow some adjustment of the output-voltage

The grid voltage for the 6BK4 can also be obtained from a tap on the B-

boost voltage supply. The use of this lower voltage (about 375 volts) eliminates the need for costly and troublesome high-voltage resistors. In this arrangement, variations in high voltage also vary the tapped-down B-boost voltage at the regulator grid, and the resulting variations in conduction of the regulator increase or decrease the loading of the high-voltage supply so that the total load remains nearly constant.

# **Frequency Conversion**

Frequency conversion is used in superheterodyne receivers to change the frequency of the rf signal to an intermediate frequency. To perform this change in frequency, a frequency-converting device consisting of an oscillator and a frequency mixer is employed. In such a device, shown diagrammatically in Fig. 84, two voltages of different frequency, the rf signal voltage and the voltage generated by the oscillator, are applied to the input of the frequency mixer. These voltages beat, or heterodyne, within the mixer tube to produce a plate current having, in addition to the frequencies of the input voltages, numerous sum and difference frequencies.

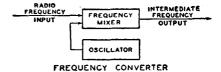


Fig. 84—Block diagram of simple frequency-converter circuit.

The output circuit of the mixer stage is provided with a tuned circuit which is adjusted to select only one beat frequency, *i.e.*, the frequency equal to the difference between the signal frequency and the oscillator frequency. The selected output frequency is known as the intermediate frequency, or if. The output frequency of the mixer tube is kept constant for all values of signal frequency by tuning the oscillator to the proper frequency.

Important advantages gained in a receiver by the conversion of signal fre-

quency to a fixed intermediate frequency are high selectivity with few tuning stages and a high, as well as stable, overall gain for the receiver.

Several methods of frequency conversion for superheterodyne receivers are of interest. These methods are alike in that they employ a frequency-mixer tube in which plate current is varied at a combination frequency of the signal frequency and the oscillator frequency. These variations in plate current produce across the tuned plate load a voltage of the desired intermediate frequency. The methods differ in the types of tubes employed and in the means of supply input voltages to the mixer tube.

A method widely used before the availability of tubes especially designed for frequency-conversion service, and currently used in many FM, television, and standard broadcast receivers, employs as mixer tube either a triode, a tetrode, or a pentode, in which oscillator voltage and signal voltage are applied to the same grid. In this method, coupling between the oscillator and mixer circuits is obtained by means of inductance or capacitance.

A second method employs a tube having an oscillator and frequency mixer combined in the same envelope. In one form of such a tube, coupling between the two units is obtained by means of the electron stream within the tube. Because five grids are used, the tube is called a pentagrid converter.

Grids No. 1 and No. 2 and the cathode are connected to an external circuit to act as a triode oscillator. Grid No. 1 is the grid of the oscillator and Grid No. 2 is the anode. These and the cathode can be considered as a composite cathode which supplies to the rest of the tube an electron stream that varies at the oscillator frequency.

This varying electron stream is further controlled by the rf signal voltage on grid No. 4. Thus, the variations in plate current are due to the combination of the oscillator and the signal frequencies. The purpose of grids No. 3 and No. 5, which are connected together within the tube, is to accelerate the electron stream and to shield grid No. 4

electrostatically from the other electrodes.

Pentagrid-converter tubes of this design are good frequency-converting devices at medium frequencies. However, their performance is better at the lower frequencies because the output of the oscillator drops off as the frequency is raised and because certain undesirable effects produced by interaction between oscillator and signal sections of the tube increase with frequency.

To minimize these effects, several of the pentagrid-converter tubes are designed so that no electrode functions alone as the oscillator anode. In these tubes, grid No. 1 functions as the oscillator grid, and grid No. 2 is connected within the tube to the screen grid (grid No. 4). The combined two grids, Nos. 2 and 4, shield the signal grid (grid No. 3) and act as the composite anode of the oscillator triode. Grid No. 5 acts as the suppressor grid.

Converter tubes of this type are designed so that the space charge around the cathode is unaffected by electrons from the signal grid. Furthermore, the electrostatic field of the signal grid also has little effect on the space charge. The result is that rf voltage on the signal grid produces little effect on the cathode current. There is, therefore, little detuning of the oscillator by ave bias because changes in ave bias produce little change in oscillator transconductance or in the input capacitance of grid No. 1.

Examples of the pentagrid converters discussed in the preceding paragraph are the single-ended types 1R5 and 6BE6. A schematic diagram illustrating the use of the 6BE6 with self-excitation is given in Fig. 85 the 6BE6 may also be used with separate excitation. A complete circuit is shown in the Circuits section.

Another method of frequency conversion utilizes a separate oscillator having its grid connected to the No. 1 grid of a mixer hexode. The cathode, triode grid, and triode plate form the oscillator unit of the tube. The cathode, hexode mixer grid (grid No. 1), hexode screen

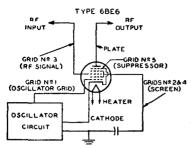


Fig. 85—Frequency-converter circuit using the 6BE6 pentagrid converter with self-excitation.

grids (grids Nos. 2 and 4), hexode signal grid (grid No. 3), and hexode plate constitute the mixer unit. The internal shields are connected to the shell of the tube and act as a suppressor grid for the hexode unit.

The action of this tube in converting a radio-frequency signal to an intermediate frequency depends on (1) the generation of a local frequency by the triode unit, (2) the transferring of this frequency to the hexode grid No. 1, and (3) the mixing in the hexode unit of this frequency with that of the rf signal applied to the hexode grid No. 3. The tube is not critical to changes in oscillatorplate voltage or signal-grid bias and, therefore, finds important use in all-wave receivers to minimize frequency-shift effects at the higher frequencies.

A further method of frequency conversion employs a tube called a pentagrid mixer. This type has two independent control grids and is used with a separate oscillator tube. RF signal voltage is applied to one of the control grids and oscillator voltage is applied to the other. It follows, therefore, that the variations in plate current are due to the combination of the oscillator and signal frequencies.

The tube contains a heater-cathode, five grids, and a plate. Grids Nos. 1 and 3 are control grids. The rf signal voltage is applied to grid No. 1. This grid has a remote-cutoff characteristic and is suited for control by ave bias voltage. The oscillator voltage is applied to grid No. 3. This grid has a sharp-cutoff characteristic and produces a comparatively

large effect on plate current for a small amount of oscillator voltage. Grids Nos. 2 and 4 are connected together within the tube. They accelerate the electron stream and shield grid No. 3 electrostatically from the other electrodes. Grid No. 5, connected within the tube to the cathode, functions similarly to the suppressor grid in a pentode.

In the converter or mixer stage of a television receiver, stable oscillator operation is most readily obtained when separate tubes or tube sections are used for the oscillator and mixer functions. A typical television mixer-oscillator circuit is shown in Fig. 86. In such circuits, the oscillator voltage is applied to the mixer grid by inductive coupling, capacitive coupling, or a combination of the two. Tubes containing electrically

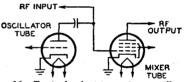


Fig. 86—Typical television mixer-oscillator circuit.

independent oscillator and mixer units in the same envelope, such as the 6U8A and 6X8, are designed especially for this application.

# **Automatic Frequency Control**

An automatic frequency control (afc) circuit provides a means of correcting automatically the intermediate frequency of a superheterodyne receiver when, for any reason, it drifts from the frequency to which the if stages are tuned. This correction is made by adjusting the frequency of the oscillator. Such a circuit will automatically compensate for slight changes in rf carrier or oscillator frequency as well as for inaccurate manual or push-button tuning.

An afc system requires two sections: a frequency detector and a variable reactance. The detector section may be essentially the same as the FM detector illustrated in Fig. 59 and discussed under **Detection**. In the afc

system, however, the output is a dc control voltage, the magnitude of which is proportional to the amount of frequency shift. This dc control voltage is used to control the grid bias of an electron tube which comprises the variable reactance section (Fig. 87).

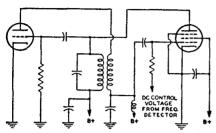


Fig. 87—Automatic-frequency-control (afc) circuit.

The plate current of the reactance tube is shunted across the oscillator tank circuit. Because the plate current and plate voltage of the reactance tube are almost 90 degrees out of phase, the control tube affects the tank circuit in the same manner as a reactance. The grid bias of the tube determines the magnitude of the effiective reactance and, consequently, a control of this grid bias can be used to control the oscillator frequency.

Automatic frequency control is also used in television receivers to keep the horizontal oscillator in step with the horizontal-scanning frequency (15,750 cps) at the transmitter. A widely used horizontal afc circuit is shown in Fig. 88. This circuit, which is often referred to as a balanced-phase-detector or phase-discriminator circuit, is usually employed to control the frequency of a multivibrator-type horizontal-oscillator circuit. The 6AL5 detector supplies a dc control voltage to the grid of the horizontal-oscillator tube which counteracts changes in its operating frequency. The magnitude and polarity of the control voltages are determined by phase relationships in the afc circuit at a given moment.

The horizontal sync pulses obtained from the sync-separator circuit are fed through a single-triode phase-inverter or phase-splitter circuit to the two diode units of the 6AL5. Because of the action of the phase-inverter circuit, the signals applied to the two diode units are equal in amplitude but 180 degrees out of

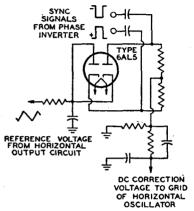


Fig. 88—Balanced phase-detector or phasediscriminator circuit for horizontal afc.

phase. A reference sawtooth voltage obtained from the horizontal output circuit is also applied simultaneously to both units. Any change in the oscillator frequency alters the phase relationship between the reference sawtooth and the incoming horizontal sync pulses, causing one diode unit of the 6AL5 to conduct more heavily than the other, and thus producing a correction signal. The system remains balanced at all times, therefore, because momentary changes in oscillator frequency are instantaneously corrected by the action of the control voltage.

The diode units of the 6AL5 are biased so that conduction takes place only during the tips of the sync pulses. The relative position of the sync pulses on the retrace portion of the sawtooth waveform at any given instant determines which diode unit conducts more heavily, and thereby establishes the magnitude and polarity of the control voltage. The network between the diode units and the grid of the horizontal-oscillator tube is essentially a low-pass filter which prevents the horizontal-oscillator performance.

# Electron Tube Installation

THE installation of electron tubes requires care if high-quality performance is to be obtained from the associated circuits. Installation suggestions and precautions which are generally common to all types of tubes are covered in this section. Careful observance of these suggestions will do much to help the experimenter and electronic technician obtain the full performance capabilities of radio tubes and circuits. Additional pertinent information is given under each tube type and in the Circuits section.

## Filament and Heater Power Supply

The design of electron tubes allows for some variation in the voltage and current supplied to the filament or heater, but most satisfactory results are obtained from operation at the rated values. When the voltage is low, the temperature of the cathode is below normal, with the result that electron emission is limited. The limited emission may cause unsatisfactory operation and reduced tube life. On the other hand, high cathode voltage may cause rapid evaporation of cathode material and shorten tube life.

To insure proper tube operation, it is important that the filament or heater voltage be checked at the socket terminals by means of a high-resistance voltmeter while the equipment is in operation. In the case of series operation of heaters or filaments, correct adjustment can be checked by means of an ammeter in the heater or filament circuit.

The filament or heater voltage sup-

ply may be a direct-current source (a battery or a de power line) or an alternating-current power line, depending on the type of service and type of tube. Frequently, a resistor (either variable or fixed) is used with a dc supply to permit compensation for battery voltage variations or to adjust the tube voltage at the socket terminals to the correct value. Ordinarily, a step-down transformer is used with an ac supply to provide the proper filament or heater voltage. Receivers intended for operation on both dc and ac power lines have the heaters connected in series with a suitable resistor and supplied directly from the power line.

DC filament or heater operation should be considered on the basis of the source of power. In the case of the battery supply for the 1.4-volt filament tubes, it is unnecessary to use a voltagedropping resistor in series with the filament and a single dry-cell; the filaments of these tubes are designed to operate satisfactorily over the range of voltage variations that normally occur during the life of a dry-cell. Likewise, no series resistor is required when the 1.25-volt filament subminiatures are operated from a single 1.5-volt flashlight-type dry-cell, when the 2-volt filament-type tubes are operated from a single storage cell, or when the 6.3-volt series are operated from a 6-volt storage battery.

In the case of dry-battery supply for 2-volt filament tubes, a variable resistor in series with the filament and the battery is required to compensate for battery variations. Turning the set on and off by means of the rheostat is advised to prevent over-voltage conditions after an off-period because the voltage of dry-cells rises during off periods.

In the case of storage-battery supply, air-cell-battery supply, or dc power supply, a non-adjustable resistor of suitable value may be used. It is well to check initial operating conditions, and thus the resistor value, by means of a voltmeter or ammeter.

AC filament or heater operation should be considered on the basis of either a parallel or a series arrangement of filaments and/or heaters. In the case of the parallel arrangements, a step-down transformer is employed. Precautions should be taken to see that the line voltage is the same as that for which the primary of the transformer is designed. The line voltage may be determined by measurement with an ac voltmeter (0-150 volts).

If the line voltage measures in excess of that for which the transformer is designed, a resistor should be placed in series with the primary to reduce the line voltage to the rated value of the transformer primary. Unless this is done, the excess input voltage will cause proportionally excessive voltage to be applied to the tubes. Any electron tube may be damaged or made inoperative by excessive operating voltages.

If the line voltage is consistently below that for which the primary of the transformer is designed, it may be necessary to install a booster transformer between the ac outlet and the transformer primary. Before such a transformer is installed, the ac line fluctuations should be very carefully noted. Some radio sets are equipped with a line-voltage switch which permits adjustment of the power transformer primary to the line voltage. When this switch is properly adjusted, the seriesresistor or booster-transformer method of controlling line voltage is seldom reauired.

In the case of the series arrangements of filaments and/or heaters, a voltage-dropping resistance in series with the heaters and the supply line is usually required. This resistance should be of such value that, for normal line voltage, tubes wil operate at their rated heater or filament current. The method

for calculating the resistor value is given below.

When the filaments of battery-type tubes are connected in series, the total filament current is the sum of the current due to the filament supply and the plate and grid-No. 2 currents (cathode current) returning to B(—) through the tube filaments. Consequently, in a series filament string it is necessary to add shunt resistors across each filament section to bypass this cathode current in order to maintain the filament voltage at its rated value.

The filament or heater resistor required when filaments and/or heaters are operated in parallel can be determined easily by a simple formula derived from Ohm's law.

Required resistance (ohms) = supply volts - rated volts of tube type total rated filament current (amperes)

Thus, if a receiver using two IT4's, one IR5, one IU5, and one 3V4 is to be operated from a storage battery, the series resistor is equal to 2 volts (the voltage from a single storage cell) minus 1.4 volts (voltage rating for these tubes) divided by 0.3 ampere (the sum of  $4 \times 0.05$  ampere  $+ 1 \times 0.1$  ampere), i.e., approximately 2 ohms. Because this resistor should be variable to allow adjustment for battery depreciation, it is advisable to obtain the next larger commercial size, although any value between 2 and 3 ohms will be quite satisfactory.

Where much power is dissipated in the resistor, the wattage rating should be sufficiently large to prevent overheating. The power dissipation in watts is equal to the voltage drop in the resistor multiplied by the total filament current in amperes. Thus, for the example above,  $0.6 \times 0.3 = 0.18$  watt. In this case, the value is so small that any commercial rheostat with suitable resistance will be adequate.

For the case where the heaters and/or filaments of several tubes are operated in series, the resistor value is calculated by the following formula, also derived from Ohm's law.

Required resistance (ohms) = supply volts - total rated volts of tubes rated amperes of tubes

Thus, if a receiver having one 6BE6, one 6BA6, one 6AT6, one 25L6GT, and one 25Z6GT is to be operated from a 117-volt power line, the series resistor is equal to 117 volts (the supply voltage) minus 68.9 volts (the sum of  $3 \times 6.3$  volts  $+ 2 \times 25$  volts) divided by 0.3 ampere (current rating of these tubes), i.e., approximately 160 ohms. The wattage dissipation in the resistor will be 117 volts minus 68.9 volts times 0.3 ampere, or approximately 14.4 watts. A resistor having a wattage rating in excess of this value should be chosen.

When the series-heater connection is used in ac/dc receivers, it is usually advisable to arrange the heaters in the circuit so that the tubes most sensitive to hum disturbances are at or near the ground potential of the circuit. This arrangement reduces the amount of ac voltage between the heaters and cathodes of these tubes and minimizes the hum output of the receiver. The order of heater connection, by tube function, from chassis to the rectifier-cathode side of the ac line is shown in Fig. 89.

the electron stream by the alternating magnetic field surrounding the heater. When a large resistor is used between heater and cathode (as in series-connected heater strings), or when one side of the heater is grounded, even a minute pulsating leakage current between heater and cathode can develop a small voltage across the cathode-circuit impedance and cause objectionable hum. The use of a large cathode bypass capacitor is recommended to minimize this source of hum.

Much lower hum levels can be achieved when heaters are connected in parallel systems in which the center-tap of the heater supply is grounded or, preferably, connected to a positive bias source of 15 to 80 volts dc to reduce the flow of alternating current. The heater leads of the tubes should be twisted and kept away from high-impedance circuits. The balanced ac supply provides almost complete cancellation of the alternating-current components.

The balanced arrangement described above also minimizes heater-

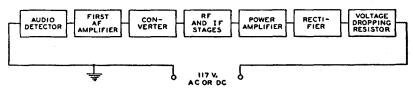


Fig. 89—Order of series heater-string connection, by tube function, to minimize hum.

# **Heater-to-Cathode Connection**

When heater-type tubes are operated from ac, their cathodes may be returned (through resistors, capacitors, or other components) to the mid-tap on the heater supply winding, to the midtap of a small resistor (about 50 ohms) connected across the winding, or to one end of the heater supply winding, depending on circuit requirements. In all circuits, it is important to keep the heater-cathode voltage within the maximum ratings specified for the tube.

Heater-type tubes may produce hum as a result of conduction between heater and cathode or between heater and control grid, or by modulation of grid hum. High grid-circuit impedances should be avoided, if possible. High heater voltages should also be avoided because heater-cathode hum rises sharply when the heater voltage is increased above the published value.

Certain tube types are designed especially to minimize hum in high-quality, high-fidelity audio equipment. Examples are the 5879, 7025, and 7199.

# Plate Voltage Supply

The plate voltage for electron tubes is obtained from batteries, rectifiers, direct-current power lines, and small local generators. The maximum plate-voltage value for any tube type should

not be exceeded if most satisfactory performance is to be obtained. Plate voltage should not be applied to a tube unless the corresponding recommended voltage is also supplied to the grid.

It is recommended that the primary circuit of the power transformer be fused to protect the rectifier tube(s), the power transformer, filter capacitor, and chokes in case a rectifier tube fails.

# **Grid Voltage Supply**

The recommended grid voltages for different operating conditions have been carefully determined to give the most satisfactory performance. Grid voltage may be obtained from a fixed source such as a separate C-battery or a tap on the voltage divider of the high-voltage dc supply, from the voltage drop across a resistor in the cathode circuit, or from the voltage drop across a resistor in the grid circuit. The first method is called "fixed bias": the second is called "cathode bias" or "self bias"; the third is called "grid-resistor bias" and is sometimes incorrectly referred to in re-"zero-bias ceiving-tube practice as operation."

In any case, the object is to make the grid negative with respect to the cathode by the specified voltage. When a C-battery is used, the negative terminal is connected to the grid return and the positive terminal is connected to the negative filament socket terminal, or to the cathode terminal if the tube is of the heater-cathode type. If the filament is supplied with alternating current, this connection is usually made to the center-tap of a low resistance (20 to 50 ohms) shunted across the filament ter-

minals. This method reduces hum disturbances caused by the ac supply. If bias voltages are obtained from the voltage divider of a high-voltage dc supply, the grid return is connected to a more negative tap than the cathode.

The cathode-biasing method utilizes the voltage drop produced by the cathode current flowing through a resistor connected between the cathode and the negative terminal of the B-supply. (See Fig. 90.) The cathode current is, of course, equal to the plate current in the case of a triode, or to the sum of the plate and grid-No. 2 currents in the case of a tetrode, pentode, or beam power tube. Because the voltage drop along the resistance is increasingly negative with respect to the cathode, the required negative grid-bias voltage can be obtained by connecting the grid return to the negative end of the resistance.

The value of the resistance for cathode-biasing a single tube can be determined from the following formula:

Resistance (ohms) = desired grid-bias voltage × 1000 rated cathode current in milliamperes

Thus, the resistance required to produce 9 volts bias for a triode which operates at 3 milliamperes plate current is  $9 \times 1000/3 = 3000$  ohms. If the cathode current of more than one tube passes through the resistor, or if the tube or tubes employ more than three electrodes, the total current determines the size of the resistor.

Bypassing of the cathode-bias resistor depends on circuit-design requirements. In rf circuits the cathode resistor usually is bypassed. In af circuits the use of an unbypassed resistor will re-

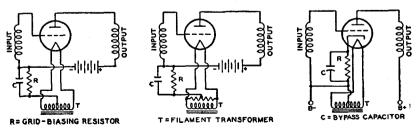


Fig. 90—Typical grid-voltage supply circuits.

duce distortion by introducing degeneration into the circuit. However, the use of an unbypassed resistor decreases gain and power sensitivity. When bypassing is used, it is important that the bypass capacitor be sufficiently large to have negligible reactance at the lowest frequency to be amplified.

In the case of power-output tubes having high transconductance, such as beam power tubes, it may be necessary to shunt the bias resistor with a small mica capacitor (approximately 0.001uF) in order to prevent oscillations. The usual af bypass may or may not be used, depending on whether or not degeneration is desired. In tubes having high values of transconductance, such as the 6BA6, 6CB6, and 6AC7, input capacitance and input conductance change appreciably with plate current. When such a tube having a separate suppressor-grid connection is used as an rf amplifier, these changes may be minimized by leaving a certain portion of the cathode-bias resistor unbypassed. In order to minimize feedback when this method is used, the external grid-No. 1to-plate (wiring) capacitances should be kept to a minimum, the grid No. 2 should be bypassed to ac ground, and the grid No. 3 should be connected to ac ground.

The use of a cathode resistor to obtain bias voltage is not recommended for amplifiers in which there is appreciable shift of electrode currents with the application of a signal. In such amplifiers, a separate fixed supply is recommended.

The grid-resistor biasing method is also a self-bias method because it utilizes the voltage drop across the grid resistor produced by small amounts of grid current flowing in the grid-cathode circuit. This current is due to (1) an electromotive potential difference between the materials comprising the grid and cathode and (2) grid rectification when the grid is driven positive. A large value of resistance is required in order to limit this current to a very small value and to avoid undesirable loading effects on the preceding stage.

Examples of this method of bias are given in circuits 24-1 and 24-3 in

the Circuits section. In both of these circuits, the audio amplifier type 1U5 or 12AV6 has a 10-megohm resistor between the grid and the negative filament or cathode to furnish the required bias, which is usually less than 1 volt. This method of biasing is used principally in the early voltage-amplifier stages (usually employing high-mu triodes) of audio amplifier circuits, where the tube dissipation will not be excessive under zero-signal conditions.

A grid resistor is also used in many oscillator circuits for obtaining the required bias. In these circuits, the grid voltage is relatively constant and its magnitude is usually in the order of 5 volts or more. Consequently, the bias voltage is obtained only through grid rectification. A relatively low value of resistor, 0.1 megohm or less, is used. Oscillator circuits employing this method of bias are given in circuits 24-1 and 24-2 in the Circuits section.

Grid-bias variation for the rf and if amplifier stages is a convenient and frequently used method for controlling receiver volume. The variable voltage supplied to the grid may be obtained: (1) from a variable cathode resistor as shown in Figs. 91 and 92; (2) from a bleeder circuit by means of a potentiometer as shown in Fig. 93; or (3) from a bleeder circuit in which the bleeder current is varied by a tube

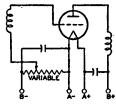


Fig. 91—Amplifier stage using a variable cathode-bias resistor for volume control.

used for automatic volume control. The latter circuit is shown in Fig. 67.

In all cases it is important that the control be arranged so that at no time will the bias be less than the recommended minimum grid-bias voltage for the particular tubes used. This requirement can be met by providing a fixed stop on the potentiometer, by connecting a fixed resistance in series with the variable resistance, or by connecting a fixed cathode resistance in series with the variable resistance used for regulation. Where receiver gain is

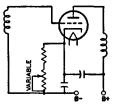


Fig. 92—Amplifier stage similar to Fig. 91 but using heater-cathode-type tube.

controlled by grid-bias variation, it is advisable to have the control voltages extend over a wide range in order to minimize cross-modulation and modulation-distortion. A remote-cutoff type of tube should, therefore, be used in the controlled stages.

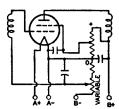


Fig. 93—Amplifier stage using a bleeder circuit and potentiometer for volume control.

In most tubes employing a unipotential cathode, a positive grid current begins to flow when the grid is slightly negative and increases rapidly as the grid is made more positive, as shown in Fig. 94. The value of grid voltage at which the grid-current curve intercepts the horizontal axis is determined by several different physical processes, including an electrothermal effect due to the differences in temperature and in material composition of the grid and the cathode, and by the positive grid current. For values of grid potentials which are larger than this intercept, the direction of the grid current is positive (i.e., from the grid to the cathode). At smaller values of grid potential, the direction of the grid current is negative (i.e., from the cathode to the grid).

Positive grid current consists of electrons emitted from the cathode which are intercepted by the control grid. Negative grid current, which becomes appreciable only when the grid potential is more negative than the value of the intercept, is a result of the emission of electrons from the heated control grid to the cathode, the effect of gas molecules in the tube, and the influence of leakage currents between the grid and cathode and the grid and the plate.

The value of grid potential at the intercept of the grid-current curve on the horizontal axis (often mistakenly called contact potential) may be as high as 1½ volts. If the operating bias of the tube is less than this intercept, it is found that two effects are present. Direct current flows in the grid circuit, and the dynamic input resistance of the tube may be relatively low. It is generally desirable to supply the tube with a value of bias sufficiently high so that the operating point of the tube is not near the value of this intercept. If the value of the operating bias is near the value of the intercept, care should be taken to avoid undesirable effects in the grid circuit due to grid current or low input resistance.

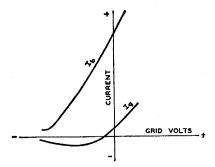


Fig. 94—Curves showing flow of positive grid current in tubes employing unipotential cathodes.

#### Screen-Grid Voltage Supply

The positive voltage for the screen grid (grid No. 2) of screen-grid tubes

may be obtained from a tap on a voltage divider, from a potentiometer, or from a series resistor connected to a high-voltage source, depending on the particular tube type and its application. The screen-grid voltage for tetrodes should be obtained from a voltage divider or a potentiometer rather than through a series resistor from a high-voltage source because of the characteristic screen-grid current variations of tetrodes. Fig. 95 shows a tetrode with its screen-grid voltage obtained from a potentiometer.

When pentodes or beam power tubes are operated under conditions where a large shift of plate and screengrid currents does not take place with the application of the signal, the screengrid voltage may be obtained through a series resistor from a high-voltage

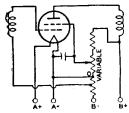


Fig. 95—Tetrode circuit in which screengrid voltage is obtained from a potentiometer.

source. This method of supply is possible because of the high uniformity of the screen-grid current characteristic in pentodes and beam power tubes. Because the screen-grid voltage rises with increase in bias and resulting decrease in screen-grid current, the cutoff characteristic of a pentode is extended by this method of supply.

This method is sometimes used to increase the range of signals which can be handled by a pentode. When used in resistance-coupled amplifier circuits employing pentodes in combination with the cathode-biasing method, it minimizes the need for circuit adjustments. Fig. 96 shows a pentode with its screen-grid voltage supplied through a series resistor.

When power pentodes and beam power tubes are operated under conditions such that there is a large change in plate and screen-grid currents with the application of signal, the seriesresistor method of obtaining screen-grid voltage should not be used. A change in screen-grid current appears as a

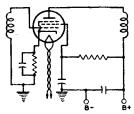


Fig. 96—Pentode circuit in which screengrid voltage is supplied through a series resistor.

change in the voltage drop across the series resistor in the screen-grid circuit; the result is a change in the power output and an increase in distortion. The screen-grid voltage should be obtained from a point in the plate-voltage-supply filter system having the correct voltage, or from a separate source.

It is important to note that the plate voltage of tetrodes, pentodes, and beam power tubes should be applied before or simultaneously with the screen-grid voltage. Otherwise, with voltage on the screen grid only, the screen-grid current may rise high enough to cause excessive screen-grid dissipation.

Screen-grid voltage variation for the rf amplifier stages has sometimes been used for volume control in older-type receivers. Reduced screen-grid voltage decreases the transconductance of the tube and results in reduced gain per stage. The voltage variation is obtained by means of a potentiometer shunted across the screen-grid voltage supply. (See Fig. 95.) When the screen-grid voltage is varied, it must never exceed the rating of the tube. This requirement can be met by providing a fixed stop on the potentiometer.

#### Shielding

In high-frequency stages having high gain, the output circuit of each stage must be shielded from the input circuit of that stage. Each high-frequency stage also must be shielded from the other high-frequency stages. Unless shielding is employed, undesired feedback may occur and may produce many harmful effects on receiver performance.

To prevent this feedback, it is a desirable practice to shield separately each unit of the high-frequency stages. For instance, in a superheterodyne receiver, each if and rf coil may be mounted in a separate shield can. Baffle plates may be mounted on the ganged tuning capacitor to shield each section of the capacitor from the other section. The oscillator coil may be especially well shielded by being mounted under the chassis.

The shielding precautions required in a receiver depend on the design of the receiver and the layout of the parts. In all receivers having high-gain highfrequency stages, it is necessary to shield separately each tube in highfrequency stages. When metal tubes, and in particular the single-ended types. are used, complete shielding of each tube is provided by the metal shell which is grounded through its grounding pin as the socket terminal. The grounding connection should be short and sturdy. Many modern tubes of glass construction have internal shields, usually connected to the cathode; where present, these shields are indicated in the socket diagram.

#### **Dress of Circuit Leads**

At high frequencies such as are encountered in FM and television receivers, lead dress, that is, the location and arrangement of the leads used for connections in the receiver, is very important. Because even a short lead provides a large impedance at high frequencies, it is necessary to keep all high-frequency leads as short as possible. This precaution is especially important for ground connections and for all connections to bypass capacitors and high-frequency filter capacitors. The ground connections of plate and screen-grid bypass capacitors of each tube should be kept short and made directly to cathode ground.

Particular care should be taken with the lead dress of the input and output circuits of high-frequency stages so that the possibility of stray coupling is minimized. Unshielded leads connected to shielded components should be dressed close to the chassis. As the frequency increases, the need for careful lead dress becomes increasingly important.

In high-gain audio amplifiers, these same precautions should be taken to minimize the possibility of self-oscillation.

#### **Filters**

Feedback effects also are caused in radio or television receivers by coupling between stages through common voltage-supply circuits. Filters find an important use in minimizing such effects. They should be placed in voltage-supply leads to each tube in order to return the signal current through a low-impedance path direct to the tube cathode rather than by way of the voltagesupply circuit. Fig. 97 illustrates several forms of filter circuits. Capacitor C

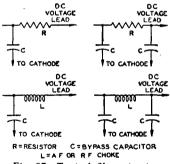


Fig. 97—Typical filter circuits.

forms the low-impedance path, while the choke or resistor assists in diverting the signal through the capacitor by offering a high impedance to the powersupply circuit.

The choice between a resistor and a choke depends chiefly upon the permissible dc voltage drop through the filter. In circuits where the current is small (a few milliamperes), resistors are practical; where the current is large or

regulation important, chokes are more suitable.

The minimum practical size of the capacitors may be estimated in most cases by the following rule: The impedance of the capacitor at the lowest frequency amplified should not be more than one-fifth of the impedance of the filter choke or resistor at that frequency. Better results will be obtained in special cases if the ratio is not more than one-tenth.

Radio-frequency circuits, particularly at high frequencies, require high-quality capacitors. Mica or ceramic capacitors are preferable. Where stage shields are employed, filters should be placed within the shield.

Another important application of filters is to smooth the output of a rectifier tube. (See Rectification.) A smoothing filter usually consists of capacitors and iron-core chokes. In any filter-design problem, the load impedance must be considered as an integral part of the filter because the load is an important factor in filter performance. Smoothing effect is obtained from the chokes because they are in series with the load and offer a high impedance to the ripple voltage. Smoothing effect is obtained from the capacitors because they are in parallel with the load and store energy on the voltage peaks; this energy is released on the voltage dips and serves to maintain the voltage at the load substantially constant. Smoothing filters are classified as choke-input or capacitor-input according to whether a choke or capacitor is placed next to the rectifier tube. (See Fig. 98.)

The Circuits section gives a number of examples of rectifier circuits with recommended filter constants.

If an input capacitor is used, consideration must be given to the instantaneous peak value of the ac input voltage. This peak value is about 1.4 times the rms value as measured by an ac voltmeter. Filter capacitors, therefore, especially the input capacitor, should have a rating high enough to withstand the instantaneous peak value if breakdown is to be avoided. When the inputchoke method is used, the available dc output voltage will be somewhat lower than with the input-capacitor method for a given ac plate voltage. However, improved regulation together with lower peak current will be obtained.

Mercury-vapor and gas-filled rectifier tubes occasionally produce a form of local interference in radio receivers through direct radiation or through the power line. This interference is generally identified in the receiver as a broadly tunable 120-cycle buzz (100 cycles for 50-cycle supply line, etc.). It is usually caused by the formation of a steep wave front when plate current within the tube begins to flow on the positive half of each cycle of the ac supply voltage.

There are several ways of eliminating this type of interference. One is to shield the tube. Another is to insert an rf choke having an inductance of one millihenry or more between each plate and transformer winding and to connect high-voltage, rf bypass capacitors between the outside ends of the transformer winding and the center tap. (See Fig. 99.) The rf chokes should be placed within the shielding of the tube. The rf bypass capacitors should have a voltage rating high enough to withstand the peak voltage of each half of the secondary, which is approximately 1.4 times the rms value.

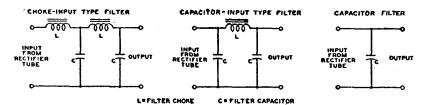


Fig. 98-Typical smoothing filters for rectifier tubes.

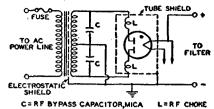


Fig. 99—Filter circuit used to eliminate interference produced by mercury-vapor or gas-filled rectifier tubes.

Transformers having electrostatic shielding between primary and secondary are not likely to transmit rf disturbances to the line. Often the interference may be eliminated simply by making the plate leads of the rectifier extremely short. In general, the particular method of interference elimination must be selected by experiment for each installation.

#### **Output Coupling Devices**

An output-coupling device is used in the plate circuit of a power output tube to keep the comparatively high de plate current from the winding of an electromagnetic speaker and, also, to transfer power efficiently from the output stage to a loudspeaker of either the electromagnetic or dynamic type.

Output-coupling devices are of two types, (1) choke-capacitor and (2) transformer. The choke-capacitor type includes an iron-core choke having an inductance of not less than 10 henries which is placed in series with the plate and B-supply. The choke offers a very low resistance to the dc plate current component of the signal voltage but opposes the flow of the fluctuating component. A bypass capacitor of 2 to 6 microfarads supplies a path to the speaker winding for the signal voltage. The choke-coil output coupling device, however, is now only of historical interest.

The transformer type is constructed with two separate windings, a primary and a secondary wound on an iron core. This construction permits designing each winding to meet the requirements of its position in the circuit. Typical

arrangements of each type of coupling device are shown in Fig 100. Examples of transformers for push-pull stages are shown in several of the circuits given in the **Circuits** section.

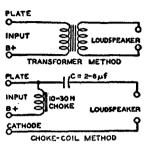


Fig. 100-Typical output-coupling devices.

#### **High-Fidelity Systems**

The results achieved from any high-fidelity amplifier system depend to a large degree upon the skill and care with which the system is constructed. Improper placement of transformers. other components, and wiring, and attempts to achieve excessive compactness, can only result in instability, oscillation, hum, and other operating difficulties, as well as in damage to components by overheating. It is important, therefore, that construction of high-fidelity amplifier systems be undertaken only by persons who have had some experience in the layout, mechanical construction, and wiring of audio equipment.

It is impractical to give specific construction data for various amplifiers and supplementary units because the best arrangement for each unit or combination of units will depend on the requirements of the user. It is possible, however, to list some general considerations which should be observed in the construction of any high-fidelity amplifier system.

Any amplifier having two or more stages should be constructed with a straight-line layout so that maximum separation is provided between the signal input and output circuits and terminals. Power-supply connections, particularly those carrying ac, should be

isolated as far as possible from signal connections, especially from the input connection. Signal-carrying conductors. even when shielded, should not be cabled together with power-supply conductors. Internal wiring for ac-operated tube heaters, switches, pilot-light sockets, and other devices, should be twisted and placed flat against the chassis. All connections to the ground side of the circuit in each unit should be made to a common bus of heavy wire. This bus should be connected to the chassis only at the point of minimum signal voltage, i.e., at the signal-input terminal of the unit.

All internal wiring that carries signal voltages should be as short as possible, and as far as possible above the chassis, to minimize losses at the higher audio frequencies due to stray shunt capacitance. All connections between units should be made with shielded cable having a capacitance of not more than 30 picofarads per foot, such as Alpha Type 1249 or 1704, Belden Type 8401 or 8410, or equivalent cable.

Because power amplifiers and power-supply units of high-fidelity systems normally dissipate large amounts of heat, they should be constructed and installed in such a manner as to assure adequate ventilation for the tubes and other components. A beam power tube or rectifier tube should be separated from any other tube or component on the same side of the chassis by at least 1½ tube diameters.

Power amplifiers and power-supply units which are to be installed horizontally (i.e., with the tubes vertical) in cabinets or on shelves should be provided with mounting feet, perforated bottom covers, and a number of small holes around each tube socket to permit relatively cool air to enter from below and provide ventilation for the under side of the chassis and tubes.

If a power amplifier, tone-control amplifier, and one or more preamplifiers are to be constructed on the same chassis, the mechanical layout should be planned so that the circuits operating at the lowest signal levels are farthest from the output stage and

power supply. Amplifier units which normally operate at comparable signal levels but are not used simultaneously (such as preamplifiers for tape pickup heads and magnetic phonograph pickups) may be installed side by side on the same chassis without danger of interaction. Units which operate simultaneously, however (such as the channels of a stereophonic system), should not be installed side by side on the same chassis without careful consideration to placement of components and wiring, and the possible use of shielding to prevent interaction.

When an amplifier, preamplifier, mixer, or other unit requiring heater power is located more than five or six feet from its power-supply unit, the heater-current conductors in the powersupply cable must be large enough to assure that each tube receives its rated heater voltage. In cases where very large heater currents or very long power-supply cables are involved, it may be desirable to install a heatersupply transformer on or near the amplifier unit. If such a transformer is installed on or near a preamplifier for a magnetic-tape pickup head, a magnetic phonograph pickup, or a dynamic microphone, the transformer should be completely shielded and positioned to prevent its field from inducing hum in the pickup device.

#### High-Voltage Considerations for Television Picture Tubes

Like other high-voltage devices, television picture tubes require that certain precautions be observed to minimize the possibility of failure caused by humidity, dust, and corona.

Humidity Considerations. When humidity is high, a continuous film of moisture may form on the glass bulb immediately surrounding the anode cavity cap of all-glass picture tubes or on the glass part of the envelope of metal picture tubes. This film may permit sparking to take place over the glass surface to the external conductive coating or to the metal shell. Such sparking may introduce noise into the

receiver. To prevent such a possibility, the uncoated bulb surface around the cap and the glass part of the envelope of metal picture tubes should be kept clean and dry.

Dust Considerations. The accumulation of dust on the uncoated area of the bulb around the anode cap of allglass picture tubes or on the glass part of the envelope or insulating supports for metal picture tubes will decrease the insulating qualities of these parts. The dust usually consists of fibrous materials and may contain soluble salts. The fibers absorb and retain moisture; the soluble salts provide electrical leakage paths that increase in conductivity as the humidity increases. The resulting high leakage currents may overload the high-voltage power supply.

It is recommended, therefore, that the uncoated bulb surface of all-glass picture tubes and the coated glass surface and insulating supports for metal picture tubes be kept clean and free from dust or other contamination such as finger-prints. The frosted Filterglass faceplate of the metal picture tubes may be cleaned with a soapless detergent, such as Dreft, then rinsed with clean water, and immediately dried.

Corona Considerations. A highvoltage system may be subject to corona, especially when the humidity is
high, unless suitable precautions are
taken. Corona, which is an electrical
discharge appearing on the surface of
a conductor when the voltage gradient
exceeds the breakdown value of air,
causes deterioration of organic insulating materials through formation of
ozone, and induces arc-over at points
and sharp edges. Sharp points or other
irregularities on any part of the highvoltage system may increase the possibility of corona and should be avoided.

In the metal-shell picture tubes,

the metal lip at the maximum diameter has rounded edges to prevent corona. Adequate spacing between the lip and any grounded element in the receiver, or between the small end of the metal shell and any grounded element, should be provided to preclude the possibility of corona. Such spacing should not be less than 1 inch of air. Similarly, an air space of 1 inch, or equivalent, should be provided around the body of the metal shell. As a further precaution to prevent corona, the deflecting-voke surface on the end adjacent to the shell should present a smooth electrical surface with respect to the small end of the metal shell or the anode terminal of all-glass tubes.

# Picture-Tube Safety Considerations

Tube Handling. Breakage of picture tubes, which contain a high vacuum, may result in injury from flying glass. Do not strike or scratch the tube or subject it to more than moderate pressure when installing it in or removing it from electronic equipment.

High-Voltage Precautions. In picture-tube circuits, high voltages may appear at normally low-potential points in the circuit because of capacitor breakdown or incorrect circuit connections. Therefore, before any part of the circuit is touched the power-supply switch should be turned off, the power plug disconnected, and both terminals of any capacitors grounded.

X-Ray Radiation Precautions. All types of picture tubes may be operated at voltages (if ratings permit) up to 16 kilovolts without producing harmful x-ray radiation or danger of personal injury on prolonged exposure at close range. Above 16 kilovolts, special x-ray shielding precautions may be necessary.

# Interpretation of Tube Data

THE tube data given in the following Technical Data section include ratings, typical operation values, characteristics, and characteristic curves.

The values for grid-bias voltages, other electrode voltages, and electrode supply voltages are given with reference to a specified datum point as follows: For types having filaments heated with dc, the negative filament terminal is taken as the datum point to which other electrode voltages are referred. For types having filaments heated with ac, the mid-point (i.e., the center tap on the filament-transformer secondary, or the mid-point on a resistor shunting the filament) is taken as the datum point. For types having unipotential cathodes indirectly heated, the cathode is taken as the datum point.

Ratings are established on electron tube types to help equipment designers utilize the performance and service capabilities of each tube type to best advantage. Ratings are given for those characteristics which careful study and experience indicate must be kept within certain limits to insure satisfactory performance.

Three rating systems are in use by the electron-tube industry. The oldest is known as the Absolute Maximum system, the next as the Design Center system, and the latest and newest as the Design Maximum system. Definitions of these systems have been formulated by the Joint Electron Device Engineering Council (JEDEC) and standardized by the National Electrical Manufacturers Association (NEMA) and the Electronic Industries Association (EIA) as follows:

Absolute Maximum ratings are limiting values which should not be exceeded with any tube of the specified type under any condition of operation. These ratings are used only in rare instances for receiving types, but are generally used for transmitting and industrial types.

Design Center ratings are limiting values which should not be exceeded with a tube of the specified type having characteristics equal to the published values under normal operating conditions. These ratings, which include allowances for normal variations in both tube characteristics and operating conditions, were used for most receiving tubes prior to 1957.

Design Maximum ratings are limiting values which should not be exceeded with a tube of the specified type having characteristics equal to the published values under any conditions of operation. These ratings include allowances for normal variations in tube characteristics, but do not provide for variations in operating conditions. Design Maximum ratings were adopted for receiving tubes in 1957.

Electrode voltage and current ratings are in general self-explanatory, but a brief explanation of other ratings will aid in the understanding and interpretation of tube data.

Heater warm-up time is defined as the time required for the voltage across the heater to reach 80 per cent of the rated value in the circuit shown in Fig. 101. The heater is placed in series with a resistance having a value 3 times the nominal heater operating resistance  $(R = 3 E_t/I_t)$ , and a voltage having a value 4 times the rated heater voltage  $(V = 4 E_t)$  is then applied. The warmup time is determined when  $E = 0.8 E_t$ .

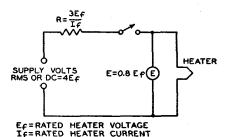


Fig. 101—Test circuit for measuring heater warm-up time.

Plate dissipation is the power dissipated in the form of heat by the plate as a result of electron bombardment. It is the difference between the power supplied to the plate of the tube and the power delivered by the tube to the load.

Grid-No. 2 (Screen-grid) Input is the power applied to the grid-No. 2 electrode and consists essentially of the power dissipated in the form of heat by grid No. 2 as a result of electron bombardment. With tetrodes and pentodes, the power dissipated in the screengrid circuit is added to the power in the plate circuit to obtain the total B-supply input power.

When the screen-grid voltage is supplied through a series voltage-dropping resistor, the maximum screen-grid voltage rating may be exceeded, provided the maximum screen-grid dissipation rating is not exceeded at any signal condition, and the maximum screen-grid voltage rating is not exceeded at the maximum-signal condition. Provided these conditions are fulfilled, the screen-grid supply voltage may be as high as, but not above, the maximum plate voltage rating.

For certain voltage amplifier types, as listed in the data section, the maximum permissible screen-grid (grid-No. 2) input varies with the screen-grid voltage, as shown in Fig. 102. (This curve cannot be assumed to apply to

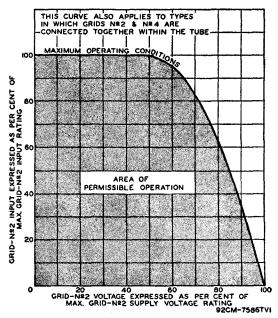


Fig. 102-Grid-No. 2 input rating curve.

types other than those for which it is specified in the data section.) Full rated screeen-grid input is permissible screen-grid voltages up to 50 per cent of the maximum rated screen-grid supply voltage. From the 50-per-cent point to the full rated value of supply voltage, the screen-grid input must be decreased. The decrease in allowable screen-grid input follows a curve of the parabolic form. This rating chart is useful for applications utilizing either a fixed screen-grid voltage or a series screen-grid voltage-dropping resistor. When a fixed voltage is used, it is necessary only to determine that the screen-grid input is within the boundary of the operating area on the chart at the selected value of screen-grid voltage to be used. When a voltagedropping resistor is used, the minimum value of resistor that will assure tube operation within the boundary of the curve can be determined from the following relation:

$$R_{g2} > \frac{E_{e2} (E_{ec2} - E_{c2})}{P_{c2}}$$

where  $R_{\rm g2}$  is the minimum value for the voltage-dropping resistor in ohms,  $E_{\rm c2}$  is the selected screen-grid voltage in volts,  $E_{\rm cc2}$  is the screen-grid supply voltage in volts, and  $P_{\rm c2}$  is the screengrid input in watts corresponding to  $E_{\rm c2}$ .

Peak heater-cathode voltage is the highest instantaneous value of voltage that a tube can safely stand between its heater and cathode. This rating is applied to tubes having a separate cathode terminal and used in applications where excessive voltage may be introduced between heater and cathode.

Maximum dc output current is the highest average plate current which can be handled continuously by a rectifier tube. Its value for any rectifier tube type is based on the permissible plate dissipation of that type. Under operating conditions involving a rapidly repeating duty cycle (steady load), the average plate current may be measured with a dc meter.

The nomograph shown in Fig. 103 can be used to determine tube voltage drop or plate current for any diode unit when values for a single plate-

voltage, plate-current condition are available from the data. It can also be used to compare the relative perveance  $(G = I_b/E_b \,^{3/2})$  of several diodes. Perveance can be considered a figure of merit for diodes; high-perveance units have lower voltage drop at a fixed current level.

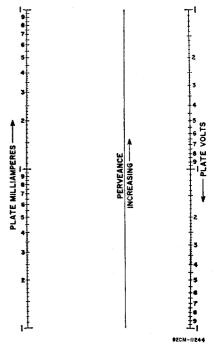


Fig. 103—Diode perveance nomograph.

Tube voltage drop or plate current for a specific diode unit can be determined as follows: First, convenient values are selected for the plate-voltage and plate-current scales of the nomograph. The published plate-current and plate-voltage values are then located on the scales and connected with a straight edge. The intersection of the connecting line with the perveance scale is then used as a pivot point to determine the value of tube voltage drop corresponding to a desired current value, or the value of plate current corresponding to a desired tube voltage drop. Because the pivot point for a specific diode unit represents its perveance, the pivot

points for several units (plotted to the same scales) can be used to compare their relative perveance.

For example, type 5U4GB has a tube voltage drop (per plate) of 44 volts at a plate current of 225 milliamperes. Convenient scales for this type are from 1 to 100 volts for plate voltage and from 10 to 1000 milliamperes for plate current. The points 44 volts and 225 milliamperes are then connected with a straight line to determine the pivot point. Using this pivot point, it is easy to determine such values as a plate current of 150 milliamperes at a tube voltage drop of 25 for a current of 100 milliamperes.

For readings in the order of one volt and/or one milliampere, the nomograph is not accurate because of the effects of contact potential and initial electron velocity.

Maximum peak plate current is the highest instantaneous plate current that a tube can safely carry recurrently in the direction of normal current flow. The safe value of this peak current in hot-cathode types of rectifier tubes is a function of the electron emission available and the duration of the pulsating current flow from the rectifier tube in each half-cycle.

The value of peak plate current in a given rectifier circuit is largely determined by filter constants. If a large choke is used at the filter input, the peak plate current is not much greater than the load current; but if a large capacitor is used as the filter input, the peak current may be many times the load current. In order to determine accurately the peak plate current in any rectifier circuit, measure it with a peak-indicating meter or use an oscillograph.

Maximum peak inverse plate voltage is the highest instantaneous plate voltage which the tube can withstand recurrently in the direction opposite to that in which it is designed to pass current. For mercury-vapor tubes and gasfilled tubes, it is the safe top value to prevent arc-back in the tube operating within the specified temperature range.

Referring to Fig. 104, when plate A

of a full-wave rectifier tube is positive, current flows from A to C, but not from B to C, because B is negative. At the instant plate A is positive, the filament is positive (at high voltage) with respect to plate B. The voltage between the positive filament and the negative plate

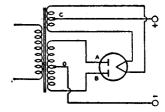


Fig. 104—Schematic diagram of full-wave rectifier tube and circuit connections.

B is in inverse relation to that causing current flow. The peak value of this voltage is limited by the resistance and nature of the path between plate B and filament. The maximum value of this voltage at which there is no danger of breakdown of the tube is known as maximum peak inverse voltage.

The relations between peak inverse voltage, rms value of ac input voltage, and dc output voltage depend largely on the individual characteristics of the rectifier circuit and the power supply. The presence of line surges or any other transient, or wave-form distortion, may raise the actual peak voltage to a value higher than that calculated for sine-wave voltages. Therefore, the actual inverse voltage, and not the calculated value, should be such as not to exceed the rated maximum peak inverse voltage for the rectifier tube. A calibrated cathode-ray oscillograph or a peakindicating electronic voltmeter is useful in determining the actual peak inverse voltage.

In single-phase, full-wave circuits with sine-wave input and with no capacitor across the output, the peak inverse voltage on a rectifier tube is approximately 1.4 times the rms value of the plate voltage applied to the tube. In single-phase, half-wave circuits with sine-wave input and with capacitor input to the filter, the peak inverse volt-

age may be as high as 2.8 times the rms value of the applied plate voltage. In polyphase circuits, mathematical determination of peak inverse voltage requires the use of vectors.

The Rating Chart for full-wave rectifiers presents graphically the relationships between maximum ac voltage input and maximum de output current derived from the fundamental ratings for conditions of capacitor-input and choke-input filters. This graphical presentation provides for considerable latitude in choice of operating conditions.

The Operation Characteristics for a full-wave rectifier with capacitor-input filter show by means of boundary line the limiting current and voltage relationships presented in the Rating Chart.

The Operation Characteristics for a full-wave rectifier with choke-input filter not only show by means of boundary line the limiting current and voltage relationships presented in the Rating Chart, but also give some information as to the effect on regulation of various sizes of chokes. The solid-line curves show the dc voltage outputs which would be obtained if the filter chokes had infinite inductance. The long-dash lines radiating from the zero position are boundary lines for various sizes of chokes as indicated. The intersection of one of these lines with a solid-line curve indicates the point on the curve at which the choke no longer behaves as though it had infinite inductance. To the left of the choke boundary line. the regulation curves depart from the solid-line curves as shown by the representative short-dash regulation curves.

Typical Operation Values. Values for typical operation are given for many types in the Technical Data section. These typical operating values are given to show concisely some guiding information for the use of each type. These values should not be confused with ratings, because a tube can be used under any suitable conditions within its maximum ratings, according to the application.

The power output value for any operating condition is an approximate tube output—that is, plate input minus

plate loss. Circuit losses must be subtracted from tube output in order to determine the useful output.

Characteristics are covered in the Electron Tube Characteristics section and such data should be interpreted in accordance with the definitions given in that section. Characteristic curves represent the characteristics of an average tube. Individual tubes, like any manufactured product, may have characteristics that range above or below the values given in the characteristic curves.

Although some curves are extended well beyond the maximum ratings of the tube, this extension has been made only for convenience in calculations. Do NOT operate a tube outside of its maximum ratings.

Interelectrode capacitances are direct capacitances measured between specified elements or groups of elements in electron tubes. Unless otherwise indicated in the data, all capacitances are measured with filament or heater cold, with no direct voltages present, and with no external shields. All electrodes other than those between which capacitance is being measured are grounded. In twin or multi-unit types, inactive units are also grounded.

The capacitance between the input electrode and all other electrodes, except the output electrode, connected together is commonly known as the input capacitance. The capacitance between the output electrode and all other electrodes, except the input electrode, connected together is known as the output capacitance.

Hum and noise characteristics of high-fidelity audio amplifier tube types such as the 7025 and the 7199 are tested in an amplifier circuit such as that shown in Fig. 105. The output of the test circuit is fed into a low-noise amplifier. The bandwidth of this amplifier depends on the characteristic being measured. If hum alone is being tested, a relatively narrow bandwidth is used to include both the line frequency and the major harmonics generated by the tube under test. In noise or combination hum-and-noise measurements, the

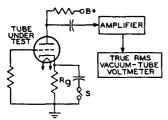


Fig. 105—Test circuit for measuring hum and noise characteristics of high-fidelity audio-amplifier tubes.

bandwidth is defined in the registration of the tube type.

The amplifier gain is calibrated so that the vacuum-tube voltmeter measures hum and noise in microvolts referenced to the grid of the tube under test. A pentode can also be evaluated in this manner by the addition of a screengrid supply adequately bypassed at the tube screen-grid pin connection. Power-supply ripple at the plate of the tube under test must be negligible compared to its hum and noise output. Extraordinary shielding of both the test socket and the associated operating circuit is required to minimize capacitances between heater leads and high-impedance connections.

The test-circuit components are determined by the tube type being tested and the type of hum to be controlled. Heater-cathode hum can be eliminated from the measurement by closing the switch S. The circuit can also be made more or less sensitive to heater-grid hum by increasing or decreasing the grid resistance R<sub>g</sub>. No circuit changes affect the component of magnetic hum generated by the tube.

# Application Guide for RCA Receiving Tubes

In the Application Guide on the following pages, RCA receiving tubes are classified in two ways: (a) by function, and (b) by structure (diode, triode, etc.). The functional classification covers 42 principal types of application, as listed below.

Tube types are grouped by structure under each classification; they are also keyed to indicate miniature, octal, nuvistor, duodecar, and novar types.

Triodes are designated as low. medium-, or high-mu types on the following basis: low, less than 10; medium. 10 or more, but less than 50; high, 50 or more. Where applicable, tubes are designated as sharp-, semiremote, or remote-cutoff on the basis of the ratio, in per cent, of the negative control-grid voltage to the screen-grid voltage (or, for triodes, the plate voltage) as given in the characteristics or typical operation values. These terms are defined as follows: sharp, less than 10 per cent; semiremote, 10 or more, but less than 20 per cent; remote, 20 per cent or more.

For more complete data on these types, refer to the Technical Data For RCA Receiving Tubes starting on page 93.

#### **APPLICATIONS**

- 1. Audio-Frequency **Amplifiers**
- 2. Automatic Gain Control (AGC and AVC) Circuits
- 3. Bandpass Amplifiers (Color TV)
- 4. Burst Amplifiers
- 5. Cathode-Drive RF Amplifiers (Grounded-Grid)
- 6. Color Killers
- 7. Color Matrixing Circuits
- 8. Complex-Wave Generators
- 9. Converters
- 10. Dampers
- 11. Demodulators (Color TV)
- 12. Detectors
- 13. DC Restorers
- 14. Discriminators

- 15. Frequency Dividers 16. FM Detectors
- 17. Gated Noise, AGC, and Sync Amplifiers
- 18. Grounded-Grid RF
- Amplifiers
- 19. Harmonic Generators 20. Horizontal-Deflection Circuits
- 21. Intermediate-Frequency
- Amplifiers 22. Keyed AGC Amplifiers
- 23. Limiters
- 24. Mixers-RF
- 25. Mixer-Oscillators-RF
- 26. Multivibrators

- 27. Noise Inverters (Noise Immune Circuits)

- 28. Oscillators
- 29. Phase Inverters
- 30. Phase Splitters 31. Radio-Frequency
- **Amplifiers**
- 32. Reactance Circuits
- 33. Rectifiers
- 34. Regulators
- 35. Sync Amplifiers
- 36. Sync Clippers 37. Sync Separators
- 38. Tuning Indicators
- 39. Vertical-Deflection
  - Circuits (Oscillator and Amplifier)
- 40. Video Amplifiers

#### 1. AUDIO-FREQUENCY AMPLIFIERS

Voltage Amplifiers

Medium-Mu Triode with Twin Diode • 6BF6

Medium-Mu Triode-Sharp-Cutoff Pentode 11LQ8 • 7199f

#### Medium-Mu Twin Triode

- 516 • 7AU7
  - 6J6A 9AU7
  - o 6SN7GTB • 17CU5
- o 12SN7GTA 1936

- Miniature
- o Octal

			Real Reversing 1 noe manua
High-Mu Tric	de with Twin I	Diode	Twin Diode—High-Mu Triode
• 3AV6	• 6BN8	• 12AV6	• 3AV6 • 6AV6 • 12AV6
• 4AV6	• 6CN7	o 12SQ7	• 4AV6 • 6SQ7 □ 12SQ7
• 6AT6	o 6SO7	• 14GT8	• 6AT6 • 12AT6 • 18FY6A
• 6AV6	• 12AT6	<ul> <li>18FY6A</li> </ul>	
			Medium-Mu Triode-Sharp-Cutoff Pentode
Title Mar. Tola			• 5AN8 • 6BA8A • 6GH8A
	de with Triple D		• 5GH8 • 6BH8 • 8BA8A
• 5T8	• 6T8A	• 19T8	• 6AN8A • 6CU8 • 8BH8
			• 6AZ8
High-Mu Twi	n Triode		High-Mu Triode—Sharp-Cutoff Pentode
• 6EU7+	• 12AZ7A	• 20EZ7	•
o 6SL7GT	• 12BZ7	· 7025†	
• 12AX7A+		• • • • • • • • • • • • • • • • • • • •	• 6HF8 • 8AW8A • 10HF8
			Sharp-Cutoff Twin Pentode
Sharp-Cutoff	Pentode		• 3BU8 • 4BU8 • 6BU8
<ul> <li>3DT6A*</li> </ul>	<ul> <li>6DT6A*</li> </ul>	• 5879 <del>†</del>	• 3GS8 • 4HS8 • 6HS8
<ul> <li>4DT6A*</li> </ul>	• 6GX6*	• 7543†	• 3HS8
• 5GX6*	• 6HZ6*		JAIN THE STATE OF
			3. BANDPASS AMPLIFIER
	Pentode with D	iode	= :
• 12CR6			(COLOR TV)
			• 6AW8A • 6LF8 • 8AW8A
F	Power Amplifie	rs	• 6HL8 • 6KT8
Beam Power	Tube		4. BURST AMPLIFIERS
• 5AQ5	o 6L6	• 17CU5	(
• 5CZ5	o 6L6GC†	• 25C5	Medium-Mu Triode—Sharp-Cutoff Pentode
	o 6V6	<ul> <li>25F5A</li> </ul>	• 5EA8 • 6EA8 • 6GH8A
<ul> <li>6AQ5A</li> </ul>	o 6V6GTA	<ul> <li>34GD5A</li> </ul>	• 5GH8
• 6AS5	o 6W6GT	• 35C5	
• 6CM6	o <b>6Y6G</b>	<ul> <li>35L6GT</li> </ul>	Medium-Mu Triode—Semiremote-Cutoff
• 6CU5	• 12AB5	• 50B5	Pentode
• 6CZ5	• 12AQ5	• 50C5	• 6LM8
o edgegt	• 12CA5	50L6GT	
• 6DS5	• 12CU5/12C5		High-Mu Triode with Twin Diodes
^ 6GC5	o 12V6GT	o <b>7408</b> †	• 6BN8 • 8BN8
o 6HG5	o 12W6GT		
Beam Power	Tube-Sharp-Cut	off Pentode	5. CATHODE-DRIVE RF AMPLI-
\$ 6AL11	# 10AL11	‡ 12AL11	FIERS (GROUNDED-GRID)
*	+	<b>*</b>	
Power Pentod	le		Medium-Mu Triode
• 6BO5	• 8BO5	• 50EH5	• 6BC4
• 6EH5	• 12EH5	• 60FX5	Medium-Mu Twin Triode
o 6F6	• 12FX5	• 7189 <del>†</del>	• 4BC8 • 5BK7A • 6BQ7A
• 6GK6	• 25EH5	▲ 7868 <del>†</del>	
o 6K6GT	• 35EH5	- 70001	• 4BQ7A • 5BQ7A • 6BS8 • 4BS8 • 6BC8 • 6BZ7
OUROGA	· JURIEU		• 4BZ7 • 6BK7A
Pentode—Bear	m Power Tube		
<b>± 6J10</b>	± 13J10		High-Mu Triode
T 00 10	4 10010		△ 2CW4 • 6AB4 △ 6DS4
			△ 2DS4 △ 6CW4 △ 13CW4
2. AUTOM	ATIC GAIN O	CONTROL	High-Mu Twin Triode
CIRCUIT	rs (agc & a	VC)	• 6DT8 • 12AZ7A • 12DT8
Diode—Sharp	-Cutoff Pentode		• 12AT7
• 6KL8	• 12KL8		6. COLOR KILLERS
Diode-Remo	te-Cutoff Pentode		Quadruple Diode
	- 12507		A CIVIO A CIVINA

<sup>•</sup> Miniature  $\ddagger$  Duodecar  $\circ$  Octal  $\, \vartriangle\,$  Nuvistor  $\, \bigstar\,$  Novar  $\, \ast\,$  Dual-control grids  $\dagger$  For high-fidelity equipment

• 6JU8

• 6JU8A

• 12EQ7

• 6EQ7

Medium-Mu Twin Triode

o Octal

12BH7A

Miniature

#### High-Mu Twin Triode 7. COLOR MATRIXING CIRCUITS 12AZ7A Medium-Mu Twin Triode Sharp-Cutoff Pentode • 6CG7 • 6GU7 8FO7 • 6FO7 • 8CG7 12BH7A 3RY6 • 6GY6 Pentagrid Amplifier 8. COMPLEX-WAVE • 6BY6 6JH8 **GENERATORS** 12. DETECTORS High-Mu Twin Double-Plate Triode • 12FO8 Diode-Sharp-Cutoff Pentode 5AM8 6AM8A Sharp-Cutoff Twin-Plate Tetrode-Diode • 5AS8 6AS8 6FA7 Diode-Remote-Cutoff Pentode 6CR6 • 12CR6 • 12EO7 Sharp-Cutoff Three-Plate Tetrode-Diode 6EO7 6KM8 Twin Diode Three-Plate Tetrode-Medium-Mu Triode 3AL5 o 6H6 o 12H6 • 6FHR • 12AL5 6AL5 Twin Diode-High-Mu Triode 9. CONVERTERS • 3AV6 6CN7 12AV6 • 4AV6 o 6SQ7 o 12SQ7 Medium-Mu Triode-Sharp-Cutoff Pentode 6AT6 • 8BN8 • 14GT8 6AV6 • 12AT6 18FY6A • 5EA8 • 5X8 6KZ8 6BN8 • 5GH8 • 6EA8 • 6U8A 5KE8 • 6GH8A 6X8 Triple Diode • 19X8 • 6KE8 • 5U8 • 6BJ7 High-Mu Twin Triode Triple Diode-High-Mu Triode • 6DT8 12AZ7A • 12DT8 •5T8 • 6T8A • 12AT7 Quadruple Diode Sharp-Cutoff Pentode 6JU8 · 6JURA • 3AU6 • 18GD6A 6AU6A • 4AU6 • 12AU6 Sharp-Cutoff Pentode 3DT6A\* • 5GX6\* 6GX6\* Pentagrid 4DT6A\* 6DT6A\* 6HZ6\* • 3BE6 o 6SA7 o 12SA7 6BA7 • 12BE6 18FX6A • 6RE6 13. DC RESTORERS Diode-Sharp-Cutoff Pentode 10. DAMPERS • 5AM8 6AM8A • 6AS8 • 5AS8 Half-Wave (Diode) Triple Diode o 6AU4GTA ▲ 17BS3 6BJ7 o 6AX4GTB ▲ 6DW4 @ 17D4 ▲ 6AY3 o 6W4GT 0 17DE4 **▲ 6BA3** o 12AX4GTA @ 19AU4 14. DISCRIMINATORS **▲ 6BH3** o 12AX4GTB ▲ 22BH3 ▲ 6BS3 4 12AY3 o 22DE4 FMo 25AX4GTA o 6CQ4 ▲ 12BS3 Twin Diode o 6DA4 o 12D4 4 17AY3 ▲ 17BH3 o 6DE4 o 17AX4GTA 3AL5 6AL5 • 12AL5 Twin Diode-High-Mu Triode 11. DEMODULATORS (COLOR TV) • 6BNS 14GT8

Triple Diode-High-Mu Triode

6T8A

\* Dual-control grids

19T8

• 5T8

A Novar

A Nuvistor

Beam Tube • 3BN6 • 4BN6	• 6BN6	20. HORIZO	ONTAL-DEFI TS	LECTION
Beam Power Tube-Sharp-Cut-	off Pentode			
\$6AL11			Oscillators	
Pentode-Beam Power Tube		Madinus Mr. T	riode—Sharp-Cu	4.# D4. I.
± 6J10 ± 13J10		• 5GH8	riode—Snarp-Cu • 6GH8A	ton Pentode
•		30116	UGHOA	
FM Quadrature-C	Grid	Medium-Mu T	win Triode	
Sharp-Cutoff Pentode		• 6CG7	• 8CG7	• 12AU7A
• 3DT6A* • 5GY6*	• 6GX6*	o 6SN7GTB	• 9AU7	• 12BH7A
• 4DT6A* • 6DT6A* • 5GX6*	• 6HZ6*	• 7AU7		o 12SN7GT <i>A</i>
Beam Tube		1	Amplifiers	
• 3BN6 • 4BN6	• 6BN6	Beam Power	Гића	
II	a	o 6AU5GT	≜ 6JG6	▲ 17GJ5
Horizontal AF	L	o 6AV5GA	▲ 6JG6A	4 17GJ5A
Twin Diode-High-Mu Triode		o 6BG6GA	<b>▲ 6JT6</b>	▲ 17GT5
• 6BN8 • 8BN8	• 8CN7	o 6BQ6GTB/		o 17GW6
• 6CN7		6CU6 ⊙ 6CB5A	<ul><li>12AV5GA</li><li>12BQ6GTB/</li></ul>	▲ 17JB6 ▲ 17JG6
		o 6CD6GA	12CT16	<b>▲ 171T6</b>
15. FREQUENCY DIVID	ERS	⊙ 6DQ5	o 12DQ6B	▲ 22JF6
~		o 6CD5A o 6CD6GA o 6DQ5 o 6DQ6B	o 12DQ6B ^ 12GT5 o 12GW6 ^ 12JB6 ^ 12JT6	* 22JG6
High-Mu Twin Double-Plate T	riode	^ 6GJ5 ^ 6GT5	0 12GW6 ▲ 12TR6	© ZSA VSGA
• 12FQ8		o 6GW6	▲ 12JT6	25CU6
		^ 6JB6		o 25CD6GB
16. FM DETECTORS		^ 6JE6	o 17DQ6B	o 25DN6
(See 14. Discriminator	s)			
(500 211 25555555555555555555555555555555	<b>5,</b>	21 INTERN	ÆDIATE-FR	FOIENCY
45 04 555 1050 404	~ 4375	AMPLIFII	-	EQUENCI
17. GATED NOISE, AGO	C, AND	ANII LIFE		
SYNC AMPLIFIERS		Medium-Mu T	riode—Sharp-Cu	toff Tetrode
High-Mu Triode—Sharp-Cutoff	Pentode	• 5CQ8	• 6CQ8	
• 6KA8 • 8KA8	• 8LC8			
• 6LC8	· OLICO	Medium-Mu T	rlode—Sharp-Cu	toff Pentode
		• 5AN8	• 6AZ8	• 6CU8
Sharp-Cutoff Pentode		• 6AN8A	• 6BH8	
• 6GY6*		i		
Sharp-Cutoff Twin Pentode		_	de—Sharp-Cutof	
• 3BU8 • 4BU8	• 6BU8	• 6AW8A		• 10GN8
• 3GS8 • 4HS8	• 6HS8	• 6GN8 • 6HF8	• 8AW8A • 8GN8	• 10HF8 • 10JA8
• 3HS8		• 6JV8	• 8JV8	• 11KV8
Pentagrid Amplifier		• 6KT8		
• 3BY6 • 4CS6	• 6CS6			
• 3CS6 • 6BY6		Sharp-Cutoff P	entode	
·		• 3AU6	• 4JC6	• 6DK6
10 CDOINDED COM	015	• 3BC5	• 4JD6•	• 6EJ7
18. GROUNDED-GRID I	K.F	• 3CB6	• 5EW6	• 6EW6
AMPLIFIERS		• 3CF6 • 3DK6	• 6AG5 • 6AK5	• 6HS6 • 6JC6
(See 5. Cathode-Drive	RF	• 3JC6	• 6AU6A	• 6JD6•
Amplifiers)		• 3JD6*	• 6BC5	• 12AU6
•		• 4AU6	• 6CB6	• 12AW6
	. mong	• 4CB6 • 4DE6	• 6CB6A • 6CF6	• 12DK6 • 18GD6A
19. HARMONIC GENER	ATUKS	• 4DK6	• 6DC6	• 19HS6
(C) (C) (T) (T)	~			

(See 8. Complex-Wave Generators)

 <sup>• 4</sup>EW6
 • 6DE6

Approaches semiremote-cutoff characteristics; used in first-if amplifier applications

#### Sharp-Cutoff Pentode with Diode High-Mu Twin Triode • 6AM8A - EAMO • 6KL8 • 6DT8 • 12AT7 • 12DT8 • 5AS8 • 6AS8 • 12KL8 Triode-Hexode Semiremote-Cutoff Pentode © 6G8 @ 12K8 4 3B76 • 5GM6 • 6HR6 • 3EH7 • 6BZ6 26. MULTIVIBRATORS 6JH6 4BZ6 • 6EH7 • 12BZ6 Medium-Mu Triode-Sharp-Cutoff Pentode 4EH7 6GM6 19HR6 4GM6 • 5GH8 • 6GH8A Remote-Cutoff Pentode Medium-Mu Twin Triode • 3BA6 4 12RA6 18FW6A . 7ATI7 @ 12SN7-• 6CG7 • 6BA6 • 18FW6 6GU7 8CG7 GTA **© 6SN7GTB** • 9AU7 Remote-Cutoff Pentode with Diode • 12AU7A • 6EO7 • 12EO7 High-Mu Twin Triode • 12AX7A 22. KEYED AGC AMPLIFIERS (See 17. Gated Noise, AGC, and 27. NOISE INVERTERS (NOISE Sync Amplifiers) IMMUNE CIRCUITS) High-Mu Triode-Sharp-Cutoff Pentode 6KA8 • 8KA8 · aLC8 23. LIMITERS 6LC8 Beam Tube Sharp-Cutoff Pentode • 3RN6 • 4BN6 • 6BN6 6GY6\* Sharp-Cutoff Pentode 28. OSCILLATORS • 3AU6 • 6AU6A • 6HZ6 • 4AU6 • 6GX6 • 12AU6 Radio Frequency-UHF • 5GX6 6HS6 • 19HS6 Medium-Mu Triode Sharp-Cutoff Pentode with Diode • 3AF4A • 2AF4R 6AF4A • 6KI.8 • 12KL8 △ 6DV4 △ 2DV4 • 3DZ4 • 2DZ4 • 6AF4 • 6DZ4 Power Pentode-Beam Power Tube 1 6J10 1 13J10 Radio Frequency-VHF Medium-Mu Twin Triode • 536 • 6J6A 24. MIXERS—RF High-Mu Triode Medium-Mu Twin Triode • 6AB4 • 5J6 • 636A Power Triode High-Mu Triode • 6C4 (Class C) A 2CW4 △ 6CW4 △ 13CW4 6AB4 Low Frequency, Sweep Type Medium-Mu Triode-Sharp-Cutoff Pentode • 5AN8 • 6RASA · SALIS 25. MIXER-OSCILLATORS—RF • 6AN8A 6BH8 8BA8B Medium-Mu Triode-Sharp-Cutoff Tetrode 6AU8A 6CH8 • 8BH8 6AZ8 • 5CL8A • 6CL8A 19CL8A • 5CO8 • 6CO8 High Mu Triode with Twin Diode • 6RNS • RRNR Medium-Mu Triode-Sharp-Cutoff Pentode • 8CN7 • 6CN7 • 5AT8 • 5X8 • 6KZ8 • 5B8 6AT8A • 6U8A High-Mu Twin Triode • 5BRS • 6BR8A 6Z8 • 12AX7A • 6CG8A • 5CG8 • 9EA8 5EA8 • 6EA8 • 9U8 29. PHASE INVERTERS • 5FG7 6FG7 • 19EAS Medium-Mu Triode-High-Mu Triode 5KE8 • 6HB7 19X8

• 12DW7

• Miniature

Medium-Mu T			Sharp-Cutoff 1	Tetrode	
• 6CG7	• 7AU7	• 12AU7A	• 2CY5	• 4CY5	• 6FV6
• 6GU7	• 8CG7	o 12SN7-	• 3CY5	• 6CY5	
o 6SN7GTB	• 9AU7	GTA			
**** * ** ** ** ** ** ** ** ** ** ** **			Sharp-Cutoff P	entode	
	de—Sharp-Cutof		• 3AU6	• 6AK5	• 6DE6
• 6AW8A	• 8AW8A	• 10GN8	• 3BC5	<ul> <li>6AU6A</li> </ul>	o 6SH7
• 6EB8	• 8EB8	• 10HF8	• 3CB6	• 6BC5	o 6SJ7
• 6GN8	• 8GN8	• 10JA8	• 3CF6	• 6BH6	• 12AU6
• 6HF8			• 4AU6	• 6CB6	• 12AW6
W-L M. T.	. T-1-1-		• 4CB6	• 6CB6A	o 12SH7
High-Mu Twir			• 4DE6 • 6AG5	• 6CF6 • 6DC6	⊙ 12SJ7
o 6SL7GT	o 12SL7GT	• 7025	• OAG5	• opco	• 18GD6A
• 12AX7A			Sharp-Cutoff P	entode with Di	ode
			• 6KL8	• 12KL8	
			V	121120	
30. PHASE	<b>SPLITTERS</b>		Remote-Cutoff	Pentode	
			• 3BA6	• 6BJ6	• 12BA6
Medium-Mu T	riode—Sharp-Cu	itoff Tetrode	• 6BA6	o 6SK7GT	• 18FW6A
• 5CQ8	• 6CQ8		<b>_</b>	_	
				Pentode with I	Diode
Medium-Mu T	`riode—Sharp-Cu	toff Pentode	• 6EQ7	• 12EQ7	
• 5AN8	• 6BA8A	• 8BA8A			
• 6AN8	• 6CH8	• 7199			
• 6AZ8	• 6CU8		32. REACTA	ANCE CIRC	UITS
			Modlem Me T	iode-Sharp-Cu	doff Books do
-	de-Sharp-Cutof	f Pentode			
• 6AW8A	• 8AW8A		• 5AN8 • 6AN8A	• 6BA8A	• 6CU8
			• 6AZ8	• 6CH8	• 8BA8A
			VOALO		
31. RADIO	FREQUENC	Y	High-Mu Triod	le with Twin I	Nodes
AMPLI	FIFDS		• 6CN7	• 8CN7	310465
PAIVER LA	PARAMS		- 00117	V OCIV	
			High-Mu Triod	le—Sharn-Cutof	F Pentode
Medium-Mu T			• 6AW8A	• 8AW8A	
• 2BN4A	• 6BC4	• 6BN4A	0.20.2	- 024 77 024	
• 3BN4A					
			33. RECTIF	IERS	
	riode—Sharp-Cu	itoff Tetrode			
• 5CQ8	• 6CQ8		Power-St	pply Types-	-Vacuum
			10000	грргу 1 урез-	-v acuum
Medium-Mu T	win Triode		Half-Wave (Di	ode)	
• 4BC8	• 5BQ7A	• 6BS8	• 35W4		
• 4BO7A	• 5J6	• 6BZ7	⊙ 35Z5GT	• 36AM3B	• 50DC4
• 4BS8	• 6BC8	• 6J6A	332301		
• 4BZ7	• 6BK7B	• 12AV7	Full-Wave (Tw	in Dioda)	
• 5BK7A	• 6BQ7A		o 3DG4		
			o 5AR4/GF34	o 5V3A	• 6CA4
High-Mu Trio	đe		0 5AS4A	⊕ 5 V G4 ⊕ 5 V 4 G A	• 6X4 • 6X5GT
△ 2CW4	• 3GK5	• 6ER5	▲ 5BC3	⊙ 5XG4	• 12CA4
A 2DS4	• 3HM5/3HA5		⊙ 5DJ4	o 5Y3GT	• 12X4
• 2ER5	• 4GK5	• 6FQ5A	⊙ 5U4G	⊙ <b>5Z4</b>	• 25CA4
• 2FH5	• 6AB4	• 6GK5	o 5U4GB		
• 2GK5	△ 6CW4	• 6HM5/6HA5	1		
• 3ER5	△ 6DS4	△ 13CW4	High-Voltage	Types (For	rf-rectifier of
• 3FH5				-current appl	
				Vacuum	
High-Mu Twin	Triode		1	r wealis	
• 6DT8	• 12AZ7A	• 12DT8	Holf Wans (T)		
•-			Half-Wave (Dic	•	
Power Triode			o 1G3GT/	• 1V2	• 2BJ2
• 6C4 (Class	C)		1B3GT	• 1X2B • 2AV2	• 3A2
- 0C4 (CIMSS	·,		0 1K3/1J3	- 4A V 4	© 3CA3

o Octal

△ Nuvistor

A Novar

# 34. REGULATORS (HIGH VOLTAGE, LOW CURRENT)

Sharp-Cutoff Beam Triode e 6BK4A e 6BK4B

#### 35. SYNC AMPLIFIERS

Medium-Mu Triode—Sharp-Cutoff Pentode

• 6AU8A • 6CX8 • 8CX8

• 6AZ8 • 8AU8

#### Medium-Mu Twin Triode

• 6CG7 • 8CG7 • 12AU7A • 7AU7

High-Mu Triode with Twin Diode
• 6CN7 • 8CN7

High-Mu Triode—Sharp-Cutoff Pentode

• 6AW8A • 6JV8 • 8JV8
• 6HF8 • 8AW8A • 10HF8

High-Mu Twin Triode
• 12RZ7

#### 36. SYNC CLIPPERS

Medium-Mu Triode—Sharp-Cutoff Tetrode
• 5CQ8 • 6CQ8

Medium-Mu Triode—Sharp-Cutoff Pentode

• 5AN8 • 6AZ8 • 6CX8 • 6AN8A • 6CH8 • 8CX8 • 6AU8A • 6CU8 • 8AU8

High-Mu Triode—Sharp-Cutoff Pentode
• 6AW8A • 6HF8 • 8JV8

6EB8 6JV8 10GN8 6GN8 8AW8A 10HF8 6GW8/ 8EB8 10JA8 ECL86 8GN8

High-Mu Twin Triode

• 12BZ7

Sharp-Cutoff Twin Pentode

• 3BU8 • 4BU8 • 6BU8 • 3GS8 • 4HS8 • 6HS8 • 3HS8

Pentagrid Amplifier

• 3BY6 • 4CS6 • 6CS6 • 3CS6 • 6BY6

#### 37. SYNC SEPARATORS

Medium-Mu Triode—Sharp-Cutoff Tetrode
• 5CO8
• 6CO8

Medium-Mu Twin Triode

• 6CG7 • 8CG7 • 12AU7A • 7AU7

. ....

High-Mu Triode with Twin Diode

• 6CN7

• 8CN7

High-Mu Triode-Sharp-Cutoff Pentode

• 6AW8A 6KV8 . RKAR • 6LC8 6EB8 8LC8 • 10GN8 • 6GN8 • 8AW8A • 8EB8 6HF8 10HF8 6JV8 • 8GN8 10JA8 • 6KA8 · SIVS • 11KV8

High-Mu Twin Triode

• 12BZ7

Sharp-Cutoff Twin Pentode

• 3BU8 • 4BU8 • 6BU8 • 3GS8 • 4GS8/4BU8 • 6HS8 • 3HS8 • 4HS8

Pentagrid Amplifier

• 3BY6 • 4CS6 • 6CS6

• 3CS6 • 6BY6

38. TUNING INDICATORS

Indicator with Triode Unit 6E5

Twin Indicator Units

o 6AF6G

# 39. VERTICAL-DEFLECTION CIRCUITS

Oscillators and Amplifiers (Combined)

Medium-Mu Triode-Low-Mu Triode

• 6DE7 • 10DE7 • 13DE7

Medium-Mu Dual Triode

• 6CM7 • 8CM7 • 8CS7 • 6CS7

High-Mu Triode-Low-Mu Triode

High-Mu Triode-Beam Power Tube

4 13GF7

<ul> <li>Miniature</li> </ul>	⊕ Octal		△ Nuvistor	: Diodecar	^ Novar
• 6AN8A • 6AU8A • 6AZ8 • 6BA8A	• 6CU8 • 6CX8 • 6HL8	• 8BA8A • 8BH8 • 8CX8 • 11LQ8	Power Pentod o 6AG7 • 6CL6	e • 6GK6	• 16GK6
• 5AN8	iode—Sharp-Cuto • 6BH8	• 8AU8	• 6BK5	• 25BK5	
40. VIDEO	AMPLIFIERS		• 5AS8	<b>.</b>	
⊙ 6K6GT			• 5AM8	• 6AM8A	• 6AS8
Power Pentode			Sharp-Cutoff P	entode with Di	ode
• 5CZ5 © 5V6GT	• 6CM6 • 6CZ5	• 8EM5 • 12AQ5	• 12BY7A	1 12HG7	
• 5AQ5	• 6AQ5A	• 6EM5	Sharp-Cutoff P	'entode	
Beam Power To	ube		• 6KT8	• 8JV8	
• 684A			• 6JV8	• 8GN8	• 12KV8
Medium-Mu Tr	iode		• 6HF8	• 8EB8	• 11KV8
• 12B4A			• 6GN8	• 8AW8A	• 10JAB
Low-Mu Triode	2		• 6EB8	• 6LF8	• 10HF8
	<b>Amplifiers</b>		High-Mu Triod	leSharp-Cutofi • 6KV8	Pentode • 10GN8

For information on picture tubes, refer to the RCA Picture Tube Characteristics Chart at the end of the Technical Data section.

# Technical Data for RCA Tube Types

THIS section contains technical descriptions of RCA tubes used in standard broadcast, FM, and television receivers, in audio amplifiers, and in many other diverse applications. It includes detailed data on current types, including characteristics curves in many cases. Essential information on types intended primarily for replacement use and on discontinued types in which there may still be some interest is given in chart form at the end of the section. Characteristics charts for RCA television picture tubes for replacement use and for RCA voltage-regulator and voltage-reference tubes are given in the following section.

In choosing tube types for the design of new electronic equipment, the designer should refer to the Application Guide for RCA Receiving Tubes in the pages immediately preceding this section.

Tube types are listed in this section according to the numerical-alphabeticalnumerical sequence of their type designations. For Key: Basing Diagrams. see inside back cover.

> This edition of the RCA Receiving Tube Manual features an all-inclusive "Index to RCA Receiving Tubes." Located on page 561 of the manual, this index includes all active, replacement, and discontinued tube types and gives the page number on which the data for each type are given. For ready location of any specific type, the reader is urged to consult the index before referring to the formal data section or the "RCA Types for Replacement Use" table.

### HALF-WAVE VACUUM RECTIFIER



Duodecar type used OLC. power to the anode of the picture tube in television receivers. Outline 9A. Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Socket

1AD2

terminals 4 and 10 may be used as tie points for components at or near filament potential. Filament volts (ac/dc), 1.25; amperes, 0.2.

Pulsed Rectifier For operation in a 525-line, 30-frame system MAXIMUM RATINGS (Design-Maximum Values): 26000 max volts Peak Inverse Plate Voltage# ........ 50 max mA Peak Plate Current ... 0.5 max mA Average Plate Current ...... CHARACTERISTICS, Instantaneous Value: 225 volts Tube Voltage Drop for plate current of 7 mA .....

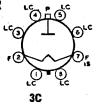
#The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10

<sup>•</sup> The dc component must not exceed 22000 volts.

#### HALF-WAVE VACUUM RECTIFIER

## IG3GT/ 1B3GT

Glass octal type used in high-voltage, LC low-current applications such as the rectifier in a high-voltage, rf-operated power supply or as a rectifier of highvoltage pulses produced in television scanning systems.



Filament Voltage (ac/dc) Filament Current	1.25* 0.2	volts ampere
Direct Interelectrode Capacitance (Approx.): Plate to Filament and Internal Shield	1.3	pF
* Under no circumstances should the filament voltage be less than 1.05	volts or	greater than

#### **Pulsed Rectifier**

MAXIMUM RATINGS (Design-Maximum Values):		
Peak Inverse Plate Voltage#	26000•max	volts
Peak Plate Current Average Plate Current	50 max 0.5 max	mA mA
CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 7 mA		volts

#### Radio-Frequency Rectifier

MAXIMUM RATINGS (Design-Maximum Values):		
Peak Inverse Plate Voltage	33000 max	volts
Peak Plate Current	35 max	mA
Average Plate Current	1.1 max	mA
Frequency Range of Supply Voltage	1.5 to 100	kc/s

<sup>#</sup>The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

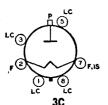
#### Installation and Application

Type 1G3GT/1B3GT requires an octal socket and may be mounted in any position. Plate connection is cap at top of bulb. Socket terminals 1, 3, 4, 5, 6, and 8 may be connected to socket terminal 7 or to a corona shield which is connected to socket terminal 7. Socket terminals 4 and 6 may be used as tie points for components at or near filament potential. This type may be supplied with pins 1, 4, and/or 6 omitted. Outline 14B, Outlines section.

The high voltages at which the 1G3GT/1B3GT is operated are very dangerous. Great care should be taken to prevent coming in contact with these high voltages. In those circuits where the filament circuit is not grounded, the filament circuit operates at dc potentials which can cause fatal shock. Extreme precautions must be taken when the filament voltage is measured. These precautions must include safeguards which definitely eliminate all hazards to personnel. The filament transformer, where it is of the iron-core or the air-core type, must be sufficiently insulated.

The voltages employed in some television receivers and other high-voltage equipment may be sufficiently high to cause high-voltage rectifier tubes such as the 1G3GT/1B3GT to produce soft X-rays which can constitute a health hazard unless the tubes are adequately shielded. Relatively simple shielding should prove adequate, but the need for this precaution should be considered.

The dc component must not exceed 22000 volts.



#### HALF-WAVE VACUUM RECTIFIER

Glass octal type used as a rectifier of high-voltage pulses produced in the scanning systems of black-and-white television receivers. Tube requires octal socket and may be mounted in any position. Plate con-

1K3/ 1J3

nection is cap at top of bulb. Socket terminals 1, 3, 4, 5, 6, and 8 may be connected to socket terminal 7 or to a corona shield which is connected to socket terminal 7. Socket terminals 4 and 6 may be used as tie points for components at or near filament potential. Outline 14B, Outlines section. For high-voltage considerations, see type 1G3GT/1B3GT.

Filament Voltage (ac/dc) Filament Current	1.25* 0.2	volts ampere
Direct Interelectrode Capacitance (Approx.): Plate to Filament and Internal Shield	1.6	pF
# Under no circumstances should the filament voltage he less than 1.05	volts or	greater than

 Under no circumstances should the filament voltage be less than 1.05 volts or greater than 1.45 volts.

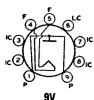
# Pulsed Rectifier For operation in a 525-line, 30-frame system

Peak Inverse Plate Voltage# Peak Plate Current Average Plate Current	50 max 0.5 max	mA mA
CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 7 mA	225	volts
#The duration of the voltage pulse must not exceed 15 per cent of c	ne horizontal	scanning

#The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

• The dc component must not exceed 22000 volts.

MAXIMUM RATINGS (Design-Maximum Values):



#### HALF-WAVE VACUUM RECTIFIER

Miniature type used in high voltage, low-current applications such as the rectifier in high-voltage, pulse-operated voltage-doubling power supplies for kinescopes. The very low power required by the filament permits the

**1V2** 

use of a rectifier transformer having small size and light weight	ht.	
Filament Voltage (ac)	0.625	volt
Filament Current	0.3	ampere
Direct Interelectrode Capacitance:		_
Plate to Filament (Approx.)	0.8	pF
• Under no circumstances should the filament voltage be less than 0.52	5 volt or	greater than
<ul> <li>Under no circumstances should the filament voltage be less than 0.52</li> <li>0.725 volt.</li> </ul>	5 volt or	greater than

#### **Pulsed Rectifier**

The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle.
In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
The dc component must not exceed 7000 volts.

#### Installation and Application

Type 1V2 requires a miniature nine-contact socket and may be mounted in any position. The socket should be made of material having low leakage and should have adequate insulation between its filament and plate terminals to withstand the maximum peak inverse plate voltage. To provide the required insulation in miniature nine-contact sockets designed with a cylindrical center shield, it is necessary to remove the center shield. In addition, socket terminals 2, 3, 7, and 8 shall not be used. Socket terminal 6 may be used as a tie point for components at or near filament potential. Outline 6B, Outlines section.

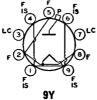
The filament is of the coated type and is designed for operation at 0.625 volt. The filament windings on the pulse transformer should be adjusted to provide the rated voltage under average line-voltage conditions. When the filament voltage is measured, it is recommended that an rms voltmeter of the thermal type be used. The meter and its leads must be insulated to withstand 15000 volts and the stray capacitances to ground should be minimized.

The high voltages at which the 1V2 is operated are very dangerous. Great care should be taken to prevent coming in contact with these high voltages. Particular care against fatal shock should be taken in measuring the filament voltage in those circuits where the filament is not grounded. Precautions must include safeguards which definitely eliminate all hazards to personnel.

#### HALF-WAVE VACUUM RECTIFIER

### 1X2B

Miniature type used in high-voltage, low-current applications such as the rectifier in a high-voltage, rf-operated power supply, or as the rectifier of high-voltage pulses produced in television scanning systems. Outline 7A,



Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Socket terminals 3 and 7 may be used as tie points for components at or near filament potential. For high-voltage considerations, refer to type 1G3GT/1B3GT.

Filament Voltage (ac) Filament Current	1.25° 0.2	volts ampere
Direct Interelectrode Capacitance: Plate to Filament and Internal Shield (Approx.)	1.0	p₽
• Under no circumstances should the filament voltage be less than 1.05 1.45 volts.	volts or	greater than

#### **Pulsed Rectifier**

For operation in a 525-line, 30-frame system MAXIMUM RATINGS (Design-Maximum Values):		
Peak Inverse Plate Voltage Peak Plate Current	22000 max 45 max	volts mA
Average Plate Current	0.5 max	mA
CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 7 mA	100	volts

• The dc component must not exceed 18000 volts.

#### HALF-WAVE VACUUM RECTIFIER

# **2AH2**

Duodecar type used to supply high voltage to the anode of picture tubes in television receivers. Outline 9A, Outlines section. Tube requires 12-contact socket and may be mounted in any position. Socket terminals 2,



12DG

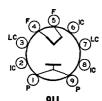
3, 5, 6, 7, 8, 9, and 11 should not be used as tie points; terminals 4 and 10 may

be used as tie points for components at or near cathode potential. For high-voltage and X-ray safety considerations, refer to type 1G3GT/1B3GT. Heater volts (ac/dc), 2.5; amperes, 0.3.

#### **Pulsed Rectifier**

For operation in a 525-line, 30-frame system

MAXIMUM RATINGS (Design-Maximum Values): Peak Inverse Plate Voltage* Peak Plate Current Average Plate Current	30000°max 80 max 1.5 max	volts mA mA
CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 7 mA	100	volts
■ The duration of the voltage pulse must not exceed 15 per cent of one In a 525-line, 30-frame system, 15 per cent of one horizontal scanning • The dc component must not exceed 24000 volts.		



#### HALF-WAVE VACUUM RECTIFIER

Miniature type used in high voltage, low-current rectifier applications such as pulse-operated, focus-rectifier circuits in color television receivers. The filament of the tube can be operated directly across the filament winding

2AV2

of the horizontal-output transformer without a series voltage-dropping resistor. Outline 6B, Outlines section. For installation and application data, see type 1V2.

Filament Voltage (ac) Filament Current Direct Interelectrode Capacitance (Approx.):	1.8 0.225	volts ampere
Plate to Filament	0.8	pF

#### **Pulsed Rectifier**

For operation in a 525-line, 30-frame system

MAXIMUM RATINGS (Design-Maximum Values): Peak Inverse Plate Voltage* Peak Plate Current Average Plate Current	8250** 50 0.6	volts mA mA
CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 1 mA	20	volts

- \* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- \*\* Under no circumstances should this absolute value be exceeded; the dc component must not exceed 7000 volts.



#### HALF-WAVE VACUUM RECTIFIER

Duodecar type used to supply high voltage to the anode of picture tubes in television receivers. Outline 9B, Outlines section. Tube requires duodecar twelve-contact socket and may be

**2AS2** 

terminals 4, 7, and 10 may be used as tie points for components at or near heater potential. For high-voltage and X-ray safety considerations, refer to type 1G3GT/1B3GT. Heater volts (ac/dc), 2.5; amperes, 0.33.

#### **Pulsed Rectifier**

For operation in a 525-line, 30-frame system

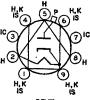
MAXIMUM RATINGS (Design-Maximum Values): Peak Inverse Plate Voltaged Peak Plate Current Average Plate Current	30000*max 80 max 1.5 max	volts mA mA
CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 7 mA	100	volts

□ The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds. • The dc component must not exceed 24000 volts.

#### HALF-WAVE VACUUM RECTIFIER

2BJ2

Miniature type used as a rectifier in high-voltage circuits of transistorized black-and-white television receivers. Outline 7A. Outlines section. Tube requires miniature socket and may be mounted in any position. The base



9RT

pins of the 2BJ2 fit the noval nine-contact socket. Socket terminals 3 and 7 should not be used as tie points for external-circuit connections. For high-voltage and X-ray safety considerations, refer to type 1G3GT/1B3GT. Heater volts (ac/ dc), 2.3; amperes, 0.3.

#### **Pulsed Rectifier**

For operation in a 525-line, 30-trame system

MAXIMUM RATINGS (Design-Maximum Values): Peak Inverse Plate Voltage* Peak Plate Current Average Plate Current	20000 max 80 max 1 max	volts mA mA
CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 7 mA	80	volts

<sup>\*</sup> The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal cycle is 10 microseconds.

3**B**2

#### HALF-WAVE VACUUM RECTIFIER

Glass octal type used as rectifier of high-voltage pulses produced in the scanning systems of color television receivers. Outline 14E, Outlines section. Tube requires octal socket and



may be mounted in any position. **8EZ**Socket terminals 1, 3, 4, 5, 6, and 8 may be connected to socket terminal 7. Socket terminals 4 and 6 may be used as tie points for components at or near heater potential. For high-voltage considerations, see type 1G3GT/1B3GT.

Heater Voltage (ac) Heater Current	3.15* 0.22	volts ampere
Direct Interelectrode Capacitance (Approx.): Plate to Heater, Cathode, and Internal Shield	1.5	pF

<sup>\*</sup> Under no circumstances should the heater voltage be less than 2.65 volts or greater than 3.65 volts.

### Pulsed Rectifier

MAXIMUM RATINGS (Design-Maximum Values):		
Peak Inverse Plate Voltage	30000 max	volts
Peak Plate Current	88 max	mA
Average Plate Current	1.7 max	mA

• The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.



#### HALF-WAVE VACUUM RECTIFIER

Duodecar type used to supply high voltage to the anode of picture tubes in television receivers. Outline 9B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. For high-

**3AT2** 

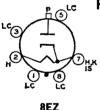
voltage and X-ray safety considerations, refer to type 1G3GT/1B3GT. Heater volts (ac/dc), 3.15; amperes 0.22.

#### Pulsed Rectifier

For operation in a 525-line, 30-frame system

MAXIMUM KATINGS (Design-Maximum Values):		
Peak Inverse Plate Voltage	30000 max	volts
Peak Plate Current	88 max	mA
Average Plate Current	1.7 max	mA

■ The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.



#### HALF-WAVE VACUUM RECTIFIER

Glass octal type used as rectifier of high-voltage pulses produced in the scanning system of television receivers. Outline 14B, Outlines section. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 3.15; amperes, 0.22.

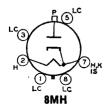
**3AW3** 

#### **Pulsed Rectifier**

For operation in a 525-line, 30-frame system

MAXIMUM RATINGS (Design-Maximum Values):Peak Inverse Plate Voltage\*30000 maxvoltsPeak Plate Current88 maxmAAverage Plate Current1.7 maxmA

\* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.



#### HALF-WAVE VACUUM RECTIFIER

Glass octal type used as a rectifier in high-voltage circuits of color television receivers. Outline 14E, **Outlines** section. Tube requires octal socket and may be mounted in any position. Socket terminals 1, 3, 4, 5, 6, and 8

**3CA3** 

may be connected to terminal 7 or to a corona shield which connects to terminal 7. Socket terminals 4 and 6 may be used as tie points at or near cathode potential.

Heater Voltage (ac) Heater Current	3.6 0.225	volts ampere
Direct Interelectrode Capacitance (Approx.): Plate to Heater, Cathode, and Internal Shield	1.6	pF
Pulsed Rectifier		
For operation in a 525-line, 30-frame system		
MAXIMUM RAŢINGS (Design-Maximum Values): Peak Inverse Plate Voltage* Peak Plate Current Average Plate Current	30000 100 2	volts mA mA
CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 11 mA	100	volts

<sup>\*</sup> The duration of the voltage pulse must not exceed 15 per cent of one scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

#### Installation and Application

The high voltages at which the 3CA3 is operated are very dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential with respect to ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel cannot possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supply when any gate or door on the protective housing is opened, and should prevent the closing of this primary circuit until the door is locked again.

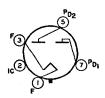
It should be noted that **high voltages** may appear at normally low-potential points in the circuit as a result of capacitor breakdown or incorrect circuit connections. Therefore, before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitor should be grounded.

Operation of the 3CA3 with a plate voltage above approximately 16000 volts (absolute value) results in the production of X-rays which can constitute a health hazard on prolonged exposure at close range unless the tube is adequately shielded. Relatively simple shielding should prove adequate, but the need for this precaution should be considered.

#### FULL-WAVE VACUUM RECTIFIER

**3DG4** 

Glass octal type used as power supply in television receivers and other equipment having high dc requirements. Outline 19E, **Outlines** section. Tube requires octal socket and may be operated in any position. It is espe-



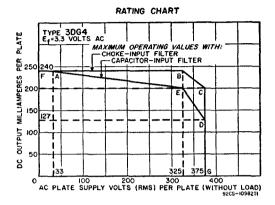
7DK

cially important that this tube, like other power-handling tubes, be adequately ventilated. For discussion of Rating Chart, refer to Interpretation of Tube Data. Filament volts (ac/dc), 3.3; amperes, 3.8.

#### Full-Wave Rectifier

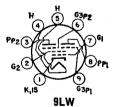
MAXIMUM RATINGS (Design-Maximum Values):		
Peak Inverse Plate Voltage	1050 max	volts
Peak Plate Current (Per Plate)	1.2 max	amperes
Hot-Switching Transient Plate Current (Per Plate)	6.5 max	amperes

AC Plate Supply Voltage (Per Plate, rms)	See Rating	Chart
DC Output Current (Per Plate)	See Rating	Chart
Bulb Temperature (at hottest point on bulb surface)	200 max	°C



TYPICAL OPERATION WITH CAPACITOR INPUT TO FILTER:		
AC Plate-to-Plate Supply Voltage (rms)	550	volts
Filter-Input Capacitor	40	$\mu$ F
Effective Plate-Supply Impedance per Plate	32	ohms
DC Output Voltage at Input to Filter (Approx.):		
At full-load current of 350 mA	300	volts
CHARACTERISTICS:		
Tube Voltage Drop for plate current of 350 mA (per plate)	25	volts

<sup>\*</sup> Higher values of capacitance than indicated may be used, but the effective plate-supply impedance may have to be increased to prevent exceeding the maximum rating for peak plate current.



#### SHARP-CUTOFF TWIN PENTODE

Miniature type used as combined sync separator, sync clipper, and agc amplifier tube in television receivers employing series-connected heater strings. Outline 6E, **Outlines** section. Tube requires miniature nine-contact

**3GS8** 

socket and may be mounted in any position.

Heater Voltage (ac/dc)	3.15	volts
Heater Current	0.6	ampere
Heater Warm-Up Time (Average)	11	seconds
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	200 max	volts
Heater positive with respect to cathode	200°max	volts
Direct Interelectrode Capacitances:		
Grid No.3 to Plate (Each Unit)	2	pF
Grid No.1 to All Other Electrodes	6	рF
Grid No.3 to All Other Electrodes (Each Unit)	3.8	рF
Plate to All Other Electrodes (Each Unit)	3.2	pF
Grid No.3 of Unit No.1 to Grid No.3 of Unit No.2	0.015 max	рF

<sup>\*</sup> The dc component must not exceed 100 volts.

Class A. Amplifier

MAXIMUM RATINGS (Design-Maximum Values):		
Plate Voltage (Each Unit)	300	max volts
Grid-No.3 (Suppressor-Grid) Voltage (Each Unit):		
Peak positive value	50	max volts
DC negative value	50	max volts
DC positive value		max volts
Grid-No.2 (Screen-Grid) Voltage	150	max volts
Grid-No.1 (Control-Grid) Voltage, Negative bias value	–50	
Cathode Current	12	max mA
Grid-No.2 Input		
Plate Dissipation (Each Unit)	1.1	max watts
COTA DA CONTINUOSCO. TIUM. D. M. T. M. O M.		
CHARACTERISTICS: With Both Units Operating		
Plate Voltage (Each Unit)	100	volts
Grid-No.3 Voltage (Each Unit)	0	volts
Grid-No.2 Voltage 67.5	67.5	volts
Grid-No.1 Voltage	•	voits
Plate Current (Each Unit)	2	mA
Grid-No.2 Current	3.6	mĄ
Cathode Current 6.1	7.7	mA
With One Unit Operating.		
Plate Voltage 100	100	volts
Grid-No.3 Voltage 0	0	volts
Grid-No.2 Voltage	67.5	volts
Grid-No.1 Voltage 0	•	volts
Grid-No.3 Transconductance	270	μmhos
Grid-No.1 Transconductance		μmhos
Plate Current	2	mA
Grid-No.3 Voltage (Approx.) for plate current of 100 $\mu$ A.	3.7	volts
Grid-No.1 Voltage (Approx.) for plate current of 100 $\mu A$ .	-2	volts
MAXIMUM CIRCUIT VALUES:		
Grid-No.3-Circuit Resistance (Each Unit)	0.5	max megohm
Grid-No.1-Circuit Resistance		max megohm
WITH TIME ATTACKS TOWNS THE TAKE THE TA		

- Adjusted to give a dc grid-No.1 current of 100 microamperes.
- With plate and grid No.3 of the other unit connected to ground.

#### **DUAL TRIODE**

### **4HC7**

Duodecar type used for sync clipper and agc-amplifier service in television receivers. Outline 30E, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac//dc),



12FR

4.2; amperes, 0.6; warm-up time, 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

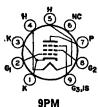
#### Class A<sub>1</sub> Amplifier

MAXIMUM RATINGS (Design-Maximum Values):	Unit No.1	Unit No.2	
Plate Voltage	330 max	330 max	volts
Grid Voltage:	_	_	
Positive-bias value	0	0	
Negative-bias value	—100 max	100 max	volts
Peak Positive-Pulse Grid Voltage	60 max	_	volts
Plate Dissipation	3 max	1.2 max	watts
CHARACTERISTICS:			•
Plate Voltage	150	150	volts
Grid Voltage	-1	-1	volt
Amplification Factor	23	100	
Plate Resistance (Approx.)	5200	53000	ohms
Transconductance	4400	1900	μmhos
Plate Current	18	1	mA
Grid Voltage (Approx.) for plate current of 10 "A	-13	-2.2	volts

#### MAXIMUM CIRCUIT VALUE:

MAXIMUM RATINGS (Design-Maximum Values):

\*\* An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



#### SEMIREMOTE-CUTOFF PENTODE

Miniature type with frame grid used in the if-amplifier stages of television receivers employing series-connected heater strings. Outline 6B, **Outlines** section. Tube requires miniature ninecontact socket and may be mounted

**4HT6** 

in any position. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

#### Class A, Amplifier

Plate Voltage	250 max	volts
Grid-No.2 (Screen-Grid) Supply Voltage	250 max	volts
Grid-No.2 Voltage	See cur	ve page 80
Grid-No.1 (Control-Grid) Voltage, Negative-bias value	-50 max	volts
Cathode Current	25 max	mA
Plate Dissipation	2.5 max	watts
Grid-No.2 Input:		
For grid-No.2 voltages up to 125 volts	0.6 max	watt
For grid-No. 2 voltages between 125 and 250 volts	See cur	ve page 80
CHARACTERISTICS:		
Plate Supply Voltage	125	volts
Grid No.3 (Suppressor Grid) Connected		
Grid-No.2 Supply Voltage	125	volts
Cathode-Bias Resistor	56	ohms
Plate Resistance (Approx.)	0.143	megohm
Transconductance	14000	umhos
Plate Current	15	mA
Grid-No.2 Current	4	mA
Grid-No.1 Voltage (Approx.) for transconductance of 100 µmhos	<b>4.5</b>	volts
MAXIMUM CIRCUIT VALUES:		
Grid-No.1-Circuit Resistance:		
For fixed-bias operation	0.25 max	megohm
For cathode-bias operation	1 max	megohm



#### **FULL-WAVE VACUUM RECTIFIER**

Glass octal type used as power supply in television receiver and other equipment having high dc requirements. Outline 13F, Outlines Section. Tube requires octal socket and may be mounted in any position. It is espe-

5AR4/ GZ34

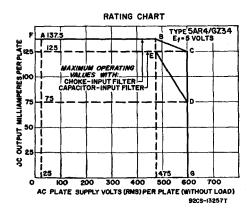
cially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 5; amperes, 1.9.

#### Full-Wave Rectifier

MAXIMUM RATINGS (Design-Maximum Values):		
Peak Inverse Plate Voltage	1700 max	volts
Peak Plate Current (per plate)	825 max	mA
Hot-Switching Transient Plate Current (per plate)	3.7 max	amperes
AC Plate-Supply Voltage (per plate, rms, without load)	See Rati	ing Chart
DC Output Current (per plate)	See Rati	ing Chart

TYPICAL	OPE	RATION	WITH	CAPACITOR
INPUT	OT	FILTER	•	

AC Plate-to-Plate Supply Voltage (rms)  Effective Plate-Supply Impedance per Plate  DC Output Current  DC Output Voltage at Input to Filter	450	550	volts
	160	200	ohms
	225	160	mA
	475	620	volts
TYPICAL OPERATION WITH CHOKE INPUT TO FILTER:			
AC Plate-to-Plate Supply Voltage (rms)  Filter Input Choke  DC Output Current  DC Output Voltage at Input to Filter	450	550	volts
	10	10	henries
	250	225	mA
	375	465	volts
CHARACTERISTICS, Instantaneous Value:  Tube Voltage Drop for plate current of 225 mA  (per plate)	_	17	volts



#### **FULL-WAVE VACUUM RECTIFIER**

# 5AS4A

Glass octal type used in power supply of television receivers having high dc requirements. Outline 19D, **Outlines** section. This type may be supplied with pins 3, 5, and 7 omitted. Tube requires octal socket. Vertical mount-



5T

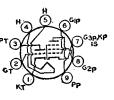
ing is preferred, but horizontal mounting is permissible if pins 1 and 4 are in vertical plane. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac), 5.0; amperes, 3.0. For maximum ratings, typical operation, and curves, refer to type 5U4GB.

#### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

**5AV8** 

Miniature type used in a wide variety of applications in television receivers employing series-connected heater strings. Outline 6B, Outlines section.

Tube requires miniature nine-contact socket and may be mounted in any position.



9DZ

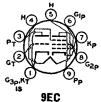
Heater Voltage (ac/dc)	4.7	volts
Heater Current	0.6	ampere
Heater Warm-Up Time (Average)	11	seconds
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	200 max	volts
Heater positive with respect to cathode	200°max	volts
Direct Interelectrode Capacitances:		
Triode Unit:		
Grid to Plate	1.5	pF
Grid to Cathode and Heater	2	pF
Plate to Cathode and Heater	0.34	pF
Pentode Unit:		•
Grid No.1 to Plate	0.04 max	рF
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and		•
Internal Shield	7	pF
Plate to Cathode, Heater, Grid No.2, Grid No.3, and		•
Internal Shield	3	pF
Triode Grid to Pentode Plate	0.005	ρF
Pentode Grid No.1 to Triode Plate	0.006	ρF
Pentode Plate to Triode Plate	0.045	pF
***************************************		F-

<sup>°</sup> The dc component must not exceed 100 volts.

Class A<sub>1</sub> Amplifier

Class At Amplifici			
MAXIMUM RATINGS (Design-Center Values):	Triode Unit		
Plate Voltage	300 max	300 max	volts
Grid No.2 Supply Voltage		300 max	volts
Grid-No.2 (Screen-Grid) Voltage			ve page 80
Grid-No.1 (Control-Grid) Voltage, Positive-bias value	0 max	0 max	volts
Plate Dissipation	2.5 max	2 max	watts
For grid-No.2 voltages up to 150 volts		0.5 max	watt
For grid-No.2 voltages between 150 and 300 volts	_		ve page 80
CHARACTERISTICS:			
Plate Supply Voltage	200	200	volts
Grid-No.2 Supply Voltage	_	150	volts
Grid-No.1 Voltage	6		volts
Cathode-Bias Resistor		180	ohms
Amplification Factor	19		ohms
Plate Resistance (Approx.)	5750	300000	ohms
Transconductance	3300	6200	µmhos
Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A.			
	-19	-8	volts
Plate Current	13	9.5	mĄ
Grid-No.2 Current		2.8	mA
Grid-No.1-Circuit Resistance:*			
For fixed-bias operation	0.5 max	0.25 max	megohm
For cathode-bias operation	1.0 max	1.0 max	megohm

<sup>\*</sup> If either unit is operating at maximum rated conditions, grid-No.1-circuit resistance for both units should not exceed the stated values,



#### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used as combined vhf oscillator and mixer in television receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature ninecontact socket and may be mounted

**5B8** 

in any position. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average) 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

#### Class A<sub>1</sub> Amplifier

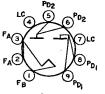
MAXIMUM RATINGS (Design-Center Values): Plate Voltage Grid No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 volts	Triode Unit 300 max 0 max 2.5 max	0 max 2 max 0.5 max	volts volts ve page 80 volts watts  watt e page 80
CHARACTERISTICS:			
Plate Supply Voltage Grid-No.2 Supply Voltage Grid Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 10 µA	200 	200 150 — 180 — 300000 6200 9.5 2.8 —8	volts volts volts ohms ohms µmhos mA wolts
MAXIMUM CIRCUIT VALUES:			
Grid-No.1-Circuit Resistance*: For fixed-bias operation For cathode-bias operation	0.5 max 1.0 max		megohm

\* If either unit is operated at maximum rated conditions, grid-No.1-circuit resistance for both units should not exceed the stated values.

#### **FULL-WAVE VACUUM RECTIFIER**

# 5BC3A

Novar types used in power supplies of radio equipment and television receivers having high dc requirements. Outlines 17C and 31C, respectively, Outlines section. Tubes require novar nine-contact socket. Vertical operation



9QJ

is preferred, but tubes may be operated in horizontal position if pins 2 and 7 are in vertical plane. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. Filament volts (ac), 5; amperes, 3.

#### **Full-Wave Rectifier**

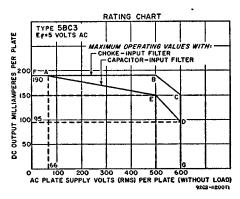
MAXIMUM RATINGS (Design-Maximum Value				
Peak Inverse Plate Voltage			1700 max	volts
Peak Plate Current (Per Plate)			1 max	ampere
Hot-Switching Transient Plate Current (Per Plate	e)°		5 max	amperes
AC Plate-Supply Voltage (Per Plate, rms)			See Ra	ting Chart
DC Output Current (Per Plate)			See Ra	ting Chart
TYPICAL OPERATION WITH CAPACITOR INPUT TO FILTER:			•	
AC Plate-to-Plate Supply Voltage (rms)	600	900	1100	volts
Filter-Input Capacitor	40	40	40	$\mu$ F
Total Effective Plate-Supply Impedance per				•
Plate	21	67	97	ohms
DC Output Voltage at Input to Filter (Approx.):				
At load current of: 300 mA	290	_	_	volts
275 mA		460	_	volts
162 mA		_	630	volts
150 mA	335	_	_	volts
137.5 mA		520		volts
81 mA			680	volts

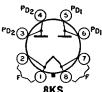
# TYPICAL OPERATION WITH CHOKE INPUT TO FILTER:

AC Plate-to-Plate Supply Voltage (rms)	900	1100	volts
Filter-Input Choke	10	10	henries
DC Output Voltage at Input to Filter (Approx.):			
At load current of: 348 mA	340		volts
275 mA	_	440	volts
174 mA	355	_	volts
137.5 mA	_	455	volts

<sup>If hot switching is regularly required in operation, the use of choke-input circuits is recommended. Such circuits limit the hot-switching current to a value no higher than that of the peak plate current. When capacitor-input circuits are used, a maximum peak current value per plate of 5 amperes during the initial cycles of the hot-switching transient should not be exceeded.
Higher values of capacitance than indicated may be used, but the effective plate-supply</sup> 

• Higher values of capacitance than indicated may be used, but the effective plate-supply impedance may have to be increased to prevent exceeding the maximum rating for peak plate current.





# **FULL-WAVE VACUUM RECTIFIER**

Glass octal type used in power supply of radio and television receivers having high dc requirements. Outline 19E, Outlines section. Tube requires octal socket; operation in vertical position is preferred, but horizontal oper-

**5DJ4** 

ation is permissible if pins 2 and 4 are in vertical plane. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Filament volts (ac/dc), 5; amperes, 3.

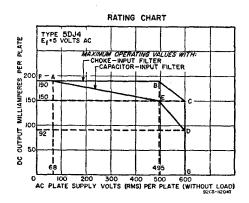
#### Full-Wave Rectifier

MAXIMUM RATINGS (Design-Maximum Values):	
Peak Inverse Plate Voltage	1700 max volts
Peak Plate Current (Per Plate)	1 max ampere
Hot-Switching Transient Plate Current (Per Plate)	5 max amperes
AC Plate-Supply Voltage (Per Plate, rms, without load)	See Rating Chart
DC Output Current (Per Plate)	See Rating Chart
TYPICAL OPERATION:	

TYPICAL OPERATION: Filter Input	Capa	citor	Choke	
AC Plate-to-Plate Supply Voltage (rms, without load)	600	900	1100	volts
Filter-Input Capacitor	40	40		$\mu$ F
Filter-Input Choke	-		10	henries

Effective Plate-Supply Impedance per Plate	21	67	-	ohms
DC Output Voltage at Input to Filter (Approx.)	290	460	420	volts
DC Output Current	300	275	275	mA

 $\bullet$  When capacitor values greater than 40  $\mu$ F are used, the effective plate-supply impedance should be increased so that the maximum rating for peak plate current is not exceeded.



# **DUAL TRIODE**

5HA7
Related type:
4HA7

Duodecar type used as a sync clipper and agc amplier in television receiv- $\kappa_{72}(3)$  ers employing series-connected heater strings. Outline 8A, Outlines Section. Tube requires duodecar twelve-contact socket and may be mounted in

volts

any position. Type 4HA7 is identical with type 5HA7 except for the heater ratings, as shown below.

Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average)	4HA7 4.2 0.6 11	5AH7 5.6 0.45 11	volts ampere seconds
Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode	200	200	volts
	200∎	200■	volts

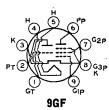
■ The dc component must not exceed 100 volts.

Grid Voltage (Approx.) for plate current of 10 µA ...

Class A<sub>1</sub> Amplifier

MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage	Unit No. 1 330 max	Unit No. 2 330 max	volts
Grid Voltage: Positive-bias value Negative-bias value Plate Dissipation Cathode Current	0 —50 max 2.75 max 20 max	0 50 max 0.3 max	volts volts watts mA
CHARACTERISTICS:			
Plate Voltage	250	250	volts
Grid Voltage	8.5 17	2.0 100	volts
Amplification Factor Plate Resistance (Approx.)	7700	62500	ohms
Transconductance	2200	1600	μmhos mA
Plate Current	10.5	1.2	11173

-24



# MEDIUM-MU TRIODE .... SHARP-CUTOFF PENTODE

Miniature type used as combined vhf oscillator and mixer in television receivers employing series-connected heater strings. Outline 6B, Outlines Section. Tube requires miniature ninecontact socket and may be mounted

**5LJ8** 

117	2 12 17	position.
111	аич	DOSILIOII.

Heater Voltage (ac/dc)	5.6	volts
Heater Current	0.45	ampere
Heater Warm-up Time (Average)	11	seconds
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	200 max	volts
Heater positive with respect to cathode	200*max	voits
Direct Interelectrode Capacitance:		
Triode Unit:		
Grid to Plate	1.4	pF
Grid to Cathode, Heater, Pentode Grid No.3, and		
Internal Shield	2.4	pF
Plate to Cathode, Heater, Pentode Grid No.3, and		_
Internal Shield	2.0	pF
Pentode Unit:		_
Grid No.1 to Plate	0.015 max	pF
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and		_
Internal Shield	5.5	рF
Plate to Cathode, Heater, Grid No.2, Grid No.3, and		_
Internal Shield	3.4	рF
* The dc component must not exceed 100 volts.		

A With external shield connected to cathode.

Class A <sub>1</sub> Amplifier			
MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage	Triode Unit 280 max	Pentode Uni 280 max 280 max See curv	it volts volts ve page 80
Grid-No.1 (Control-Grid) Voltage, Positive-bias Value Plate Dissipation Grid-No.2 Input Cathode Current	0 max 2 max — 20 max	0 max 2 max 0.5 max 20 max	volts watts watt mA
CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) Transconductance	125  0 68 40 5000 8000	125 125 0 33 	volts volts volts ohms ohms μmhos
Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 30 µA	13 —6.5	12 3.5 —4	mA mA volts
MAXIMUM CIRCUIT VALUES: Grid-No. 1-Circuit Resistance: For fixed-bias operation For cathode-bias operation	1.0 max 0.5 max	0.5 max 0.25 max	megohm megohm



# **FULL-WAVE VACUUM RECTIFIER**

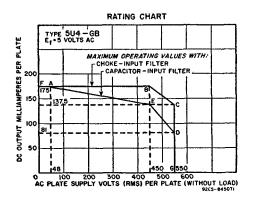
Glass octal type used in power supplies of radio and television receivers having high dc requirements. Outline 19E, Outlines section. Tube requires octal socket. This type may be supplied with pins 3, 5, and 7 omitted.

5U4GB

Vertical mounting is preferred but horizontal mounting is permissible if pins 1 and 4 are in vertical plane. The coated filament is designed to operate from the ac line through a step-down transformer. The voltage at the filament terminals should be 5.0 volts at an average line voltage of 117 volts. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. For discussion of Rating Chart and Operation Characteristics, refer to Interpretation of Tube Data. Filament volts (ac), 5; amperes, 3.

#### **Full-Wave Rectifier**

MAXIMUM RATINGS (Design-Center Values):	
Peak Inverse Plate Voltage	1550 max volts
Peak Plate Current (Per Plate)	1.0 max ampere
Hot-Switching Transient Plate Current (Per Plate)	#
AC Plate Supply Voltage (Per Plate, rms)	See Rating Chart
DC Output Current (Per Plate)	See Rating Chart



TYPICAL OPERATION	WITH	CAPACITOR
INPUT TO FILTER: AC Plate-to-Plate Supply Filter-Input Capacitor*	Voltage	(rms)

AC Plate-to-Plate Supply	Voltage (rms)	600	900	1100	volts
Filter-Input Capacitor*	******	40	40	40	$\mu$ F
Total Effective Plate-Supply	Impedance per Plate	21	67	97	ohms
DC Output Voltage at Inpu	at to Filter (Approx.):				
	150 mA	335	_		volts
At half-load current of			520	_	volts
	81 mA	_		680	volts
	( 300 mA	290			volts
At full-load current of	275 mA	_	460		volts
	162 mA	_	_	630	volts
Voltage Regulation (Appr	ox.):				
Half-load to full-load	current	45	60	50	volts

---

~~~

4400

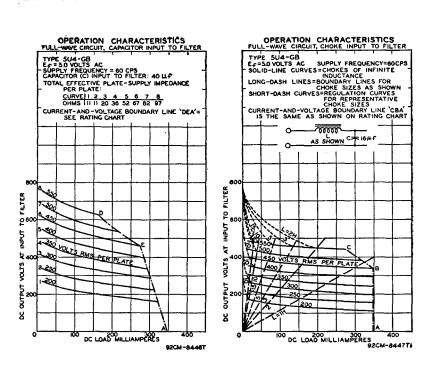
# TYPICAL OPERATION WITH CHOKE INPUT TO FILTER:

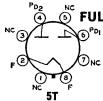
| TO FILTER:  AC Plate-to-Plate Supply V Filter-Input Choke  DC Output Voltage at Inpu |        | 900<br>10 | 1100<br>10 | volts<br>henries |
|--------------------------------------------------------------------------------------|--------|-----------|------------|------------------|
| At half-load current of                                                              | 174 mA | 355       | <br>455    | volts<br>volts   |

<sup>#</sup> If hot switching is regularly required in operation, the use of choke-input circuits is recommended. Such circuits limit the hot-switching current to a value no higher than that of the peak plate current. When capacitor-input circuits are used, a maximum peak current value per plate of 4.6 amperes during the initial cycles of the hot-switching transient should not be exceeded.

<sup>\*</sup> Higher values of capacitance than indicated may be used, but the effective plate-supply impedance may have to be increased to prevent exceeding the maximum rating for peak plate current.

| At full-load current of { 348 mA                              | 340 | 440 | volts<br>volts |
|---------------------------------------------------------------|-----|-----|----------------|
| Voltage Regulation (Approx.):  Half-load to full-load current | 15  | 15  | volts          |





# **FULL-WAVE VACUUM RECTIFIER**

Glass octal type used as power supply in color television receivers and other equipment having high dc requirements. Outline 19E, Outlines section.

Tube requires octal socket. Vertical mounting is preferred, but horizontal

5V3A

mounting is permissible if pins 2 and 4 are in vertical plane. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. For discussion of Rating Chart, refer to Interpretation of Tube Data. Filament volts (ac/dc), 5; amperes, 3.

#### **Full-Wave Rectifier**

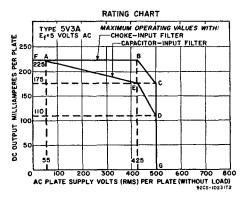
| MAXIMUM RATINGS (Design-Maximum Values):               |          |         |
|--------------------------------------------------------|----------|---------|
| Peak Inverse Plate Voltage                             | 1550 max | volts   |
| Peak Plate Current (Per Plate)                         | 1.4 max  | amperes |
| Hot-Switching Transient Plate Current (Per Plate)      | 6.6 max  | amperes |
| AC Plate-Supply Voltage (Per Plate, rms, without load) | 550 max  | volts   |
| DC Output Current (Per Plate)                          | 415°max  | mA      |

<sup>•</sup> With capacitor-input filter for ac plate-supply volts (rms, per plate, without load) = 470.

#### TYPICAL OPERATION:

| Filter Input                                            | Capacitor | Choke |         |
|---------------------------------------------------------|-----------|-------|---------|
| AC Plate-to-Plate Supply Voltage (rms)                  | 850       | 1000  | volts   |
| Filter-Input Capacitors                                 | 40        | _     | $\mu$ F |
| Effective Plate-Supply Impedance per Plate              | 50        | -     | ohms    |
| Minimum Filter-Input Choke                              | _         | 10    | henries |
| DC Output Current                                       | 350       | 350   | mA      |
| DC Output at Input to Filter (Approx.)                  | 440       | 390   | volts   |
| CHARACTERISTICS:                                        |           |       |         |
| Tube Voltage Drop for plate current of 350 mA (per plat | te)       | 42    | volts   |

 $\blacksquare$  When capacitor values greater than 40  $\mu F$  are used, the effective plate-supply impedance should be increased so that the maximum rating for peak plate current is not exceeded.



# **FULL-WAVE VACUUM RECTIFIER**

# 5V4G 5V4GA

Glass octal types used in full-wave power supplies having high dc requirements. Outlines 25 and 19B, respectively, **Outlines** section. Tubes require octal socket and may be mounted in any position. The heater is designed



5L

410

volte

410

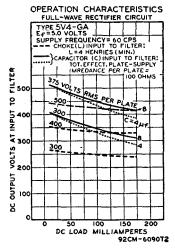
to operate from the ac line through a step-down transformer. The voltage at the heater terminals should be 5.0 volts under operating conditions at an average line voltage of 117 volts. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 5; amperes, 2.

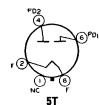
#### **Full-Wave Rectifier**

| MAXIMUM RATINGS (Design-Center Values): Peak Inverse Plate Voltage |           | 1400 max | volts   |
|--------------------------------------------------------------------|-----------|----------|---------|
| AC Plate-Supply Voltage (Per Plate, rms):                          |           |          | •.      |
| With capacitor-input filter                                        |           | 375 max  | volts   |
| With choke-input filter                                            |           | 500 max  | volts   |
| Peak Plate Current (Per Plate)                                     |           | 525 max  | mA      |
| DC Output Current                                                  |           | 175 max  | mA      |
| TYPICAL OPERATION:                                                 |           |          |         |
| Filter Input                                                       | Capacitor | Choke    |         |
| AC Plate-to-Plate Supply Voltage (rms)                             | 750       | 1000     | volts   |
| Filter-Input Capacitor*                                            | 10        |          | $\mu$ F |
| Total Effective Plate-Supply Impedance per Plate                   | 100       |          | ohms    |
| Filter-Input Choke                                                 |           | 4        | henries |
| DC Output Voltage at Input to Filter (Approx.) for dc              |           |          |         |

output current of 175 mA ......

\* Higher values of capacitance than indicated may be used, but the effective plate-supply impedance may have to be increased to prevent exceeding the maximum rating for peak plate current.





# **FULL-WAVE VACUUM RECTIFIER**

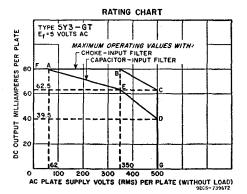
Glass octal type used in power supply of radio equipment having moderate dc requirements. Outline 13E, Outlines section. Tube requires octal socket. Vertical mounting is preferred, but horizontal mounting is permis-

**5Y3GT** 

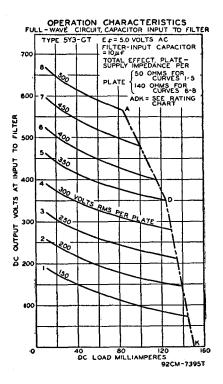
5T but horizontal mounting is permissible if pins 2 and 8 are in horizontal plane. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. For discussion of Rating Chart and Operating Characteristics, refer to Interpretation of Tube Data. Filament volts (ac), 5; amperes, 2.

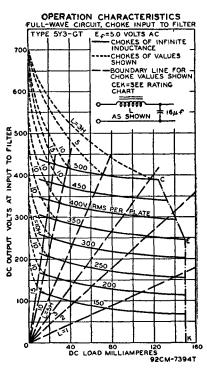
#### **Full-Wave Rectifier**

| MAXIMUM RATINGS (Design-Center Values): |          |       |
|-----------------------------------------|----------|-------|
| Peak Inverse Plate Voltage              | 1400 max | volts |
| Peak Plate Current (Per Plate)          | 440 max  | mA    |



| Hot-Switching Transient Plate Current (Per Plate) AC Plate Supply Voltage (Per Plate, rms) DC Output Current (Per Plate) |     | See Ra | amperes<br>ting Chart<br>ting Chart |
|--------------------------------------------------------------------------------------------------------------------------|-----|--------|-------------------------------------|
| TYPICAL OPERATION WITH CAPACITOR INPUT TO FILTER:                                                                        |     |        |                                     |
| AC Plate-to-Plate Supply Voltage (rms)                                                                                   | 700 | 1000   | volts                               |
| Filter Input Capacitor*                                                                                                  | 20  | 10     | $\mu$ F                             |
| Effective Plate-Supply Impedance per Plate                                                                               | 50  | 140    | ohms                                |
| DC Output Voltage at Input to Filter (Approx.):                                                                          |     |        |                                     |
| At half-load current of 62.5 mA                                                                                          | 390 |        | volts                               |
| At half-load current of \ 42 mA                                                                                          |     | 610    | volts                               |
|                                                                                                                          | 360 | _      | volts                               |
| At full-load current of { 125 mA                                                                                         |     | 560    | volts                               |
| Voltage Regulation (Approx.):                                                                                            |     |        |                                     |
| Half-load to full-load current                                                                                           | 40  | 50     | volts                               |





# TYPICAL OPERATION WITH CHOKE INPUT TO FILTER:

| AC Plate-to-Plate Supply Voltage (rms)               | 700 | 1000             | Volts   |
|------------------------------------------------------|-----|------------------|---------|
| Filter Input Choke#                                  | 10  | 10               | henries |
| DC Output Voltage at Input to Filter (Approx.):      |     |                  | _       |
| At half-load current of<br>{ 75 mA                   | 270 | _                | volts   |
| At hair-load current of 62.5 mA                      | _   | 405              | volts   |
| AA 6-11 land assessed of ( 150 mA                    | 245 |                  | volts   |
| At full-load current of { 150 mA                     |     | 380              | volts   |
| Voltage Regulation (Approx.): Half-load to full-load |     |                  |         |
| current                                              | 25  | 15               | volts   |
| Voltage Regulation (Approx.): Half-load to full-load | 25  | 380<br><b>15</b> |         |

- \* Higher values of capacitance than indicated may be used but the effective plate supply impedance may have to be increased to prevent exceeding the maximum rating for hot-switching transient plate current.
- #This value is adequate to maintain optimum regulation in the region to the right of line L=10H on curve OPERATION CHARACTERISTICS with Choke Input to Filter, provided the load currents are not less than 35 mA, and 50 mA, respectively, for Plate-to-Plate supply voltages of 700 and 1000 volts (rms).



## HIGH-MU TRIODE

Miniature type used as cathode-drive amplifier, frequency converter, or oscillator at frequencies up to about 300 megacycles per second, particularly in television and FM receivers. Outline 5C, Outlines section. Tube re-

**6AB4** 

5CE

quires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.15. For maximum ratings, characteristics, and curves, refer to type 12AT7.



# HALF-WAVE VACUUM RECTIFIER

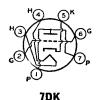
Miniature type used as a damper tube in horizontal deflection circuits of television receivers. Outline 7C, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Socket ter-

6AF3
Related type:
12AF3

minals 1, 2, 3, 6, 7, and 8 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Type 12AF3 is identical with type 6AF3 except for heater ratings, as shown below.

| Heater Voltage (ac/dc)                   | 6.3         | 12.6     | volts   |
|------------------------------------------|-------------|----------|---------|
| Heater Current                           | 1.2         | 0.6      | amperes |
| Heater Warm-up Time (Average)            |             | 11       | seconds |
| Damper Service                           |             |          |         |
| For operation in a 525-line, 30-f        | rame system |          |         |
| MAXIMUM RATINGS (Design-Maximum Values): |             |          |         |
| Peak Inverse Plate Voltage†              |             | 4500 max | volts   |
| Peak Plate Current                       |             | 750 max  | mA      |
| Average Plate Current                    |             | 185 max  | mA      |
| Bulb Temperature (At hottest point)      |             | 210 max  | °C      |
| Peak Heater-Cathode Voltage:             |             |          |         |
| Heater negative with respect to cathode  |             | 4500°max | volts   |
| Heater positive with respect to cathode  |             | 300△max  | volts   |
|                                          |             |          |         |

- † The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- The dc component must not exceed 1000 volts.
- A The dc component must not exceed 100 volts.



# MEDIUM-MU TRIODE

Miniature types used as local oscillators in uhf television receivers covering the frequency range of 470 to 890 megacycles per second. Outlines SC and 5B, respectively, **Outlines** section. Tubes require miniature seven-

6AF4A
6AF4A
Related types:
2AF4B, 3AF4A

contact socket and may be mounted in any position. Types 2AF4B and 3AF4A are identical with type 6AF4A except for heater and heater-cathode ratings, as shown below.

|                                           |        |       | 6AF4   |         |
|-------------------------------------------|--------|-------|--------|---------|
|                                           | 2AF4B  | 3AF4A | 6AF4A  |         |
| Heater Voltage (ac/dc)                    | . 2.35 | 3.15  | 6.3    | volts   |
| Heater Current                            |        | 0.45  | 0.225  | ampere  |
| Heater Warm-up Time (Average)             | . 11   | 11    | _      | seconds |
| Peak Heater-Cathode Voltage:              |        |       |        |         |
| Heater negative with respect to cathode.  | . 180  | 50    | 50 max | volts   |
| Heater positive with respect to cathode . | . 180* | 50₄   | 50₄max | volts   |
| Direct Interelectrode Capacitances:       |        |       |        |         |
| Grid to Plate                             |        |       | 1.9    | ρF      |
| Grid to Cathode and Heater                |        |       | 2.2    | pF      |
| Plate to Cathode and Heater               |        |       | 1.4    | pF      |
| Heater to Cathode*                        |        |       | 2.2    | pF      |
| - 70h - J                                 |        |       |        | -       |

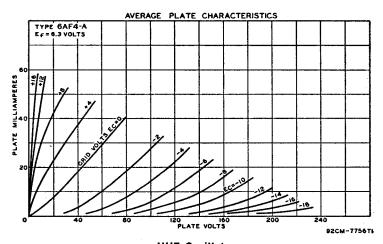
- The dc component must not exceed 100 volts.
- △ The dc component must not exceed 25 volts.
- · With external shield connected to cathode, except as noted,

\* With external shield connected to plate.

Plate Current

## Class A, Amplifier

| CHARACTERISTICS:           |      |       |
|----------------------------|------|-------|
| Plate Supply Voltage       | 80   | volts |
| Cathode-Bias Resistor      | 150  | ohms  |
| Amplification Factor       | 13.5 |       |
| Plate Resistance (Approx.) | 2100 | ohms  |
| Transconductance           | 6500 | μmhos |
| Plate Current              | 17.5 | mA    |



## **UHF** Oscillator

| MAXIMUM RATINGS (Design-Maximum Values):      |         |       |
|-----------------------------------------------|---------|-------|
| Plate Voltage                                 | 150 max | volts |
| Grid Voltage, Negative-bias value             | -50 max | volts |
| Grid Current                                  |         | mA    |
| Plate Dissipation                             |         | watts |
| DC Cathode Current                            |         | mA    |
| TYPICAL OPERATION AS OSCILLATOR AT 1000 Mc/s: |         |       |
| Plate Supply Voltage                          | 100     | volts |
| Plate Resistor                                | 220     | ohms  |
| Grid Resistor                                 | 10000   | ohms  |

Grid Current (Approx.)

17

750

mA

μΑ

#### **MAXIMUM CIRCUIT VALUES:**

Grid-Circuit Resistance:
For fixed-bias operation

For fixed-bias operation

For cathode-bias operation

Not recommended
0.5 max megohm



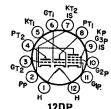
## **ELECTRON-RAY TUBE**

Glass octal type used to indicate visually, by means of two shadows on the fluorescent target, the effects of changes in the controlling voltages. It is a twin-indicator type and is used as a convenient means of indicating

6AF6G

7AG

accurate radio-receiver tuning. This type may be supplied with pin No.1 omitted. Tube requires octal socket. Heater volts (ac/dc), 6.3; amperes, 0.15. Maximum ratings in indicator service; fluorescent-target volts, 250 max, 125 min; ray-control-electrode supply volts, 250 max; peak heater-cathode volts, 90 max. Typical operation: fluorescent-target volts, 250; fluorescent-target mA, 3.75; ray-contact-electrode volts (approx. for 0° shadow angle), 155; ray-control-electrode volts (approx. for 100° shadow angle), 0.



# DUAL TRIODE— SHARP-CUTOFF PENTODE

Duodecar type used in a variety of applications in television receivers. The high-mu triode unit is used for agc keyer service, the medium-mu triode unit for sync separator service, and the pentode unit for video am-

6AF11
Related type:
15AF11

plifier service. Outline 8C, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 15AF11 is identical with type 6AF11 except for heater ratings, as shown below.

|                                               |            | 6AF11      | 15AF11   |           |
|-----------------------------------------------|------------|------------|----------|-----------|
| Heater Voltage (ac/dc)                        |            | 6.3        | 14.7     | volts     |
| Heater Current                                |            | 1.05       | 0.45     | amperes   |
| Heater Warm-up Time (Average)                 |            |            | 11       | seconds   |
| Peak Heater-Cathode Voltage:                  |            |            |          |           |
| Heater negative with respect to cathode       |            | 200 max    | 200 max  | volts     |
| Heater positive with respect to cathode       |            | 200 max    | 200 max  | volts     |
| •                                             |            | 200 max    | 200 Mun  | 70.00     |
| • The dc component must not exceed 100 volts. |            |            |          |           |
| Class A <sub>1</sub>                          | Amplifier  |            |          |           |
|                                               | Triode     | Triode     | Pentode  |           |
| MAXIMUM RATINGS                               | Unit No. 1 | Unit No. 2 | Unit     |           |
| (Design-Maximum Values):                      |            | •          |          |           |
| Plate Voltage                                 | _          | _          | 330 max  | volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage        | 330 max    | 330 max    | 330 max  | volts     |
| Grid-No.2 Voltage                             | DOO MAN    | 000 111411 |          | e page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-   |            |            |          | r page or |
| bias value                                    | 0 max      | 0 max      | 0 max    | volts     |
| Plate Dissipation                             | 1.1 max    |            | 5 max    | watts     |
| Grid-No.2 Input:                              | 1.1 11147  |            | •        |           |
| For grid-No.2 voltages up to 165 volts        |            |            | 1.25 max | watts     |
| For grid-No.2 voltages between 165 and 330    |            |            | 1.25 man | Wittes    |
| volts                                         |            |            | See cur  | e page 80 |
|                                               |            |            | Dec cur  | e page oo |
| CHARACTERISTICS:                              |            |            |          |           |
| Plate Supply Voltage                          | 200        | 200        | 250      | volts     |
| Grid-No.2 Supply Voltage                      | _          | _          | 150      | volts     |
| Grid-No.1 Voltage                             | 2          |            | -        | volts     |
| Cathode-Bias Resistor                         |            | 220        | 100      | ohms      |
| Amplification Factor                          | 68         | 41         |          |           |
| Plate Resistance (Approx.)                    | 12400      | 9400       | 68000    | ohms      |
|                                               |            |            |          |           |

| Transconductance                              |           | 4400      | 11000    | μmhos  |
|-----------------------------------------------|-----------|-----------|----------|--------|
| Plate Current                                 | 7         | 9.2       | 24       | mA     |
| Grid-No.2 Current                             |           | -         | 4.8      | mA.    |
| Grid-No.1 Voltage (Approx.) for plate current |           |           |          |        |
| of 100 μA                                     |           | -6.5      | -10      | volts  |
|                                               | Triode    | Triode    | Pentode  |        |
| MAXIMUM CIRCUIT VALUES:                       | Unit No.1 | Unit No.2 | Unit     |        |
| Grid-No.1-Circuit Resistance:                 | _         |           |          |        |
| For fixed-bias operation                      | 0.5 ma    | x 0.5 max | 0.25 max | megohm |
| For cathode-bias operation                    |           |           | 1 max    | megohm |

## SHARP-CUTOFF PENTODE

6AG5

Miniature type used in compact radio equipment as an rf or if amplifier up to 400 megacycles per second. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.



7BD

Heater volts (ac/dc), 6.3; amperes, 0.3. For typical operation as a resistancecoupled amplifier, refer to Resistance-Coupled Amplifier section.

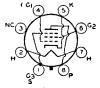
# Class A<sub>1</sub> Amplifier

| MAXIMUM RATINGS (Design-Center Values):                |       | Triode<br>nnection |           | Pento<br>Connec                         |           |         |
|--------------------------------------------------------|-------|--------------------|-----------|-----------------------------------------|-----------|---------|
| Plate Voltage                                          | 3     | 00 max             | ĸ         | 300 m                                   | ax        | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                 |       | _                  |           | 300 n                                   | nax       | volts   |
| Grid-No.2 Voltage                                      |       | _                  |           | See                                     | curve     | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value. |       | 0 ma               | ĸ         | 0 n                                     |           | volts   |
| Plate Dissipation                                      | :     | 2.5 ma             |           | 2 n                                     | nax       | watts   |
| Grid-No.2 Input:                                       |       |                    |           |                                         |           |         |
| For grid-No.2 voltages up to 150 volts                 |       | _                  |           | 0.5 n                                   | 1ax       | watt    |
| For grid-No.2 voltages between 150 and 300 volts.      |       |                    |           | See                                     | curve     | page 80 |
| ari Briariosa i briagos berinaria 100 mila 500 forta . |       |                    |           | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | , , , , , | Page ou |
|                                                        | Tr    | ode                |           | Pento                                   | đe        |         |
| CHARACTERISTICS:                                       | Conn  | ection*            | C         | onnect                                  | ion       |         |
| Plate Supply Voltage                                   | 180   | 250                | 100       | 125                                     | 250       | volts   |
| Grid-No.2 Supply Voltage                               | _     |                    | 100       | 125                                     | 150       | volts   |
| Cathode-Bias Resistor                                  | 330   | 820                | 180       | 100                                     | 180       | ohms    |
| Amplification Factor                                   | 45    | 42                 | _         | _                                       | _         |         |
| Plate Resistance (Approx.)                             | 0.008 | 0.01               | 0.6       | 0.5                                     | 0.81      | neghom  |
| Transconductance                                       | 5700  | 3800               | 4500      | 5100                                    | 5000      | µmhos   |
| Grid-No.1 Voltage (Approx.) for plate current of       | •     |                    |           |                                         | • • • •   | m-111   |
| 10 μΑ                                                  |       | _                  | <b>—5</b> | 6                                       | 8         | volts   |
| Plate Current                                          | 7     | 5.5                | 4.5       | 7.2                                     | 6.5       | mA      |
| Grid-No.2 Current                                      |       | J.5                | 1.4       | 2.1                                     | 2.0       | mA      |
| * Grid No.2 connected to plate.                        |       |                    | 4.4       | ~                                       | 2.0       | 11121   |

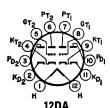
#### POWER PENTODE

6AG7

Metal type used in output stage of video amplifier of television receivers. Outline 2B, Outlines section. Tube requires octal socket. Heater volts (ac/dc), 6.3; amperes, 0.65. Typical operation as class A<sub>1</sub> amplifier: plate



volts, 300 max; grid No.3 connected to cathode at socket; grid-No.2 volts, 150 (300 max); grid-No.1 volts. -3 (0 max); peak af grid-No.1 volts, 3; plate mA, 30 (zero signal), 30.5 (maximum signal); grid-No.2 mA, 7 (zero signal); 9 (maximum signal); plate resistance (approx.), 0.13 megohm; transconductance, 11000 μmhos; load resistance, 10000 ohms; maximum-signal power output, 3 watts; plate dissipation, 9 max watts; grid-No.2 input, 1.5 max watts.



# TWIN DIODE—TWIN TRIODE

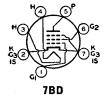
Duodecar type containing two diodes and two high-mu triodes, used primarily in FM stereo multiplex service. Outline 8A, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any

6**AG**11

position. Heater volts (ac/dc), 6.3; amperes, 0.75; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

| Class A. Amplifier | Each | Triode | Unit) |
|--------------------|------|--------|-------|
|--------------------|------|--------|-------|

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Plate Dissipation | 330 max<br>2 max | volts<br>watts |
|--------------------------------------------------------------------------|------------------|----------------|
| CHARACTERISTICS:                                                         | ·                |                |
| Plate Voltage                                                            | 125              | volts          |
| Grid Voltage                                                             | -1               | voit           |
| Amplification Factor                                                     | 66               |                |
| Plate Resistance (Approx.)                                               | 8500             | ohms           |
| Transconductance                                                         | 7800             | μmhos          |
| Plate Current                                                            | 7.5              | mA             |
| Grid Voltage (Approx.), for plate current of 30 $\mu$ A                  | <b></b> 5        | volts          |
| Pinda Haita (Fach Hait)                                                  |                  |                |
| Diode Units (Each Unit)                                                  |                  |                |
| MAXIMUM RATINGS (Design-Maximum Values):                                 |                  |                |
| Plate Current CHARACTERISTICS, Instantaneous Value:                      | 5 max            | mA             |
| Tube Voltage Drop for plate current of 18 mA                             | 5                | volts          |



#### SHARP-CUTOFF PENTODE

Miniature types used as rf or if amplifiers especially in high-frequency wide-band applications. They are useful as amplifiers at frequencies up to 400 megacycles per second. Outline 5B, Outlines section. Tubes require

**6AK5** 6AK5/ **EF95** 

miniature seven-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: | 6.3<br>0.175 |     | volts<br>ampere |
|--------------------------------------------------------------------|--------------|-----|-----------------|
| Heater negative with respect to cathode                            | 90           | max | volts           |
| Heater positive with respect to cathode                            | 90           | max | volts           |
| Direct Interelectrode Capacitances (Approx.):                      |              |     |                 |
| Grid No.1 to Plate                                                 | 0.02         | max | pF              |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and            |              |     | -               |
| Internal Shield                                                    | 4.0          |     | рF              |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and                |              |     | -               |
| Internal Shield                                                    | 2.8          |     | pF              |
| With external shield connected to pins 2 or 7                      |              |     |                 |

# Class A. Amplifier

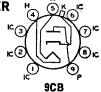
| MAXIMUM RATINGS (Design-Center Values):       |                                    |
|-----------------------------------------------|------------------------------------|
| Plate Voltage Grid-No.2 (Screen-Grid) Voltage | 180 max volts<br>See curve page 80 |
| Grid-No.2 Supply Voltage                      | 180 max volts                      |

| Grid-No.1 Voltage, Positive-bias value          |      | 0 ma<br>1.7 ma |             |
|-------------------------------------------------|------|----------------|-------------|
| Grid-No.2 Input:                                |      | 1.7 ma         | A watts     |
| For grid-No.2 voltages up to 90 volts           |      | 0.5 ma         | x watt      |
| For grid-No.2 voltages between 90 and 180 volts |      | See cu         | rve page 80 |
| Cathode Current                                 |      | 18 ma:         | k mA        |
| CHARACTERISTICS:                                |      |                |             |
| Plate Supply Voltage                            | 120  | 180            | volts       |
| Grid-No.2 Supply Voltage                        | 120  | 120            | volts       |
| Cathode-Bias Resistor                           | 180  | 180            | ohms        |
| Plate Resistance (Approx.)                      | 0.3  | 0.5            | megohm      |
| Transconductance                                | 5000 | 5100           | μmhos       |
| Grid-No.1 Voltage for plate current of 10 µA    | -8.5 | 8.5            | volts       |
| Plate Current                                   | 7.5  | 7.7            | mA          |
| Grid-No.2 Current                               | 2.5  | 2.4            | mA          |

# HALF-WAVE VACUUM RECTIFIER

6AL3

Miniature type used as damper tube in horizontal-deflection circuits of television receivers. Outline 7D, Outlines section. Tube requires miniature ninecontact socket and may be mounted in any position. Socket terminals 1,



2, 3, 6, 7, and 8 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 6.3; amperes, 1.55.

**Damper Service** 

| For operation in 525-line, 30-frame system    |          |       |
|-----------------------------------------------|----------|-------|
| MAXIMUM RATINGS (Design-Center Values):       |          |       |
| Peak Inverse Plate Voltage (Absolute maximum) | 7500°max | volts |
| Peak Plate Current                            | 550 max  | mA    |
| DC Plate Current                              | 220 max  | mA    |
| Plate Dissipation                             | 5 max    | watts |
| Peak Heater-Cathode Voltage                   | 6600 max | volts |

Ounder no circumstances should this absolute value be exceeded.

# TWIN DIODE

6AL5
Related types: 3AL5, 12AL5

Miniature, high-perveance type used as detector in FM and television circuits. It is especially useful as a ratio detector in ac-operated FM receivers. Each diode section can be used independently of the other, or the two

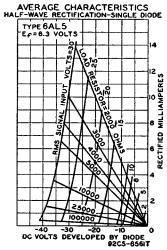


6BT

sections can be combined in parallel or full-wave arrangement. Resonant frequency of each unit is approximately 700 megacycles per second. Outline 5B, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Types 3AL5 and 12AL5 are identical with type 6AL5 except for heater ratings, as shown below.

|                                         | 3AL5    | 6AL5    | 12AL5   |         |
|-----------------------------------------|---------|---------|---------|---------|
| Heater Voltage (ac/dc)                  | 3.15    | 6.3     | 12.6    | volts   |
| Heater Current                          | 0.6     | 0.3     | 0.15    | ampere  |
| Heater Warm-up Time (Average)           | 11      | _       |         | seconds |
| Peak Heater-Cathode Voltage:            |         |         |         |         |
| Heater negative with respect to cathode | 330 max | 330 max | 330 max | volts   |
| Heater positive with respect to cathode | 330 max | 330 max | 330 max | volts   |

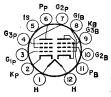
<sup>•</sup> The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.



| Direct Interelectrode Capacitances:                     |           |    |
|---------------------------------------------------------|-----------|----|
| Plate No.1 to Cathode No.1, Heater, and Internal Shield | 2.5       | pF |
| Plate No.2 to Cathode No.2, Heater, and Internal Shield | 2.5       | pF |
| Cathode No.1 to Plate No.1, Heater, and Internal Shield | 3.4       | pF |
| Cathode No.2 to Plate No.2, Heater, and Internal Shield | 3.4       | pF |
| Plate No.1 to Plate No.2                                | 0.068 max | pF |

#### Half-Wave Rectifier

| Peak Inverse Plate Voltage Peak Plate Current (Per Plate) DC Output Current (Per Plate) | 330 max<br>54 max<br>9 max | volts<br>mA<br>mA |
|-----------------------------------------------------------------------------------------|----------------------------|-------------------|
| TYPICAL OPERATION:                                                                      |                            |                   |
| AC Plate Voltage per Plate (rms)                                                        | 117                        | volts             |
| Min. Total Effective Plate-Supply Impedance per Plate                                   | 300                        | ohms              |
| DC Output Current per Plate                                                             | 9                          | mA                |



# BEAM POWER TUBE— SHARP-CUTOFF PENTODE

Duodecar type used as FM detector of same and audio-frequency output amplifier in television receivers. Outline 8B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Types

6**AL**11

Related types: 10AL11, 12AL11

10AL11 and 12AL11 are identical with type 6AL11 except for heater ratings, as shown below.

|                                         | 6AL11   | 10AL11    | 12AL11  |         |
|-----------------------------------------|---------|-----------|---------|---------|
| Heater Voltage (ac/dc)                  | 6.3     | 9.8       | 12.6    | volts   |
| Heater Current                          | 0.9     | 0.6       | 0.45    | ampere  |
| Heater Warm-up Time (Average)           | _       | 11        | 11      | seconds |
| Peak Heater-Cathode Voltage:            |         |           |         |         |
| Heater negative with respect to cathode | 200 max | 200 max   | 200 max | volts   |
| Heater positive with respect to cathode | 200=max | c 200=max | 200 max | volts   |

The dc component must not exceed 100 volts.

MAXIMUM RATINGS (Design-Center Values):

| Beam Power Unit as Class A <sub>1</sub> Amplifier MAXIMUM RATINGS (Design-Maximum Values):                |             |                  |
|-----------------------------------------------------------------------------------------------------------|-------------|------------------|
| Plate Voltage                                                                                             | 275 max     |                  |
| Grid-No.2 (Screen-Grid) Voltage                                                                           | 275 max     |                  |
| Plate Dissipation                                                                                         | 10 max      |                  |
| Grid-No.2 Input                                                                                           | 2 max       | watts            |
| TYPICAL OPERATION:                                                                                        |             |                  |
| Plate Voltage                                                                                             | 250         | volts            |
| Grid-No.2 Voltage                                                                                         | 250         | volts            |
| Grid-No.1 (Control-Grid) Voltage                                                                          | -8          | volts            |
| Peak AF Grid-No.1 Voltage                                                                                 | 8           | volts            |
| Zero-Signal Plate Current                                                                                 | 35          | mĄ               |
| Maximum-Signal Plate Current                                                                              | 39          | mA               |
| Zero-Signal Grid-No.2 Current                                                                             | 2.5         | mA               |
| Maximum-Signal Grid-No.2 Current                                                                          | 7           | mA               |
| Plate Resistance (Approx.)                                                                                | 0.1<br>6500 | megohm           |
| Transconductance                                                                                          | 5000        | μmhos<br>ohms    |
| Load Resistance Total Harmonic Distortion                                                                 | 10          | per cent         |
| Maximum-Signal Power Output                                                                               | 4.2         | watts            |
| waxinum-signat rower Output                                                                               | 4.2         | watts            |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation |             | megohm<br>megohm |
| Pentode Unit as Class A <sub>1</sub> Amplifier                                                            |             |                  |
| CHARACTERISTICS: Plate Supply Voltage                                                                     | 150         | volts            |
| Grid-No.3 (Suppressor-Grid) Voltage                                                                       | 0           | volts            |
| Grid-No.2 (Screen-Grid) Supply Voltage                                                                    | 100         | volts            |
| Cathode-Bias Resistor                                                                                     | 560         | ohms             |
| Plate Resistance (Approx.)                                                                                | 0.15        | megohm           |
| Transconductance, Grid No.1 to Plate                                                                      | 1000        | μmhos            |
| Transconductance, Grid No.3 to Plate                                                                      | 400         | μmhos            |
| Plate Current                                                                                             | 1.3         | mA               |
| Grid-No.2 Current                                                                                         | 2.1         | mA.              |
| Grid-No.1 Voltage (Approx.) for plate current of 30 μA                                                    | <b>-4.5</b> | volts            |
| Grid-No.3 Voltage (Approx.) for plate current of 50 $\mu$ A                                               | 4.5         | volts            |
| Pentode Unit as FM Detector                                                                               |             |                  |

# MAXIMUM RATINGS (Design-Maximum Values):

Plate Voltage .....

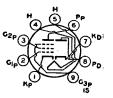
Grid-No.3 Voltage

| Grid-No.2 Supply Voltage                              | 330 max volts     |
|-------------------------------------------------------|-------------------|
| Grid-No.2 Voltage                                     | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max volts       |
| Plate Dissipation                                     | 1.7 max watts     |
| Grid-No.2 Input:                                      |                   |
| For grid-No.2 voltages up to 165 volts                | 1.1 max watts     |
| For grid-No.2 voltages between 165 and 330 volts      | See curve page 80 |

## DIODE—SHARP-CUTOFF PENTODE

6AM8A
Related type:
5AM8

Miniature type used in diversified applications in television receivers employing series-connected heater strings. The pentode unit is used as an if amplifier, video amplifier, or agc amplifier. The high-perveance diode is



330 max

28 max

volts

volts

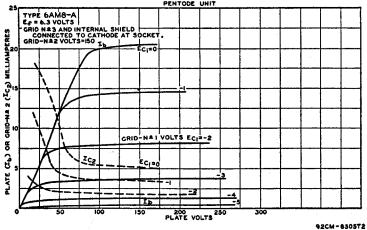
9CY

used as an audio detector, video detector, or dc restorer. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 5AM8 is identical with type 6AM8A except for heater ratings, as shown below.

|                                                     | 5AM8    | 6AM8A     |         |
|-----------------------------------------------------|---------|-----------|---------|
| Heater Voltage (ac/dc)                              | 4.7     | 6.3       | volts   |
| Heater Current                                      | 0.6     | 0.45      | ampere  |
| Heater Warm-up Time (Average)                       | 11      | 11        | seconds |
| Peak Heater-Cathode Voltage:                        |         |           |         |
| Heater negative with respect to cathode             | 200 max | 200 max   | volts   |
| Heater positive with respect to cathode             | 200°max | 200°max   | volts   |
| Direct Interelectrode Capacitances:                 |         |           |         |
| Diode Unit:                                         |         |           |         |
| Plate to Cathode and Heater                         |         | 1.8       | pF      |
| Cathode to Plate and Heater                         |         | 3         | pF      |
| Pentode Unit:                                       |         |           | -       |
| Grid No.1 to Plate                                  |         | 0.015 max | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, No.3 and   |         |           | -       |
| Internal Shield                                     |         | 6.5       | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and |         |           | -       |
| Internal Shield                                     |         | 2.6       | pF      |
| Pentode Grid No.1 to Diode Plate                    |         | 0.006 max | pF      |
| Pentode Plate to Diode Cathode                      |         | 0.15 max  | pF      |
| Pentode Plate to Diode Plate                        |         | 0.1 max   | pF      |
|                                                     |         |           | P-      |

<sup>\*</sup> The dc component must not exceed 100 volts.

# AVERAGE CHARACTERISTICS



# Pentode Unit as Class A1 Amplifier

| rentous out as olass At Ampinist                                   |            |             |
|--------------------------------------------------------------------|------------|-------------|
| MAXIMUM RATINGS (Design-Maximum Values):                           |            |             |
| Plate Voltage                                                      | 330 max    | volts       |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value                | 0 max      | volts       |
| Grid-No.2 (Screen-Grid) Supply Voltage                             | 330 max    | volts       |
| Grid-No.2 Voltage                                                  | See cui    | ve page 80  |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value              | 0 max      |             |
| Plate Dissipation                                                  | 3.2 max    |             |
| Grid-No.2 Input:                                                   |            |             |
| For grid-No.2 voltages up to 165 volts                             | 0.55 max   | watt        |
| For grid-No.2 voltages between 165 and 330 volts                   |            | ve page 80  |
|                                                                    | 500 000    | , o page oo |
| CHARACTERISTICS:                                                   |            |             |
| Plate Supply Voltage                                               | 125        | volts       |
| Grid No.3 Connected                                                | to cathode | at socket   |
| Grid-No.2 Supply Voltage                                           | 125        | volts       |
| Cathode-Bias Resistor                                              | 56         | ohms        |
| Plate Resistance (Approx.)                                         | 0.3        | megohm      |
| Transconductance                                                   | 7800       | umhos       |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A        | -6         | volts       |
| Grid-No.1 Voltage (Approx.) for plate current of 2 mA and cathode- | ·          | 1016        |
| bias resistor of 0 ohms                                            | 3          | volts       |
| Plate Current                                                      | 12.5       | mA          |
| Grid-No.2 Current                                                  | 3.2        | mA          |
|                                                                    |            |             |

| MAXIMUM CIRCUIT<br>Grid-No.1-Circuit Resi<br>For fixed-bias ope<br>For cathode-bias |                                                                                                                    | 0.25 max 1<br>1.0 max 1       |    |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------------------|----|
| NA VINELIA DATINO                                                                   | Diode Unit                                                                                                         |                               |    |
|                                                                                     | S (Design-Maximum Values):                                                                                         | 5 max                         | mA |
|                                                                                     | HIGH-MU TRIODE                                                                                                     | <sup>4</sup> € © <sup>*</sup> | ı  |
| 6AN4                                                                                | Miniature type used as mixer or rf<br>amplifier in cathode-drive circuits of<br>uhf television tuners covering the |                               | ©° |

frequency range of 470 to 890 megacycles per second. Outline 5B, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.



7DK

| Heater Voltage (ac/dc)                        | 6.3       | voits  |
|-----------------------------------------------|-----------|--------|
| Heater Current                                | 0.225     | ampere |
| Peak Heater-Cathode Voltage:                  |           |        |
| Heater negative with respect to cathode       | 200 max   | volts  |
| Heater positive with respect to cathode       | 200 • max | volts  |
| Direct Interelectrode Capacitances:           |           |        |
| Grid to Plate                                 | 1.7°      | pF     |
| Grid to Cathode and Heater                    | 3.3°      | pF     |
| Plate to Cathode and Heater                   | 1.8°      | pF     |
| Heater to Cathode                             | 2.94      | рF     |
| Grid to Cathode                               | 2.6▲      | pF     |
| Plate to Cathode                              | 0.184     | pF     |
| Cathode to Grid and Heater                    | 5.7*      | pF     |
| Plate to Grid and Heater                      | 3.4*      | υF     |
|                                               | 3.4       | p.     |
| • The dc component must not exceed 100 volts. |           |        |
| With external shield connected to cathode.    |           |        |
| * With external shield connected to ground.   |           |        |
| * With external shield connected to grid.     |           |        |
| Class A <sub>1</sub> Amplifier                |           |        |
| - · ·                                         |           |        |
| MAXIMUM RATINGS (Design-Center Values):       |           |        |
| Plate Voltage                                 | 300 max   | volts  |
| Plate Dissipation                             | 4 max     | watts  |
| Cathode Current                               | 30 max    | mA     |
|                                               |           |        |

| MAXIMUM      | CIRCUIT     | <b>VALUES:</b> |
|--------------|-------------|----------------|
| Grid-Circuit | Resistance: |                |

For fixed-bias operation For cathode-bias operation .....

Plate-Supply Voltage ......

Cathode-Bias Resistor .....

Amplification Factor .....

Transconductance ......

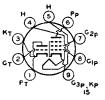
Grid Voltage (Approx.) for plate current of 20  $\mu$ A ......

# MEDIUM-MU TRIODE-SHARP-CUTOFF PENTODE

Related type: 5AN8

CHARACTERISTICS:

Miniature type used in a wide variety of applications in color television reemploying series-connected heater strings. The pentode unit is used as an intermediate-frequency amplifier, a video amplifier, an agc



0.1 max meghom 0.5 max megohm

200

100

70 10000

13

volts

ohms

μmhos.

mA

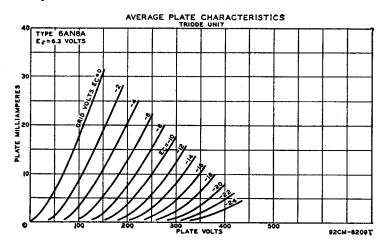
volts

9DA

amplifier, or as a reactance tube. The triode unit is used in low-frequency oscillator, sync-separator, sync-clipper, and phase-splitter circuits. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 5AN8 is identical with type 6AN8A except for heater ratings, as shown below.

|                                                    | 5AN8     | 6AN8A    |         |
|----------------------------------------------------|----------|----------|---------|
| Heater Voltage (ac/dc)                             | 4.7      | 6.3      | volts   |
| Heater Current                                     | 0.6      | 0.45     | ampere  |
| Heater Warm-Up Time (Average)                      | 11       | 11       | seconds |
| Peak Heater-Cathode Voltage:                       |          |          |         |
| Heater negative with respect to cathode            | 200 max  | 200 max  | volts   |
| Heater positive with respect to cathode            | 200° max | 200° max | volts   |
| Direct Interelectrode Capacitances:                |          |          |         |
| Triode Unit:                                       |          |          |         |
| Grid to Plate                                      |          | 1.5      | pF      |
| Grid to Cathode and Heater                         |          | 2.0      | pF      |
| Plate to Cathode and Heater                        |          | 0.26     | pF      |
| Pentode Unit:                                      |          |          | =       |
| Grid No.1 to Plate                                 |          | 0.04 max | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid      |          |          | _       |
| Internal Shield                                    |          | 7        | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, as |          |          | _       |
| Shield                                             |          | 2.4      | pF      |
| Triode Grid to Pentode Plate                       |          | 0.02     | pF      |
| Pentode Grid No.1 to Triode Plate                  |          | 0.02     | pF      |
| Pentode Plate to Triode Plate                      |          | 0.15     | pF      |
|                                                    |          |          | _       |

<sup>°</sup> The dc component must not exceed 100 volts.

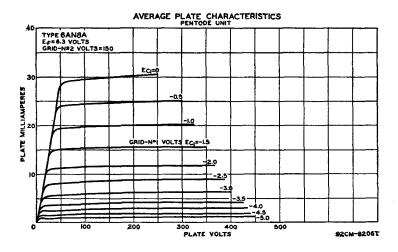


#### Class A. Amplifier

| Class At Ampimer                                       |             |              |         |
|--------------------------------------------------------|-------------|--------------|---------|
| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Pentode Unit |         |
| Plate Voltage                                          | 330 max     | 330 max      | volts   |
| Grid-No.2 Supply Voltage                               | <del></del> | 330 max      | volts   |
| Grid-No.2 (Screen-Grid) Voltage                        |             | See curve    | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value. | 0 max       | 0 max        | volts   |
| Plate Dissipation                                      | 2.8 max     | 2.3 max      | watts   |
| Grid-No.2 Input:                                       |             |              |         |
| For grid-No.2 voltages up to 165 volts                 |             | 0.55 max     | watt    |
| For grid-No.2 voltages between 165 and 330 volts       | -           | See curve    | page 80 |
| CHARACTERISTICS:                                       |             |              |         |
| Plate Supply Voltage                                   | 150         | 125          | volts   |
| Grid-No.2 Supply Voltage                               | _           | 125          | volts   |
| Grid-No.1 Voltage                                      | -3          |              | volts   |
|                                                        |             |              |         |

| Cathode-Bias Resistor Amplification Factor                                                  | 21                 | 56                  | ohms              |
|---------------------------------------------------------------------------------------------|--------------------|---------------------|-------------------|
| Plate Resistance (Approx.) Transconductance                                                 | 4700<br>4500       | 170000<br>7800      | ohms<br>µmhos     |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A                                 | <del>-17</del>     | <b>–6</b>           | volts             |
| Grid-No.1 Voltage (Approx.) for plate current of 1.6 mA and cathode-bias resistor of 0 ohms | 15                 | -3<br>12<br>3.8     | volts<br>mA<br>mA |
| MAXIMUM CIRCUIT VALUES:                                                                     | _                  | 3.0                 | 11171             |
| Grid-No.1-Circuit Resistance:*  For fixed-bias operation  For cathode-bias operation        | 0.5 max<br>1.0 max | 0.25 max<br>1.0 max | megohm<br>megohm  |

<sup>\*</sup> If either unit is operating at maximum rated conditions, grid-No.1-circuit resistance for both units should not exceed the stated values.



# **BEAM POWER TUBE**

6AQ5A Related types: 5AQ5, 12AQ5

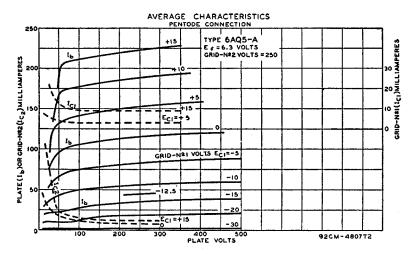
Miniature type used as output amplifier primarily in automobile receivers and in ac-operated receivers and, triode-connected, as a vertical deflection amplifier in television receivers series-connected heater employing



strings. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Within its maximum ratings, the performance of this type is equivalent to that of larger types 6V6 and 6V6GTA. Types 5AQ5 and 12AQ5 are identical with type 6AQ5A except for heater ratings, as shown below.

|                                                                                                                  | 5AQ5               | 6AQ5A | 12AQ5              |                |
|------------------------------------------------------------------------------------------------------------------|--------------------|-------|--------------------|----------------|
| Heater Voltage (ac/dc)                                                                                           | 4.7                | 6.3   | 12.6               | volts          |
| Heater Current                                                                                                   | 0.6                | 0.45  | 0.225              | ampere         |
| Heater Warm-up Time (Average)                                                                                    | 11                 | 11    | -                  | seconds        |
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode.  Heater positive with respect to cathode. | 200 maz<br>200=maz |       | 200 max<br>200•max | volts<br>volts |

<sup>•</sup> The dc component must not exceed 100 volts.

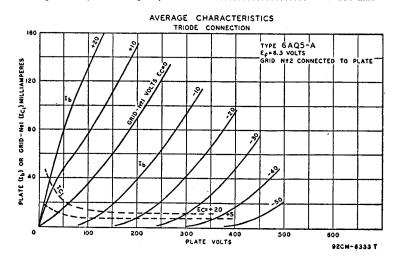


| Direct Interelectrode Capacitances (Approx.):                                       |            |              |
|-------------------------------------------------------------------------------------|------------|--------------|
| Grid No.1 to Plate                                                                  | 0.4        | pF           |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3                              | 8          | pF           |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3                                  | 8.5        | pF           |
| Amplification Factor*                                                               | 9.5        |              |
| Plate Resistance (Approx.)*                                                         | 1970       | ohms         |
| Transconductance*                                                                   | 4800       | μmhos        |
| Grid-No.1 Voltage (Approx.) for plate current of 0.5 mA                             | <b>—37</b> | volts        |
| * Grid No.2 connected to plate; plate and grid-No.2 volts, 250; grid-No.1 mA, 49.5. | volts,     | -12.5; plate |

# Class A<sub>1</sub> Amplifier

| MAXIMUM | RATINGS | (Design-Maximum | Values): |
|---------|---------|-----------------|----------|
|---------|---------|-----------------|----------|

| Piate Voltage Grid-No.2 (Screen-Grid) Voltage Plate Dissipation Grid-No.2 Input | 275 max<br>275 max<br>12 max<br>2 max | volts<br>volts<br>watts<br>watts |
|---------------------------------------------------------------------------------|---------------------------------------|----------------------------------|
| Bulb Temperature (At hottest point)                                             | 250 max                               | "°C                              |



#### TYPICAL OPERATION:

Same as for type 6V6GTA within the limitations of the maximum ratings.

| MAXIMUM       | CIRCUI   | T VALU   | ES: |
|---------------|----------|----------|-----|
| Grid-No.1-Cit | cuit Res | istance: |     |

| Grid-No.1-Circuit Resistance: |                |
|-------------------------------|----------------|
| For fixed-bias operation      | 0.1 max megohm |
| For cathode-bias operation    | 0.5 max megohm |

# Vertical Deflection Amplifier (Triode Connection)°

|                 | For operation in a 525-un | e, 50-irame system |
|-----------------|---------------------------|--------------------|
| MAXIMUM RATINGS | (Design-Maximum Values):  |                    |

| 275 max  | volts                                              |
|----------|----------------------------------------------------|
| 1100 max | volts                                              |
| 275 max  | volts                                              |
| 115 max  | mA                                                 |
|          | mA                                                 |
| 10 max   | watts                                              |
| 250 max  | °C                                                 |
|          | 1100 max<br>275 max<br>115 max<br>40 max<br>10 max |

# MAXIMUM CIRCUIT VALUE:

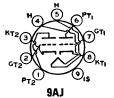
Grid-No.1-Circuit Resistance:

† The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

# 6AQ8 6AQ8/ ECC85

# HIGH-MU TWIN TRIODE

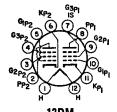
Miniature types used as rf amplifier KT2(3) and self-oscillating mixer in FM/AM radio receivers. Outline 6B, Outlines section. Tubes require nine-contact socket and may be operated in any position.



| Heater Voltage (ac/dc)                                    |           | 6.3       | volts  |
|-----------------------------------------------------------|-----------|-----------|--------|
| Heater Current                                            |           | 0.435     | ampere |
| Peak Heater-Cathode Voltage:                              |           |           | -      |
| Heater negative with respect to cathode                   |           | 90 max    | volts  |
| Heater positive with respect to cathode                   |           | 90 max    | volts  |
| Direct Interelectrode Capacitances:                       | Unit No.1 | Unit No.2 |        |
| Grid to Plate                                             | 1.5       | 1.5       | pF     |
| Cathode to Plate                                          | 0.18      | 0.18      | pF     |
| Grid to Cathode, Heater, and Internal Shield              | 3         | 3         | pF     |
| Plate to Cathode, Heater, and Internal Shield             | 1.2       | 1.2       | pF     |
| Plate to Grid of Other Unit                               | 0.008 max | 0.008 max | pF     |
| Plate to Cathode of Other Unit                            | 0.008 max | 0.008 max | pF     |
| Grid to Cathode of Other Unit                             | 0.003 max | 0.003 max | pF     |
| Plate of Unit No.1 to Plate of Unit No.2                  |           | 0.04 max  | pF     |
| Grid of Unit No.1 to Grid of Unit No.2                    |           | 0,003 max | pF     |
| Amplification Factor*                                     |           | 57        | •      |
| Plate Resistance (Approx.)*                               |           | 9700      | ohms   |
| Transconductance*                                         |           | 5900      | μmhos  |
| * Each unit; with plate volts, 250; grid volts, -2.3; pla |           |           |        |
| MAXIMUM RATINGS (Design-Center Values, Each V             | Unit):    |           |        |
| Plate Supply Voltage                                      |           | 550 max   | volts  |
| Plate Voltage                                             |           | 300 max   | volts  |
| Grid Voltage, Negative-bias value                         |           | -100 max  | volts  |
| Plate Dissipation:                                        |           |           |        |
| For either plate                                          |           | 2.5 max   | watts  |
| For both plates with both units operating                 |           | 4.5 max   | watts  |
| Cathode Current                                           |           | 15 max    | mA     |

o Grid No.2 connected to plate.

| TYPICAL OPERATION (Each Unit):            | RF<br>Amplifier | Converter |        |
|-------------------------------------------|-----------------|-----------|--------|
| Plate Supply Voltage                      | 250             | 250       | volts  |
| Plate Voltage                             | 230             | _         | volts  |
| Plate Resistor                            | 1800            | 12000     | ohms   |
| Grid Resistor                             |                 | 1         | megohm |
| Grid Voltage                              | —2              | _         | volts  |
| RMS Oscillator Voltage                    |                 | 3         | volts  |
| Cathode-Bias Resistor                     | 200             | _         | ohms   |
| Plate Resistance (Approx.)                | 9700            | 22000     | ohms   |
| Transconductance                          | 6000            | _         | µmhos  |
| Conversion Transconductance               | _               | 2300      | µmhos  |
| Input Resistance at frequency of 100 Mc/s | 6000            | 15000     | ohms   |
| Plate Current                             | 10              | 5.2       | mA     |
| Equivalent Noise Resistance               | 500             | _         | ohms   |
| MAXIMUM CIRCUIT VALUES (Each Unit):       |                 |           |        |
| Grid-Circuit Resistance                   | <b></b>         | 1 max     | megohm |
| Resistance between Cathode and Heater     |                 | 20000 max |        |



# SEMIREMOTE-CUTOFF TWIN PENTODE

Duodecar type used as if-amplifier tube in television receivers. Outline 8A, Outlines section. Tube requires duodecar twelve-contact-socket and may be mounted in any position. Type 11AR11 is identical with type 6AR11

CA D 11

6ARII Related type: 11AR11

except for heater ratings, as show below.

|                                                 | OAKII     | HAKH      |         |
|-------------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                          | 6.3       | 11.2      | volts   |
| Heater Current                                  | 0.8       | 0.45      | ampere  |
| Heater Warm-up Time (Average)                   | _         | 11        | seconds |
| Peak Heater-Cathode Voltage:                    |           |           |         |
| Heater negative with respect to cathode         | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode         | 200*max   | 200 * max | volts   |
| Direct Interelectrode Capacitances:             | Unit No.1 | Unit No.2 |         |
| Grid No.1 to Plate                              | 0.026     | 0.026     | p₹      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid   |           |           |         |
| No.3, and Internal Shield                       | 10        | 10        | рF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, |           |           |         |
| and Internal Shield                             | 2.8       | 3         | рF      |
| Grid No.1 to Plate of Other Unit                | 0.002 max | 0.002 max | pF      |
| Plate of Unit No.1 to Plate of Unit No.2        |           | 0.02 max  | ₽F      |
| ■ The dc component must not exceed 100 volts.   |           |           |         |

|         |                | Class           | A <sub>1</sub> AIT | ipittier    |  |
|---------|----------------|-----------------|--------------------|-------------|--|
| MAXIMUM | <b>RATINGS</b> | (Design-Maximum | Values,            | Each Unit): |  |

| Plate Voltage                                         | 330 max   | volts   |
|-------------------------------------------------------|-----------|---------|
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value   | 0 max     | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                | 330 max   | volts   |
| Grid-No.2 Voltage                                     | See curve | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max     | volts   |
| Grid-No.2 Input:                                      |           |         |
| For grid-No.2 voltages up to 165 volts                | 0.65 max  | watt    |
| For grid-No.2 voltages between 165 and 330 volts      | See curve | page 80 |
| Plate Dissipation                                     | 3.1 max   | watts   |

#### CHARACTERISTICS (Each Unit):

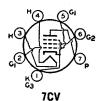
| Plate Supply Voltage     | 125              | volts     |
|--------------------------|------------------|-----------|
| Grid No.3 Conn           | ected to cathode | at socket |
| Grid-No.2 Supply Voltage | . 125            | volts     |
| Cathode-Bias Resistor    | . 56             | ohms      |

| Plate Resistance (Approx.)                                   | 0.2   | megohm |
|--------------------------------------------------------------|-------|--------|
| Transconductance                                             | 10500 | μmhos  |
| Plate Current                                                | 11    | mA     |
| Grid-No.2 Current                                            | 3.5   | mA     |
| Grid-No.1 Voltage (Approx.) for transconductance of 50 umhos | 15    | volts  |

# **BEAM POWER TUBE**

# **6AS5**

Miniature type used as output amplifier primarily in automobile and in ac-operated receivers. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. For curves



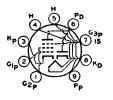
of average plate characteristics, refer to type 35C5.

| Heater Voltage (ac/dc)                                 | 6.3     | volts    |
|--------------------------------------------------------|---------|----------|
| Heater Current                                         | 0.8     | ampere   |
| Peak Heater-Cathode Voltage:                           |         | _        |
| Heater negative with respect to cathode                | 100 max | volts    |
| Heater positive with respect to cathode                | 100 max | volts    |
| Direct Interelectrode Capacitances (Approx.):          |         |          |
| Grid No.1 to Plate                                     | 0.6     | рF       |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 12      | pF       |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 9.0     | pF       |
| ,,                                                     |         |          |
| Class A <sub>1</sub> Amplifier                         |         |          |
| MAXIMUM RATINGS (Design-Center Values):                |         |          |
| Plate Voltage                                          | 150 max | volts    |
| Grid-No.2 (Screen-Grid) Voltage                        | 117 max | volts    |
| Plate Dissipation                                      | 5.5 max | watts    |
| Grid-No.2 Input                                        | 1.0 max | watt     |
| Bulb Temperature (At hottest point)                    | 250 max | ۰c       |
|                                                        |         |          |
| TYPICAL OPERATION:                                     |         | _        |
| Plate Voltage                                          | 150     | volts    |
| Grid-No.2 Voltage                                      | 110     | volts    |
| Grid-No.1 (Control-Grid) Voltage                       | -8.5    | volts    |
| Peak AF Grid-No.1 Voltage                              | 8.5     | volts    |
| Zero-Signal Plate Current                              | 35      | mA       |
| Maximum-Signal Plate Current                           | 36      | mA       |
| Zero-Signal Grid-No.2 Current (Approx.)                | 2       | mA       |
| Maximum-Signal Grid-No.2 Current (Approx.)             | 6.5     | mA       |
| Transconductance                                       | 5600    | μmhos    |
| Load Resistance                                        | 4500    | ohms     |
| Total Harmonic Distortion                              | 10      | per cent |
| Maximum-Signal Power Output                            | 2.2     | watts    |
|                                                        |         |          |
| MAXIMUM CIRCUIT VALUES:                                |         |          |
| Grid-No.1-Circuit Resistance:                          | 0.4     |          |
| For fixed-bias operation                               |         | megohm   |
| For cathode-bias operation                             | 0.5 max | megohm   |
| •                                                      |         |          |

# DIODE— SHARP-CUTOFF PENTODE

6AS8
Related type: 5AS8

Miniature type used in diversified applications in television and radio receivers. The pentode unit is used as an if amplifier, video amplifier, or agc amplifier. The high-perveance diode is used as an audio detector, video de-



9DS

330 max

50 max

5 max

volts

mA

mΑ

tector, or dc restorer. Outline 6B, Outlines section. Tube requires miniature ninecontact socket and may be mounted in any position. For curve of average plate characteristics of pentode unit, see type 6AN8A. Type 5AS8 is identical with type 6AS8 except for heater ratings, as shown below.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5AS8                                    | 6AS8             |                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------|-------------------|
| Heater Voltage (ac/dc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 4.7                                     | 6.3              | volts             |
| Heater Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.6                                     | 0.45             | ampere            |
| Heater Warm-up Time (Average)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 11                                      | _                | seconds           |
| Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 200 max                                 | 200 max          | volts             |
| Heater positive with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 200=max                                 | 200 max          |                   |
| Direct Interelectrode Capacitances:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                         |                  |                   |
| Diode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                         |                  |                   |
| Plate to Cathode, Heater, Pentode Grid No.3, and<br>Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                         | 3.0              | pF                |
| Pentode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | • • • • • • • • • • • • •               | 5.0              | pı                |
| Grid No.1 to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                         | 0.03 max         | pF                |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                         | _                | _                 |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         | 7                | pF                |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         | 2.4              | pF                |
| Pentode Grid No.1 to Diode Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         | 0.005 max        | pF                |
| Pentode Plate to Diode Cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                         | 0.15 max         | pF                |
| Pentode Plate to Diode Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | · · · · · · · · · · · · · · · ·         | 0.10 max         | pF                |
| ■ The dc component must not exceed 100 volts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         |                  |                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         |                  |                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         |                  |                   |
| Pentode Unit As Class A.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Amplifier                               |                  |                   |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | •                                       |                  |                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1                                       |                  |                   |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         | 300 max          | volts             |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | • • • • • • • • • • •                   | 0 max<br>300 max | volts<br>volts    |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         |                  | e page 80         |
| Grid-No.1 (Control-Grid) Voltage, Positive bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                         | 0 max            | volts             |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | • • • • • • • • • •                     | 2.5 max          | watts             |
| Grid-No.2 Input:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         | 0.5              |                   |
| For grid-No.2 voltages up to 150 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | • • • • • • • • • • • • • • • • • • • • | 0.5 max          | watt<br>e page 80 |
| Tot Bild-140.2 Voltages between 150 and 500 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                         | See cur          | c page ou         |
| CHARACTERISTICS:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         |                  |                   |
| Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                         | 200              | volts             |
| Grid No.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                         |                  |                   |
| Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                         | 150              | volts             |
| Cathode-Bias Resistor Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         | 180<br>300000    | ohms<br>ohms      |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         | 6200             | μmhos             |
| Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                         | -8               | volts             |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         | 9.5              | mA                |
| Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                         | 3                | mA                |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |                  |                   |
| Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         |                  |                   |
| For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                         | 0.25 max         |                   |
| For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | • • • • • • • • • • • • • • • • • • • • | 1.0 max          | megohm            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         |                  |                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         |                  |                   |
| Diode Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                         |                  |                   |
| between the manufacture of the contraction of the c |                                         |                  |                   |

MAXIMUM RATINGS (Design-Center Values):

Peak Inverse Plate Voltage .....

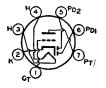
Peak Plate Current .....

DC Plate Current .....

# TWIN DIODE— HIGH-MU TRIODE

6AT6
Related type: 12AT6

Miniature type used as a combined detector, amplifier, and ave tube in automobile and ac-operated radio receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any



7BT

position. For typical operation as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Type 12AT6 is identical with type 6AT6 except for heater ratings, as shown below.

| Heater Voltage (ac/dc)                                                        | 6AT6<br>6.3<br>0.3 | 12AT6<br>12.6<br>0.15 | volts<br>ampere |
|-------------------------------------------------------------------------------|--------------------|-----------------------|-----------------|
| Heater negative with respect to cathode                                       |                    | 90 max                | volts           |
| Heater positive with respect to cathode  Direct Interelectrode Capacitances:  |                    | 90 max                | volts           |
| Triode Grid to Triode Plate                                                   |                    | 2.0                   | pF              |
| Triode Grid to Cathode and Heater                                             |                    | 2.2                   | рF              |
| Triode Plate to Cathode and Heater                                            |                    | 0.8                   | рF              |
| Plate of Diode Unit No.2 to Triode Grid                                       |                    | 0.04 max              | pF              |
| Triode Unit As Class A <sub>1</sub> A MAXIMUM RATINGS (Design-Center Values): | Amplifier          |                       |                 |
| Plate Voltage                                                                 |                    | 300 max               | volts           |
| Plate Dissipation                                                             |                    | 0.5 max               | watts           |
| Grid Voltage, Positive-bias value                                             |                    | 0 max                 | volts           |
| CHARACTERISTICS:                                                              |                    |                       |                 |
| Plate Voltage                                                                 | 100                | 250                   | volts           |
| Grid Voltage                                                                  | <u>-1</u>          | -3                    | volts           |
| Amplification Factor                                                          | 70                 | 70                    |                 |
| Plate Resistance                                                              | 54000              | 58000                 | ohms            |
| Transconductance                                                              | 1300               | 1200                  | μmhos           |
| Plate Current                                                                 | 0.8                | 1.0                   | mA              |
| MAXIMUM RATING (Design-Center Value):                                         |                    |                       |                 |
| Plate Current (Each Unit)                                                     |                    | 1.0 max               | mA              |

The two diode plates are placed around a cathode, the sleeve of which is common to the triode unit. Each diode plate has its own base pin. For diode operation curves, refer to type 6AV6.

# MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

6AT8A
Related type:
5AT8

Miniature types used as combined oscillator and mixer tubes in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. This type has a controlled heater warm-up time for use in receiv-



9DW

ers employing series-connected heater strings. Outline 6B, Outlines section. Except for interelectrode capacitances and basing arrangement, this type is identical with miniature type 6X8. The basing arrangement is particularly suitable for connection to the coils of certain designs of turret tuners. Type 5AT8 is identical with type 6AT8A except for heater ratings, as shown below.

|                               | 5AT8 | 6AT8A |         |
|-------------------------------|------|-------|---------|
| Heater Voltage (ac/dc)        | 4.7  | 6.3   | volts   |
| Heater Current                | 0.6  | 0.45  | ampere  |
| Heater Warm-up Time (Average) | 11   | 11    | seconds |

|                                             | Without  | With      |    |
|---------------------------------------------|----------|-----------|----|
| Direct Interelectrode Capacitances:         | External | External  |    |
| Triode Unit:                                | Shield   | Shield•   |    |
| Grid to Plate                               | 1.5      | 1.5       | pF |
| Grid to Cathode and Heater                  | 2.0      | 2.4       | pF |
| Plate to Cathode and Heater                 | 0.5      | 1.0       | pF |
| Pentode Unit:                               |          |           |    |
| Grid No.1 to Plate                          | 0.06 max | 0.03 max  | pF |
| Grid No.1 to Cathode, Heater, Grid No.2 and |          |           |    |
| Grid No.3                                   | 4.6      | 4.8       | pF |
| Plate to Cathode, Heater, Grid No.2, and    |          |           |    |
| Grid No.3                                   | 0.9      | 1.6       | рF |
| Pentode Grid No.1 to Triode Plate           | 0.05 max | 0.04 max  | pF |
| Pentode Plate to Triode Plate               | 0.05 max | 0.008 max | рF |
| Heater to Cathode                           | 6.0      | 6.0†      | pF |

<sup>•</sup> With external shield connected to cathode except as noted.

<sup>†</sup> With external shield connected to plate.



# HALF-WAVE VACUUM RECTIFIER

Glass octal type used as damper tube in horizontal-deflection circuits of 6AU4GTA color television receivers and of television receivers utilizing picture tubes having wide-angle deflection. Outline 13G, Outlines section. This type re-

quires octal socket and may be mounted in any position. Type may be supplied with pin No.1 omitted. Socket terminals 1, 2, 4, and 6 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated.

| Heater Voltage (ac/dc) Heater Current                                                                                   | 6.3<br>1.8         | volts<br>amperes |
|-------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|
| Direct Interelectrode Capacitances (Approx.): Plate to Heater and Cathode Cathode to Heater and Plate Heater to Cathode | 8.5<br>11.5<br>4.0 | pF<br>pF<br>pF   |

# Damper Service

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |          |       |
|------------------------------------------|----------|-------|
| Peak Inverse Plate Voltage†              | 4500 max | volts |
| Peak Plate Current                       | 1300 max | mA    |
| DC Plate Current                         | 210 max  | mA    |
| Plate Dissipation                        | 6.5 max  | watts |
| Peak Heater-Cathode Voltage:             |          |       |
| Heater negative with respect to cathode  | 4500*max | volts |
| Heater positive with respect to cathode  | 300#max  | volts |

<sup>†</sup> The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

<sup>#</sup> The dc component must not exceed 100 volts.



#### **BEAM POWER TUBE**

Glass octal type used as horizontal deflection amplifier in low-cost, highefficiency deflection circuits of television receivers employing either transformer coupling or direct coupling to the deflecting yoke. Outline

6AU5GT

<sup>\*</sup> The dc component must not exceed 900 volts.

13D, Outlines section. Tube requires octal socket and may be mounted in any

| Heater Voltage (ac/dc)                                 | 6.3     | volts   |
|--------------------------------------------------------|---------|---------|
| Heater Current                                         | 1.25    | amperes |
| Peak Heater-Cathode Voltage:                           |         |         |
| Heater negative with respect to cathode                | 200 max | volts   |
| Heater positive with respect to cathode                | 200 max | volts   |
| Direct Interelectrode Capacitances (Approx.):          |         |         |
| Grid No.1 to Plate                                     | 0.5     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 11.3    | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 7.0     | pF      |
| Transconductance#                                      | 5600    | μmhos   |
| Mu-Factor, Grid No.2 to Grid No.1†                     | 5.9     |         |
| The dc component must not exceed 100 volts             |         |         |

- # For plate volts, 115; grid-No.2 volts, 175; grid-No.1 volts, -20.
- † For plate volts, 100; grid-No.2 volts, 100; grid-No.1 volts, -4.5.

## Horizontal Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS | (Design-Center | Values): |
|-----------------|----------------|----------|
|-----------------|----------------|----------|

| DC Plate Voltage                                      | 550 max   | volts |
|-------------------------------------------------------|-----------|-------|
| Peak Positive-Pulse Plate Voltage* (Absolute Maximum) | 5500°max  | volts |
| Peak Negative-Pulse Plate Voltage                     | -1250 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage*                   | 200 max   | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage  | 300 max   | volts |
| Peak Cathode Current                                  | 400 max   | mA    |
| Average Cathode Current                               | 110 max   | mA    |
| Grid-No.2 Input                                       | 2.5 max   | watts |
| Plate Dissipation††                                   | 10 max    | watts |
| Bulb Temperature (At hottest point)                   | 210 max   | °C    |

#### **MAXIMUM CIRCUIT VALUE:**

Grid-No.1-Circuit Resistance

0.47 max megohm

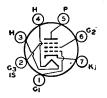
- \* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10
- Ounder no circumstances should this absolute value be exceeded.
- \* Obtained through a series dropping resistor of sufficient magnitude to limit the grid-No.2 input to the rated maximum value.
- †† An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

# SHARP-CUTOFF PENTODE

**6AU6A** Related types:

3AU6, 4AU6, 12AU6

Miniature type used in compact radio equipment as rf amplifier especially in high-frequency, wide-band applications; also used as limiter tube in FM equipment. Type 6AU6A has a controlled heater warm-up time for



**7BK** 

use in applications employing series-connected heater strings. Outline 5C, Outlines section. Type requires miniature seven-contact socket and may be operated in any position. For a discussion of limiters, refer to Electron Tube Applications section. For typical operation as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Types 3AU6, 4AU6, and 12AU6 are identical with type 6AU6A except for heater ratings, as shown below.

| 3AU6                             | 4AU6 | 6AU6A | 12AU6 |         |
|----------------------------------|------|-------|-------|---------|
| Heater Voltage (ac/dc)3.15       | 4.2  | 6.3   | 12.6  | volts   |
| Heater Current 0.6               | 0.45 | 0.3   | 0.15  | ampere  |
| Heater Warm-up Time (Average) 11 | 11   | 11    | -     | seconds |

| Peak Heater-Cathode Voltage:                                     |            |       |
|------------------------------------------------------------------|------------|-------|
| Heater negative with respect to cathode                          | 200 max    | volts |
| Heater positive with respect to cathode                          | 200△max    | volts |
| Direct Interelectrode Capacitances:                              |            |       |
| Pentode Connection:                                              |            |       |
| Grid No.1 to Plate                                               | 0.0035 max | pF    |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal |            |       |
| Shield                                                           | 5.5        | pF    |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal     |            |       |
| Shield                                                           | 5.0        | pF    |
| Triode Connection:†                                              |            |       |
| Grid No.1 to Plate, Grid No.2, Grid No.3, and Internal Shield    | 2.6        | pF    |
| Grid No.1 to Cathode and Heater                                  | 3.2        | ρF    |
| Plate, Grid No.2, Grid No.3, and Internal Shield to Cathode and  |            |       |
| Heater                                                           | 1.2•       | pF    |
| A The dc component must not exceed 100 volts.                    |            |       |

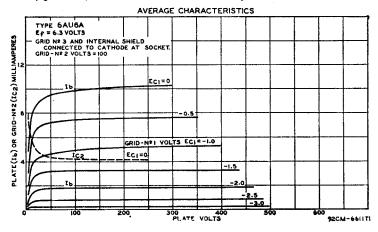
- † Grid No.2, grid No.3, and internal shield connected to plate.
- Value is 8.5 pF with external shield connected to cathode.

## Class A<sub>1</sub> Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):            | Triode†<br>Connection | Pentode<br>Connection |       |
|-----------------------------------------------------|-----------------------|-----------------------|-------|
| Plate Voltage                                       | 275 max               | 330 max               | volts |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value | _                     | 0 max                 | volts |
| Grid-No.2 (Screen-Grid) Voltage                     | -                     | See curve pa          | ge 80 |
| Grid-No.2 Supply Voltage                            |                       | 330 max               | volts |
| Plate Dissipation                                   | 3.5 max               | 3.5 max               | watts |
| Grid-No.2 Input:                                    |                       |                       |       |
| For grid-No.2 voltages up to 165 volts              | _                     | 0.75 max              | watt  |
| For grid-No.2 voltages between 165 asd 330 volts.   | _                     | See curve pa          | ge 80 |
| Grid-No.1 (Control-Grid) Voltage:                   |                       |                       |       |
| Positive-bias value                                 | 0 max                 | 0 max                 | volts |

|                                     | Triode  |           | 4- 0        |            |         |
|-------------------------------------|---------|-----------|-------------|------------|---------|
| CHARACTERISTICS:                    | Connect | ion Pento | de Connecti | O <b>n</b> |         |
| Plate Supply Voltage                | 250     | 100       | 250         | 250        | volts   |
| Grid No.3                           | _       | Connected | to cathode  | at socket  |         |
| Grid-No.2 Supply Voltage            | _       | 100       | 125         | 150        | volts   |
| Cathode-Bias Resistor               | 330     | 150       | 100         | 68         | ohms    |
| Amplification Factor                | 36      | _         | _           | _          |         |
| Plate Resistance (Approx.)          |         | 0.5       | 1.5         | 1.0        | megohms |
| Transconductance                    | 4800    | 3900      | 4500        | 5200       | μmhos   |
| Grid-No.1 Voltage for plate current |         |           |             |            |         |
| of 10 μA                            | _       | -4.2      | -5.5        | -6.5       | volts   |
| Plate Current                       | 12.2    | 5.0       | 7.6         | 10.6       | mA      |
| Grid-No.2 Current                   |         | 2.1       | 3.0         | 4.3        | mA      |

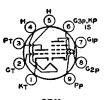
† Grid No.2, grid No.3, and internal shield connected to plate.



# MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

# 6AU8A Related type:

Miniature type used in television receiver applications. This type has controlled heater warm-up time for use in series-heater strings. Pentode unit is used as video amplifier, if amplifier, age amplifier. Triode unit is used in



9DX

sync-amplifier, sync-separator, sync-clipper, and phase-inverter circuits. Outline 6E, **Outlines** section. This type requires nine-contact socket and may be mounted in any position. Type 8AU8 is identical with type 6AU8A except for heater ratings, as shown below.

|                                                         | 6AU8A             | 8AU8        |              |
|---------------------------------------------------------|-------------------|-------------|--------------|
| Heater Voltage (ac/dc)                                  | 6.3               | 8.4         | volts        |
| Heater Current                                          | 0.6               | 0.45        | ampere       |
| Heater Warm-up Time (Average)                           | 11                | -           | seconds      |
| Peak Heater-Cathode Voltage:                            |                   |             | 20002140     |
| Heater negative with respect to cathode                 | 200 max           | 200 max     | volts        |
| Heater positive with respect to cathode                 | 200 max           | 200 max     | volts        |
| Direct Interelectrode Capacitances:                     | 200-max           | 200-max     | VOILS        |
| Triode Unit:                                            |                   |             |              |
| Grid to Plate                                           |                   | 2.2         | ρF           |
| Grid to Cathode and Heater                              |                   | 2.6         | pF           |
| Plate to Cathode and Heater                             |                   | 0.34        | pF           |
| Pentode Unit:                                           |                   | 0.34        | рг           |
|                                                         |                   | 0.06        | n te         |
| Grid No.1 to Plate                                      | ad Internal       | 0.00        | pF           |
|                                                         | nu internai       | 7.5         | - 17         |
|                                                         |                   | 1.5         | pF           |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, an      | id internal       | 2.4         | 17           |
| Shield Triode Grid to Pentode Plate                     | • • • • • • • • • | 3.4         | pF           |
| Pentode Grid No.1 to Triode Plate                       |                   | 0.022 max   | pF           |
| Pentode Dista to Trieda Dista                           | • • • • • • • •   | 0.006 max   | pF           |
| Pentode Plate to Triode Plate                           | • • • • • • • • • | 0.12 max    | pF           |
| • The dc component must not exceed 100 volts.           |                   |             |              |
| MAXIMUM RATINGS (Design-Maximum Values):                | Triode Unit       | Pentode Uni | t            |
| Plate Voltage                                           | 330 max           | 330 max     | volts        |
| Grid-No.2 (Screen-Grid) Supply Voltage                  |                   | 330 max     | volts        |
| Grid-No.2 Voltage                                       | _                 |             | page 80      |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value   | 0 max             | 0 max       | volts        |
| Plate Dissipation                                       | 2.8 max           | 3.3 max     | watts        |
| Grid-No.2 Input:                                        | 2.0 Illax         | J.J IIIAA   | watts        |
| For grid-No.2 voltages up to 165 volts                  |                   | 1 max       | watt         |
| For grid-No.2 voltages between 165 and 330 volts        |                   | See curve   |              |
|                                                         |                   | DCC CUI (   | page oo      |
|                                                         |                   |             |              |
| CHARACTERISTICS:                                        |                   |             |              |
|                                                         |                   | •••         |              |
| Plate Supply Voltage                                    | 150               | 200         | volts        |
| Grid-No.2 Supply Voltage                                | 450               | 125         | volts        |
| Cathode-Bias Resistor                                   | 150               | 82          | ohm <b>s</b> |
| Amplification Factor                                    | 43                | 400000      | _            |
| Plate Resistance (Approx.)                              | 8100              | 100000      | ohms         |
| Transconductance                                        | 5300              | 8000        | μmhos        |
| Grid-No.1 Voltage (Approx.) for plate current of 100 µA | -6.5              | <b>-7.5</b> | volts        |
| Plate Current Grid-No.2 Current                         | 9.5               | 17          | mA           |
| Glid-No.2 Cultent                                       | -                 | 3.4         | mA           |
| MAXIMUM CIRCUIT VALUES:                                 |                   |             |              |
| Grid-No.1-Circuit Resistance:                           |                   |             |              |
| For fixed biog assertion                                |                   | 0.05        |              |

C.5 max

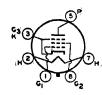
1.0 max

0.25 max megohm

1.0 max megohm

For fixed-bias operation .....

For cathode-bias operation .....



# **BEAM POWER TUBE**

Glass octal type used as horizontal deflection amplifier in television receivers employing either transformer coupling or direct coupling to the de- 12AV5GA, 25AV5GA flecting yoke. Outline 19C, Outlines section. This type requires octal socket

# 6AV5GA

Related types:

6CK

and may be mounted in any position. Types 12AV5GA and 25AV5GA are identical with type 6AV5GA except for heater ratings, as shown below.

|                                         | 6AV5GA  | 12AV5GA   | 25AV5GA |               |
|-----------------------------------------|---------|-----------|---------|---------------|
| Heater Voltage (ac/dc)                  | 6.3     | 12.6      | 25      | volts         |
| Heater Current                          |         | 0.6       | 0.3     | amperes       |
| Heater Warm-up Time (Average)           |         | 11        | _       | seconds       |
| Peak Heater-Cathode Voltage:            |         |           |         |               |
| Heater negative with respect to cathode | 200 max | 200 max   | 200 max | volts         |
| Heater positive with respect to cathode | 200 max | c 200=max | 200=max | volts         |
| Transconductance*                       |         |           | 5900    | μmho <b>s</b> |
| Mu Factor, Grid No.2 to Grid No.1**     |         |           | 4.3     |               |

- The dc component must not exceed 100 volts.
- \* Plate volts, 250; grid-No.2 volts, 150; grid-No.1 volts, -22.5.
- \*\* Triode connected; plate and grid-No.2 volts, 150; grid-No.1 volts, -22.5.

### **Horizontal Deflection Amplifier**

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Center Values):               |           |       |
|-------------------------------------------------------|-----------|-------|
| DC Plate Voltage                                      | 550 max   | volts |
| Peak Positive-Pulse Plate Voltage† (Absolute Maximum) | 5500°max  | volts |
| Peak Negative-Pulse Plate Voltage                     | -1250 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage                    | 175 max   | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage  | -300 max  | volts |
| Peak Cathode Current                                  | 400 max   | mΑ    |
| Average Cathode Current                               | 110 max   | mΑ    |
| Grid-No.2 Input                                       | 2.5 max   | watts |
| Plate Dissipation††                                   | 11 max    | watts |
| Bulb Temperature (at hottest point)                   | 210 max   | ۰c    |

#### MAXIMUM CIRCUIT VALUE:

Grid-No.1 Circuit Resistance ......

0.47 max megohm

- † The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- Under no circumstances should this absolute value be exceeded.
- †† An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

# P02

# TWIN DIODE ... HIGH-MU TRIODE

Miniature type used as combined detector, amplifier, and ave tube in automobile and ac-operated radio re- 3AV6, 4AV6, 12AV6 ceivers. The 6AV6 may be substidirectly for the 6AT6 tuted applications where the higher ampli-

Related types:

fication of the 6AV6 is advantageous. Types 3AV6, 4AV6, and 12AV6 are identical with type 6AV6 except for heater ratings, as shown below.

| Hanton Waltone (a-/da)                                        | 3AV6         | 4AV6                | 6AV6              | 12AV6      |         |
|---------------------------------------------------------------|--------------|---------------------|-------------------|------------|---------|
| Heater Voltage (ac/dc)                                        | 3.15         | 4.2                 | 6.3               | 12.6       | volts   |
| Heater Current                                                | 0.6          | 0.45                | 0.3               | 0.15       | ampere  |
| Heater Warm-up Time (Average)                                 | 11           | 11                  | _                 |            | seconds |
| Peak Heater-Cathode Voltage:                                  |              |                     |                   |            |         |
| Heater negative with respect to cath                          | 10d <b>e</b> |                     |                   | 200 max    | volts   |
| Heater positive with respect to cath                          | ode          |                     |                   | 200₄max    | volts   |
| Direct Interelectrode Capacitances:                           |              |                     |                   | 200-1114.1 | TOTES   |
| Triode Grid to Triode Plate                                   |              |                     |                   | 2.0        | pF      |
| Triode Grid to Cathode and Heater                             |              |                     |                   | 2.2        | pF      |
| Triode Plate to Cathode and Heater                            |              |                     |                   | 0.8=       | ρF      |
| Plate of Diode Unit No.2 to Triode                            | Grid         |                     |                   | 0.04 max   | рF      |
|                                                               |              |                     |                   | 0.04 max   | рг      |
| a The dc component must not exceed 100                        | volts.       |                     |                   |            |         |
| <ul> <li>This value is 1.2 pF with external shield</li> </ul> | connecte     | d to cathod         | de.               |            |         |
| Triode Unit                                                   | As Cla       | ıss A. Am           | plifier           |            |         |
| MAXIMUM RATING (Design-Maximum                                | Value)       | :                   |                   |            |         |
| Plate Voltage                                                 |              |                     |                   | 330 max    | volts   |
| Grid Voltage, Positive-bias value                             |              |                     |                   | 0 max      | volts   |
| Plate Dissipation                                             |              |                     | • • • • • • • • • | 0.55 max   |         |
|                                                               |              | • • • • • • • • • • |                   | 0.55 max   | watt    |
| CHARACTERISTICS:                                              |              |                     |                   |            |         |
| Plate Voltage                                                 |              |                     | 100               | 250        | volts   |
| Grid Voltage                                                  |              |                     | -1                | 2          | volts   |
| Amplification Factor                                          |              |                     | 100               | 100        | 7 Oxto  |

## **Diode Units**

80000

1250

0.50

MAXIMUM RATING (Design-Maximum Value):

Plate Current .....

Plate Resistance .....

Transconductance .....

# Installation and Application

Type 6AV6 requires miniature seven-contact socket and may be mounted in any position. Outline 5C, **Outlines** section.

The triode unit of the 6AV6 is recommended for use only in resistance-coupled circuits. Refer to the Resistance-Coupled Amplifier section for typical operating conditions.

Grid bias for the triode unit of the 6AV6 may be obtained from a fixed source, such as a fixed-voltage tap on the dc power supply, or from a cathode-bias resistor. It should not be obtained by the diode-biasing method because of the probability of plate-current cutoff, even with relatively small signal voltages applied to the diode circuit.

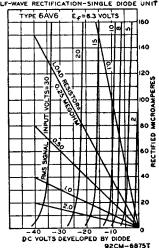


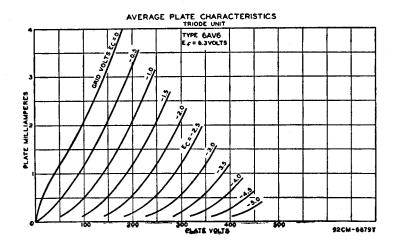
62500

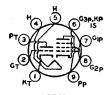
1600

ohms

umhos







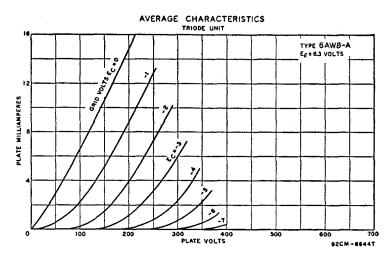
# HIGH-MU TRIODE-SHARP-CUTOFF PENTODE

Miniature type used in a wide variety of applications in television receivers. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. The pentode unit is used as an if am**6AW8A** Related type: 8AW8Å

plifier, video amplifier, agc amplifier, or reactance tube. The triode unit is used in low-frequency oscillator, sync-separator, sync-clipper, and phase-splitter circuits. Outline 6E, Outlines section. This type requires miniature nine-contact socket and may be mounted in any position. Type 8AW8A is identical with type 6AW8A except for heater ratings, as shown below.

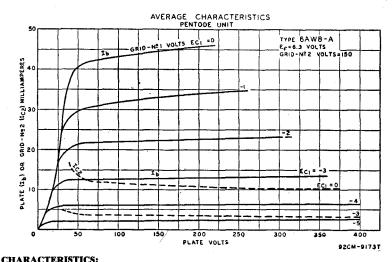
|                                             | 6AW8A     | 8AW8A     | •.      |
|---------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                      | 6.3       | 8.4       | volts   |
| Heater Current                              | 0.6       | 0.45      | ampere  |
| Heater Warm-up Time (Average)               | 11        | 11        | seconds |
| Heater negative with respect to cathode     |           | 200 max   | volts   |
| Heater positive with respect to cathode     |           | 200°max   | volts   |
| Direct Interelectrode Capacitances:         | Without   | With      |         |
| Triode Unit:                                | External  | External  |         |
|                                             | Shield    | Shield*   |         |
| Grid to Plate                               | 2.2       | 2.2       | pF      |
| Grid to Cathode, Pentode Cathode, Pentode   |           |           |         |
| Grid No.3, Internal Shield, and Heater      | 3.2       | 3.4       | pF      |
| Grid to Cathode, Pentode Cathode, Pentode   |           |           |         |
| Grid No.3, Internal Shield, and Heater      | 1.8       | 3.0       | pF      |
| Pentode Unit:                               |           |           |         |
| Grid No.1 to Plate                          | 0.06 max  | 0.05 max  | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2,    |           |           |         |
| Grid No.3, and Internal Shield              | 10        | 10        | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid   |           |           | -       |
| No.3, and Internal Shield                   | 3.6       | 4.5       | рF      |
| Pentode Grid No.1 to Triode Plate           | 0.008 max | 0.005 max | ρF      |
| Pentode Plate to Triode Plate               | 0.15 max  | 0.025 max | pF      |
| The dc component must not exceed 100 volts. |           |           | •       |

• With external shield connected to pins 4 and 5.



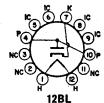
## Class A. Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):          | Triode Unit | Pentode Unit      |
|---------------------------------------------------|-------------|-------------------|
| Plate Voltage                                     | 330 max     | 330 max volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage            | _           | 330 max volts     |
| Grid-No.2 Voltage                                 |             | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage:                 |             |                   |
| Positive bias value                               | 0 max       | 0 max volts       |
| Plate Dissipation                                 | 1.1 max     | 3.75 max watts    |
| Grid-No.2 Input:                                  |             |                   |
| For grid-No.2 voltages up to 165 volts            | _           | 1.1 max watts     |
| For grid-No.2 voltages between 165 and 330 volts. |             | See curve page 80 |



| CHARACTERISTICS.         |     |     |       |
|--------------------------|-----|-----|-------|
| Plate Supply Voltage     | 200 | 150 | volts |
| Grid-No.2 Supply Voltage | _   | 150 | volts |
| Grid-No.1 Voltage        | -2  |     | volts |
| Cathode-Bias Resistor    | _   | 150 | ohms  |
| Amplification Factor     | 70  |     |       |

| 4                                                | Triode Unit Pentode Un |         | nit      |  |
|--------------------------------------------------|------------------------|---------|----------|--|
| Plate Resistance (Approx.)                       | -                      | 0.2     | megohm   |  |
| Transconductance                                 | 4000                   | 9500    | μmhos    |  |
| Grid-No.1 Voltage (Approx.) for plate current of |                        |         |          |  |
| 20 μΑ                                            | <b>—5</b>              | 8       | volts    |  |
| Plate Current                                    | . 4                    | 15      | mA.      |  |
| Grid-No.2 Current                                | _                      | 3.5     | mA       |  |
| MAXIMUM CIRCUIT VALUES:                          |                        |         |          |  |
| Grid-No.1-Circuit Resistance:                    |                        |         |          |  |
| For fixed-bias operation                         | 0.5 max                | 0.25 ma | x megohm |  |
| For cathode-bias operation                       | 1.0 max                | 1.0 ma  | x megohm |  |



# HALF-WAVE VACUUM RECTIFIER

Duodecar type used as damper tube in horizontal-deflection circuits of television receivers. Outline 8C, Outlines Tube requires 12-contact socket and may be mounted in any position. Socket terminals 5, 6, 8, and

12AX3, 17AX3

9 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Types 12AX3 and 17AX3 are identical with type 6AX3 except for heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average) | 1.2 | 12AX3<br>12.6<br>0.6<br>11 | 17AX3<br>16.8<br>0.45<br>11 | volts<br>amperes<br>seconds |  |  |  |
|---------------------------------------------------------------------|-----|----------------------------|-----------------------------|-----------------------------|--|--|--|
| Damper Service                                                      |     |                            |                             |                             |  |  |  |

# For operation in a 525-line, 30-frame system

MAXIMUM RATINGS (Design-Maximum Values):

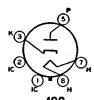
Tube Voltage Drop for plate current of 250 mA .....

| Peak Inverse Plate Voltage <sup>o</sup> | 5000 max | volts |
|-----------------------------------------|----------|-------|
| Peak Plate Current                      | 1000 max | mA    |
| DC Plate Current                        | 165 max  | mA    |
| Plate Dissipation                       | 5.3 max  | watts |
| Peak Heater-Cathode Voltage:            |          |       |
| Heater negative with respect to cathode | 5000=max | volts |
| Heater positive with respect to cathode | 300°max  | volts |
| CITA DA CONDINACIONA                    |          |       |

## CHARACTERISTICS, Instantaneous Value:

The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning

- cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- The dc component must not exceed 900 volts.
- The dc component must not exceed 100 volts.



# HALF-WAVE VACUUM RECTIFIER

Glass octal type used as damper tube in horizontal deflection circuits of 6A television receivers. Outline 13D, Outlines section. May be supplied with pin No.1 omitted. This type requires octal socket and may be operated in

32

volts

Related types: LZAX4GTB. 17AX4GTA. 25AX4GT

any position. Socket terminals 1, 2, 4, and 6 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Types 12AX4GTB, 17AX4GTA, and 25AX4GT are identical with type 6AX4GTB except for heater ratings, as shown below.

|                                           | 6AX4-<br>GTB | 12AX4-<br>GTB | 17AX4-<br>GTA | 25AX4GT       |          |
|-------------------------------------------|--------------|---------------|---------------|---------------|----------|
| Heater Voltage (ac/dc)                    |              | 12.6          | 16.8          | 25            | volts    |
| Heater Current                            | 1.2          | 0.6           | 0.45          | 0.3           | amperes  |
| Heater Warm-up Time (Average)             |              | 11            | 11            | <b>0.</b> 5   | seconds  |
| Direct Interelectrode Capacitances (Appro |              | **            | . 11          |               | seconds  |
| Cathode to Plate and Heater               |              |               |               | 8.5           | pF       |
| Plate to Cathode and Heater               |              |               |               | 5             | pF       |
| Heater to Cathode                         |              |               |               | 4             | pF       |
|                                           |              |               |               |               | •        |
| Date For operation in                     | mper S       |               | me system     |               |          |
| MAXIMUM RATINGS (Design-Maximus           | n Value      | s):           |               |               |          |
| Peak Inverse Plate Voltage                |              |               |               | 5000 max      | volts    |
| Peak Plate Current                        |              |               |               | 1000 max      | mA.      |
| DC Plate Current                          |              |               |               | 165 max       | mA.      |
| Plate Dissipation                         |              |               |               | 5.3 max       | watts    |
| Peak Heater-Cathode Voltage:              |              |               |               |               |          |
| Heater negative with respect to cath      | ode          |               |               | 5000°max      | volts    |
| Heater positive with respect to cath      |              |               |               | 300□max       | volts    |
| CHARACTERISTICS, Instantaneous Te         | st Cond      | ition:        |               |               |          |
| Tube Voltage Drop for plate current of    |              |               |               | 32            | volts    |
| The duration of the voltage pulse must    | not ex       | ceed 15 p     | er cent of o  | ne horizontal | scanning |

- microseconds.
   The dc component must not exceed 900 volts.
- The dc component must not exceed 100 volts.

# **FULL-WAVE VACUUM RECTIFIER**

cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10

# 6AX5GT

Glass octal type used in power supply of radio equipment having moderate dc requirements. Outline 13D, Outlines section. This type may be supplied with pin No.1 omitted. Tube requires octal socket and may be



68

mounted in any position. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac), 6.3; amperes, 1.2.

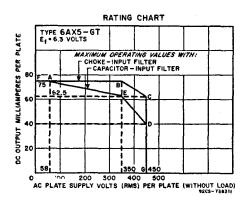
#### **Full-Wave Rectifier**

| MAXIMUM RATINGS (Design-Center Values):                                    |          |           |                  |
|----------------------------------------------------------------------------|----------|-----------|------------------|
| Peak Inverse Plate Voltage                                                 |          | 1250 max  | volts            |
| Peak Plate Current (Per Plate)                                             |          | 375 max   | mA               |
| Hot-Switching Transient Plate Current:                                     |          |           |                  |
| For duration of 0.2 second maximum                                         |          | 2.6 max   | amperes          |
| AC Plate Supply Voltage (Per Plate, rms)                                   |          | See Ratin | g Chart          |
| DC Output Current (Per Plate, rms)                                         |          | See Ratin | g Chart          |
| Peak Heater-Cathode Voltage:                                               |          |           | -                |
| Heater negative with respect to cathode                                    |          | 450 max   | volts            |
| Heater positive with respect to cathode                                    |          | 450 max   | volts            |
| TYPICAL OPERATION WITH CAPACITOR INPUT TO FILTER:                          |          |           |                  |
| AC Plate-to-Plate Supply Voltage (rms)                                     | 700      | 900       | volts            |
| Filter Input Capacitor*                                                    | 10       | 10        | $\mu \mathbf{F}$ |
| Effective Plate-Supply Impedance Per Plate                                 | 50       | 105       | ohms             |
| DC Output Voltage at Input to Filter (Approx.):                            |          |           |                  |
| At half-load current of \ \ \ 62.5 mA \\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ | 395      |           | volts            |
| At hair-load current of 40 mA                                              | <u> </u> | 540       | volts            |
| At full-load current of 125 mA                                             | 350      | _         | volts            |
| 80 mA                                                                      | -        | 490       | volts            |
| Voltage Regulation (Approx.):                                              | 1        |           |                  |
| Half-load to full-load current                                             | 45       | 50        | volts            |
|                                                                            |          |           |                  |

## TYPICAL OPERATION WITH CHOKE INPUT

| IO I'LLIEM.                                                 |       |     |      |         |
|-------------------------------------------------------------|-------|-----|------|---------|
| AC Plate-to-Plate Supply Voltage                            | (rms) | 700 | 900  | volts   |
| Filter Input Choke                                          |       | 10# | 10## | henries |
| DC Output Voltage at Input to F                             |       |     |      |         |
| At half-load current of \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ | 0 mA  | 270 |      | volts   |
| At nan-load current of 125                                  | 5 mA  | _   | 365  | volts   |
| At full-load current of $\begin{cases} 7 \\ 62 \end{cases}$ | 5 mA  | 250 |      | volts   |
| 62.                                                         | 5 mA  |     | 350  | volts   |
| Voltage Regulation (Approx.):                               |       |     |      |         |
| Half-load to full-load current                              |       | 20  | 15   | volts   |
|                                                             |       |     |      |         |

- \* Higher values of capacitance than indicated may be used but the effective plate-supply impedance may have to be increased to prevent exceeding the maximum rating for hot-switching transient plate current.
- # This value is adequate to maintain optimum regulation provided the load current is not less than 30 mA. For load currents less than 30 mA, a larger value of inductance is required for optimum regulation.
- ## This value is adequate to maintain optimum regulation provided the load current is not less than 35 mA. For load currents less than 35 mA, a larger value of inductance is required for optimum regulation.





## HALF-WAVE VACUUM RECTIFIER

Novar types used as damper tubes in horizontal deflection circuits of black-and-white television receivers. Outlines 11D and 30B, respectively, **Outlines** section. Tubes require novar socket and may be operated in any position.

6AY3 6AY3B

Related types: 12AY3, 12AY3A 17AY3, 17AY3A

Socket terminals 1, 3, 6, and 8 should not be used as tie points. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. Types 12AY3 and 12AY3A and types 17AY3 and 17AY3A are identical with types 6AY3 and 6AY3B except for heater ratings, as shown below.

|                                               | DAIS  | 12A Y 3 | 17AY3  |         |
|-----------------------------------------------|-------|---------|--------|---------|
|                                               | 6AY3B | 12AY3A  | 17AY3A |         |
| Heater Voltage (ac/dc)                        | 6.3   | 12.6    | 16.8   | volts   |
| Heater Current                                | 1.2   | 0.6     | 0.45   | amperes |
| Heater Warm-up Time (Average)                 |       | 11      | 11     | seconds |
| Direct Interelectrode Capacitances (Approx.): |       |         |        | overnus |
| Plate to Cathode and Heater                   |       |         | 6.5    | pF      |
| Cathode to Plate and Heater                   |       |         | 9.0    | pF      |
| Heater to Cathode                             |       |         | 2.8    | pF      |
|                                               |       |         | 2.0    | PI      |

Damper Service

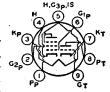
| For operation in a 525-line, 30-frame system                    |          |       |
|-----------------------------------------------------------------|----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):                        |          |       |
| Peak Inverse Plate Voltage                                      | 5000 max | volts |
| Peak Plate Current                                              | 1100 max | mA    |
| DC Plate Current                                                | 175 max  | mA    |
| Plate Dissipation                                               | 6.5 max  | watts |
| Peak Heater-Cathode Voltage:                                    |          |       |
| Heater negative with respect to cathode                         | 5000 max | volts |
| Heater positive with respect to cathode                         | 300□max  | volts |
| The direction of the voltage mules must not arread 15 mm and af |          |       |

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- The dc component must not exceed 900 volts.
- ☐ The dc component must not exceed 100 volts.

## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

6AZ8

Miniature type used in a wide variety of applications in television receivers. The pentode unit is used as an if amplifier, video amplifier, agc amplifier, or reactance tube. The triode unit is used in low-frequency oscillator, sync-



9ED

separator, sync-clipper, and phase-splitter circuits. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc) Heater Current                                                                                                               | 6.3<br>0.45                         | volts<br>ampere |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode  Direct Interelectrode Capacitances: | 200 max<br>200=max                  | volts<br>volts  |
| Triode Unit: Grid to Plate                                                                                                                          | 1.7                                 | рF              |
| Grid to Cathode, Heater, Pentode Grid No.3, and Internal Shield<br>Plate to Cathode, Heater, Pentode Grid No.3, and Internal Shield                 | 2<br>1.7                            | pF<br>pF        |
| Pentode Unit: Grid No.1 to Plate                                                                                                                    | 0.02 max                            | рF              |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield                                                                             | 6.5                                 | pF              |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield                                                                                 | 2.2                                 | pF              |
| Triode Grid to Pentode Plate Pentode Grid No.1 to Triode Plate Pentode Plate to Triode Plate                                                        | 0.027 max<br>0.020 max<br>0.045 max | pF<br>pF<br>pF  |

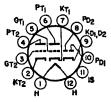
a The heater-cathode voltage of the pentode unit should not exceed the value of the operating cathode bias. If the heater-cathode voltage exceeds the operating cathode bias value, grid No.3 will be made negative with respect to cathode, and thus possibly cause a change in tube characteristics.

• The dc component must not exceed 100 volts.

| - The de component mast not exceed to verse                                          |             |                         |         |
|--------------------------------------------------------------------------------------|-------------|-------------------------|---------|
| Class A <sub>1</sub> Amplifier MAXIMUM RATINGS (Design-Center Values): Plate Voltage | Triode Unit | Pentode Unit<br>300 max | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                                               |             | 300 max                 | volts   |
| Grid-No.2 Voltage                                                                    |             | See curve               | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value.                               | 0 max       | 0 max                   | volts   |
| Plate Dissipation                                                                    | 2.6 max     | 2 max                   | watts   |
| Grid-No.2 Input:                                                                     |             |                         |         |
| For grid-No.2 voltages up to 150 volts                                               | _           | 0.5 max                 | watt    |
| For grid-No.2 voltages between 150 and 300 volts                                     | _           | See curve               | page 80 |
| CHARACTERISTICS:                                                                     |             |                         |         |
| Plate Supply Voltage                                                                 | 200         | 200                     | volts   |
| Grid-No.2 Voltage                                                                    |             | 150                     | volts.  |

| Grid-No.1 Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) Transconductance Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A Grid-No.1 Voltage (Approx.) for transconductance of | -6<br>-9<br>5750<br>3300<br>-19 | 300000<br>6000   | volts<br>ohms<br>ohms<br>µmhos<br>volts |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------|-----------------------------------------|
| 100 μmhos Plate Current Grid-No.2 Current                                                                                                                                                                                | 13                              | 12.5<br>9.5<br>3 | volts<br>mA<br>mA                       |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:* For fixed-bias operation For cathode-bias operation                                                                                                               | 0.5 max<br>1.0 max              |                  | megohm<br>meghom                        |

<sup>\*</sup> If either unit is operating at maximum rated conditions, grid-No.1-circuit resistance for both units should not exceed the stated values.



## TWIN DIODE— MEDIUM-MU TWIN TRIODE

Duodecar type used in television receivers; diode units are used in horizontal-phase-detector circuits, and triode units are used in horizontal-oscillator circuits. Outline 8A, Outlines section. Tube requires duodecar

6B10
Related type:
8B10

5 max

mĄ

volts

12BF lines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 8B10 is identical with type 6B10 except for heater ratings, as shown below

| with type 6B10 except for heater ratings, as shown                                                                           |                          | ODIU IS I                  | dennear                      |
|------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------|------------------------------|
| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average) Peak Heater-Cathode Voltage:                             | 6B10<br>6.3<br>0.6<br>11 | 8B10<br>8.5<br>0.45<br>11  | volts<br>ampere<br>seconds   |
| Heater negative with respect to cathode Heater positive with respect to cathode  The dc component must not exceed 100 volts, | 200 max<br>200°max       | 200 max<br>200°max         | volts<br>volts               |
| Class A, Amplifier (Each Tri                                                                                                 | iode Unit)               |                            |                              |
| MAXIMUM RATINGS (Design-Maximum Value):                                                                                      |                          |                            |                              |
| Plate Voltage DC Cathode Current Plate Dissipation CHARACTERISTICS:                                                          |                          | 330 max<br>20 max<br>3 max | volts<br>mA<br>watts         |
| Plate Voltage Grid Voltage Amplification Factor                                                                              |                          | 250<br>8<br>18             | volts<br>volts               |
| Plate Resistance (Approx.) Transconductance Plate Current Grid Voltage (Approx.) for plate current of 50 μA                  |                          | 7200<br>2500<br>10<br>—20  | ohms<br>µmhos<br>mA<br>volts |
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance: For fixed-bias operation                                                    |                          | 0.25 max                   | megohm                       |
| For cathode-bias operation                                                                                                   |                          |                            | megohm                       |
| Diode Units (Each Ur                                                                                                         | nit)                     |                            |                              |
| MAXIMUM RATING (Design-Maximum Value):                                                                                       |                          |                            |                              |

Plate Current .....

Tube Voltage Drop for plate current of 20 mA ......

CHARACTERISTICS, Instantaneous Value:

## HALF-WAVE VACUUM RECTIFIER

**6BA3** 

Novar type used as damper tube in horizontal-deflection circuits of television receivers. Outline 11B or 30C, Outlines section. Tube requires novar nine-contact socket and may be mounted in any position. Socket termi-



9HP

nals 1, 3, 6, and 8 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated.

| Heater Voltage (ac/dc)                         | 6.3 | volts   |
|------------------------------------------------|-----|---------|
| Heater Current                                 | 1.2 | amperes |
| Direct Interelectrode Capacitances, (Approx.): |     | •       |
| Plate to Cathode and Heater                    | 4.4 | рF      |
| Cathode to Plate and Heater                    | 6   | pF      |
| Heater to Cathode                              | 1.8 | pF      |
| 4                                              |     |         |

#### Damper Service

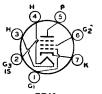
For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |          |       |
|------------------------------------------|----------|-------|
| Peak Inverse Plate Voltage               | 5000 max | volts |
| Peak Plate Current                       | 1000 max | mA    |
| DC Plate Current                         | 165 max  | mA    |
| Plate Dissipation                        | 5.3 max  | watts |
| Peak Heater-Cathode Voltage:             |          |       |
| Heater negative with respect to cathode  | 5000*max | volts |
| Heater positive with respect to cathode  | 300□max  | volts |

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- The dc component must not exceed 900 volts.
- D The dc component must not exceed 100 volts.

## REMOTE-CUTOFF PENTODE

6BA6 Related types: 3BA6, 12BA6 Miniature type used as rf amplifier in standard broadcast and FM receivers, as well as in wide-band, highfrequency applications. The low value of grid-No.1-to-plate capacitance minimizes regenerative effects, while the



7BK

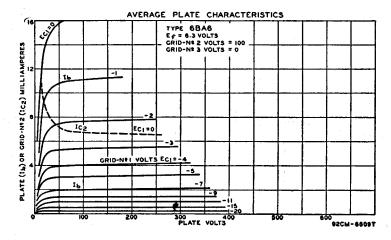
high transconductance makes possible high signal-to-noise ratio. Types 3BA6 and 12BA6 are identical with type 6BA6 except for heater ratings, as shown below.

|                                              | 3BA6                          | 6BA6       | 12BA6      |         |
|----------------------------------------------|-------------------------------|------------|------------|---------|
| Heater Voltage (ac/dc)                       | 3.15                          | 6.3        | 12.6       | volts   |
| Heater Current                               | 0.6                           | 0.3        | 0.15       | ampere  |
| Heater Warm-up Time (Average)                | 11                            |            | _          | seconds |
| Peak Heater-Cathode Voltage:                 |                               |            |            |         |
| Heater negative with respect to cathode      | 200 max                       | 200 max    | 200 max    | volts   |
| Heater positive with respect to cathode      | 200△max                       | 200₄max    | 200∧max    | volts   |
| Direct Interelectrode Capacitances:          |                               |            |            |         |
| Grid No.1 to Plate                           | · · · · · · · · · · · · · · · |            | 0.0035 max | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Gr. | id No.3, an                   | d Internal |            |         |
| Shield                                       |                               |            | 5.5        | рF      |
| Plate to Cathode, Heater, Grid No.2, Grid    | No.3, and                     | d Internal |            | _       |
| Shield                                       | <del></del> .                 |            | 5=         | рF      |

- A The dc component must not exceed 100 volts.
- This value is 5.5 pF with external shield connected to cathode.

| C | 220 | ٨  | A  | mi | ifier |
|---|-----|----|----|----|-------|
|   | 255 | A. | AШ | DI | птег  |

| MAXIMUM RATINGS (Design-Maximum Values):            |                 |              |              |
|-----------------------------------------------------|-----------------|--------------|--------------|
| Plate Voltage                                       |                 | 330 m        | ax volts     |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value |                 | 0 m          | ax volts     |
| Grid-No.2 (Screen-Grid) Voltage                     |                 | See o        | urve page 80 |
| Grid-No.2 Supply Voltage                            |                 | 330 m        | ax volts     |
| Plate Dissipation                                   |                 | 3.4 m        | ax watts     |
| Grid-No.2 Input:                                    |                 |              |              |
| For grid-No.2 voltages up to 165 volts              |                 | 0.7 m        | ax watt      |
| For grid-No.2 voltages between 165 and 330 volts    |                 | See c        | urve page 80 |
| Grid-No.1 (Control-Grid) Voltage:                   |                 |              | • -          |
| Negative bias value                                 |                 | 55 m         | ax volts     |
| Positive bias value                                 | • • • • • • • • | 0 m          | ax volts     |
| CHARACTERISTICS:                                    |                 |              |              |
| Plate Supply Voltage                                | 100             | 250          | volts        |
| Grid No.3 and Internal Shield                       | Connec          | ted to catho | de at socket |
| Grid-No. 2 Supply Voltage                           | 100             | 100          | volts        |
| Cathode-Bias Resistor                               | 68              | 68           | ohms         |
| Plate Resistance (Approx.)                          | 0.25            | 1.0          | megohm       |
| Transconductance                                    | 4300            | 4400         | μmhos        |
| Grid-No.1 Voltage (Approx.) for transconductance    | 4               |              | •            |
| of 40 $\mu$ mhos                                    | -20             | -20          | volts        |
| Plate Current                                       | 10.8            | 11           | mA           |
| Grid-No.2 Current                                   | 4.4             | 4.2          | mA           |



## **Installation and Application**

Type 6BA6 requires miniature seven-contact socket and may be mounted in any position. Outline 5C, Outlines section.

Control-grid bias variation will be found effective in changing the volume of the receiver. In order to obtain adequate volume control, an available grid-No.1-bias voltage of approximately 50 volts will be required. The exact value will depend upon the circuit design and operating conditions. This voltage may be obtained, depending on the receiver requirements, from a potentiometer across a fixed supply voltage, from a variable cathode-bias resistor, from the avc system or from a combination of these methods.

The grid-No.2 (screen-grid) voltage may be obtained from a potentiometer or bleeder circuit across the B-supply source, or through a dropping resistor from the plate supply. The use of series resistors for obtaining satisfactory control of grid-No.2 voltage in the case of four-electrode tubes is usually impossible because of secondary-emission phenomena. In the 6BA6, however, because grid No.3 practically removes these effects, it is practical to obtain grid-No.2 voltage through a

series-dropping resistor from the plate supply or from some high intermediate voltage, provided the source does not exceed the plate-supply voltage. With this method, the grid-No.2-to-cathode voltage will fall off very little from minimum to maximum value of the resistor controlling cathode bias. In some cases, it may actually rise. This rise of grid-No.2-to-cathode voltage above the normal maximum value is allowable because both the grid-No.2 current and the plate current are reduced simultaneously by a sufficient amount to prevent damage to the tube. It should be recognized that, in general, the series-resistor method of obtaining grid-No.2 voltage from a higher voltage supply necessitates the use of the variable cathode-resistor method of controlling volume in order to prevent too high a voltage on grid No.2. When grid-No.2 and control-grid voltage are obtained in this manner, the remote "cutoff" advantage of the 6BA6 can be fully realized. However, it should be noted that the use of a resistor in the grid-No.2 circuit will have an effect on the change in plate resistance with variation in grid-No.3 (suppressorgrid) voltage in case grid No.3 is utilized for control purposes.

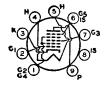
Grid No.3 (suppressor grid) may be connected directly to the cathode or it may be made negative with respect to the cathode. For the latter condition, the grid-No.3 voltage may be obtained from a potentiometer or bleeder circuit, or

from the avc system.

#### PENTAGRID CONVERTER

# **6BA7**

Miniature type used as converter in superheterodyne circuits especially those for the FM broadcast band. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.



8CT

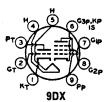
Heater volts (ac/dc), 6.3; amperes, 0.3; peak heater-cathode volts, 90.

#### **Converter Service**

| MAXIMUM RATINGS (Design-Center Values):   |           |            |          |
|-------------------------------------------|-----------|------------|----------|
| Plate Voltage                             |           | 300 max    | voits    |
| Grid-No.5-and-Internal-Shield Voltage     |           | 0 max      | volts    |
| Grids-No.2-and-No.4 (Screen-Grid) Voltage |           | 100 max    | volts    |
| GridsNo.2-and-No.4 Supply Voltage         |           | 300 max    | volts    |
| Plate Dissipation                         |           | 2.0 max    | watts    |
| Grids-No.2-and-No4 Input                  |           | 1.5 max    | watts    |
| Total Cathode Current                     |           | 22 max     | mA       |
| Grid-No.3 Voltage:                        |           |            |          |
| Negative bias value                       |           | -100 max   | volts    |
| Positive bias value                       |           | 0 max      | volts    |
| CHARACTERISTICS (Separate Excitation):*   |           |            |          |
| Plate Voltage                             | 100       | 250        | volts    |
| Grid No.5 and Internal Shielda            | Connected | directly t | o ground |
| Grids-No.2-and-No.4 (Screen-Grid) Voltage | 100       | 100        | volts    |
| Grid-No.3 (Control-Grid) Voltage          | -1.0      | -1.0       | volt     |
| Grid-No.1 (Oscillator-Grid) Resistor      | 20000     | 20000      | ohms     |
| Plate Resistance (Approx.)                | 0.5       | 1.0        | megohm   |
| Conversion Transconductance               | 900       | 950        | μmhos    |
| Conversion Transconductance (Approx.)**   | 3.5       | 3.5        | μmhos    |
| Plate Current                             | 3.6       | 3.8        | mA       |
| Grids-No.2-and-No.4 Current               | 10.2      | 10         | m.A.     |
| Grid-No.1 Current                         | 0.35      | 0.35       | mA       |
| Total Cathode Current                     | 14.2      | 14.2       | mA       |

NOTE: The transconductance between grid No.1 and grids No.2 and No.4 connected to plate (not oscillating) is approximately 8000  $\mu$ mhos under the following conditions: signal applied to grid No.1 at zero bias; grids No.2 and No.4 and plate at 100 volts; grid No.3 grounded. Under the same conditions, the plate current is 32 milliamperes, and the amplification factor is 16.5.

- The characteristics shown with separate excitation correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.
- \*\* With grid-No.3 bias of -20 volts.
- AInternal Shield (pins No.6 and No.8) connected directly to ground.



## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in a wide variety of applications in color and blackand-white television receivers. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. The 6BA8A
Related type:
8BA8A

pentode unit is used as a video amplifier, an age amplifier, or a reactance tube. The triode unit is used in low-frequency oscillator and phase-splitter circuits. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 8BA8A is identical with type 6BA8A except for the heater ratings, as shown below.

|                                               | 6BA8A    | 8BA8A    |         |
|-----------------------------------------------|----------|----------|---------|
| Heater Voltage (ac/dc)                        | 6.3      | 8.4      | volts   |
| Heater Current                                | 0.3      | 0.45     | ampere  |
| Heater Warm-up Time (Average)                 | 11       | _        | seconds |
| Peak Heater-Cathode Voltage:                  |          |          |         |
| Heater negative with respect to cathode       | 200 max  | 200 max  | volts   |
| Heater positive with respect to cathode       | 200° max | 200° max | volts   |
|                                               | Without  | With     |         |
| Direct Interelectrode Capacitances (Approx.): | External | External |         |
| Triode Unit:                                  | Shield   | Shield=  |         |
| Grid to Plate                                 | 2.2      | 2.2      | pF      |
| Grid to Cathode and Heater                    | 2.5      | 2.7      | рF      |
| Plate to Cathode and Heater                   | 0.4      | 1.9      | pF      |
| Pentode Unit:                                 |          |          | -       |
| Grid No.1 to Plate                            | 0.06     | 0.05     | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid |          |          |         |
| No.3, and Internal Shield                     | 10       | 10       | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid     |          |          |         |
| No.3, and Internal Shield                     | 3.6      | 4.5      | ₽F      |
| Triode Grid to Pentode Plate                  | 0.016    | 0.006    | pF      |
| Pentode Grid No.1 to Triode Plate             | 0.006    | 0.003    | pF      |
| Pentode Plate to Triode Plate                 | 0.15     | 0.023    | рF      |
|                                               |          |          |         |

<sup>°</sup> The dc component must not exceed 100 volts.

#### Class A<sub>1</sub> Amplifier

| MAXIMUM RATINGS (Design-Center Values):           | Triode<br>Unit | Pentode<br>Unit |         |
|---------------------------------------------------|----------------|-----------------|---------|
| Plate Voltage                                     | 300 max        | 300 max         | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage            | _              | 300 max         | volts   |
| Grid-No.2 Voltage                                 | -              | See curve 1     | page 80 |
| Grid-No.1 (Control-Grid) Voltage:                 |                | •               |         |
| Negative bias value                               |                | 50 max          | voits   |
| Positive bias value                               |                | 0 max           | volts   |
| Plate Dissipation                                 | 2 max          | 3.25 max        | watts   |
| Grid-No.2 Input:                                  | Triode Unit    | Pentode Unit    |         |
| For grid-No.2 voltages up to 150 volts            | _              | . 1 max         | watt    |
| For grid-No.2 voltages between 150 and 300 volts. | _              | See curve p     | page 80 |
| CHARACTERISTICS:                                  |                |                 |         |
| Plate-Supply Voltage                              | 200            | 200             | volts   |
| Grid-No.2 Supply Voltage                          | <del></del>    | 150             | volts   |
| Grid-No.1 Voltage                                 | 8              |                 | volts   |
| Cathode-Bias Resistor                             | _              | 180             | ohms    |

With external shield connected to cathode of unit under test.

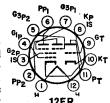
Amplification Factor

| Plate Resistance (Approx.) Transconductance Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A Plate Current Grid-No.2 Current | 6700<br>2700<br>16<br>8 | 400000<br>9000<br>—10<br>13<br>3.5 | ohms<br>µmhos<br>volts<br>mA<br>mA |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------------|------------------------------------|
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation                               | 0.5 max<br>1.0 max      |                                    | x megohm                           |

## TRIODE—TWIN PENTODE

# 6**BA11**

Duodecar type used as vertical deflection oscillator and for combined sync-age applications in television receivers employing series-connected heater strings. Outline 8B, Outlines section. Tube requires duodecar



twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.6; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode). For ratings and characteristics of pentode units, refer to type 6HS8.

Triode Unit As Class A. Amplifier

| MAXIMUM RATINGS (Design-Center Values): Plate Voltage   | 300 max  | volts      |
|---------------------------------------------------------|----------|------------|
| Average Cathode Current                                 | 20 max   | mA         |
|                                                         |          |            |
| Plate Dissipation                                       | 1.5 max  | watts      |
| CHARACTERISTICS:                                        |          |            |
| Plate Voltage                                           | 250      | volts      |
| Grid Voltage                                            | -11      | volts      |
| Amplification Factor                                    | 18       |            |
| Transconductance                                        | 1800     | $\mu$ mhos |
| Plate Current                                           | 5        | mA         |
| Grid Voltage (Approx.) for plate current of 100 $\mu$ A | -18      | volts      |
| MAXIMUM CIRCUIT VALUES:                                 |          |            |
| Grid-Circuit Resistance:                                |          |            |
| For fixed-bias operation                                | 0.25 max | megohm     |
| For cathode-bias operation                              | 1 max    | megohm     |

## MEDIUM-MU TRIODE

6BC4

Miniature type used as an rf amplifier in the cathode-drive circuits of uhf television tuners covering the frequency range of 470 to 890 megacycles per second. Outline 6A, Outlines section. Tube requires miniature ninecontact socket and may be mounted in any position.

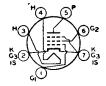


9DR

| volts    | 6.3    | Heater Voltage (ac/dc)                        |
|----------|--------|-----------------------------------------------|
| ampere   | 0.225  | Heater Current                                |
| -        |        | Peak Heater-Cathode Voltage:                  |
| ax volts | 75 max | Heater negative with respect to cathode       |
| ax volts | 75 max | Heater positive with respect to cathode       |
|          |        | Direct Interelectrode Capacitances (Approx.): |
| pF       | 1.6    | Grid to Plate                                 |
| pF       | 2.9    | Grid to Heater and Cathode                    |
| pF       | 0.26   | Plate to Heater and Cathode                   |
| pF       | 2.7    | Heater to Cathode                             |

#### Class A. Amplifier

| MAXIMUM RATINGS (Design-Center Values): Plate Voltage Plate Dissipation Cathode Current                        | 250 max<br>2.5 max<br>25 max | watts                |
|----------------------------------------------------------------------------------------------------------------|------------------------------|----------------------|
| CHARACTERISTICS: Plate Supply Voltage Cathode-Bias Resistor Amplification Factor                               | 150<br>100<br>48<br>4800     | volts<br>ohms        |
| Plate Resistance (Approx.)  Transconductance  Grid Voltage (Approx.) for plate current of 10 µA  Plate Current | 10000<br>10<br>14.5          | μmhos<br>volts<br>mA |
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance: For fixed-bias operation For cathode-bias operation           |                              | ommended<br>megohm   |



#### SHARP-CUTOFF PENTODE

Miniature type used in compact radio equipment as an rf or if amplifier at frequencies up to 400 megacycles per second. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any

6BC5
Related type: 3BC5

7BD

position. For typical operation as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Type 3BC5 is identical with type 6BC5 except for heater ratings, as shown below.

|                                                      | 3BC5      | 6BC5      |         |
|------------------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                               | 3.15      | 6.3       | volts   |
| Heater Current                                       | 0.6       | 0.3       | ampere  |
| Heater Warm-up Time (Average)                        | 11        | _         | seconds |
| Peak Heater-Cathode Voltage:                         |           |           |         |
| Heater negative with respect to cathode              | 200 max   | 90 max    | volts   |
| Heater positive with respect to cathode              | 200 ■ max | 90 max    | volts   |
| Direct Interelectrode Capacitances:                  |           |           |         |
| Pentode Connection:                                  |           |           |         |
| Grid No.1 to Plate                                   |           | 0.030 max | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3   | 3, and    |           |         |
| Internal Shield                                      |           | 6.5       | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and  |           |           |         |
| Internal Shield                                      |           | 1.8       | рF      |
| Triode Connection:*                                  |           |           |         |
| Grid No.1 to Plate and Grid No.2                     |           | 2.5       | pF      |
| Grid No.1 to Cathode, Heater, Grid No.3, and Interna | al Shield | 3.9       | pF      |
| Plate and Grid No.2 to Cathode, Heater, Grid No.3,   | and       |           |         |
| Internal Shield                                      |           | 3.0       | pF      |
|                                                      |           |           |         |

<sup>•</sup> The dc component must not exceed 100 volts.

#### Class A<sub>1</sub> Amplifier

|                                                        | 1 riode     | Pentode       |       |
|--------------------------------------------------------|-------------|---------------|-------|
| MAXIMUM RATINGS (Design-Center Values):                | Connection* | Connection    |       |
| Plate Voltage                                          | 300 max     | 300 max       | volts |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | _           | 300 max       | volts |
| Grid-No.2 Voltage                                      |             | See curve pag | e 80  |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value. | 0 max       | 0 max         | volts |
| Plate Dissipation                                      | 2.5 max     | 2 max v       | vatts |
| Grid-No.2 Input:                                       |             |               |       |
| For grid-No.2 voltages up to 150 volts                 | _           | 0.5 max       | watt  |
| For grid-No.2 voltages between 150 and 300 volts       | _           | See curve pag | e 80  |
| -                                                      |             |               |       |

<sup>\*</sup> Grid No.2 connected to plate,

| <u></u>                                          | Tr    | iod <b>e</b> |      | Pentod  | e    |           |
|--------------------------------------------------|-------|--------------|------|---------|------|-----------|
| CHARACTERISTICS:                                 |       | ection*      | C    | onnecti | ion  |           |
| Plate Supply Voltage                             | 180   | 250          | 100  | 125     | 250  | volts     |
| Grid-No.2 Supply Voltage                         | _     |              | 100  | 125     | 150  | volts     |
| Cathode-Bias Resistor                            | 330   | 820          | 180  | 100     | 180  | ohms      |
| Amplification Factor                             |       | 40           | _    |         |      | 0111110   |
| Plate Resistance (Approx.)                       | 0.006 | 0.009        | 0.6  | 0.5     | 0.8  | megohm    |
| Transconductance                                 | 6000  | 4400         | 4900 | 6100    | 5700 | umhos     |
| Grid-No.1 Voltage (Approx.) for plate current of |       |              |      |         | 2.00 | , million |
| 10 μΑ                                            | _     |              | 5    | -6      | 8    | volts     |
| Plate Current                                    | 8     | 6            | 4.7  | 8       | 7.5  | mA        |
| Grid-No.2 Current                                | _     | _            | 1.4  | 2.4     | 2.1  | mA        |
|                                                  |       |              |      |         |      |           |

<sup>•</sup> Grid No.2 connected to plate.

#### TRIPLE DIODE

**6BC7** 

Miniature type containing three highperveance diode units in one envelope; used in dc restorer circuits of Po<sub>3</sub>(2) color television receivers. Also used in AM/FM radio receivers as a combination FM discriminator and AM



detector tube. Outline 6B, Outlines section. Tube requires nine-contact miniature socket and may be mounted in any position.

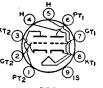
| Heater Voltage (ac/dc)                                   | 6.3    | volts     |
|----------------------------------------------------------|--------|-----------|
| Heater Current                                           | 0.450  | ampere    |
| Peak Heater-Cathode Voltage:                             | 0,450  | umpero    |
| Heater negative with respect to cathode                  | 200 m  | ax volts  |
| Heater positive with respect to cathode                  | 200 m  |           |
| Direct Interelectrode Capacitances (Approx.):            | 200 11 | iaa toits |
| Diode-No.1 Plate to Diode-No.1 Cathode, Heater, and      |        |           |
| Internal Shield                                          | 3.5    | рF        |
| Diode-No.2 Plate to Diode-No.2 Cathode, Heater, and      | 3.3    | pr.       |
| Internal Shield                                          | 5.5    | pF        |
| Diode-No.3 Plate to Diode-No.3 Cathode, Heater, and      | 5.5    | Px.       |
| Internal Shield                                          | 3.5    | рF        |
|                                                          | 3.3    | p.        |
| MAXIMUM RATINGS (Design-Center Values, Each Diode Unit): |        |           |
| Peak Inverse Plate Voltage                               | 330 m  | ax volts  |
| Peak Plate Current*                                      | 54 m   |           |
| DC Output Current                                        | 12 m   |           |
| De duput current                                         | 12 111 | 10A 211/1 |

<sup>\*</sup> In rectifier service, the minimum total effective plate-supply impedance per plate is 560 ohms.

## MEDIUM-MU TWIN TRIODE

6BC8
Related type:
4BC8

Miniature type used in direct-coupled KT2 cathode-drive rf amplifier circuits of whf television tuners. In such circuits, one triode unit is used as the direct-coupled grounded-cathode driver for the other unit. This type is also used



9AJ

in push-pull cathode-drive rf amplifiers. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 4BC8 is identical with type 6BC8 except for heater ratings, as shown below.

|                                         | 4BC8    | 6BC8    |         |
|-----------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                  | 4.2     | 6.3     | volts   |
| Heater Current                          | 0.6     | 0.4     | ampere  |
| Heater Warm-up Time (Average)           | 11      |         | seconds |
| Peak Heater-Cathode Voltage:            |         |         |         |
| Heater negative with respect to cathode | 200₄max | 200₄max | volts   |
| Heater positive with respect to cathode | 200=max | 200 max | volts   |
|                                         |         |         |         |

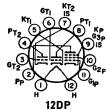
| Direct Interelectrode Capacitances*:              | Unit No.1   | Unit No.2 |    |
|---------------------------------------------------|-------------|-----------|----|
| Grid to Plate                                     | 1.2         | 1.2       | рF |
| Grid to Cathode, Heater, and Internal Shield      | 2.6         |           | рF |
| Cathode to Grid, Heater, and Internal Shield      |             | 5.5       | pF |
| Plate to Cathode, Heater, and Internal Shield     | 1.3         | _         | pF |
| Plate to Grid, Heater, and Internal Shield        | <del></del> | 2.4       | рF |
| Plate to Cathode                                  | _           | 0.12      | рF |
| Heater to Cathode                                 | 2.8         | 2.8       | pF |
| Plate of Unit No.1 to Plate of Unit No.2          | 0.02        | 2 max     | рF |
| Plate of Unit No.2 to Plate and Grid of Unit No.1 | 0.04        | max       | рF |

- A This rating may be as high as 300 volts under cutoff conditions, when the tube is used as a cascode amplifier and the two units are connected in series.
- The dc component must not exceed 100 volts.
- With external shield connected to internal shield.

#### Class A, Amplifier (Each Unit)

| * *                                                                     |               |            |
|-------------------------------------------------------------------------|---------------|------------|
| MAXIMUM RATINGS (Design-Maximum Values):                                | 250₄max       | volts      |
| Plate Voltage                                                           |               |            |
| Plate Dissipation                                                       | 2.2 max       | watts      |
| Cathode Current                                                         | 22 max        | mA         |
| CHARACTERISTICS:                                                        |               |            |
| Plate Supply Voltage                                                    | 150           | volts      |
| Cathode-Bias Resistor                                                   | 220           | ohms       |
| Plate Resistance (Approx.)                                              | 5300          | ohms       |
| Amplification Factor                                                    | 35            |            |
| Transconductance                                                        | 6200          | $\mu$ mhos |
| Grid Voltage (Approx.) for transconductance of 50 µmhos                 | <b>—13</b>    | volts      |
| Plate Current                                                           | 10            | mA         |
| MAXIMUM CIRCUIT VALUES:                                                 |               |            |
| Grid-Circuit Resistance                                                 | 0.5 max       | megohm     |
| A This rating may be as high as 300 volts under cutoff conditions, when | the tube is u | sed as a   |

cascode amplifier and the two units are connected in series.



## **DUAL TRIODE**— SHARP-CUTOFF PENTODE

Duodecar type used in a variety of applications in television receivers. The high-mu triode unit No.1 is used in general-purpose applications, the medium-mu triode unit No.2 in syncseparator circuits, and the pentode 6BD11 15RD11

unit as a video amplifier. Outline 8B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 15BD11 is identical with type 6BD11 except for heater ratings, as shown below.

|                                               | 6BD11     | 15BD11    |         |
|-----------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                        | 6.3       | 14.7      | volts   |
| Heater Current                                | 1.05      | 0.45      | amperes |
| Heater Warm-up Time (Average)                 |           | 11        | seconds |
| Peak Heater-Cathode Voltage:                  |           |           |         |
| Heater negative with respect to cathode       | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode       | 200 • max | 200 • max | volts   |
| • The dc component must not exceed 100 volts. |           |           |         |

| -                                               | •                   |                     |                 |         |
|-------------------------------------------------|---------------------|---------------------|-----------------|---------|
| Class A, A                                      | mplifier            |                     |                 |         |
| MAXIMUM RATINGS (Design-Maximum Values):        | Triode<br>Unit No.1 | Triode<br>Unit No.2 | Pentode<br>Unit |         |
|                                                 | 330 max             | 330 max             | 330 max         | volts   |
| Plate Voltage                                   | Jou max             | JJU IIIAX           |                 |         |
| Grid-No.2 (Screen-Grid) Supply Voltage          | _                   | _                   | 330 max         | volts   |
| Grid-No.2 Voltage                               | _                   | -                   | See curve p     | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias |                     |                     |                 |         |
| value                                           | 0 max               | 0 max               | 0 max           | volts   |
| Plate Dissipation                               | 1.5 max             | 2 max               | 4 max           | watts   |
| Grid-No.2 Input:                                |                     |                     |                 |         |
| For grid-No.2 voltages up to 165 volts          |                     | _                   | 1.1 max         | watts   |
| For grid-No.2 voltages between 165 and          |                     |                     |                 |         |
| 330 volts                                       | _                   | _                   | See curve 1     | page 80 |
|                                                 |                     |                     |                 |         |

|                                               | Triode    | Triode           |       |           |         |
|-----------------------------------------------|-----------|------------------|-------|-----------|---------|
| CHARACTERISTICS:                              | Unit No.1 | Unit No.2        | Pente | de Unit   |         |
| Plate Supply Voltage                          | 200       | 200              | 35    | 135       | volts   |
| Grid-No.2 Supply Voltage                      |           |                  | 135   | 135       | volts   |
| Grid-No.1 Voltage                             | -2        | _                | 0     | 0         | volts   |
| Cathode-Bias Resistor                         | _         | 220              | _     | 100       | ohms    |
| Amplification Factor                          | 68        | 41               |       | -         |         |
| Plate Resistance (Approx.)                    | 12400     | 9400             | _     | 45000     | ohms    |
| Transconductance                              | 5500      | 4400             | _     | 10400     | μmhos   |
| Plate Current                                 | 7         | 9.2              | 34=   | 17        | mA.     |
| Grid-No.2 Current                             |           |                  | 13•   | 4         | mA      |
| Grid-No.1 Voltage (Approx.) for plate current |           |                  |       |           |         |
| of 100 μA                                     |           | 6.5              | _     | -6        | volts   |
| MAXIMUM CIRCUIT VALUES:                       |           |                  |       |           |         |
| Grid-No.1-Circuit Resistance:                 |           |                  |       |           |         |
| For fixed-bias operation                      | 0.5 m     | ax 0.5 max       |       | 1 max i   | negohm  |
| For cathode-bias operation                    | 1 ma      |                  |       |           | negohm  |
| This value may be measured by a method invo   |           | current wavefore | n suc | h that th | e maxi- |

# HALF-WAVE VACUUM RECTIFIER

Related types: 12BE3, 17BE3 Duodecar type used as damper tube horizontal-deflection circuits of television receivers. Outline 8D. Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Types

12GA

12BE3 and 17BE3 are identical with type 6BE3 except for the heater ratings, as shown below.

|                               | 6BE3 | 12BE3 | 17BE3 |         |
|-------------------------------|------|-------|-------|---------|
| Heater Voltage (ac/dc)        | 6.3  | 12.6  | 16.8  | volts   |
| Heater Current                | 1.2  | 0.6   | 0.45  | ampere  |
| Heater Warm-up Time (Average) |      | 11    | 11    | seconds |
| · ·                           |      |       |       |         |

#### Damper Service

| For operation in a 525-line, 30-frame system                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------|
| Tor operation in a 525-inic, 50 frame system                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |       |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |       |
| Peak Inverse Plate Voltage#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>7</b> 000 |       |
| reak inverse riate voltage#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 5000 max     | volts |
| Peak Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1200 max     | . mA  |
| The state of the s |              |       |
| DC Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 200 max      | mA    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |       |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | o.o max      | watts |
| Peak Heater-Cathode Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |       |
| Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 5000 • max   | volts |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |       |
| Heater positive with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 300¤max      | volts |

#### CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for dc plate current of 350 mA .....

mum ratings of the tube will not be exceeded.

#The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10

microseconds.

- The dc component must not exceed 900 volts.
- The dc component must not exceed 100 volts.

## PENTAGRID CONVERTER

Related types: 3BE6, 12BE6

Miniature type used as converter in superheterodyne circuits in both the standard broadcast and FM bands. The 6BE6 is similar in performance to metal type 6SA7. For general discussion of pentagrid types, see



volts

Frequency Conversion in Electron Tube Application section. Types 3BE6 and 12BE6 are identical with type 6BE6 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up time (Average) Peak Heater-Cathode Voltage: | 3BE6<br>3.15<br>0.6<br>11 | 6BE6<br>6.3<br>0.3      | 12BE6<br>12,6<br>0.15 | volts<br>ampere<br>seconds |
|--------------------------------------------------------------------------------------------------|---------------------------|-------------------------|-----------------------|----------------------------|
| Heater negative with respect to cathode Heater positive with respect to cathode                  | 200 max<br>200₄max        |                         | 200 max<br>200₄max    | volts<br>volts             |
|                                                                                                  | 200-iiiax                 | Without<br>External     | With<br>External      | voits                      |
| Direct Interelectrode Capacitances: Grid No.3 to Plate                                           | •                         | Shield<br>0.30 max      | Shield<br>0.25 max    | рF                         |
| Grid No.3 to Grid No.1                                                                           | • • • • • •               | 0.15 max                | 0.15 max              | pF                         |
| Grid No.1 to Plate                                                                               |                           | 0.10 max                | 0.05 max              | pF                         |
| Grid No.3 to All Other Electrodes                                                                |                           | 7.0                     | 7.0                   | pF                         |
| Grid No.1 to All Other Electrodes                                                                |                           | 5.5                     | 5.5                   | pF                         |
| Plate to All Other Electrodes                                                                    |                           | 8.0                     | 13.0                  | ρF                         |
| Grid No.1 to Cathode and Grid No.5                                                               |                           | 3.0                     | 3.0                   | pF                         |
| Cathode and Grid No.5 to All Other Electr                                                        | odes                      |                         |                       | •                          |
| except Grid No.1                                                                                 |                           | 15.0                    | 20.0                  | pF                         |
| A The dc component must not exceed 100 volts.                                                    |                           |                         |                       | -                          |
| • With external shield connected to cathode and                                                  | grid No.5                 | •                       |                       |                            |
| Conve                                                                                            | erter                     |                         |                       |                            |
| MAXIMUM RATINGS (Design-Maximum Val                                                              | ues):                     |                         |                       |                            |
| Plate Voltage                                                                                    |                           |                         | 330 max               | volts                      |
| Grids-No.2-and-No.4 (Screen-Grid) Voltage                                                        |                           |                         | 110 max               | volts                      |
| Grids-No.2-and-No.4 Supply Voltage                                                               |                           |                         | 330 max               | volts                      |
| Plate Dissipation                                                                                |                           |                         | 1.1 max               | watts                      |
| Grids-No.2-and-No.4 Input                                                                        |                           |                         | 1.1 max               | watts                      |
| Cathode Current                                                                                  |                           |                         | 15.5 max              | mA                         |
| Grid-No.3 Voltage: Negative bias value                                                           |                           |                         | -55 max               | volts                      |
| Positive bias value                                                                              | • • • • • • • • •         |                         | 0 max                 | volts                      |
| Peak Heater-Cathode Voltage: Heater negative with respect to cathode                             |                           |                         | 200 max               | volts                      |
| Heater positive with respect to cathode                                                          | · · · · · · · · · · ·     | · · · · · · · · · · · · | 200△max               | volts                      |
| TYPICAL OPERATION (Separate Excitation):                                                         |                           |                         |                       |                            |
| Plate Voltage                                                                                    | <b></b>                   | 100                     | 250                   | volts                      |
| Grids-No.2-and-No.4 (Screen-Grid) Voltage                                                        |                           | 100                     | 100                   | volts                      |
| Grid-No.1 (Oscillator-Grid) Voltage (rms)                                                        |                           | 10                      | 10                    | voits                      |
| Grid-No.3 (Control-Grid) Voltage                                                                 |                           | -1.5                    | 1.5                   | volts                      |
| Grid-No.1 (Oscillator-Grid) Resistor                                                             |                           | 20000                   | 20000                 | ohms                       |
| Plate Resistance (Approx.)                                                                       |                           | 0.4                     | 1.0                   | megohm                     |
| Conversion Transconductance                                                                      |                           | 455                     | 475                   | μmhos                      |
| Grid-No.3 Voltage for conversion transconductan                                                  |                           | ••                      |                       |                            |
| 10 μmhos                                                                                         |                           | <b>—30</b>              | -30                   | volts                      |
| Plate Current                                                                                    | • • • • •                 | 2.6                     | 2.9                   | mA.                        |
| Grids-No.2-and-No.4 Current                                                                      |                           | 7.0                     | 6.8                   | mA                         |
| Cathode Current                                                                                  |                           | 0.5<br>10.1             | 0.5<br>10.2           | mA<br>mA                   |
| NOTE: The transcenductures between acid No.                                                      |                           |                         | 10.2                  | mA                         |

NOTE: The transconductance between grid No.1 and grids No.2 and No.4 connected to plate (not oscillating) is approximately 7250  $\mu$ mhos under the following conditions: grids No.1 and No.3 at 0 volts; grids No.2 and No.4 and plate at 100 volts. Under the same conditions, the cathode current is 25 mA, and the amplification factor is 20. Grid-No.1 voltage (Approx.) for plate current of 10  $\mu$ A is -11 volts.

#### Installation and Application

Type 6BE6 requires miniature seven-contact socket and may be mounted in any position. Outline 5C, Outlines section.

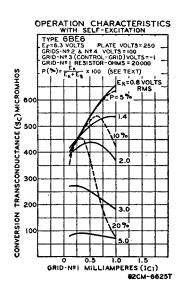
Because of the special structural arrangement of the 6BE6, a change in signal-grid voltage produces little change in cathode current. Consequently, an rf voltage on the signal grid produces little modulation of the electron current flowing in the cathode circuit. This feature is important because it is desirable that the impedance in the cathode circuit should produce little degeneration or regeneration of the signal-frequency input and intermediate-frequency output.

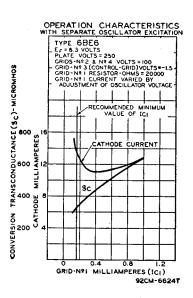
<sup>\*</sup> The characteristics shown with separate excitation correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.

Another important feature is that, because signal-grid voltage has very little effect on the space charge near the cathode, changes in avc bias produce little change in oscillator transconductance and in the input capacitance of grid No.1. There is, therefore, little detuning of the oscillator by avc bias.

A typical self-excited oscillator circuit employing the 6BE6 is given in the Circuit section.

In the 6BE6 operation characteristics curves with self-excitation,  $E_k$  is the voltage across the oscillator-coil section between cathode and ground;  $E_g$  is the oscillator voltage between cathode and grid.





## BEAM POWER TUBE— SHARP-CUTOFF PENTODE

6BF11 Related type: Duodecar type used as combined detector and amplifier tube in television  $e_{ip}$  receivers. The dual-control, sharpcutoff pentode unit is used as an FM detector and the beam power unit as an af output amplifier. Outline 8B,



Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 17BF11 is identical with type 6BF11 except for heater ratings, as shown below.

|                                         | 6BF11   | 17BF11  |         |
|-----------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                  | 6.3     | 16.8    | volts   |
| Heater Current                          | 1.2     | 0.45    | amperes |
| Heater Warm-up Time (Average)           | _       | 11      | seconds |
| Peak Heater-Cathode Voltage:            |         |         |         |
| Heater negative with respect to cathode | 200 max | 200 max | volts.  |
| Heater positive with respect to cathode | 200 max | 200=max | volts   |
|                                         |         |         |         |

<sup>•</sup> The dc component must not exceed 100 volts.

| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                         |              |                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------|
| Plate Voltage                                                                                                                                                                                                                                    | 165 max      | volts                            |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                  | 150 max      |                                  |
| Plate Dissipation                                                                                                                                                                                                                                | 6.5 max      |                                  |
| Grid-No.2 Input                                                                                                                                                                                                                                  | 1.8 max      |                                  |
| Average Cathode Current                                                                                                                                                                                                                          | 65 max       |                                  |
| •                                                                                                                                                                                                                                                |              |                                  |
| TYPICAL OPERATION: Plate Voltage                                                                                                                                                                                                                 | 145          | volts                            |
| Grid-No.2 Voltage                                                                                                                                                                                                                                | 110          | volts                            |
| Grid-No.1 (Control-Grid) Voltage                                                                                                                                                                                                                 | 6            | volts                            |
| Peak AF Grid-No.1 Voltage                                                                                                                                                                                                                        | 6            | volts                            |
| Zero-Signal Plate Current                                                                                                                                                                                                                        | 36           | mA                               |
| Maximum-Signal Plate Current                                                                                                                                                                                                                     | 40           | mA                               |
| Zero-Signal Grid No.2 Current                                                                                                                                                                                                                    | 3            | mA                               |
| Maximum-Signal Grid-No.2 Current                                                                                                                                                                                                                 | 9            | mA                               |
| Plate Resistance (Approx.)                                                                                                                                                                                                                       | 0.03         | megohm                           |
| Transconductance                                                                                                                                                                                                                                 | 8600         | μmhos                            |
| Load Resistance                                                                                                                                                                                                                                  | 3000         | ohms                             |
| Total Harmonic Distortion                                                                                                                                                                                                                        | 10           | per cent                         |
| Maximum-Signal Power Output                                                                                                                                                                                                                      | 2.4          | watts                            |
| For fixed-bias operation  For cathode-bias operation  Pentode Unit as Class A <sub>1</sub> Amplifier  CHARACTERISTICS:  Plate Supply Voltage  Grid-No.3 (Suppressor-Grid) Voltage  Grid-No.3 (Screen-Grid) Supply Voltage  Cathode-Bias Resistor |              | volts<br>volts<br>volts<br>volts |
| Plate Resistance (Approx.)                                                                                                                                                                                                                       | 0.15         | megohm                           |
| Transconductance, Grid No.1 to Plate                                                                                                                                                                                                             | 1000         | μmhos                            |
| Transconductance, Grid No.3 to Plate                                                                                                                                                                                                             | 400          | µmhos                            |
| Plate Current                                                                                                                                                                                                                                    | 1.1 max      | watts                            |
| Grid-No.2 Current                                                                                                                                                                                                                                | 1.3          | mA                               |
| Grid-No.1 Voltage (Approx.) for plate current of 30 $\mu$ A                                                                                                                                                                                      | 2            | mA                               |
| Grid-No.3 Voltage (Approx.) for plate current of 50 $\mu$ A                                                                                                                                                                                      | See cur      | ve page 80                       |
| Pentode Unit as FM Detector MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                             |              |                                  |
| Plate Voltage                                                                                                                                                                                                                                    | 330 max      | volts                            |
| Grid-No.3 Voltage                                                                                                                                                                                                                                | 28 max       | volts                            |
| Grid No.2 Supply Voltage                                                                                                                                                                                                                         | 330 max      | volts                            |
| Grid-No.2 Voltage                                                                                                                                                                                                                                |              | ve page 80                       |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                                                                            | 0 max        | volts                            |
| Plate Dissipation                                                                                                                                                                                                                                | 1.7 max      | watts                            |
| Grid-No.2 Input:                                                                                                                                                                                                                                 | <b>-4</b> .5 | volts                            |
| For grid-No.2 voltages up to 165 volts                                                                                                                                                                                                           | <b>-4.5</b>  | volts                            |

Beam Power Unit as Class A. Amplifier



# HALF-WAVE VACUUM RECTIFIER

Novar types used as damper tubes in horizontal deflection circuits of black-and-white television receivers. Outlines 11D and 30B, respectively, Outlines section. Tubes require novar socket and may be operated in any position.

6BH3A

Related types: 17BH3, 17BH3A, 22BH3, 22BH3A

Socket terminals 1, 3, 6, and 8 should not be used as tie points. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. Types 17BH3 and 17BH3A and types 22BH3 and 22BH3A are identical with types 6BH3 and 6BH3A except for the heater ratings, as shown below.

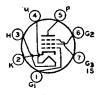
|                                                                   | 6BH3<br>6BH3A | 17BH3<br>17BH3A           | 22BH3<br>22BH3A |               |
|-------------------------------------------------------------------|---------------|---------------------------|-----------------|---------------|
| Heater Voltage (ac/dc)                                            | 6.3           | 17                        | 22.4            | volts         |
| Heater Current                                                    |               | 0.6                       | 0.45            | amperes       |
| Heater Warm-up Time (Average)                                     | ¥.0           | 11                        | 11              | seconds       |
| Direct Interelectrode Capacitances (Approx.):                     |               | **                        | **              | seconds       |
| Plate to Cathode and Heater                                       |               |                           | 6.5             | ρF            |
|                                                                   |               |                           |                 |               |
| Cathode to Plate and Heater                                       |               |                           | 9.0             | ₽F            |
| Heater to Cathode                                                 |               | · · · · · · · · · · · · · | 2.8             | pF            |
| Damper For operation in a 525 MAXIMUM RATINGS (Design-Maximum Val | -line, 30-f   | rame system               |                 |               |
| Peak Inverse Plate Voltage                                        | <i></i> .     |                           | 5500 max        | <b>v</b> olts |
| Peak Plate Current                                                |               |                           | 1100 max        | mA            |
| DC Plate Current                                                  | . <b></b>     |                           | 180 max         | mA            |
| Plate Dissipation                                                 |               |                           | 6.5 max         | watts         |
| Peak Heater-Cathode Voltage:                                      |               |                           | *** ******      |               |
| Heater negative with respect to cathode                           |               |                           | 5500 max        | volts         |
| Heater positive with respect to cathode                           |               |                           | 300□max         | volts         |
|                                                                   |               |                           |                 |               |

The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

## SHARP-CUTOFF PENTODE

# **6BH6**

Miniature type used as rf amplifier particularly in ac/dc receivers and in mobile equipment where low heatercurrent drain is important. It is particularly useful in high-frequency, wide-band applications. Outline 5C,



Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

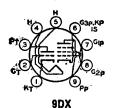
| Heater Voltage (ac/dc)                                  | 6.3        | volts  |
|---------------------------------------------------------|------------|--------|
| Heater Current                                          | 0.15       | ampere |
| Peak Heater-Cathode Voltage:                            |            |        |
| Heater negative with respect to cathode                 | 90 max     | volts  |
| Heater positive with respect to cathode                 | 90 max     | volts  |
| Direct Interelectrode Capacitances:                     |            |        |
| Grid No.1 to Plate                                      | 0.0035 max | pF     |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and |            | _      |
| Internal Shield                                         | 5.4        | pF     |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and     |            | -      |
| Internal Shield                                         | 4.4        | pF     |
|                                                         |            | -      |

| Peak Heater-Cathode Voltage:                                            |           |         |                                         |
|-------------------------------------------------------------------------|-----------|---------|-----------------------------------------|
| Heater negative with respect to cathode                                 | - 90      | max     | volts                                   |
| Heater positive with respect to cathode                                 |           | max     | volta                                   |
| Direct Interelectrode Capacitances:                                     | 70        | IIIQA   | VOILS                                   |
| Grid No.1 to Plate                                                      | 0.0035    | may     | pF                                      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and                 | 0.0033    | IIIda   | Pr.                                     |
| Internal Shield                                                         | 5.4       |         | pF                                      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and                     | J.4       |         | ŅΓ                                      |
| Internal Shield                                                         | 4.4       |         | pF                                      |
| Intellial Shield                                                        | 4.4       |         | þr                                      |
| • Without external shield, or with external shield connected to cathode | <b>.</b>  |         |                                         |
| Class A <sub>1</sub> Amplifier                                          |           |         |                                         |
| MAXIMUM RATINGS (Design-Center Values):                                 |           |         |                                         |
| Plate Voltage                                                           | 300       | max     | volts                                   |
| Grid-No.2 (Screen-Grid) Voltage                                         |           |         | page 80                                 |
| Grid-No.2 Supply Voltage                                                |           | max     | volts                                   |
| Plate Dissipation                                                       |           | max     | watts                                   |
| Grid-No.2 Input:                                                        | •         | 111011  | *************************************** |
| For grid-No.2 voltages up to 150 volts                                  | 0.5       | max     | watt                                    |
| For grid-No.2 voltages between 150 and 300 volts                        |           |         | page 80                                 |
| Grid-No.1 (Control-Grid) Voltage:                                       | 50        | c carve | page oo                                 |
| Negative-bias value                                                     | 50        | max     | volts                                   |
| Positive-bias value                                                     |           | max     | volts                                   |
| 1 Ositive-olas value                                                    | v         | шал     | VUILS                                   |
| CHARACTERISTICS:                                                        |           |         |                                         |
| Plate Voltage 100                                                       | 250       |         | volts                                   |
| Grid No.3 Connected                                                     | l to cath | ode at  | socket                                  |
|                                                                         |           |         |                                         |

The dc component must not exceed 900 volts.

The dc component must not exceed 100 volts.

| Grid-No.2 Voltage                                | 100       | 150        | volts      |
|--------------------------------------------------|-----------|------------|------------|
| Grid-No.1 Voltage                                | -1        | —1         | volt       |
| Plate Resistance (Approx.)                       | 0.7       | 1.4        | megohms    |
| Transconductance                                 | 3400      | 4600       | $\mu$ mhos |
| Grid-No.1 Voltage (Approx.) for plate current of |           |            |            |
| 10 μΑ                                            | <b></b> 5 | <b>7.7</b> | volts      |
| Plate Current                                    | 3.6       | 7.4        | mA         |
| Grid-No.2 Current                                | 1.4       | 2.9        | mA         |



## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in a wide variety of applications in television receivers. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. The pentode unit is used as

6BH8
Related type:
8BH8

an if amplifier, a video amplifier, or an agc amplifier. The triode unit is used in low-frequency oscillator circuits. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 8BH8 is identical with type 6BH8 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average) Peak Heater-Cathode Voltage:                                | 6BH8<br>6.3<br>0.6<br>11 | 8BH8<br>8.4<br>0.45 | volts<br>ampere<br>seconds |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------|----------------------------|
| Heater negative with respect to cathode  Heater positive with respect to cathode  Direct Interelectrode Capacitances (Approx.): | 200 max<br>200=max       | 200 max<br>200 max  | volts<br>volts             |
| Triode Unit: Grid to Plate                                                                                                      |                          | 2.4                 | pF                         |
| Grid to Cathode and Heater                                                                                                      |                          | 2.6                 | pF                         |
| Plate to Cathode and Heater                                                                                                     |                          | 0.38                | pF                         |
| Pentode Unit:                                                                                                                   |                          | , 0,00              | <b>.</b>                   |
| Grid No.1 to Plate                                                                                                              |                          | 0.046               | рF                         |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid                                                                                   |                          | ******              |                            |
| Internal Shield                                                                                                                 |                          | 7                   | pF                         |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, a                                                                               |                          |                     | -                          |
| Shield                                                                                                                          |                          | 2.4                 | pF                         |
| Triode Grid to Pentode Plate                                                                                                    |                          | 0.016               | pF                         |
| Pentode Grid No.1 to Triode Plate                                                                                               |                          | 0.004               | pF                         |
| Pentode Plate to Triode Plate                                                                                                   |                          | 0.095               | pF                         |
| a The do component must not exceed 100 volts                                                                                    |                          |                     |                            |

<sup>•</sup> The dc component must not exceed 100 volts.

Amplification Factor .....

## Class A, Amplifier

| MAXIMUM RATINGS (Design-Center Values):               | Triode Unit     | Pentode Unit | :       |
|-------------------------------------------------------|-----------------|--------------|---------|
| Plate Voltage                                         | 300 max         | 300 max      | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                | _               | 300 max      | volts   |
| Grid-No.2 Voltage                                     |                 | See curve    | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max           | 0 max        | volts   |
| Plate Dissipation                                     | 2.5 max         | 3 max        | watts   |
| Grid-No.2 Input:                                      |                 |              |         |
| For grid-No.2 voltages up to 150 volts                | _               | 1 max        | watt    |
| For grid-No.2 voltages between 150 and 300 volts      |                 | See curve    | page 80 |
| CHARACTERISTICS:                                      |                 |              |         |
| Plate Supply Voltage                                  | 150             | 200          | volts   |
| Grid-No.2 Supply Voltage                              |                 | 125          | volts   |
| Grid-No.1 Voltage                                     | <del>-</del> -5 | _            | volts   |
| Cathode-Bias Resistor                                 |                 | 82           | ohms    |

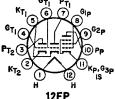
17

| Plate Resistance (Approx.)  Transconductance Grid-No.1 Voltage (Approx.) for plate current of 100 μA Plate Current Grid-No.2 Current | 5150<br>3300<br>14<br>9.5 | 150000<br>7000<br>-8<br>15<br>3.4 | ohms<br>µmhos<br>volts<br>mA<br>mA |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------------------------|------------------------------------|
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation                            | 0.5 max<br>1.0 max        |                                   | ıx megohm<br>ıx megohm             |

## MEDIUM-MU TWIN TRIODE-SHARP-CUTOFF PENTODE

# 6BH11

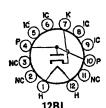
Duodecar type used in television receivers. The triode units are used for P<sub>T2</sub>(3) general-purpose applications, and the pentode unit is used for horizontal-K<sub>T2</sub>(deflection service. Outline 8B, Outlines section. Tube requires duodecar



twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.8; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

#### Pentode Unit As Horizontal-Oscillator

| Tonesac One As Horizon                        | ar osomator                           |          |       |         |
|-----------------------------------------------|---------------------------------------|----------|-------|---------|
| MAXIMUM RATINGS (Design-Maximum Values):      |                                       |          |       |         |
| Plate Voltage                                 |                                       | 350      | max   | volts   |
| Grid-No.2 (Screen-Grid) Voltage               |                                       | 330      | max   | volts   |
| Grid-No.1 (Control-Grid) Voltage:             |                                       |          |       |         |
| Positive-bias value                           |                                       | 0        | max   | volts   |
| Peak negative value                           |                                       | -175     | max   | volts   |
| Peak Cathode Current                          |                                       | 300      | max   | mA      |
| Average Cathode Current                       |                                       | 20       | max   | mA      |
| Plate Dissipation                             |                                       | 2.5      | max   | watts   |
| Grid-No. 2 Input                              |                                       | 0.55     | max   | watt    |
| Class A, Amplifi                              | er                                    |          |       |         |
| MAXIMUM RATINGS (Design-Maximum Values):      |                                       | Each T   | riode | Unit    |
| Plate Voltage                                 |                                       | 330      | max   | volts   |
| Grid Voltage, Positive-bias Value             |                                       | 0        | max   | volts   |
| Plate Dissipation                             |                                       | 2.5      | max   | watts   |
|                                               |                                       | Each     | 1     |         |
| CHARACTERISTICS:                              | Pentode Unit                          | Triode U | Jnit  |         |
| Plate Voltage                                 | 125                                   | 125      |       | volts   |
| Grid-No.2 Voltage                             | 125                                   |          |       | volts   |
| Grid-No.1 Voltage                             | -1                                    | 1        |       | volt    |
| Amplification Factor                          |                                       | 46       |       |         |
| Plate Resistance (Approx.)                    | 200000                                | 5400     |       | ohms    |
| Transconductance                              | 7500                                  | 8500     |       | umhos   |
| Plate Current                                 | 12                                    | 13.5     |       | mA      |
| Grid-No.2 Current                             | 4                                     |          |       | mA      |
| Grid-No.1 Voltage (Approx.) for plate current |                                       |          |       |         |
| of 10 μA                                      | 8                                     | 8        |       | volts   |
| MAXIMUM CIRCUIT VALUES:                       |                                       |          |       |         |
| Grid-Circuit Resistance:                      |                                       |          |       |         |
| For fixed-bias operation                      |                                       |          |       | megohms |
| For cathode-bias operation                    | · · · · · · · · · · · · · · · · · · · | 2.2      | max   | megohms |
| MAXIMUM CIRCUIT VALUES:                       |                                       |          |       |         |
| Grid-No. 1-Circuit Resistance:                |                                       |          |       |         |
| For fixed-bias operation                      |                                       |          |       | megohms |
| For cathode-bias operation                    |                                       | 2.2      | max   | megohms |



## HALF-WAVE VACUUM RECTIFIER

Duodecar type used as damper tube in horizontal-deflection circuits of television receivers. Outline 8C, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Socket ter-

**6BJ3** 

minals 5, 6, 8, and 9 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 6.3; amperes, 1.2.

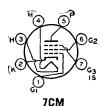
#### **Damper Service**

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values):      |          |       |
|-----------------------------------------------|----------|-------|
| Peak Inverse Plate Voltage#                   | 3300 max | volts |
| Peak Plate Current                            | 840 max  | mA    |
| DC Plate Current                              | 140 max  | mA    |
| Plate Dissipation                             | 4 max    | watts |
| Peak Heater-Cathode Volts:                    |          |       |
| Heater negative with respect to cathode       | 3300*max | volts |
| Heater positive with respect to cathode       | 300∙max  | volts |
| CHARACTERISTICS, Instantaneous Value:         |          |       |
| Tube Voltage Drop for plate current of 250 mA | 21       | volts |

#The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

<sup>•</sup> The dc component must not exceed 100 volts.



#### . . .

## REMOTE-CUTOFF PENTODE

Miniature type used as rf amplifier in high-frequency and wide-band applications. Features high transconductance and low grid-to-plate capacitance. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

6BJ6

| · · · · · · · · · · · · · · · · · · ·                                                      |        |       |        |
|--------------------------------------------------------------------------------------------|--------|-------|--------|
| Heater Voltage (ac/dc)                                                                     | 6.3    |       | volts  |
| Heater Current                                                                             | 0.15   |       | ampere |
| Peak Heater-Cathode Voltage:                                                               | 0.13   |       | ampere |
| Heater negative with respect to cathode                                                    | 90     | max   | volts  |
| Heater positive with respect to cathode                                                    |        | max   | volts  |
| Direct Interelectrode Capacitances:                                                        | 90     | max   | VOIES  |
| Grid No.1 to Plate                                                                         | 0.0035 | max   | pF     |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and                                    | 0.0055 | IIIUA | PI.    |
| Internal Shield                                                                            | 4.5    |       | ρF     |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal                               |        |       |        |
| Shield                                                                                     | 5.5    |       | pF     |
| 33714                                                                                      |        |       | •      |
| <ul> <li>Without external shield, or with external shield connected to cathode.</li> </ul> |        |       |        |
|                                                                                            |        |       |        |
| O1 = = A A                                                                                 |        |       |        |

| • Without external shield, or with external shield connected to cathode.                                  |                                                                    |
|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Class A, Amplifier                                                                                        |                                                                    |
| MAXIMUM RATINGS (Design-Center Values):                                                                   |                                                                    |
| Plate Voltage Grid-No.2 (Screen-Grid) Voltage Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input: | 300 max volts<br>See curve page 80<br>300 max volts<br>3 max watts |
| For grid-No.2 voltages up to 150 volts                                                                    | 0.6 max watt<br>See curve page 80                                  |

<sup>▲</sup> The dc component must not exceed 600 volts.

| Grid-No.1 (Control-Grid) Voltage: Negative bias value Positive bias value |      | 50 ms          |              |
|---------------------------------------------------------------------------|------|----------------|--------------|
| CHARACTERISTICS:                                                          |      |                |              |
| Plate Voltage                                                             | 100  | 250            | volts        |
| Grid No.3                                                                 | Cont | ected to catho | de at socket |
| Grid-No.2 Voltage                                                         | 100  | 100            | volts        |
| Grid-No.1 Voltage                                                         | -1.0 | -1.0           | volt         |
| Plate Resistance (Approx.)                                                | 0.25 | 1.3            | megohms      |
| Transconductance                                                          | 3650 | 3600           | umhos        |
| Grid-No.1 Voltage (Approx.) for transconductance of                       |      |                | •            |
| 10 μmhos                                                                  | 20   | -20            | voits        |
| Plate Current                                                             | 9.0  | 9.2            | mA           |
| Grid-No.2 Current                                                         | 3.5  | 3.3            | mA           |

#### TRIPLE DIODE

**6BJ7** 

Miniature type used as a dc-restorer tube in each of the three signal channels of color-television receivers. PD3 (2) Each diode has a separate cathode. Outline 6B, Outlines section. Tube requires miniature nine-contact socket



XAE

and may be mounted in any position. Heater volts, 6.3; amperes, 0.45.

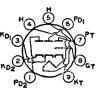
#### DC Restorer Service

| MAXIMUM RATINGS (Design-Center Values, Each Diode Unit): |         |       |
|----------------------------------------------------------|---------|-------|
| Peak Inverse Plate Voltage                               | 330 max | volts |
| Peak Plate Current                                       | 10 max  | mA    |
| DC Output Current                                        | 1 max   | mA    |
| Peak Heater-Cathode Voltage:                             |         |       |
| Heater negative with respect to cathode                  | 330 max | volts |
| Heater positive with respect to cathode                  | 100 max | volts |

# TWIN DIODE.... MEDIUM-MU TRIODE

**6BJ8** 

Miniature type used in a wide variety of applications in black-and-white and color television receivers. The diode units are used in phase-detector, phase-comparator, ratio-detector or discriminator, and horizontal afc dis-

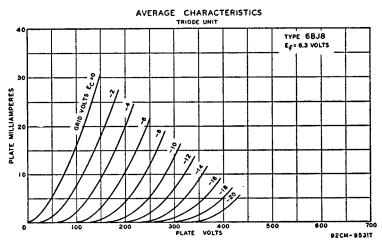


9FR

criminator circuits. The triode unit is used in phase-splitter, audio-frequency amplifier, and low-frequency oscillator applications; it may also be used as a vertical-deflection amplifier in compact portable television receivers. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Each of the three units has its own cathode with individual base-pin terminal to provide for flexibility of circuit connections. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| Heater Volts (ac/dc)                    | 6.3     | volts   |
|-----------------------------------------|---------|---------|
| Heater Current                          | 0.6     | ampere  |
| Heater Warm-up Time (Average)           | 11      | seconds |
| Peak Heater-Cathode Voltage:            |         |         |
| Heater negative with respect to cathode | 200 max | volts   |
| Heater positive with respect to cathode | 200 max | volts   |

| Direct Interelectrode Capacitances: Triode Unit: Grid to Plate Grid to Cathode and Heater Plate to Cathode and Heater                                                                                                                                                                                                                                                                        | 2.6<br>2.8<br>0.31                                           | pF<br>pF<br>pF                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------|
| Diode Units: Plate to Cathode and Heater (Each Unit) Cathode to Plate and Heater (Each Unit) Plate of Unit No.1 to Plate of Unit No.2 Plate of Diode Unit No.1 to Triode Grid Plate of Diode Unit No.2 to Triode Grid Plate of Either Diode Unit to All Other Electrodes Cathode of Either Diode Unit to All Other Electrodes                                                                | 1.9<br>4.6<br>0.06 max<br>0.07 max<br>0.11 max<br>3.0<br>4.8 | pF<br>pF<br>pF<br>pF<br>pF<br>pF                     |
| • The dc component must not exceed 100 volts.                                                                                                                                                                                                                                                                                                                                                |                                                              |                                                      |
| Triode Unit As Class A, Amplifier  MAXIMUM RATINGS (Design-Maximum Values):  Plate Voltage Grid Voltage, Positive-bias value Average Cathode Current Plate Dissipation                                                                                                                                                                                                                       | 330 max<br>0 max<br>22 max<br>4 max                          | volts<br>volts<br>mA<br>watts                        |
| CHARACTERISTICS:           Plate Voltage         90           Grid Voltage         0           Amplification Factor         22           Plate Resistance (Approx.)         4700           Transconductance         4700           Grid Voltage (Approx.) for plate current of 10 μA         -7           Plate Current         13.5           Plate Current for grid voltage of -12.5 volts | 250<br>9<br>20<br>7150<br>2800<br>18<br>8<br>1.7             | volts<br>volts<br>ohms<br>µmhos<br>volts<br>mA<br>mA |
| MAXIMUM CIRCUIT VALUE: Grid-Circuit Resistance                                                                                                                                                                                                                                                                                                                                               | 1 max                                                        | megohm                                               |



## Triode Unit As Vertical Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM KATINGS (Design-Maximum Values): |          |       |
|------------------------------------------|----------|-------|
| DC Plate Voltage                         | 330 max  | volts |
| Peak Positive-Pulse Plate Voltage†       | 1200 max | volts |
| Peak Negative-Pulse Grid Voltage         | —275 max | volts |
| Peak Cathode Current                     | 77 max   | mA    |
| Average Cathode Current                  | 22 max   | mΑ    |
| Plate Dissipation                        | 4 max    | watts |

#### MAXIMUM CIRCUIT VALUE:

Grid-Circuit Resistance:

For cathode-bias operation .....

2.2 max megohms

† The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

#### **Diode Units** MAXIMIM RATINGS (Design-Maximum Values):

| Plate Current (Each Unit): |                 |          |
|----------------------------|-----------------|----------|
| Peak Average               | 54 max<br>9 max | mA<br>mA |
|                            | э шах           | MA       |

## SHARP-CUTOFF **BEAM TRIODE**

# 6BK4A 6BK4B

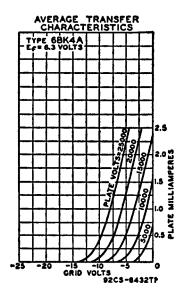
Glass octal types used for the voltage regulation of high-voltage, low-current dc power supplies in color television receivers. Outline 21B, Outlines section. Tubes require octal socket and may be mounted in any position.



Type 6BK4B is identical with type 6BK4A except for a higher plate dissipation and peak heater-cathode voltage.

| Heater Voltage (ac/dc)                                    | 6.3              | volts        |
|-----------------------------------------------------------|------------------|--------------|
| Heater Current                                            |                  | ampere       |
| Peak Heater-Cathode Voltage: 6                            | BK4A 6BK         | 4B           |
| Heater negative with respect to cathode                   | 200 450*1        | nax voits    |
| Heater positive with respect to cathode No                |                  |              |
| Direct Interelectrode Capacitances (Approx.):             |                  |              |
| Grid to Plate                                             | 0.03             | pF           |
| Grid to Cathode and Heater                                | 2.6              | pF           |
| Plate to Cathode and Heater                               |                  | pF           |
| Amplification Factor (Approx.)                            |                  | • .          |
| * Series impedance should be used with the cathode to lim | it the cathode o | urrent under |

prolonged short-circut conditions to 450 mA.



#### **Voltage-Control Service**

| MAXIMUM RATINGS (Design-Maximum Values): |           |       |
|------------------------------------------|-----------|-------|
| DC Plate Voltage                         | 27000 max | volts |
| Unregulated DC Supply Voltage            | 60000 max | volts |
| DC Grid Voltage                          | —135 max  | volts |
| Peak Grid Voltage                        | -440 max  | volts |
| DC Plate Current                         |           | mA    |
| Plate Dissipation (6BK4A)                | 30 max    | watts |
| Plate Dissipation (6BK4B)                | 40 max    | watts |
| MAXIMUM CIRCUIT VALUE:                   |           |       |

## Grid-Circuit Resistance:

For use with "Flyback Transformer" high-voltage supply ...... 3 max megohms

• For interval of 20 seconds maximum duration during equipment warm-up period.



#### MEDIUM-MU TWIN TRIODE

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners. In such circuits, one triode unit is used as the directcoupled grounded-cathode driver for the other unit. This type is also used

Related type: 5BK7A

in push-pull cathode-drive rf amplifiers. It has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Outline 6B, Outlines section. Type requires miniature nine-contact socket and may be mounted in any position. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Type 5BK7A is identical with type 6BK7B except for the heater ratings, as shown below.

|                                               | 5BK7A      | 6BK7B      |         |
|-----------------------------------------------|------------|------------|---------|
| Heater Voltage (ac/dc)                        | 4.7        | 6.3        | volts   |
| Heater Current                                | 0.6        | 0.45       | ampere  |
| Heater Warm-up Time (Average)                 | 11         | 11         | seconds |
| Peak Heater-Cathode Voltage:                  |            |            |         |
| Heater negative with respect to cathode       | 200*       | 200*       | volts   |
| Heater positive with respect to cathode       | 200=       | 200=       | volts   |
| Direct Interelectrode Capacitances:           | Unit No. 1 | Unit No. 2 |         |
| Grid to Plate                                 | 1.8        | 1.8        | pF      |
| Grid to Cathode, Heater, and Internal Shield  | 3          | 3          | pF      |
| Plate to Cathode, Heater, and Internal Shield | 1          | 0.9        | pF      |
| Cathode to Grid, Heater, and Internal Shield  | 6          | 6          | pF      |
| Plate to Grid, Heater, and Internal Shield    | 2.4        | 2.4        | pF      |
| Plate to Cathode                              | 0.22       | 0.22       | pF      |
| Heater to Cathode                             | 2.8        | 3          | pF      |
| Grid of Unit No.1 to Grid of Unit No.2        |            | 0.004 max  | pF      |
| Plate of Unit No.1 to Plate of Unit No.2      |            | 0.075 max  | pF      |
|                                               |            |            | _       |

In cathode-drive circuits with direct-coupled drive, it is permissible for this voltage to be as high as 300 volts under cutoff conditions.

#### Class A. Amplifier (Each Unit)

| MAXIMUM RATINGS (Design-Center Values):           |         |       |
|---------------------------------------------------|---------|-------|
| Plate Voltage                                     | 300 max | volts |
| Grid Voltage, Negative-bias value                 | -50 max | volts |
| Plate Dissipation                                 | 2.7 max | watts |
| CHARACTERISTICS:                                  |         |       |
| Plate Supply Voltage                              | 150     | volts |
| Cathode-Bias Resistor                             | 56      | ohms  |
| Amplification Factor                              | 43      |       |
| Plate Resistance (Approx.)                        | 4600    | ohms  |
| Transconductance                                  | 9300    | μmhos |
| Plate Current                                     | 18      | mA    |
| Grid Voltage (Approx.) for plate current of 10 µA | -11     | volts |

The dc component must not exceed 100 volts.

#### MEDIUM-MU TWIN TRIODE

# 6BL7GTA

Glass octal type used as combined kT2(3) vertical deflection amplifier and vertical deflection oscillator in television PT2(2) receivers. When so operated, it is recommended that unit No.1 (pins 4, 5, and 6) be used as the oscillator.



8RD

Outline 13D, Outlines section. This type requires octal socket and may be mounted in any position.

| Heater Voltage (ac/dc)                                   | 6.3        | volts   |
|----------------------------------------------------------|------------|---------|
| Heater Current                                           | 1.5        | amperes |
| Peak Heater-Cathode Voltage:                             |            |         |
| Heater negative with respect to cathode                  | 200 max    | volts   |
| Heater positive with respect to cathode                  | 200 max    | voits   |
| Direct Interelectrode Capacitances (Approx.): Unit No. 1 | Unit No. 2 |         |
| Grid to Plate 6                                          | 6          | pF      |
| Grid to Cathode and Heater                               | 4.6        | pF      |
| Plate to Cathode and Heater 0.9                          | 0.9        | pF      |
| Amplification Factor*                                    | 15         |         |
| Plate Resistance (Approx.)*                              | 2150       | ohms    |
| Transconductance*                                        | 7000       | μmhos   |
| The de component must not exceed 100 volte               |            | -       |

The dc component must not exceed 100 volts.

# Vertical Deflection Oscillator Or Amplifier\* For operation in a 525-line, 30-frame system

| ,,,,,,,,,,,                                           |            |           |         |
|-------------------------------------------------------|------------|-----------|---------|
| MAXIMUM RATINGS (Design-Center Values):               | Oscillator | Amplifier |         |
| DC Plate Voltage                                      | 500 max    | 500 max   | volts   |
| Peak Positive-Pulse Plate Voltaget (Absolute Maximum) |            | 2000△max  | volts   |
| Peak Negative-Pulse Grid Voltage                      | -400 max   | -250 max  | volts   |
| Peak Cathode Current                                  | 210 max    | 210 max   | mA      |
| Average Cathode Current                               | 60 max     | 60 max    | mA      |
| Plate Dissipation:                                    |            |           |         |
| For either plate                                      | 10 max     | 10 max    | watts   |
| For both plates with both units operating             | 12 max     | 12 max    | watts   |
| MAXIMUM CIRCUIT VALUES:                               |            |           |         |
| Grid-Circuit Resistance                               | 4.7 max    | 4.7#max n | negohms |

<sup>•</sup> Unless otherwise specified, values are for each unit.

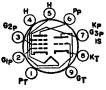
6BL8/ 6BL8/ ECF80

Related type: 4BL8, 4BL8/CXF80

## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature types used in frequency-changer service in television receivers. Outline 6B, Outlines section. Tubes require miniature nine-contact socket and may be mounted in any position.

Types 4BL8/CXF80 and 6BL8/



9DC

ECF80 are identical with types 4BL8 and 6BL8, respectively. Type 4BL8 is identical with type 6BL8 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc)                                                           |                    | 6.3<br>0.45        | volts          |
|----------------------------------------------------------------------------------|--------------------|--------------------|----------------|
| Heater Current                                                                   | 0.6                | 0.43               | ampere         |
| Heater negative with respect to cathode  Heater positive with respect to cathode | 100 max<br>100 max | 100 max<br>100 max | volts<br>volts |

<sup>\*</sup> Each unit; for plate volts, 250; grid volts, -9; plate mA, 40.

<sup>†</sup> The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds. a Under no circumstances should this absolute value be exceeded.

<sup>#</sup> For cathode-bias operation.

Class A. Amplifier

| Oldos Al Ampinior                             |               |             |        |
|-----------------------------------------------|---------------|-------------|--------|
| MAXIMUM RATINGS (Design-Center Values):       | Triode Unit   | Pentode Uni | it     |
| Plate Supply Voltage                          | 550 max       | 550 max     | volts  |
| Plate Voltage                                 | 250 max       | 250 max     | volts  |
| Grid-No.2 (Screen-Grid) Supply Voltage        |               | 550 max     | volts  |
| Grid-No.2 Voltage:                            |               |             |        |
| With cathode current of 14 mA                 | _             | 175 max     | volts  |
| With cathode current less than 10 mA          |               | 200 max     | volts  |
| Cathode Current                               | 14 max        | 14 max      | mA     |
| Grid-No.2 Input:                              |               |             |        |
| With plate dissipation greater than 1.2 watts | _             | 0.5 max     | watt   |
| With plate dissipation less than 1.2 watts    | -             | 0.75 max    | watt   |
| Plate Dissipation                             | 1.5 max       | 1.7 max     | watts  |
| CHARACTERISTICS:                              |               |             |        |
| Plate Voltage                                 | 100           | 170         | volts  |
| Grid-No.2 Voltage                             |               | 170         | voits  |
| Grid-No.1 Voltage                             | <u></u>       | _2          | volts  |
| Amplification Factor                          | 20            |             | VOICS  |
| Mu-Factor, Grid No.2 to Grid No.1             | <del>20</del> | 47          |        |
| Plate Resistance (Approx.)                    |               |             | megohm |
| Transconductance (Approx.)                    | 5000          | 6200        | umhos  |
| Plate Current                                 | 14            | 10          | mA     |
| Grid-No.2 Current                             | _             | 2.8         | mA     |
| Input Resistance at frequency of 50 Mc/s      | _ =           |             | megohm |
| Equivalent Noise Resistance                   | _             | 1500        | ohms   |
|                                               | _             | 1500        | Omis   |
| MAXIMUM CIRCUIT VALUES:                       |               |             |        |
| Grid-No.1-Circuit Resistance:                 |               |             |        |
| For fixed-bias operation                      | 0.5 max       | 0.5 max     | megohm |
| For cathode-bias operation                    | 0.5 max       | 1 max       | megohm |
|                                               |               |             |        |



# HIGH-MU TRIODE—POWER PENTODE

O<sup>cap</sup>Miniature type used in television receivers. The pentode unit is used as an audio output tube, and the triode unit as an oscillator and af voltage amplifier. Outline 6G, Outlines section.

Tube requires miniature nine-contact

6BM8/ ECL82

socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.78; peak heater-cathode volts, 100.

## Class A, Amplifier

| MAXIMUM RATINGS (Design-Center Values): Plate Supply Voltage Plate Voltage Grid-No.2 Supply Voltage Grid-No.2 Voltage Cathode Current                               | Triode Unit 550 max 300 max — — — — 15 max | Pentode Uni<br>900 max<br>600 max<br>550 max<br>300 max | volts<br>volts<br>volts<br>volts<br>mA                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|---------------------------------------------------------|--------------------------------------------------------|
| Plate Dissipation Grid-No.2 Input                                                                                                                                   | 1 max<br>—                                 | 7 max<br>1.8 max                                        | watts<br>watts                                         |
| CHARACTERISTICS: Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Amplification Factor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current | 100<br>0<br>70<br>2500<br>3.5              | 200<br>200<br>16<br>9.5*<br>0.02<br>6400<br>35<br>7     | volts<br>volts<br>volts<br>megohm<br>μmhos<br>mA<br>mA |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation Grid No.2 to Grid No.1.                                   | 1 max<br>2 max                             | 1 max :<br>2 max n                                      |                                                        |

#### MEDIUM-MU TRIODE

6BN4A
Related types:
2BN4A, 3BN4A

Miniature type used as rf amplifier tube in grid-drive circuits of vhf television tuners. The double base-pin connections for both cathode and grid reduce effective lead inductance and lead resistance with consequent reduc-



7EG

tion in input conductance. In addition, the basing arrangement facilitates isolation of input and output circuits and permits short, direct connections to base-pin terminals. Outline 5C, Outlines section. This type requires miniature seven-contact socket and may be mounted in any position. Types 2BN4A and 3BN4A are identical with type 6BN4A except for the heater ratings, as shown below.

|                                                | 2BN4A               | 3BN4A      | 6BN4 | A   |         |
|------------------------------------------------|---------------------|------------|------|-----|---------|
| Heater Voltage (ac/dc)                         | 2.35                | 3          | 6.3  |     | volts   |
| Heater Current                                 |                     | 0.45       | 0.2  |     | ampere  |
| Heater Warm-up Time (Average)                  | 11                  | 11         | _    |     | seconds |
| Peak Heater-Cathode Voltage:                   |                     |            |      |     |         |
| Heater negative with respect to cathode        | 100 ma              | ax 100 max | 100  | max | volts   |
| Heater positive with respect to cathode        | 100 ma              | ax 100 max | 100  | max | volts   |
| Direct Interelectrode Capacitances (Approx.):  |                     |            |      |     |         |
| Grid to Plate                                  |                     |            | 1.2  |     | рF      |
| Grid to Cathode and Heater                     |                     |            | 3.2  |     | pF      |
| Plate to Cathode and Heater                    |                     |            | 1.4  |     | рF      |
| • With external shield connected to cathode.   |                     |            |      |     |         |
| Class A.                                       | Amplifier           |            |      |     |         |
|                                                |                     |            |      |     |         |
| MAXIMUM RATINGS (Design-Center Values          |                     |            | 275  |     | volts   |
| Plate Voltage                                  |                     |            |      | max | volts   |
| Grid Voltage, Positive-bias value              |                     |            |      | max |         |
| Plate Dissipation                              |                     |            |      | max | watts   |
| Cathode Current                                | • • • • • • • • • • |            | 2.2  | max | mA      |
| CHARACTERISTICS:                               |                     |            |      |     |         |
| Plate-Supply Voltage                           |                     |            | 150  |     | volts   |
| Cathode-Bias Resistor                          |                     |            | 220  |     | ohms    |
| Amplification Factor                           |                     |            | 43   |     |         |
| Plate Resistance (Approx.)                     |                     | <i></i>    | 5400 |     | ohms    |
| Transconductance                               |                     |            | 7700 |     | μmhos   |
| Grid Voltage (Approx.) for plate current of 10 | 0 μΑ,               |            | 6    |     | voits   |
| Plate Current                                  |                     |            | 9    |     | mA      |
| MAXIMUM CIRCUIT VALUE:                         |                     |            |      |     |         |
| Grid-Circuit Resistance                        |                     |            | 0.5  | max | megohm  |

#### **BEAM TUBE**

6BN6
Related types:
3BN6, 4BN6

Miniature type used as combined limiter, discriminator, and audio-voltage amplifier in intercarrier television and FM receivers. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be



7DF

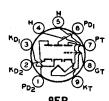
mounted in any position. Types 3BN6 and 4BN6 are identical with type 6BN6 except for the heater ratings, as shown below.

|                                         | 3BN6    | 4BN6    | 6BN6    |         |
|-----------------------------------------|---------|---------|---------|---------|
| Heater Voltage (ac/dc)                  | 3.15    | 4.2     | 6.3     | voits   |
| Heater Current                          | 0.6     | 0.45    | 0.3     | ampere  |
| Heater Warm-Up Time (Average)           | 11      | 11      |         | seconds |
| Peak Heater-Cathode Voltage:            |         |         |         |         |
| Heater negative with respect to cathode | 200 max | 200 max | 200 max | volts   |
| Heater positive with respect to cathode | 200°max | 200°max | 200°max | volts   |

<sup>•</sup> The dc component must not exceed 100 volts.

| 1   | imiter     | And | Die | rrim: | inata | - 00 | ruica   |
|-----|------------|-----|-----|-------|-------|------|---------|
| - 1 | 1111111111 | Ann | MIN |       | шаты  | 36   | I VILLE |

| MAXIMUM RATINGS (Design-Maximum Values): |         |       |
|------------------------------------------|---------|-------|
| Plate-Supply Voltage                     | 330 max | volts |
| Grid-No.2 Voltage                        | 110 max | volts |
| Grid-No.1 Voltage, Positive peak value   | 60 max  | voits |
| Cathode Current                          | 13 max  | mA    |



#### TWIN DIODE-HIGH-MU TRIODE

Miniature type used in a wide variety of applications in color and blackand-white television receivers. This type has a controlled heater warm-up time for use in receivers employing

6BN8 Related type: **8BN8** 

07870

54 max

9 max

mA

mA

ger series-connected heater strings. The triode unit is used in burst-amplifier, af amplifier, and low-frequency oscillator applications. The diode units are used in phase-detector, ratio-detector or discriminator, and horizontal afc discriminator circuits. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 8BN8 is identical with type 6BN8 except for the heater ratings, as shown below.

CD310

|                                                      | 6BN8       | 8BN8      |         |
|------------------------------------------------------|------------|-----------|---------|
| Heater Voltage (ac/dc)                               | 6.3        | 8.4       | volts   |
| Heater Current                                       | 0.6        | 0.45      | ampere  |
| Heater Warm-up Time (Average)                        | 11         | 11        | seconds |
| Peak Heater-Cathode Voltage:                         |            |           |         |
| Heater negative with respect to cathode              | 200 max    | 200 max   | volts   |
| Heater positive with respect to cathode              | 200=max    | 200 • max | volts   |
| Direct Interelectrode Capacitances:                  |            |           |         |
| Triode Grid to Triode Plate                          |            | 2.5       | рF      |
| Triode Grid to Cathode and Heater                    |            | 3.6       | pF      |
| Triode Plate to Cathode and Heater                   |            | 0.25      | pF      |
| Plate of Diode Unit No.1 to Triode Grid              |            | 0.06 max  | pF      |
| Plate of Diode Unit No.2 to Triode Grid              |            | 0.1 max   | pF      |
| Plate of Diode Unit No.1 to Plate of Diode Unit No.2 |            | 0.07 max  | рF      |
| Diode Cathode to All Other Electrodes (Each Diode U  | Jnit)      | 5         | pF      |
| Diode Plate to Diode Cathode and Heater (Each Diod   | e Unit)    | 1.9       | pF      |
| Diode Cathode to Diode Plate and Heater (Each Diod   | e Unit)    | 4.8       | рF      |
| Diode Plate to All Other Electrodes (Each Diode Unit | ) <b>.</b> | 3         | pF      |
|                                                      |            |           |         |

<sup>•</sup> The dc component must not exceed 100 volts.

MAXIMUM RATINGS (Design-Maximum Values):

#### Triode Unit as Class A, Amplifier

| Plate Voltage                                     |       | 330 max      | volts      |
|---------------------------------------------------|-------|--------------|------------|
| Grid Voltage, Positive bias value                 |       | 0 max        | volts      |
| Plate Dissipation                                 |       | 1.7 max      | watts      |
| CHARACTERISTICS:                                  |       |              |            |
| Plate Voltage                                     | 100   | 250          | volts      |
| Grid Voltage                                      | -1    | -3           | volts      |
| Amplification Factor                              | 75    | 70           |            |
| Plate Resistance (Approx.)                        | 21000 | 28000        | ohms       |
| Transconductance                                  | 3500  | 2500         | $\mu$ mhos |
| Grid Voltage (Approx.) for plate current of 10 µA | -2.5  | <b>—</b> 5.5 | volts      |
| Plate Current                                     | 1.5   | 1.6          | mA         |
| MAXIMUM CIRCUIT VALUE:                            |       |              |            |

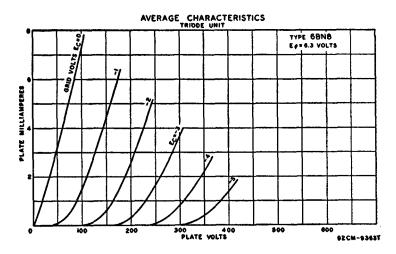
#### Grid-Circuit Resistance .....

1.0 max megohm

#### **Diode Units**

| MAXIMUM       | RATIN | igs ( | Design-Maximum | Values): |
|---------------|-------|-------|----------------|----------|
| Plate Current | (Each | Unit) | ):             |          |

| Peak  |     |  |
|-------|-----|--|
| Avera | age |  |



#### **POWER PENTODE**

6BQ5
Related type:
8BQ5

Miniature type used in the output stage of audio-frequency amplifiers. Outline 6G, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 8BQ5 is identical with type 6BQ5



48

50.6

mA

mA

except for the heater ratings, as shown below.

|                                                    | 6BQ5    | 8BQ5     |         |
|----------------------------------------------------|---------|----------|---------|
| Heater Voltage (ac/dc)                             | 6.3     | 8        | volts   |
| Heater Current                                     | 0.76    | 0.6      | ampere  |
| Heater Warm-up Time (Average)                      | _       | 11       | seconds |
| Peak Heater-Cathode Voltage:                       |         |          |         |
| Heater negative with respect to cathode            | 100 max | 100 max  | volts   |
| Heater positive with respect to cathode            | 100△max | 100∧max  | voits   |
| Direct Interelectrode Capacitances:                |         |          |         |
| Grid No.1 to Plate                                 |         | 0.5 max  | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid  | No.3    | 10.8     | рF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3 |         | 6.5      | рF      |
| Grid No.1 to Heater                                |         | 0.25 max | pF      |
| ▲ The dc component must not exceed 100 volts.      |         |          |         |

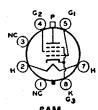
## Class A, Amplifier

Zero-Signal Plate Current

Maximum-Signal Plate Current .....

| MAXIMUM RATINGS (Design-Center Values):               |              |       |
|-------------------------------------------------------|--------------|-------|
| Plate Voltage                                         | 300 max      | volts |
| Grid-No.2 (Screen-Grid) Voltage                       | 300 max      | volts |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max        | volts |
| Grid-No.2 Input                                       | 2 max        | watts |
| Plate Dissipation                                     | 12 max       | watts |
| Cathode Current                                       | 65 max       | mA    |
| TYPICAL OPERATION:                                    |              |       |
| Plate Voltage                                         | 250          | volts |
| Grid-No.2 Voltage                                     | 250          | volts |
| Grid-No.1 (Control-Grid) Voltage                      | <b>—</b> 7.3 | volts |
| Peak AF Grid-No.1 Voltage                             | 6.2          | volts |
|                                                       |              |       |

| Zero-Signal Grid-No.2 Current  Maximum-Signal Grid-No.2 Current  Plate Resistance (Approx.)  Transconductance Load Resistance  Total Harmonic Distortion  Maximum-Signal Power Output |            | 5.5<br>10<br>38000<br>11300<br>4500<br>10<br>5.7 | mA<br>mA<br>ohms<br>μmhos<br>ohms<br>per cent<br>watts |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------------------------------------|--------------------------------------------------------|
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                               |            |                                                  |                                                        |
| Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation                                                                                                     |            | 0.3 max<br>1.0 max                               | megohm<br>megohm                                       |
| Push-Pull Class AB; Ampli                                                                                                                                                             | fier       |                                                  |                                                        |
| MAXIMUM RATINGS: (Same as for Single-Tube Class A1                                                                                                                                    | Amplifier) |                                                  |                                                        |
| TYPICAL OPERATION (Values are for two tubes):                                                                                                                                         |            |                                                  |                                                        |
| Plate Supply Voltage                                                                                                                                                                  | 250        | 300                                              | volts                                                  |
| Grid-No.2 Supply Voltage                                                                                                                                                              | 250        | 300                                              | volts                                                  |
| Cathode-Bias Resistor                                                                                                                                                                 | 130        | 130                                              | ohms                                                   |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage                                                                                                                                                | 22.6       | 28.3                                             | volts                                                  |
| Zero-Signal Plate Current                                                                                                                                                             | 62         | 72                                               | mA                                                     |
| Maximum-Signal Plate Current                                                                                                                                                          | 75         | 92                                               | mA                                                     |
| Zero-Signal Grid-No.2 Current                                                                                                                                                         | 7          | 8                                                | mA                                                     |
| Maximum-Signal Grid-No.2 Current                                                                                                                                                      | 15         | 22                                               | mA                                                     |
| Effective Load Resistance (Plate-to-plate)                                                                                                                                            | 3000       | 8000                                             | ohms                                                   |
| Total Harmonic Distortion                                                                                                                                                             | 3          | 4                                                | per cent                                               |
| Maximum-Signal Power Output                                                                                                                                                           | 11         | 17                                               | watts                                                  |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                               |            |                                                  |                                                        |
| Grid-No.1-Circuit Resistance:                                                                                                                                                         |            |                                                  |                                                        |
| For fixed-bias operation                                                                                                                                                              |            | 0.3 max                                          | megohm                                                 |
| For cathode-bias operation                                                                                                                                                            |            | 1.0 max                                          | megohm                                                 |



## **BEAM POWER TUBE**

Glass octal type used as horizontal deflection amplifier in television receivers. Outline 14D, Outlines section. Tube requires octal socket and may

6BQ6GTB /6CU6

Tube requires octal socket and may Related types:
be mounted in any position. This type 12BQ6GTB/12CU6, 17BQ6AM may be supplied with pin No.1

omitted. Types 12BQ6GTB/12CU6, 17BQ6GTB, and 25BQ6GTB/25CU6 are identical with type 6BQ6GTB/6CU6 except for the heater ratings, as shown below.

|                                                            | 6BQ6GTB/<br>6CU6 | 12BQ6G-<br>TB/12CU6 | 17BQ6-<br>GTB | 25BQ6GTB/<br>25CU6 |               |
|------------------------------------------------------------|------------------|---------------------|---------------|--------------------|---------------|
| Heater Voltage (ac/dc)                                     | 6.3              | 12.6                | 16.8          | 25                 | volts         |
| Heater Current                                             | 1.2              | 0.6                 | 0.45          | 0.3                | ampere        |
| Heater Warm-up Time (Average) Peak Heater-Cathode Voltage: | _                | 11                  | 11            | -                  | seconds       |
| Heater negative with respect to cathode                    | 200 max          | 200 max             | 200 max       | 200 max            | volts         |
| Heater positive with respect to cathode                    | 200=max          | 200=max             | 200=max       | 200=max            | volts         |
| Direct Interelectrode Capacitances (A                      |                  |                     |               |                    |               |
| Grid No.1 to Plate                                         |                  |                     |               | 0.6                | pF            |
| Grid No.1 to Cathode, Heater, G                            | rid No.2, as     | nd Grid No          | .3            | 15                 | pF            |
| Plate to Cathode, Heater, Grid 1                           | No.2, and G      | rid No.3 .          |               | 7                  | pF            |
| Transconductance*                                          | <i></i>          |                     |               | 5900               | μmho <b>s</b> |
| Mu-Factor, Grid No.2 to Grid No.1                          | ••               |                     | • • • • • • • | 4.3                | -             |

- The dc component must not exceed 100 volts.
- \* For plate volts, 250; grid-No.2 volts, 150; grid-No.1 volts, -22.5; plate mA, 57; grid-No.2 mA, 2.1.
- \*\* For plate and grid-No.2 volts, 150; grid-No.1 volts, -22.5.

#### **Horizontal Deflection Amplifier**

For operation in a 525-line, 30-frame system

#### MAXIMUM RATINGS (Design-Center Values):

| DC Plate Voltage                                      | 600 max  | volts |
|-------------------------------------------------------|----------|-------|
| Peak Positive-Pulse Plate Voltage* (Absolute Maximum) | 6000†max | volts |
| Peak Negative-Pulse Plate Voltage                     | 1250 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage                    | 200 max  | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage  | -300 max | volts |
| Peak Cathode Current                                  | 400 max  | mA    |
| Average Cathode Current                               | 110 max  | mA    |
| Grid-No.2 Input                                       | 2.5 max  | watts |
| Plate Dissipation#                                    | 11 max   | watts |
| Bulb Temperature (At hottest point)                   | 220 max  | °C    |

#### **MAXIMUM CIRCUIT VALUE:**

Grid-No.1-Circuit Resistance ......

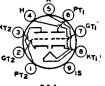
0.47 max megohm

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- † Under no circumstances should this absolute value be exceeded.
- # An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

## MEDIUM-MU TWIN TRIODE

6BQ7A
Related types:
4BQ7A, 5BQ7A

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of whf television tuners. In such circuits, one triode unit is used as the direct-coupled grounded-cathode driver for the other unit. This type is also used in



LA<sub>2</sub>

push-pull cathode-drive rf amplifiers. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Types 4BQ7A and 5BQ7A are identical with type 6BQ7A except for the heater ratings, as shown below.

....

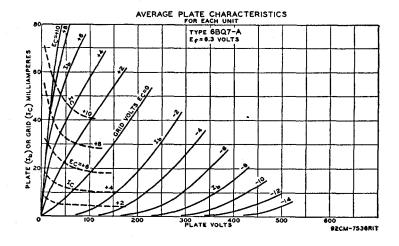
|                                              | 4BQ7A     | 5BQ7A     | 6BQ7A     |         |
|----------------------------------------------|-----------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                       | 4.2       | 5.6       | 6.3       | volts   |
| Heater Current                               | 0.6       | 0.45      | 0.4       | ampere  |
| Heater Warm-up Time (Average)                | 11        | 11        | _         | seconds |
| Peak Heater-Cathode Voltage:                 |           |           |           |         |
| Heater negative with respect to cathode      | 200*max   | 200*max   | 200*max   | volts   |
| Heater positive with respect to cathode      | 200 • max | 200=max   | 200=max   | volts   |
| Direct Interelectrode Capacitances:          |           | Unit No.1 | Unit No.2 |         |
| Grid to Plate                                |           | 1.2       | 1.2       | pF      |
| Grid to Cathode, Heater, and Internal Shield | i         | 2.6       |           | рF      |
| Cathode to Grid, Heater, and Internal Shield | 1         | _         | 5.0       | pF      |
| Plate to Cathode, Heater, and Internal Shie  | eld       | 1.2       | _         | pF      |
| Plate to Grid, Heater, and Internal Shield   |           | _         | 2.2       | pF      |
| Plate to Cathode                             |           | • 0.12    | 0.12      | рF      |
| Heater to Cathode                            |           | 2.6       | 2.6       | pF      |
| Plate of Unit No.1 to Plate of Unit No.2     | <i></i> . | 0.01      | 0 max     | рF      |
| Plate of Unit No.2 to Plate and Grid of Unit | i No.1    | 0.02      | 4 max     | pF      |

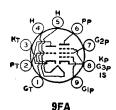
- \* With external shield connected to internal shield.
- In cathode-drive circuits with direct-coupled drive, it is permissible for this voltage to be as high as 300 volts.

<sup>•</sup> The dc component must not exceed 100 volts.

#### Class A, Amplifier (Each Unit)

| MAXIMUM RATINGS (Design-Center Values):                                                         |         |        |
|-------------------------------------------------------------------------------------------------|---------|--------|
| Plate Supply Voltage                                                                            | 250*max | volts  |
| Plate Dissipation                                                                               | 2 max   | watts  |
| Cathode Current                                                                                 | 20 max  | mA     |
| CHARACTERISTICS:                                                                                |         |        |
| Plate Supply Voltage                                                                            | 150     | volts  |
| Cathode-Bias Resistor                                                                           | 220     | ohms   |
| Amplification Factor                                                                            | 38      |        |
| Plate Resistance (Approx.)                                                                      | 5900    | ohms   |
| Transconductance                                                                                | 6400    | μmhos  |
| Plate Current                                                                                   | 9       | mA     |
| Grid Voltage (Approx.):                                                                         |         |        |
| For plate current of 100 $\mu A$                                                                | 6.5     | volts  |
| For plate current of 10 $\mu$ A                                                                 | _       | volts  |
| MAXIMUM CIRCUIT VALUE:                                                                          |         |        |
| Grid-Circuit Resistance                                                                         | 0.5 max | megohm |
| * In cathode-drive circuits with direct-coupled drive, it is permissible for high as 300 volts. |         |        |





## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in a wide variety of applications in color and blackand-white television receivers. Especially useful as combined triode oscillator and pentode mixer in vhf television tuners. Tube has a con-

6BR8A
Related type:
5BR8

trolled heater warm-up time for use in receivers employing series-connected heater strings. Outline 6B, Outlines section. Except for basing arrangement and grid-No.1-to-plate capacitance of pentode unit, this type is identical with type 6U8A.

12BS3

## HALF-WAVE VACUUM RECTIFIER

6BS3 6BS3A

Related types: 12BS3, 12BS3A, 17BS3, 17BS3A Novar types used as damper tubes in horizontal-deflection circuits of black-and-white television receivers. Outlines 11D and 30B, respectively, **Outlines** section. Tubes require novar nine-contact socket and may be mounted in



17BS3

any position. Socket terminals 1, 3, 6, and 8 should not be used as tie points; it is recommended that socket clips for these pins be removed to reduce the possibility of arc-over and to minimize leakage. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. Types 12BS3 and 12BS3A and types 17BS3 and 17BS3A are identical with types 6BS3 and 6BS3A, respectively, except for the heater ratings, as shown below.

|                                               | 6BS3A       | 12BS3A      | 17BS3A   |         |
|-----------------------------------------------|-------------|-------------|----------|---------|
| Heater Voltage (ac/dc)                        | 6.3         | 12.6        | 16.8     | volts   |
| Heater Current                                | 1.2         | 0.6         | 0.45     | ampere  |
| Heater Warm-up Time (Average)                 | _           | 11          | 11       | seconds |
| Direct Interelectrode Capacitances (Approx.): |             |             |          |         |
| Plate to Cathode and Heater                   |             |             | 6.5      | pF      |
| Cathode to Plate and Heater                   |             |             | 9        | pF      |
| Heater to Cathode                             |             |             | 2.8      | pF      |
|                                               |             |             | 2.0      | Ρ.      |
| Damper                                        | Service     |             |          |         |
| For operation in a 525                        | -line, 30-f | rame system |          |         |
| MAXIMUM RATINGS (Design-Maximum Value         | tes):       |             |          |         |
| Peak Inverse Plate Voltage                    |             |             | 5000 max | volts   |
| Peak Plate Current                            |             |             | 1100 max | mA      |
| DC Plate Current                              |             |             | 200 max  | mA      |
| Plate Dissipation                             |             |             | 6 max    | watts   |
| Peak Heater-Cathode Voltage:                  |             |             | Ullian   | watts   |
| Heater negative with respect to Cathode       |             |             | 5000 max | volts   |
| Heater positive with respect to cathode       |             |             | 300□max  | volts   |
| reater positive with respect to cathode       |             |             | 3000max  | voits   |
| CHARACTERISTICS. Instantaneous Value:         |             |             |          |         |

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- The dc component must not exceed 900 volts.

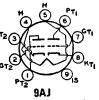
Tube Voltage Drop for plate current of 140 mA ...

The dc component must not exceed 100 volts.

## MEDIUM-MU TWIN TRIODE

6BS8
Related type:
4BS8

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of whf television tuners. In such circuits, one triode unit is used as the direct-coupled grounded-cathode driver for the other unit. This type is also used



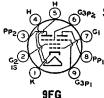
12

voite

in push-pull cathode-drive rf amplifiers. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 4BS8 is identical with type 6BS8 except for the heater ratings, as shown below.

|                                         | 4000    | GDSC    |         |
|-----------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                  | 4.5     | 6.3     | voits   |
| Heater Current                          | 0.6     | 0.4     | ampere  |
| Heater Warm-up Time (Average)           | 11      |         | seconds |
| Peak Heater-Cathode Voltage:            |         |         |         |
| Heater negative with respect to cathode | 200 max | 200 max | volts   |
| Heater positive with respect to cathode | 200 max | 200 max | volts   |

| Direct Interelectrode Capacitances: Grid to Plate (Each Unit) Grid to Cathode, Heater, and Internal Shield (Unit No.1) Plate to Cathode, Heater, and Internal Shield (Unit No.1) Plate to Cathode (Each Unit) Heater to Cathode (Each Unit) Cathode to Grid, Heater, and Internal Shield (Unit No.2) Plate to Grid, Heater, and Internal Shield (Unit No.2) Plate of Unit No.1 to Plate of Unit No.2 Plate of Unit No.2 to Plate and Grid of Unit No.1 | 1.15<br>2.6<br>1.2<br>0.15<br>2.6<br>5<br>2.2<br>0.010<br>0.024 | max | PP<br>PF<br>PF<br>PF<br>PF<br>PF<br>PF |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----|----------------------------------------|
| Class A, Amplifier (Each Unit)                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                 |     |                                        |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                 |     |                                        |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                          | 150                                                             | max | volts                                  |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2                                                               | max | watts                                  |
| Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                        | 20                                                              | max | mA                                     |
| CHARACTERISTICS:                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                 |     |                                        |
| Plate-Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                   | 150                                                             |     | volts                                  |
| Cathode-Bias Resistor                                                                                                                                                                                                                                                                                                                                                                                                                                  | 220                                                             |     | ohms                                   |
| Amplification Factor                                                                                                                                                                                                                                                                                                                                                                                                                                   | 36                                                              |     | onins                                  |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                             | 5000                                                            |     | ohms                                   |
| Transconductance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                             | 7200                                                            |     | μmhos                                  |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10                                                              |     | mA                                     |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A*                                                                                                                                                                                                                                                                                                                                                                                                | _7                                                              |     | volts                                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                 |     | 10113                                  |
| MAXIMUM CIRCUIT VALUE:                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                 |     | _                                      |
| Grid-Circuit Resistance                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.5                                                             | max | megohm                                 |
| * This value applies to Unit No.2 only.                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                 |     |                                        |



# <sup>დე</sup>იგ SHARP-CUTOFF TWIN PENTODE

Miniature type used as combined sync separator, sync clipper, and age amplifier tube in television receivers. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

6BU8
Related types:
3BU8, 4BU8

-

Types 3BU8 and 4BU8 are identical with type 6BU8 except for the heater ratings, as shown below.

|                                           | 3BU8      | 4BU8    | 6BU8      |         |
|-------------------------------------------|-----------|---------|-----------|---------|
| Heater Voltage (ac/dc)                    | 3.15      | 4.2     | 6.3       | volts   |
| Heater Current                            | 0.6       | 0.45    | 0.3       | ampere  |
| Heater Warm-up Time (Average)             | 11        | 11      | _         | seconds |
| Peak Heater-Cathode Voltage:              |           |         |           |         |
| Heater negative with respect to cathode   | 200 max   | 200 max | 200 max   | volts   |
| Heater positive with respect to cathode   | 200=max   | 200 max | 200 max   | volts   |
| Direct Interelectrode Capacitances:       |           |         |           |         |
| Grid No.3 to Plate (Each Unit)            |           |         | 1.9       | pF      |
| Grid No.1 to All Other Electrodes         |           |         | 6         | pF      |
| Grid No.3 to All Other Electrodes (Each   | Unit)     |         | 3.6       | pF      |
| Plate to All Other Electrodes (Each Unit) |           |         | 3         | pF      |
| Grid No.3 of Unit No.1 to Grid No.3 of    | Unit No.2 |         | 0.015 max | rF      |
|                                           |           |         |           |         |

<sup>\*</sup> The dc component must not exceed 100 volts.

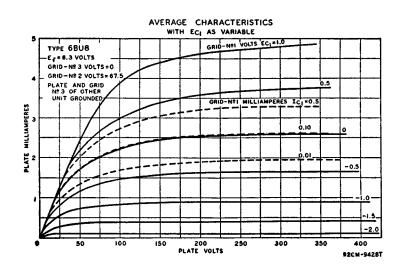
MAXIMUM RATINGS (Design-Maximum Values):

## Class A<sub>1</sub> Amplifier

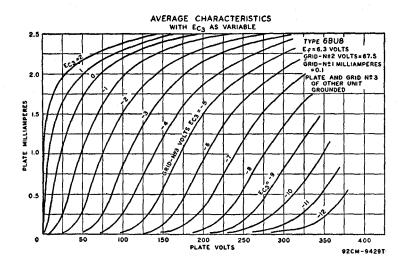
| Plate Voltage (Each Unit) | <br>300 max | volts |
|---------------------------|-------------|-------|

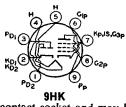
| Grid-No.3 (Suppressor-Grid) Voltage (Each Unit):        |               |            |
|---------------------------------------------------------|---------------|------------|
| Peak positive value                                     | 50            | max volts  |
| DC negative value                                       | —50           | max volts  |
| DC positive value                                       | 3             | max volts  |
| Grid-No.2 (Screen-Grid) Voltage                         | 150           | max volts  |
| Grid-No.1 (Control-Grid) Voltage, Negative bias value   | <b>—50</b>    | max volts  |
| Cathode Current                                         |               | max mA     |
| Grid-No.2 Input                                         | 0.75          | max watt   |
| Plate Dissipation (Each Unit)                           | 1.1           | max watts  |
| CHARACTERISTICS: With Both Units Operating              |               |            |
|                                                         | 100 100       | volts      |
|                                                         | -10 0         |            |
|                                                         | 7.5 67.5      |            |
| Grid-No.1 Voltage                                       | •             | volts      |
| Plate Current (Each Unit)                               | - 2.2         |            |
| Grid-No.2 Current                                       | 6.5 3.3       | mA.        |
| Cathode Current                                         | 6.6 7.8       | mA.        |
| With One Unit Operating?                                |               |            |
| Plate Voltage                                           | 100 100       | volts      |
| Grid-No.3 Voltage                                       | 0 0           | volts      |
|                                                         | 7.5 67.5      | volts      |
| Grid-No.1 Voltage                                       | 0 •           | volts      |
| Grid-No.3 Transconductance                              | 180           |            |
|                                                         | 500           | μmhos      |
| Plate Current                                           | - 2.2         | mA         |
| Grid-No.3 Voltage (Approx.) for plate current of        |               |            |
| 100 μA Grid-No.1 Voltage (Approx.) for plate current of | <b>-</b> -4.5 | volts      |
| 100 $\mu$ A                                             | 2.3           | volts      |
| 100 μα                                                  | 2.3           | VOIIS      |
| MAXIMUM CIRCUIT VALUES:                                 |               |            |
| Grid-No.3-Circuit Resistance (Each Unit)                | 0.5           | max megohm |
| Grid-No.1-Circuit Resistance                            | 0.5           | max megohm |

<sup>\*</sup> Adjusted to give a dc grid-No.1 current of 100 microamperes.



<sup>†</sup> With plate and grid No.3 of the other unit connected to ground.





## TWIN DIODE-SHARP-CUTOFF PENTODE

Miniature type used in television receivers; diodes are used as horizontal phase detectors; pentode is used as a sound if amplifier, sound limiter, and agc keyer. Outline 6B, Outlines section. Tube requires miniature nine-

**6BW8** Related type: 5BW8

contact socket and may be operated in any position. Type 5BW8 is identical with type 6BW8 except for the heater ratings, as shown below.

| YYA YY-1                                                 | 5BW8    | 6BW8      |         |
|----------------------------------------------------------|---------|-----------|---------|
| Heater Voltage (ac/dc)                                   | 4.7     | 6.3       | volts   |
| Heater Current                                           | 0.6     | 0.45      | атреге  |
| Heater Warm-up Time (Average)                            | 11      |           | seconds |
| Peak Heater-Cathode Voltage:                             |         |           | becomes |
| Heater negative with respect to cathode                  | 200 max | 200 max   | volts   |
| Heater positive with respect to cathode                  | 200°max | 200°max   | volts   |
| Direct Interelectrode Capacitances:                      |         |           | , , , , |
| Pentode Unit:                                            |         |           |         |
| Grid No.1 to Plate                                       |         | 0.02 max  | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3,      | ลกส์    | 0.02 max  | pr      |
| Internal Shield                                          | , and   | 4.8       | - 17    |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, an       |         | 4.0       | рF      |
| Internal Shield                                          | ıa      |           | _       |
|                                                          |         | 2.6       | pF      |
| Plate of Diode Unit No.1 to Cathode and Heater           |         | 1.3       | pF      |
| Plate of Diode Unit No.2 to Cathode and Heater           |         | 1.2       | pF      |
| Pentode Grid No.1 to Either Diode Plate                  |         | 0.006 max | рF      |
| <sup>o</sup> The dc component must not exceed 100 volta, |         |           |         |

## Pentode Unit as Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):            |           |         |
|-----------------------------------------------------|-----------|---------|
| Plate Voltage                                       | 330 max   | volts   |
| Gild-No.2 (Screen-Gild) Supply Voltage              | 330 max   | volts   |
| Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage; | See curve | page 80 |
| Positive-bias value                                 | 0 max     | volts   |
| Negative-bias value                                 | -55 max   | volts   |

| Grid-No.2 Input: For grid-No.2 voltages up to 165 volts | 0.55 max |            |
|---------------------------------------------------------|----------|------------|
| For grid-No.2 voltages between 165 and 330 volts        |          | ve page 80 |
| Plate Dissipation                                       | 3 max    | watts      |
| CHARACTERISTICS:                                        |          |            |
| Plate Voltage                                           | 250      | volts      |
| Grid-No.2 Voltage                                       | 110      | voits      |
| Cathode-Bias Resistor                                   | 68       | ohms       |
| Plate Resistance (Approx.)                              | 0.25     | megohm     |
| Transconductance                                        | 5200     | $\mu$ mhos |
| Grid-No.1 Voltage (Approx.) for plate current of 10 μA  | 10       | volts      |
| Plate Current                                           | 10       | mA         |
| Grid-No.2 Current                                       | 3.5      | mA         |
| MAXIMUM CIRCUIT VALUES:                                 |          |            |
| Grid-No.1 Circuit Resistance:                           |          |            |
| For fixed-bias operation                                | 0.1 max  | megohm     |
| For cathode-bias operation                              | 0.5 max  | megohm     |
| Diode Units (Each Unit)                                 |          |            |
| MAXIMUM RATINGS (Design-Maximum Value):                 |          |            |
| Plate Current                                           | 5 max    | mA         |
| THE CHILDREN                                            | Jillan   | 1117-7     |

## PENTAGRID AMPLIFIER

6BY6
Related type:
3BY6

Miniature type used as a gated amplifier in color television receivers. In such service, it may be used as a combined sync separator and sync clipper. Outline 5C, Outlines section. Tube requires miniature seven-contact sock-



7CH

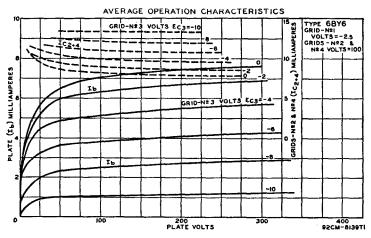
et and may be mounted in any position. Type 3BY6 is identical with type 6BY6 except for the heater ratings, as shown below.

| except for the heater ratings, as shown below.           |         |          |         |
|----------------------------------------------------------|---------|----------|---------|
|                                                          | 3BY6    | 6BY6     |         |
| Heater Voltage (ac/dc)                                   | 3.15    | 6.3      | volts   |
| Heater Current                                           | 0.6     | 0.3      | ampere  |
| Heater Warm-up Time (Average)                            | 11      |          | seconds |
| Peak Heater-Cathode Voltage:                             |         |          |         |
| Heater negative with respect to cathode                  | 200 max | 200 max  | volts   |
| Heater positive with respect to cathode                  | 200°max | 200°max  | volts   |
| Direct Interelectrode Capacitances:                      |         |          |         |
| Grid No.1 to Plate                                       |         | 0.08 max | рF      |
| Grid No.3 to Plate                                       |         | 0.35 max | pF      |
| Grid No.1 to Grid No.3                                   |         | 0.22 max | pF      |
| Grid No.1 to All Other Electrodes                        |         | 5.4      | pF      |
| Grid No.3 to All Other Electrodes                        |         | 6.9      | pF      |
| Plate to All Other Electrodes                            |         | 7.6      | рF      |
| <sup>o</sup> The dc component must not exceed 100 volts. |         |          |         |
| Class A, Amplifier                                       |         |          |         |
| CHARACTERISTICS:                                         |         |          |         |
| Plate Voltage                                            |         | 250      | volts   |
| Grids-No.2-and-No.4 Voltage                              |         | 100      | volts   |
| Grid No 2 Voltage                                        |         | _25      | wolte   |

| Plate Voltage                                                 | 250  | volts      |
|---------------------------------------------------------------|------|------------|
| Grids-No.2-and-No.4 Voltage                                   | 100  | volts      |
| Grid-No.3 Voltage                                             | -2.5 | volts      |
| Grid-No.1 Voltage                                             | -2.5 | volts      |
| Grid-No.3-to-Plate Transconductance                           | 500  | μmhos      |
| Grid-No.1-to-Plate Transconductance                           | 1900 | $\mu$ mhos |
| Plate Current                                                 | 6.5  | mA         |
| Grids-No.2-and-No.4 Current                                   | 9    | mA         |
| Grid-No.3 Volts (Approx.) for plate current of 35 $\mu$ A and |      |            |
| grid-No.1 volts = $-4$                                        | 15   | volts      |
| Grid-No.1 Volts (Approx.) for plate current of 35 $\mu$ A and |      |            |
| grid-No.3 volts = $0$                                         | -12  | volts      |
|                                                               |      |            |

### **Gated Amplifier**

| dated Amphher                                                                                                                                                     |                |        |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|-----------|
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                          |                |        |           |
| Plate Voltage                                                                                                                                                     | 330            | max    | volts     |
| Grids-No.2-and-No.4 Voltage                                                                                                                                       | See            | e curv | e page 80 |
| Grids-No.2-and-No.4 Supply Voltage                                                                                                                                | 330            | max    | volts     |
| Negative bias value                                                                                                                                               | <del></del> 55 | max    | volts     |
| Positive bias value                                                                                                                                               | . 0            |        | volts     |
| Positive peak value                                                                                                                                               | 27             | max    | volts     |
| Grid-No.1 Voltage, Negative bias value                                                                                                                            | -110           | max    | voits     |
| Plate Dissipation                                                                                                                                                 | 2.3            | max    | watts     |
| Grid-No.3 Input Grids-No.2-and-No.4 Input:                                                                                                                        | 0.1            | max    | watt      |
| For grids-No.2-and-No.4 voltages up to 165 volts                                                                                                                  | 1.1            | max    | watts     |
| For grids-No.2-and-No.4 voltages between 165 and 330 volts                                                                                                        | Sec            | e curv | e page 80 |
| Grid-No.1 Input                                                                                                                                                   | 0.1            | max    | watt      |
| CHARACTERISTICS AS SYNC SEPARATOR AND SYNC CLIPPER:                                                                                                               |                |        |           |
| Plate Voltage                                                                                                                                                     | 10             |        | volts     |
| Grid-No.3 Voltage                                                                                                                                                 | 0              |        | volts     |
| Grids-No.2-and-No.4 Voltage                                                                                                                                       | 25             |        | volts     |
| Grid-No.1 Voltage                                                                                                                                                 | 0              |        | volts     |
| Plate Current                                                                                                                                                     | 1.4            |        | mA        |
| Grids-No.2-and-No.4 Current                                                                                                                                       | 3.5            |        | mA        |
| Grid-No.3 Volts (Approx.) for plate voltage of 25 volts, grids-No.2-<br>and-No.4 voltage of 25 volts, grid-No.1 voltage of 0 volts, and                           |                |        |           |
| plate current of 50 μA<br>Grid-No.1 Volts (Approx.) for plate voltage of 25 volts, grids-No.2-<br>and-No.4 voltage of 25 volts, grid-No.3 voltage of 0 volts, and | -2.5           |        | volts     |
| plate current of 50 $\mu$ A                                                                                                                                       | -2.3           |        | volts     |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                           |                |        | 1010      |
| Grid-No.1 or Grid-No.3-Circuit Resistance:                                                                                                                        |                |        |           |
| For fixed-bias operation                                                                                                                                          | 0.5            | max    | megohm    |
| For cathode-bias operation                                                                                                                                        |                |        | megohm    |
|                                                                                                                                                                   |                |        |           |





### DIODE— SHARP-CUTOFF PENTODE

Miniature type used in diversified applications in television receivers. The pentode unit is used as an rf amplifier and the high-perveance diode as a limiter or detector. This type has a controlled heater warm-up time for

**6BY8** 

use in receivers employing series-connected heater strings. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc)                                  | 6.3        | volts   |
|---------------------------------------------------------|------------|---------|
| Heater Current                                          | 0.6        | ampere  |
| Heater Warm-up Time (Average)                           | 11         | seconds |
| Peak Heater-Cathode Voltage:                            |            |         |
| Heater negative with respect to cathode                 | 200 max    | volts   |
| Heater positive with respect to cathode                 | 200₄max    | volts   |
| Direct Interelectrode Capacitances:                     | 200-1114.1 |         |
| Pentode Unit:                                           |            |         |
| Grid No.1 to Plate                                      | 0.0035 max | pΡ      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and | 0.0055 Max | pı.     |
| Internal Shield                                         | 5.5        | ρF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and     | 2.5        | pr.     |
| Internal Shield                                         | 5          | -17     |
| Diada Diada da Ali Odia Diada da                        | •          | рF      |
| Diode Plate to All Other Electrodes                     | 4.8■       | ₽₽      |
| The decomposite water and 100 ct                        |            |         |

- A The dc component must not exceed 100 volts.
- <sup>a</sup> With external shield connected to cathode of pentode unit (pin 9), except as noted.
- With external shield connected to ground.

### Pentode Unit as Class A. Amplifier

| rentede onit as olds A <sub>1</sub>                         | Annih miner |                 |             |
|-------------------------------------------------------------|-------------|-----------------|-------------|
| MAXIMUM RATINGS (Design-Center Values):                     |             |                 |             |
| Plate Voltage                                               |             | . 300 ma:       | k volts     |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value         |             | . 0 ma:         | k volts     |
| Grid-No.2 (Screen Grid) Supply Voltage                      |             | 300 max         |             |
| Grid-No.2 Voltage                                           |             | . See cu        | rve page 80 |
| Grid-No.1 (Control-Grid) Voltage:                           |             |                 |             |
| Negative bias value                                         |             | 50 max          | k volts     |
| Positive bias value                                         |             | . 0 ma:         | x volts     |
| Plate Dissipation                                           |             | . 3 ma          |             |
| Grid-No.2 Input:                                            |             |                 |             |
| For grid-No.2 voltages up to 150 volts                      |             | . 0.65 ma       | x watt      |
| For grid-No.2 voltages between 150 and 300 volts.           |             | See cu          | rve page 80 |
| CHARACTERISTICS:                                            |             |                 |             |
| Plate Supply Voltage                                        | 100         | 250             | volts       |
| Grid No.3                                                   | Co          | nnect to cathod |             |
| Grid-No.2 Supply Voltage                                    | 100         | 150             | volts       |
| Cathode-Bias Resistor                                       | 150         | 68              | ohms        |
| Plate Resistance (Approx.)                                  | 0.5         | 1               | megohm      |
| Transconductance                                            | 3900        | 5200            | μmhos       |
| Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A | -4.2        | 6.5             | volts       |
| Plate Current                                               | 5           | 10.6            | mA          |
| Grid-No.2 Current                                           | 2.1         | 4.3             | mA          |
| MAXIMUM CIRCUIT VALUES:                                     |             |                 |             |

Grid-No.1-Circuit Resistance:

For fixed-bias operation ...... 0.25 max megohm For cathode-bias operation ..... 1.0 max megohm

#### **Diode Unit**

| MAXIMUM RATINGS (Design-Center Values): |         |       |
|-----------------------------------------|---------|-------|
| Peak Inverse Plate Voltage              | 430 max | volts |
| Peak Plate Current                      | 180 max | mA    |
| DC Plate Current                        | 45 max  | mA    |

### SEMIREMOTE-CUTOFF PENTODE

Related types:

Miniature type used in gain-controlled video if stages of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket 3BZ6, 4BZ6, 12BZ6 and may be mounted in any position. Types 3BZ6, 4BZ6, and 12BZ6 are

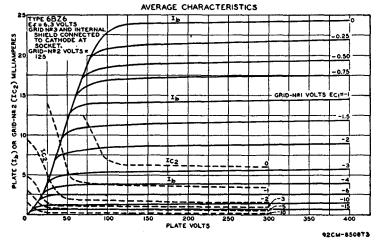
identical with type 6BZ6 except for the heater ratings, as shown below.

|                                                                | 3BZ6      | 4BZ6   | 6BZ6                | 12BZ6            |         |
|----------------------------------------------------------------|-----------|--------|---------------------|------------------|---------|
| Heater Voltage (ac/dc)                                         | 3.15      | 4.2    | 6.3                 | 12.6             | volts   |
| Heater Current                                                 | . 0.6     | 0.45   | 0.3                 | 0.15             | ampere  |
| Heater Warm-up Time (Average)                                  | . 11      | 11     | _                   |                  | seconds |
| Peak Heater-Cathode Voltage:<br>Heater negative with respect   |           |        |                     |                  |         |
| to cathode  Heater positive with respect                       | , 200 тах | 200 ma | x 200 max           | 200 max          | volts   |
| to cathode                                                     | . 200 max | 200 ma | x 200 max           | 200 • max        | volts   |
|                                                                |           |        | Without<br>External | With<br>External |         |
| Direct Interelectrode Capacitances:                            |           |        | Shield              | Shield△          |         |
| Grid No.1 to Plate                                             |           |        | 0.025 max           | 0.015 max        | рF      |
| Grid No.1 to Cathode, Heater, Gri<br>No.3, and Internal Shield |           |        | 7                   | 7                | pF      |
| Plate to Cathode, Heater, Grid No                              |           |        | ·                   |                  |         |
| and Internal Shield                                            |           |        | 2                   | 3                | pF      |

<sup>■</sup> The dc component must not exceed 100 volts. ∆ With external shield connected to cathode.

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              |           |         |
|-------------------------------------------------------|-----------|---------|
| Plate Voltage                                         | 330 max   | volts   |
| Grid No.3 (Suppressor-Grid) Voltage, Positive Value   | 0 max     | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                | 330 max   | volts   |
| Grid-No.2 Voltage                                     | See curve | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive bias value | 0 max     | volts   |
| Plate Dissipation                                     | 2.3 max   | watts   |
| Grid-No.2 Input:                                      |           |         |
| For grid-No.2 voltages up to 165 volts                | 0.55 max  | watt    |
| For grid-No.2 voltages between 165 and 330 volts      | See curve | page 80 |



| CHARACTERISTICS:                                                   |            |            |
|--------------------------------------------------------------------|------------|------------|
| Plate Supply Voltage                                               | 125        | volts      |
| Grid No.3 Connected                                                | to cathode | at socket  |
| Grid-No.2 Supply Voltage                                           | 125        | volts      |
| Cathode-Bias Resistor                                              | 56         | ohms       |
| Plate Resistance (Approx.)                                         | 0.26       | megohm     |
| Transconductance                                                   | 8000       | μmhos      |
| Grid-No.1 Voltage (Approx.) for transconductance of 50 \(\mu\)mhos | 19         | volts      |
| Grid No.1 Voltage (Approx.) for transconductance of 700 μmhos      |            |            |
| and cathode resistor of 0 ohms                                     | 4.5        | volts      |
| Plate Current                                                      | 14         | m <b>A</b> |
| Grid-No.2 Current                                                  | 3.6        | mA.        |

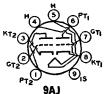
#### **MAXIMUM CIRCUIT VALUES:**

| Grid-No.1-Circuit Resistance: |                 |
|-------------------------------|-----------------|
| For fixed-bias operation      | 0.25 max megohm |
| For cathode-bias operation    | 1.0 max megohm  |

#### MEDIUM-MU TWIN TRIODE

6BZ7
Related type:

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of whf television tuners. In such circuits, one triode unit is used as the direct-coupled grounded-cathode driver for the other unit. This type is also used

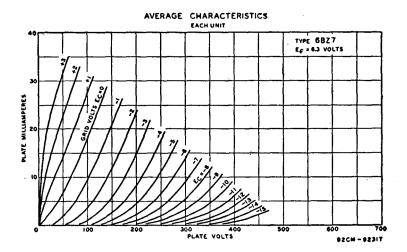


in push-pull cathode-drive rf amplifiers. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Type 4BZ7 is identical with type 6BZ7 except for the heater ratings, as shown below.

|                                                      | 4BZ7      | 6BZ7      |         |
|------------------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                               | 4.2       | 6.3       | voits   |
| Heater Current                                       | 0.6       | 0.4       | ampere  |
| Heater Warm-up Time (Average)                        | 11        |           | seconds |
| Peak Heater-Cathode Voltage:                         |           |           |         |
| Heater negative with respect to cathode              | 200*max   | 200*max   | volts   |
| Heater positive with respect to cathode              | 200 • max | 200 • max | volts   |
| Direct Interelectrode Capacitances:                  |           |           |         |
| Grid to Plate (Each Unit)                            |           | 1.2       | рF      |
| Grid to Cathode, Heater, and Internal Shield (Unit   | No.1)     | 2.6       | рF      |
| Plate to Cathode, Heater, and Internal Shield (Unit  | No.1)     | 1.2       | pF      |
| Plate to Cathode (Each Unit)                         |           | 0.12      | pF      |
| Heater to Cathode (Each Unit)                        |           | 2.6       | рF      |
| Cathode to Grid, Heater, and Internal Shield (Unit   |           | 5         | pF      |
| Plate to Grid, Heater, and Internal Shield (Unit No. |           | 2.2       | pF      |
| Plate of Unit No.1 to Plate of Unit No.2             |           | 0.010 max | рF      |
| Plate of Unit No.2 to Plate and Grid of Unit No.1.   |           | 0.024 max | рF      |

<sup>\*</sup> In cathode-drive circuits with direct-coupled drive, it is permissible for this voltage to be as high as 300 volts under cutoff conditions.

The dc component must not exceed 100 volts.



#### Class A, Amplifier

| MAXIMUM RATINGS (Design-Center Values):            | •          |        |
|----------------------------------------------------|------------|--------|
| Plate Voltage                                      | 250*max    | volts  |
| Plate Dissipation                                  | 2.0 max    | watts  |
| Cathode Current                                    | 20 max     | mA     |
| CHARACTERISTICS:                                   |            |        |
| Plate Supply Voltage                               | 150        | volts  |
| Cathode-Bias Resistor                              | 220        | ohms   |
| Amplification Factor                               | 36         |        |
| Plate Resistance (Approx.)                         | 5300       | ohms   |
| Transconductance                                   | 6800       | μmhos  |
| Plate Current                                      | 10         | mA     |
| Grid Voltage (Approx.) for plate current of 100 µA | <b>—</b> 7 | volts  |
| MAXIMUM CIRCUIT VALUE:                             |            |        |
| Grid-Circuit Resistance                            | 0.5 max    | megohm |

\* In cathode-drive circuits with direct-coupled drive, it is permissible for this voltage to be as high as 300 volts under cutoff conditions.



#### **POWER TRIODE**

Miniature type used in compact radio equipment as a local oscillator in FM and other high-frequency circuits. It may also be used as a class C rf amplifier. In such service, it delivers a power output of 5.5 watts at moder-

**6C4** 

ate frequencies, and 2.5 watts at 150 megacycles per second. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. For additional curve of plate characteristics, refer to type 12AU7A.

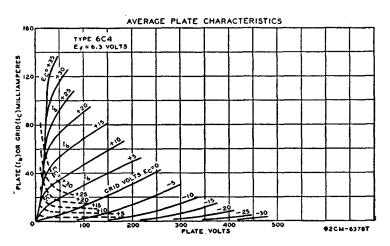
| Heater Voltage (ac/dc) Heater Current                                                                          |                     | 6.3<br>0.15        | volts<br>ampere |
|----------------------------------------------------------------------------------------------------------------|---------------------|--------------------|-----------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode |                     | 200 max<br>200-max | volts<br>volts  |
|                                                                                                                | Without<br>External | With<br>External   |                 |
| Direct Interelectrode Capacitances (Approx.):                                                                  | Shield              | Shield₄            | _               |
| Grid to Plate                                                                                                  | 1.6                 | 1.4                | pF              |
| Grid to Cathode and Heater                                                                                     | 1.8                 | 1.8                | pF              |
| Plate to Cathode and Heater                                                                                    | 1.3                 | 2.5                | рF              |
| ■ The dc component must not exceed 100 volts.  A With external shield connected to cathode.                    |                     |                    |                 |
| Class A, Amplifier                                                                                             | •                   |                    |                 |
| MAXIMUM RATINGS (Design-Center Values):                                                                        |                     |                    |                 |
| Plate Voltage                                                                                                  |                     | 300 max            | volts           |
| Plate Dissipation                                                                                              |                     | 3.5 max            | watts           |
| CHARACTERISTICS:                                                                                               | •                   |                    |                 |
| Plate Voltage                                                                                                  | 100                 | 250                | volts           |
| Grid Voltage*                                                                                                  | 100                 | -8.5               | volts           |
| Amplification Factor                                                                                           | 19.5                | 17                 | 10.65           |
| Plate Resistance (Approx.)                                                                                     | 6250                | 7700               | ohms            |
| Transconductance                                                                                               | 3100                | 2200               | μmhos           |
| Plate Current                                                                                                  | 11.8                | 10.5               | mA              |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A                                                         | -10                 | -25                | volts           |
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance:                                                               |                     |                    |                 |
| For fixed bias operation                                                                                       |                     | 0.25 max           | mench-          |
| For cathode-bias operation                                                                                     |                     |                    | megohm          |
|                                                                                                                |                     |                    |                 |
| * Transformer- or impedance-type input coupling devices                                                        | are recomm          | enaca to min       | muze re-        |

\* Transformer- or impedance-type input coupling devices are recommended to minimize resistance in the grid circuit.

### RF Power Amplifier and Oscillator—Class C Telegraphy

| MAXIMUM RATINGS (Design-Center Values):         | 0 . ,   |       |
|-------------------------------------------------|---------|-------|
| Plate Voltage                                   | 300 max | volts |
| Grid Voltage                                    | -50 max | volts |
| Plate Current                                   | 25 max  | mA    |
| Grid Current                                    |         | mA    |
| Plate Dissipation                               | 5 max   | watts |
| TYPICAL OPERATION AT FREQUENCIES UP TO 50 Mc/s: |         |       |
| Plate Voltage                                   | 300     | volts |
| Grid Voltage                                    | -27     | volts |
| Plate Current                                   | 25      | mA    |
| Grid Current (Approx.)                          | 7       | mA    |
| Driving Power (Approx.)                         | 0.35    | watt  |
| Power Output (Approx.).                         | 5.5     | watts |

• Approximately 2.5 watts power output can be obtained when the 6C4 is used at 150 megacycles as an oscillator with grid resistor of 10,000 ohms and with maximum rated input,



## SHARP-CUTOFF DUAL TETRODE

6C9
Related type:

Miniature type used as vhf rf-amplifier and autodyne mixer tube. Outline 6B, Outlines section, except center pin is added to base. Tube requires miniature ten-contact socket and may be mounted in any position. Type 17C9

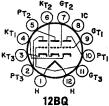


1700

is identical with type 6C9 except for the heater ratings, as shown below.

|                                              | 609       | 1/09      |        |
|----------------------------------------------|-----------|-----------|--------|
| Heater Voltage (ac/dc)                       | 6.3       | 16.8      | volts  |
| Heater Current                               | 0.4       | 0.15      | ampere |
| Peak Heater-Cathode Voltage:                 |           |           | -      |
| Heater negative with respect to cathode      | 100 max   | 100 max   | volts  |
| Heater positive with respect to cathode      | 100 max   | 100 max   | volts  |
| Direct Interelectrode Capacitances:          | Unit No.1 | Unit No.2 |        |
| Grid No.1 to Plate                           | 0.055 max | 0.06 max  | pF     |
| Grid No.1 to Cathode, Heater, Grid No.2, and |           |           | -      |
| Internal Shield                              | 4.4       | 4.2       | pF     |
| Plate to Cathode, Heater, Grid No.2, and     |           |           | •      |
| Internal Shield                              | 2.2       | 2.2       | ρF     |
| Heater to Cathode                            | 4.2       | 4.8       | p₽     |
|                                              |           |           | -      |

| Plate of Unit No.1 to Plate of Unit No.2               | 0.003 max<br>0.001 max |                                         |
|--------------------------------------------------------|------------------------|-----------------------------------------|
| Grid No.1 of Unit No.1 to Grid No.1 of Unit No.2       |                        |                                         |
| Grid No.1 of Unit No.1 to Plate of Unit No.2           | 0.001 max              |                                         |
| Grid No.1 of Unit No.2 to Plate of Unit No.1           | 0.032 max              | pF                                      |
| Class A, Amplifier (Each Unit)                         |                        |                                         |
| MAXIMUM RATINGS (Design-Maximum Values):               |                        |                                         |
| Plate Voltage                                          | 250 max                | volts                                   |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | 180 max                | volts                                   |
| Grid-No.2 Voltage                                      | See cur                | ve page 80                              |
| Cathode Current                                        | 20 max                 |                                         |
| Plate Dissipation:                                     |                        |                                         |
| Either plate                                           | 1.5 max                | watts                                   |
| Both plates (both units operating)                     | 2.5 max                | watts                                   |
| Grid-No.2 Input:                                       |                        |                                         |
| For grid-No.2 voltages up to 90 volts                  | 0.5 max                | watt                                    |
| For grid-No.2 voltages between 90 and 180 volts        |                        | ve page 80                              |
| CHARACTERISTICS:                                       | 540 451                | . • • • • • • • • • • • • • • • • • • • |
|                                                        | 125                    | volts                                   |
| Plate Voltage                                          | 80                     | volts                                   |
| Grid-No.2 Voltage                                      |                        | volt                                    |
| Grid-No.1 Voltage                                      | -1                     |                                         |
| Plate Resistance (Approx.)                             | 0.1                    | megohm                                  |
| Transconductance                                       | 8000                   | μmhos                                   |
| Plate Current                                          | 10                     | mA                                      |
| Grid-No.2 Current                                      | 1.5                    | mA                                      |
| Grid-No.1 Voltage (Approx.) for plate current of 20 μA | 6                      | volts                                   |
|                                                        |                        |                                         |



### HIGH-MU TRIPLE TRIODE

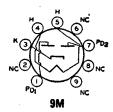
Duodecar type used for resistancecoupled voltage amplifiers, phase inverters, and other circuits requiring high voltage gain. Outline 8A, Outlines section. Type requires duodecar twelve-contact socket and may be

6C10

mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.6; average warm-up time (for series heater operation), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values, Each Plate Voltage | Triode Unit): | 330 max          | volts          |
|------------------------------------------------------------|---------------|------------------|----------------|
| Grid Voltage:                                              |               | •                | 11             |
| Positive-bias value Negative-bias value                    |               | 0 max<br>—50 max | volts<br>volts |
| Plate Dissipation                                          |               |                  | volt           |
| Total Plate Dissipation (All plates)                       |               | 3 max            | watts          |
| CHARACTERISTICS (Each Triode Unit):                        | 100           | 050              |                |
| Plate Voltage Grid Voltage                                 | 100<br>—1     | 250<br>—-2       | volts<br>volts |
| Amplification Factor                                       | 100           | 100              | 70103          |
| Plate Resistance (Approx.)                                 | 80000         | 62500            | ohms           |
| Transconductance                                           | 1250          | 1600             | μmhos          |
| Plate Current                                              | 0.5           | 1.2              | . mA           |



## **FULL-WAVE VACUUM RECTIFIER**

Miniature type used in power-supply of compact, audio equipment having moderate dc requirements. Outline 6G, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. It is

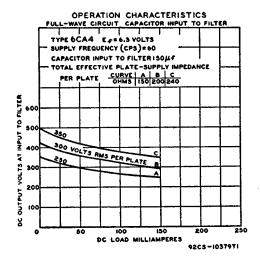
6CA4

especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 6.3; amperes, 1.

#### **Full-Wave Rectifier**

| MAXIMUM RATINGS (Design-Center Values):           |          |                     |          |       |
|---------------------------------------------------|----------|---------------------|----------|-------|
| Peak Inverse Plate Voltage                        |          |                     | 1000 max | volts |
| Peak Plate Current (Per Plate)                    |          |                     | 450 max  | mA    |
| AC Plate Supply Voltage (Per Plate, rms) with C   | apacitor | Input               |          |       |
| to Filter                                         |          |                     | 350 max  | volts |
| DC Output Current                                 |          |                     | 150 max  | mA    |
| Hot Switching Transient Plate Current (Per Plate  |          |                     | #        |       |
| Peak Heater-Cathode Voltage:                      | .,       |                     |          |       |
| Heater negative with respect to cathode           |          | · • · · · · · · • • | 500 max  | volts |
| TYPICAL OPERATION with Capacitor Input to Filter: |          |                     |          |       |
| AC Plate-to-Plate Supply Voltage (rms)            | 500      | 600                 | 700      | volts |
| Filter-Input Capacitor                            | 50       | 50                  | 50       | μF    |
| Total Effective Plate Supply Impedance            |          |                     |          |       |
| per Plate                                         | 150      | 200                 | 240      | ohms  |
| DC Output Voltage at Input to Filter (Approx.)    |          |                     |          |       |
| For dc output current of 150 mA                   | 245      | 293                 | 347      | volts |
|                                                   |          |                     |          |       |

# When capacitor-input circuits are used, a maximum peak current value per plate of 1 ampere during the initial cycles of the hot-switching transient should not be exceeded.



#### **BEAM POWER TUBE**

6CA5 Related types: 12CA5, 25CA5 Miniature type used in af power output stage of radio and television receivers. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be operated in any position. Types 12CA5 and 25CA5



are identical with type 6CA5 except for the heater ratings, as shown below.

|                               | OUAS | 12CA5 | 23CA3 |         |
|-------------------------------|------|-------|-------|---------|
| Heater Voltage (ac/dc)        | 6.3  | 12.6  | 25    | volts   |
| Heater Current                | 1.2  | 0.6   | 0.3   | ampere  |
| Heater Warm-up Time (Average) | -    | 11    | _     | seconds |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 6CA5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 12CA5                                                          | 25CA:                                                                        | 5                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 200 max<br>200°max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 300=max<br>200°max                                             | 200 ma<br>200°ma                                                             |                                                         |
| <ul> <li>The dc component must not exceed 200 volts.</li> <li>The dc component must not exceed 100 volts.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                |                                                                              |                                                         |
| Class A,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Amplifier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                |                                                                              |                                                         |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                |                                                                              |                                                         |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                | 130 max                                                                      | volts<br>volts                                          |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                | 130 max<br>0 max                                                             | volts                                                   |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                | 5 max                                                                        | watts                                                   |
| Grid-No.2 Input  Bulb Temperature (At hottest point)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                | 1.4 max<br>180 max                                                           | watts<br>°C                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | • • • • • • •                                                  | 100 max                                                                      | ·                                                       |
| TYPICAL OPERATION:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 440                                                            | 405                                                                          | 1                                                       |
| Plate Voltage Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 110<br>110                                                     | 125<br>125                                                                   | volts<br>volts                                          |
| Grid-No.1 (Control-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -4                                                             | <b>-4.5</b>                                                                  | volts                                                   |
| Grid-No.1 (Control-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 4                                                              | 4.5                                                                          | volts                                                   |
| Zero-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 32                                                             | 37                                                                           | mA                                                      |
| Maximum-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 31<br>3.5                                                      | 36<br>4                                                                      | mA<br>mA                                                |
| Maximum-Signal Grid-No.2 Current (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 7.5                                                            | 11                                                                           | mA                                                      |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 5000                                                           | 15000                                                                        | ohms                                                    |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3100                                                           | 9200                                                                         | μmhos                                                   |
| Load Resistance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3500<br>5                                                      | 4500<br>6                                                                    | ohms<br>per cent                                        |
| Maximum-Signal Power Output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1.1                                                            | 1.5                                                                          | watts                                                   |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                |                                                                              | megohm                                                  |
| For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ••••                                                           | 0.5 max                                                                      | megohm                                                  |
| G G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | •••••                                                          | 0.5 max                                                                      | megohm                                                  |
| POWER F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                |                                                                              | _                                                       |
| POWER F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | PENTODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                | 0.5 max                                                                      | _                                                       |
| POWER F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | PENTODE used in the                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | output                                                         | 6CA                                                                          | 7                                                       |
| POWER F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | PENTODE used in the quency am                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | output<br>plifiers.                                            | 6CA                                                                          | 7                                                       |
| POWER F  Glass octal types of audio-free  Maximum dimension                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | PENTODE used in the quency ampons: over-all                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | output<br>plifiers.<br>length,                                 | 6CA                                                                          | 7                                                       |
| POWER F  Glass octal types of audio-free  Maximum dimensic  47/16 inches; seated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | PENTODE used in the quency ampons: over-all height, 3%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | output<br>plifiers.<br>length,<br>inches;                      | 6CA                                                                          | 7                                                       |
| POWER F  Glass octal types of stage of audio-free  Maximum dimension  47/16 inches; seated diameter, 11/2 inch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | PENTODE used in the quency ampons: over-all height, 3% uses. Tubes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | output<br>plifiers.<br>length,<br>inches;<br>require           | 6CA                                                                          | 7                                                       |
| POWER F  Glass octal types of audio-free  Maximum dimensic  47/16 inches; seated diameter, 1½ inch octal eight-contact                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | PENTODE used in the quency ampons: over-all height, 3% uses. Tubes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | output<br>plifiers.<br>length,<br>inches;<br>require           | 6CA                                                                          | 7                                                       |
| POWER F  Glass octal types of stage of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches octal eight-contact mounted in any position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | PENTODE used in the quency amples: over-all height, 3% less. Tubes a socket and r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA7<br>6CA7<br>EL34                                                         | 7<br>1                                                  |
| POWER F  Glass octal types of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches octal eight-contact mounted in any position.  Heater Voltage (ac/dc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | PENTODE used in the quency amp us: over-all height, 3% uss. Tubes usocket and r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA7<br>6CA7<br>EL34                                                         | 7<br>//                                                 |
| POWER F  Glass octal types of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches octal eight-contact mounted in any position.  Heater Voltage (ac/dc) Heater Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | PENTODE used in the quency amp us: over-all height, 3% uss. Tubes usocket and r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA7<br>6CA7<br>EL34                                                         | 7<br>1                                                  |
| POWER F  Glass octal types stage of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches octal eight-contact mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | PENTODE used in the quency amp us: over-all height, 3% uss. Tubes usocket and r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA76CA7EL34                                                                 | volts amperes                                           |
| POWER F  Glass octal types of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches; seated diamet | PENTODE used in the quency amp us: over-all height, 3% uss. Tubes usocket and r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA7<br>6CA7<br>EL34                                                         | yolts amperes                                           |
| POWER F  Glass octal types of stage of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches; seated diameter, 1½ inches; seated diameter voltage (ac/dc)  Heater Current  Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode  Direct Interelectrode Capacitances:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | PENTODE used in the quency amples: over-all height, 3% les. Tubes a socket and r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | output<br>plifiers.<br>length,<br>inches;<br>require<br>may be | 6CA76CA7EL34                                                                 | volts amperes                                           |
| POWER F  Glass octal types of stage of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches; seat | PENTODE used in the quency amp uns: over-all height, 37% les. Tubes socket and r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA7<br>6CA7<br>EL34<br>6.3<br>1.5<br>200 max<br>200 max<br>15.5             | volts amperes volts volts                               |
| POWER F  Glass octal types of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches; seated diamet | PENTODE used in the quency amp uns: over-all height, 37% les. Tubes socket and r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA76CA7EL34                                                                 | volts amperes volts volts                               |
| POWER F  Glass octal types of stage of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches; seat | PENTODE used in the quency amples: over-all height, 3% les. Tubes is socket and resocket and res | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA7<br>6CA7<br>EL34<br>6.3<br>1.5<br>200 max<br>200 max<br>15.5             | volts amperes volts volts                               |
| POWER F  Glass octal types of stage of audio-free Maximum dimension 47/16 inches; seated diameter, 11/2 inches octal eight-contact mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Office of Interelectrode Capacitances:  Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, and Plate to Cathode, Heater, Grid No.2, and office of the cathode of the cathode of the cathode of the cathode, Heater, Grid No.2, and office of the cathode | PENTODE used in the quency amples: over-all height, 3% les. Tubes in socket and resocket and res | output<br>plifiers.<br>length,<br>inches;<br>require<br>nay be | 6CA7<br>6CA7<br>EL34<br>6.3<br>1.5<br>200 max<br>200 max<br>15.5             | volts amperes volts volts                               |
| POWER F  Glass octal types of stage of audio-free Maximum dimension 47/16 inches; seated diameter, 11/2 inches; seated diamete | PENTODE used in the quency amp uns: over-all height, 3% uses. Tubes usocket and r socket and r ad Grid No.3 Grid No.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | output plifiers. length, inches; require may be                | 6CA76CA76CA76CA76CA76CA76CA76CA76CA76CA7                                     | volts amperes volts volts pF pF volts                   |
| POWER F  Glass octal types stage of audio-free Maximum dimension 47/16 inches; seated diameter, 11/2 inches octal eight-contact mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Capacitances: Grid No.1 to Plate Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, and Plate to Cathode, Heater, Grid No.2, and Class A.  MAXIMUM RATINGS (Design-Center Values): Plate Voltages Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | PENTODE used in the quency amples: over-all height, 3% les. Tubes is socket and resocket and res | output<br>plifiers.<br>length,<br>inches;<br>require<br>may be | 6CA7<br>6CA7<br>EL34<br>6.3<br>1.5<br>200 max<br>200 max<br>1<br>15.5<br>7.2 | volts volts pf pf pf volts volts volts                  |
| POWER F  Glass octal types stage of audio-free Maximum dimension 47/16 inches; seated diameter, 11/2 inches octal eight-contact mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, and Plate to Cathode, Heater, Grid No.2, and Plate Voltages  Grid-No.2 (Screen-Grid) Voltage Grid-No.2 (Screen-Grid) Voltage Grid-No.2 (Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PENTODE used in the quency amples: over-all height, 3% les. Tubes is socket and resocket and res | output plifiers. length, inches; require may be                | 6CA76CA7EL34 6.3 1.5 200 max 200 max 115.5 7.2 800 max 425 max 8 max         | volts amperes volts volts pF pF volts volts volts volts |
| POWER F  Glass octal types stage of audio-free Maximum dimension 47/16 inches; seated diameter, 11/2 inches octal eight-contact mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Capacitances: Grid No.1 to Plate Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, and Plate to Cathode, Heater, Grid No.2, and Class A.  MAXIMUM RATINGS (Design-Center Values): Plate Voltages Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | PENTODE used in the quency amples: over-all height, 3% less. Tubes in socket and resocket and re | output plifiers. length, inches; require nay be                | 6CA7<br>6CA7<br>EL34<br>6.3<br>1.5<br>200 max<br>200 max<br>1<br>15.5<br>7.2 | volts volts pf pf pf volts volts volts                  |
| Glass octal types is stage of audio-free Maximum dimension 47/16 inches; seated diameter, 11/2 inches octal eight-contact mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, and Plate to Cathode, Heater, Grid No.2, and Plate Voltages Grid-No.2 (Screen-Grid) Voltage Grid-No.2 (Screen-Grid) Voltage Grid-No.2 Input Plate Dissipation Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | PENTODE used in the quency amples: over-all height, 3% less. Tubes in socket and resocket and re | output plifiers. length, inches; require nay be                | 6CA<br>6CA7<br>EL34<br>6.3<br>1.5<br>200 max<br>200 max<br>1<br>15.5<br>7.2  | volts amperes volts volts volts volts volts watts watts |
| POWER F  Glass octal types stage of audio-free Maximum dimension 47/16 inches; seated diameter, 1½ inches; seated diameter, 2½ inches; seated  | PENTODE used in the quency amples: over-all height, 3% less. Tubes is socket and resocket and re | output plifiers. length, inches; require nay be                | 6CA<br>6CA7<br>EL34<br>6.3<br>1.5<br>200 max<br>200 max<br>1<br>15.5<br>7.2  | volts amperes volts volts volts volts volts watts watts |

| Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage Peak AF Grid-No.1 Voltage Zero-Signal Plate Current Zero-Signal Grid-No.2 Current Transconductance Plate Resistance Load Resistance Maximum-Signal Power Output Total Harmonic Distortion | 250<br>-13.5<br>12.3<br>100<br>15<br>11000<br>15000<br>2000<br>11 | volts volts volts volts mA mA |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------|
| MAXIMUM CIRCUIT VALUES: Grid-No.1 Circuit Resistance: For cathode-bias resistance  Push-Pull Class AB, Amplifier  MAXIMUM RATINGS: (Same as for Class A1 Amplifier)                                                                          | 0.7 max                                                           | megohm                        |
| TEXTELON OPERATION (Values ore for two tubes)                                                                                                                                                                                                |                                                                   |                               |
| TYPICAL OPERATION (Values are for two tubes): Plate Supply Voltage                                                                                                                                                                           | 450                                                               | volts                         |
| Grid-No.2 Supply Voltage                                                                                                                                                                                                                     | 450                                                               | volts                         |
| Cathode-Bias Resistor                                                                                                                                                                                                                        | 232                                                               | ohms                          |
| Grid-No.2 Resistor                                                                                                                                                                                                                           | 1000                                                              | ohms                          |
| Peak AF Grid-No.1 to Grid-No.1 Voltage                                                                                                                                                                                                       | 38.2                                                              | volts                         |
| Zero-Signal Plate Current                                                                                                                                                                                                                    | 120                                                               | mĄ                            |
| Maximum-Signal Plate Current                                                                                                                                                                                                                 | 143                                                               | mA                            |
| Zero-Signal Grid-No.2 Current                                                                                                                                                                                                                | 20                                                                | mA                            |
| Maximum-Signal Grid-No.2 Current                                                                                                                                                                                                             | 44                                                                | mA                            |
| Effective Load Resistance (Plate-to-plate)                                                                                                                                                                                                   | 6500                                                              | ohms                          |
| Total Harmonic Distortion                                                                                                                                                                                                                    | 5.1                                                               | per cent                      |
| Maximum-Signal Power Output                                                                                                                                                                                                                  | 40                                                                | watts                         |

### **BEAM POWER TUBE**

# 6CB5A

Glass octal type used as horizontal deflection amplifier in color television receivers. Outline 21B, Outlines section. This tube requires octal socket and may be mounted in any position.



| Heater Voltage (ac/dc)                                 | 6.3     | volts      |
|--------------------------------------------------------|---------|------------|
| Heater Current                                         | 2.5     | amperes    |
| Peak Heater-Cathode Voltage:                           |         |            |
| Heater negative with respect to cathode                | 200 max | volts      |
| Heater positive with respect to cathode                | 200#max | volts      |
| Direct Interelectrode Capacitances (Approx.):          |         |            |
| Grid No.1 to Plate                                     | 0.4     | рF         |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 22      | рF         |
| Plate to Cathode, Heater, Grid No.2 and Grid No.3      | 10      | рF         |
| Transconductance*                                      | 8800    | $\mu$ mhos |
| Mu-Factor, Grid No.2 to Grid No.1*                     | 3.8     |            |
| # T1 1 1 1 1 1 100 1                                   |         |            |

#### **Horizontal Deflection Amplifier**

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |           |       |
|------------------------------------------|-----------|-------|
| DC Plate Voltage                         | 880 max   | volts |
| Peak Positive-Pulse Plate Voltage#       | 6800 max  | volts |
| Peak Negative-Pulse Plate Voltage        | -1650 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage       | 220 max   | volts |
| DC Grid-No.1 (Control-Grid) Voltage      | 55 max    | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | -220 max  | volts |
| Peak Cathode Current                     | 850 max   | mA    |
| Average Cathode Current                  | 240 max   | mA    |

<sup>#</sup> The dc component must not exceed 100 volts.

\* For plate and grid No.2 volts, 175; grid-No.1 volts, -30; plate mA, 90; grid-No.2 mA, 6.

| Grid-No.2 Input Plate Dissipation† Bulb Temperature (At hottest point) | 4 max<br>26 max<br>220 max | watts<br>watts<br>°C |
|------------------------------------------------------------------------|----------------------------|----------------------|
| BEATTERETER CONSCION WAS VID                                           |                            |                      |

MAXIMUM CIRCUIT VALUE:

Grid-No.1-Circuit Resistance 0.47 max megohm
# The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning

#The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

† An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### SHARP-CUTOFF PENTODE

Miniature types used in television receivers as intermediate-frequency amplifier at frequencies up to about 45 megacycles per second and as rf amplifier in vhf television tuners. Tubes feature very high transconductance 6CB6 6CB6A Related types: 3CB6, 4CB6

/CM

combined with low interelectrode capacitance values, and are provided with separate base pins for grid No.3 and the cathode to permit the use of an unbypassed cathode resistor to minimize the effects of regeneration. Type 6CB6A has a controlled heater warm-up time for use in television receivers employing series-connected heater strings. Outline 5C, Outlines section. Tubes require miniature seven-contact socket and may be mounted in any position. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Types 3CB6, 4CB6, and 6CB6 are identical with type 6CB6A except for the heater ratings, as shown below.

| · ·                                                        | 3CB6       | 4CB6    | 6CB6      | 6CB6A     |         |
|------------------------------------------------------------|------------|---------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                                     | 3.15       | 4.2     | 6.3       | 6.3       | volts   |
| Heater Current                                             | 0.6        | 0.45    | 0.3       | 0.3       | ampere  |
| Heater Warm-up Time (Average) Peak Heater-Cathode Voltage: | 11         | 11      | _         | 11        | seconds |
| Heater negative with respect to                            |            |         |           |           |         |
| cathode  Heater positive with respect to                   | 300 max    | 300=max | 200 max   | 200 max   | volts   |
| cathode                                                    | 200°max    | 200°max | 200°max   | 200°max   | volts   |
|                                                            |            |         | Without   | With      |         |
|                                                            |            |         | External  | External  |         |
| Direct Interelectrode Capacitances:                        |            |         | Shield    | Shield₄   |         |
| Grid No.1 to Plate                                         |            |         | 0.025 max | 0.015 max | pF      |
| Grid No.1 to Cathode, Heater,                              | Grid No.2, | Grid    |           |           |         |
| No.3, and Internal Shield                                  | <i></i> .  |         | 6.5       | 6,5       | pF      |
| Plate to Cathode, Heater, Grid N                           |            |         |           |           |         |
| and Internal Shield                                        |            |         | 2         | 3         | p₽      |
| The de component must not exceed                           | 200 volte  |         |           |           | -       |

The dc component must not exceed 200 volts.

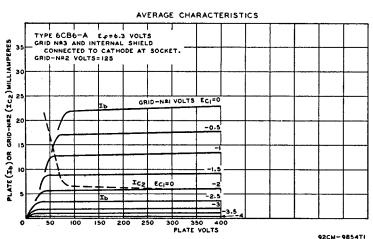
### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              |                   |
|-------------------------------------------------------|-------------------|
| Plate Voltage                                         | 330 max volts     |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value   | 0 max volts       |
| Grid-No.2 (Screen-Grid) Voltage                       | See curve page 80 |
| Grid-No.2 Supply Voltage                              | 330 max volts     |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max volts       |
| Plate Dissipation                                     | 2.3 max watts     |
| Grid-No.2 Input:                                      |                   |
| For grid-No.2 voltages up to 165 volts                | 0.55 max watt     |
| For grid-No.2 voltages between 165 and 330 volts      | See curve page 80 |

The dc component must not exceed 100 volts.

<sup>△</sup> With external shield connected to cathode.

| CHARACTERISTICS:                                            |       |              |
|-------------------------------------------------------------|-------|--------------|
| Plate Supply Voltage                                        | . 125 | volts        |
| Grid No.3Con                                                |       | de at socket |
| Grid-No.2 Supply Voltage                                    | . 125 | volts        |
| Cathode-Bias Resistor                                       | . 56  | ohms         |
| Plate Resistance (Approx.)                                  |       | megohm       |
| Transconductance                                            |       | μmhos        |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A | 6.5   | volts        |
| Grid-No.1 Voltage (Approx.) for plate current of 2.8 mA and |       |              |
| cathode-bias resistor of 0 ohms                             |       | volts        |
| Plate Current                                               |       | mA           |
| Grid-No.2 Current                                           | . 3.7 | mA           |



#### **BEAM POWER TUBE**

6CD6GA
Related type:
25CD6GB

Glass octal type used as horizontal deflection amplifier in high-efficiency deflection circuits of television receivers employing either transformer coupling or direct coupling to the deflection yoke. Outline 21B, Outlines



5BT

section. Tube requires octal socket. This type may be supplied with pins 1, 4, and 6 omitted. Vertical tube mounting is preferred but horizontal operation is permissible if pins No.2 and 7 are in vertical plane. Type 25CD6GB is identical with type 6CD6GA except for the heater ratings, as shown below.

|                                                     | 6CD6GA  | 25CD6GB |         |
|-----------------------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                              | 6.3     | 25      | volts   |
| Heater Current                                      | 2.5     | 0.6     | ampere  |
| Heater Warm-up Time (Average)                       | _       | 11      | seconds |
| Peak Heater-Cathode Voltage:                        |         |         |         |
| Heater negative with respect to cathode             | 200 max | 200 max | volts   |
| Heater positive with respect to cathode             | 200△max | 200₄max | volts   |
| Direct Interelectrode Capacitances (Approx.):       |         |         |         |
| Grid No.1 to Plate                                  |         | 1.1     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid N | No.3    | 22      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3  |         | 8.5     | pF      |
| Transconductance°                                   |         | 7700    | μmhos   |
| Plate Resistance (Approx.)°                         |         | 7200    | ohms    |
| Mu-Factor, Grid No.2 to Grid No.1                   |         | 3.9     |         |

<sup>△</sup> The dc component must not exceed 100 volts.

<sup>•</sup> For plate and grid-No.2 volts, 175; grid-No.1 volts, -30; plate mA, 75; grid-No.2 mA, 5.5.

#### Horizontal Deflection Amplifier

For operation in a 525-line, 30-frame system

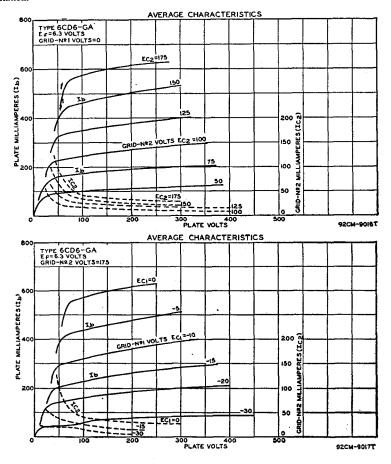
| MAXIMUM RATINGS (Design-Center Values):  DC Plate Voltage Peak Positive-Pulse Plate Voltage* (Absolute Maximum) Peak Negative-Pulse Plate Voltage DC Grid-No.2 (Screen-Grid) Voltage Peak Negative-Pulse Grid-No.1 Voltage Peak Cathode Current Average Cathode Current Plate Dissipation† Grid-No.2 Input | 700 max<br>7000*max<br>-1500 max<br>175 max<br>700 max<br>200 max<br>-200 max<br>3 max | volts volts volts volts mA mA volts watts watts |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-------------------------------------------------|
|                                                                                                                                                                                                                                                                                                            | 3 max<br>225 max                                                                       | watts<br>°C                                     |

MAXIMUM CIRCUIT VALUE:
Grid-No.1-Circuit Resistance:

For grid-resistor-bias operation .....

0.47 max megohm

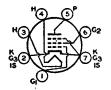
- \* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- Under no circumstances should this absolute value be exceeded.
- † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



#### SHARP-CUTOFF PENTODE

6CE5
Related type: 3CE5

Miniature type used as rf and if amplifier in vhf television receivers employing series-connected heater strings. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be operated in



7BD

any position. Type 3CE5 is identical with type 6CE5 except for the heater ratings, as shown below.

|                                                                     | 3CE5    | 6CE5     |         |
|---------------------------------------------------------------------|---------|----------|---------|
| Heater Voltage (ac/dc)                                              | 3.15    | 6.3      | volts   |
| Heater Current                                                      | 0.6     | 0.3      | ampere  |
| Heater Warm-up Time (Average) Peak Heater-Cathode Voltage:          | 11      | 11       | seconds |
| Heater negative with respect to cathode                             | 200 max | 200 max  | volts   |
| Heater positive with respect to cathode                             | 200-max | 200 max  | volts   |
| Direct Interelectrode Capacitances:                                 |         |          |         |
| Grid No.1 to Plate                                                  |         | 0.03 max | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.                   |         |          |         |
| and Internal Shield                                                 |         | 6.5      | рF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield |         | 1.9      | pF      |
| • The dc component must not exceed 100 volts.                       |         |          |         |

#### Class A. Amplifier

| MAXIMUM RATINGS (Design-Center Values): Plate Voltage       | 300 max    | volts  |
|-------------------------------------------------------------|------------|--------|
|                                                             |            |        |
| Grid-No.2 (Screen-Grid) Voltage                             | 150 max    | volts  |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value       | 0 max      | volts  |
| Grid-No.2 Input                                             | 0.5 max    | watt   |
| Plate Dissipation                                           | 2 max      | watts  |
| CHARACTERISTICS:                                            |            |        |
| Plate Voltage                                               | 125        | volts  |
| Grid-No.2 Voltage                                           | 125        | volts  |
| Grid-No.1 Supply Voltage                                    | 1          | volt   |
| Grid-No.1 Resistor (Bypassed)                               | 1          | megohm |
| Plate Resistance (Approx.)                                  | 0.3        | megohm |
| Transconductance                                            | 7600       | μmhos  |
| Grid-No.1 Voltage (Approx.) for plate current of 35 $\mu$ A | <b>—</b> 5 | volts  |
| Plate Current                                               | 11         | mA     |
| Grid-No.2 Current                                           | 2.3        | mA     |

### SHARP-CUTOFF PENTODE

6CF6
Related type: 3CF6

Miniature type used in television receivers as an intermediate-frequency amplifier at frequencies up to about 45 megacycles per second and as an rf amplifier in vhf television tuners. Because of its plate-current cutoff



7CM

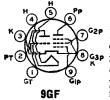
characteristic, this type is used in gain-controlled stages of video if amplifiers. This type is electrically similar to miniature type 6CB6. Outline 5C, Outlines section. Type 3CF6 is identical with type 6CF6 except for the heater ratings, as shown below.

|                               | 3CF0 | OCFO |         |
|-------------------------------|------|------|---------|
| Heater Voltage (ac/dc)        | 3.15 | 6.3  | volts   |
| Heater Current                | 0.6  | 0.3  | ampere  |
| Heater Warm-up Time (Average) | 11   | _    | seconds |

| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode 300 max Heater positive with respect to cathode 200 max  The dc component must not exceed 100 volts. | 200 max<br>200•max | volts<br>volts |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|
| CHARACTERISTICS:                                                                                                                                                           |                    |                |
| Plate Supply Voltage                                                                                                                                                       | 125                | volts          |
| Grid No.3                                                                                                                                                                  | cted to cathode    | at socket      |
| Grid-No.2 Supply Voltage                                                                                                                                                   | 125                | volts          |
| Cathode-Bias Resistor                                                                                                                                                      | 56                 | ohms           |
| Plate Resistance (Approx.)                                                                                                                                                 | 0.3                | megohm         |
| Transconductance                                                                                                                                                           | 7800               | μmhos          |
| Grid-No.1 Voltage (Approx.) for plate current of 20 µA                                                                                                                     | -6                 | volts          |
| Grid-No.1 Voltage (Approx.) for plate current of 2.2 mA and                                                                                                                |                    |                |
| cathode-bias resistor of 0 ohms                                                                                                                                            | 3                  | volts          |
| Plate Current                                                                                                                                                              | 12.5               | mA             |
| Grid No.2 Current                                                                                                                                                          | 3.7                | mA             |

Refer to type 6FQ7/6CG7

**6CG7** 



### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used as combined oscillator and mixer tube in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. When used in an AM/FM receiver, the triode unit is used as an

6CG8A
Related type:
5CG8

oscillator for both sections. In the AM section, the pentode unit is used as a high-gain pentode mixer; in the FM section, the pentode unit is used either as a pentode mixer or as a triode-connected mixer depending on signal-to-noise considerations. This type has a controlled heater warm-up time for use in television receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 5CG8 is identical with type 6CG8A except for the heater ratings. These types are electrically identical with miniature type 6X8 except for interelectrode capacitances.

|                                                            | 5CG8     | 6CG8A     |         |
|------------------------------------------------------------|----------|-----------|---------|
| Heater Voltage (ac/dc)                                     | 4.7      | 6.3       | volts   |
| Heater Current                                             | 0.6      | 0.45      | ampere  |
| Heater Warm-up Time (Average) Peak Heater-Cathode Voltage: | 11       | 11        | seconds |
| Heater negative with respect to cathode                    | 200 max  | 200 max   | volts   |
| Heater positive with respect to cathode                    | 200 max  | 200-max   | volts   |
|                                                            | Without  | With      |         |
| Direct Interelectrode Capacitances:                        | External | External  |         |
| Triode Unit:                                               | Shield   | Shield°   |         |
| Grid to Plate                                              | 1.5      | 1.5       | pF      |
| Grid to Cathode, Heater, and Pentode Grid No.3             | 2        | 2.4       | ρF      |
| Plate to Cathode, Heater, and Pentode Grid No.3            | 0.5      | 1         | pF      |
| Pentode Unit:                                              |          |           | -       |
| Grid No.1 to Plate                                         | 0.04 max | 0.02 max  | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and               |          |           | •       |
| Grid No.3                                                  | 4.6      | 4.8       | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid              |          |           | -       |
| No.3                                                       | 0.9      | 1.6       | pF      |
| Pentode Grid No.1 to Triode Plate                          | 0.05 max | 0.04 max  | pF      |
| Pentode Plate to Triode Plate                              | 0.05 max | 0.008 max | pF      |
| Heater to Cathode                                          | 6.5      | 6.5●      | pF      |
| . The do component must not exceed 100 valte               |          |           | =       |

The dc component must not exceed 100 volts.

<sup>\*</sup> With external shield connected to cathode, except as noted.

<sup>•</sup> With external shield connected to plate.

### **POWER PENTODE**

6CL6

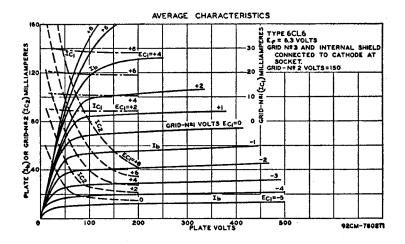
Miniature type used in output stage of video amplifier of television receivers and as wide-band amplifier tube in industrial and laboratory equipment. Outline 6E, Outlines section. Tube requires miniature nine-ax be mounted in any position.

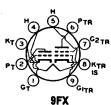


9BV

| contact socket an | d may be | mounted | in | any | position. |
|-------------------|----------|---------|----|-----|-----------|
|-------------------|----------|---------|----|-----|-----------|

| contact socket and may be mounted in any position      |                  |                |
|--------------------------------------------------------|------------------|----------------|
| Heater Voltage (ac/dc)                                 | 6.3              | volts          |
| Heater Current                                         | 0.65             | ampere         |
| Peak Heater-Cathode Voltage:                           |                  | -              |
| Heater negative with respect to cathode                | 100 max          | volts          |
| Heater positive with respect to cathode                | 100 max          | volts          |
| Direct Interelectrode Capacitances (Approx.):          |                  |                |
| Grid No.1 to Plate                                     | 0.12             | pF             |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3,    |                  |                |
| and Internal Shield                                    | 11               | pF             |
| Plate to Cathode, Heater, Grid No.2, Grid No.3,        |                  | _              |
| and Internal Shield                                    | 5.5              | pF             |
| Class A, Amplifier                                     |                  |                |
| • •                                                    |                  |                |
| MAXIMUM RATINGS (Design-Center Values):                | 200              | 14-            |
| Plate Voltage                                          | 300 max<br>0 max | volts          |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive Value    | 300 max          | volts<br>volts |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | 150 max          | voits          |
| Grid-No.1 (Control-Grid) Voltage:                      | 130 max          | VOILS          |
| Negative-bias value                                    | -50 max          | volts          |
| Positive-bias value                                    | 0 max            | volts          |
| Plate Dissipation                                      | 7.5 max          | watts          |
| Grid-No.2 Input                                        | 1.7 max          | watts          |
| Bulb Temperature (At hottest point)                    | 200 max          | °C             |
|                                                        |                  |                |
| TYPICAL OPERATION:                                     | 250              | 14-            |
| Plate Voltage Grid No.3 Connected                      | 250              | volts          |
| Grid-No.2 Voltage                                      | 150              | voits          |
| Grid-No.1 Voltage                                      | -3               | volts          |
| Peak AF Grid-No.1 Voltage                              | 3                | volts          |
| Zero-Signal Plate Current                              | 30               | mA             |
| Maximum-Signal Plate Current                           | 31               | mA             |
| Zero-Signal Grid-No.2 Current                          | 7                | mA             |
| Maximum-Signal Grid-No.2 Current                       | 7.2              | mA             |
| Plate Resistance (Approx.)                             | 0.09             | megohm         |
| Transconductance                                       | 11000            | $\mu$ mhos     |
| Grid-No.1 Voltage (Approx.) for plate current of 10 μA | -14              | volts          |
| Load Resistance                                        | 7500             | ohms           |
| Total Harmonic Distortion                              | 8                | per cent       |
| Maximum-Signal Power Output                            | 2.8              | watts          |
| TYPICAL OPERATION IN 4-MC-BANDWITH VIDEO               |                  |                |
| AMPLIFIER:                                             |                  |                |
| Plate Supply Voltage                                   | 300              | volts          |
| Grid No.3 Connected                                    |                  |                |
| Grid-No.2 Supply Voltage                               | 300              | volts          |
| Grid-No.1 Bias Voltage                                 | 2                | volts          |
| Grid-No.1 Signal Voltage (Peak to Peak)                | 3<br>24000       | volts          |
| Grid-No.2 Resistor                                     | 0.1              | ohms           |
| Grid-No.1 Resistor                                     | 3900             | megohm<br>ohms |
| Load Resistor Zero-Signal Plate Current                | 3900             | mA             |
| Zero-Signal Grid-No.2 Current                          | 7.0              | mA             |
| Voltage Output (Peak to Peak)                          | 132              | volts          |
|                                                        |                  | 10163          |
| MAXIMUM CIRCUIT VALUES:                                |                  |                |
| Grid-No.1 Circuit Resistance:                          |                  |                |
| For fixed-bias operation                               |                  | megohm         |
| For cathode-bias operation                             | U.5 max          | megohm         |
|                                                        |                  |                |





### MEDIUM-MU TRIODE— SHARP-CUTOFF TETRODE

Miniature type used as combined vhf oscillator and mixer in television receivers employing series-connected heater strings. Outline 6B, Outlines section. This tube requires miniature nine-contact socket and may be

6CL8A
Related types:
5CL8A, 19CL8A

mounted in any position. For maximum ratings as class A<sub>1</sub> amplifier, see type 6U8A. Types 5CL8A and 19CL8A are identical with type 6CL8A except for the heater ratings, as shown below.

|                                               | <b>JUL8A</b> | <b>OCL8A</b> | 19CL8A |         |
|-----------------------------------------------|--------------|--------------|--------|---------|
| Heater Voltage (ac/dc)                        | 4.7          | 6.3          | 18.9   | volts   |
| Heater Current                                | 0.6          | 0.45         | 0.15   | ampere  |
| Heater Warm-up Time (Average)                 | 11           | 11           | 11     | seconds |
| Heater negative with respect to cathode .     | 200          | 200          | 200    | volts   |
| Heater positive with respect to cathode.      | 200=         | 200=         | 200=   | volts   |
| * The dc component must not exceed 100 volts. |              |              |        |         |

#### Class A. Amplifier

| Viass A <sub>1</sub> Amplimo                           | it.            |              |        |
|--------------------------------------------------------|----------------|--------------|--------|
| CHARACTERISTICS:                                       | Triode Unit    | Tetrode Unit |        |
| Plate Supply Voltage                                   | 125            | 125          | volts  |
| Grid-No.2 (Screen-Grid) Voltage                        | . <del>-</del> | 125          | volts  |
| Grid-No.1 Voltage                                      | -1             | 1            | volt   |
| Amplification Factor                                   | 40             |              |        |
| Plate Resistance (Approx.)                             | 0.005          | 0.2          | megohm |
| Transconductance                                       | 8000           | 6500         | μmhos  |
| Grid-No.1 Voltage (Approx.) for plate current of 20 µA | 9              | 9            | volts  |
| Plate Current                                          | 14             | 12           | mA     |
| Grid-No.2 Current                                      |                | 4            | mA     |
| MAXIMUM CIRCUIT VALUES:                                |                |              |        |
| Grid-No.1-Circuit Resistance:                          |                |              |        |
| For fixed-bias operation                               | 0.5 max        | 0.25 max     | megohm |

1 max

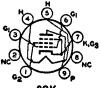
1 max megohm

For cathode-bias operation ......

### **BEAM POWER TUBE**

6CM6

Miniature type used as vertical deflection amplifier in television receivers and as audio power amplifier in radio and television receivers. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and



9CK

may be mounted in any position. For typical operation and maximum circuit values as class  $A_1$  amplifier, refer to type 6V6GTA. For curves of average plate characteristics, refer to type 6AQ5A.

| Heater Voltage (ac/dc)                  | 6.3     | volts      |
|-----------------------------------------|---------|------------|
| Heater Current                          | 0.45    | ampere     |
| Peak Heater-Cathode Voltage:            |         | • <u>•</u> |
| Heater negative with respect to cathode | 200 max | volts      |
| Heater positive with respect to cathode | 200=max | volts      |
| Amplification Factor*                   | 9.8     |            |
| Plate Resistance (Approx.)*             | 1960    | ohms       |
| Transconductance*                       | 5000    | umhos      |
|                                         | 2000    | m141104    |

The dc component must not exceed 100 volts.

• Grid No.2 connected to plate; plate and grid-No.2 volts, 250; grid-No.1 volts, —12.5; plate and grid-No.2 mA, 49.5.

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Center Values): |         |       |
|-----------------------------------------|---------|-------|
| Plate Voltage                           | 315 max | volts |
| Grid-No.2 (Screen-Grid) Voltage         | 285 max | volts |
| Grid-No.2 Input                         | 2 max   | watts |
| Plate Dissipation                       | 12 max  | watts |

# Vertical Deflection Amplifier

For operation in a 525-line, 30-frame system

|                                                      | Triode      | Pentode    |       |
|------------------------------------------------------|-------------|------------|-------|
| MAXIMUM RATINGS (Design-Center Values):              | Connection* | Connection |       |
| DC Plate Voltage                                     | 315 max     | 315 max    | volts |
| Peak Positive-Pulse Plate Voltage† (Absolute         |             |            |       |
| Maximum)                                             | 2000△max    | 2000△max   | volts |
| DC Grid-No.2 (Screen-Grid) Voltage                   |             | 285 max    | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage | -250 max    | -250 max   | volts |
| Peak Cathode Current                                 | 120 max     | 120 max    | mA    |
| Average Cathode Current                              | 40 max      | 40 max     | mA    |
| Plate Dissipation                                    | 9 max       | 8 max      | watts |
| Grid-No.2 Input                                      | -           | 1.75 max   | watts |
| MAXIMUM CIRCUIT VALUES:                              |             |            |       |
| Grid-No.1-Circuit Resistance:                        |             |            |       |

For cathode-bias operation ......

• Grid No.2 connected to plate.

† The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

2.2 max

A Under no circumstances should this absolute value be exceeded.

## MEDIUM-MU DUAL TRIODE

6CM7
Related type:
8CM7

Miniature type used as combined vertical deflection oscillator and vertical deflection amplifier in television receivers employing series-connected heater strings. Unit No.1 is used as a conventional blocking oscillator in



2.2 max megohms

conventional blocking oscillator in SES vertical deflection circuits, and unit No.2 as a vertical deflection amplifier. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be

mounted in any position. Type 8CM7 is identical with type 6CM7 except for the heater ratings, as shown below.

|                                               | 6CM7      | 8CM7      |         |
|-----------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                        | 6.3       | 8.4       | volts   |
| Heater Current                                | 0.6       | 0.45      | ampere  |
| Heater Warm-up Time (Average)                 | 11        | 11        | seconds |
| Peak Heater-Cathode Voltage:                  |           |           |         |
| Heater negative with respect to cathode       | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode       | 200△max   | 200△max   | volts   |
| Direct Interelectrode Capacitances (Approx.): | Unit No.1 | Unit No.2 |         |
| Grid to Plate                                 | 3.8       | 3         | pF      |
| Grid to Cathode and Heater                    | 2         | 3.5       | pF      |
| Plate to Cathode and Heater                   | 0.5       | 0.4       | рF      |
| A The dc component must not exceed 100 volts. |           |           |         |

#### Class A, Amplifier

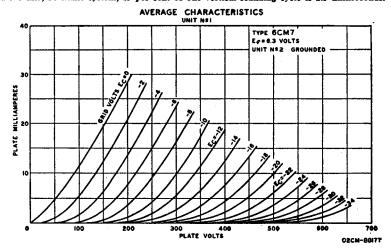
| CHARACTERISTICS:                                             | Unit No.1 | Unit No.2 |            |
|--------------------------------------------------------------|-----------|-----------|------------|
| Plate Voltage                                                | 200       | 250       | volts      |
| Grid Voltage                                                 | 7         | 8         | volts      |
| Amplification Factor                                         | 21        | 18        |            |
| Plate Resistance (Approx.)                                   | 10500     | 4100      | ohms       |
| Transconductance                                             | 2000      | 4400      | $\mu$ mhos |
| Grid Voltage (Approx.) for plate current of $10 \mu A \dots$ | 14        |           | volts      |
| Plate Current                                                | 5         | 20        | mA         |
| Plate Current for grid voltage of -10 volts                  | 1         |           | mA         |

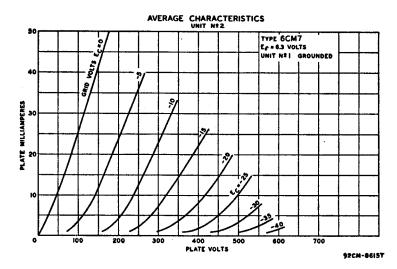
### Vertical Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage Peak Positive-Pulse Plate Voltage# Peak Negative-Pulse Grid Voltage Peak Cathode Current Average Cathode Current Plate Dissipation | Unit No.1<br>Oscillator<br>550 max<br>—<br>—220 max<br>77 max<br>17 max<br>1.45 max | Unit No.2<br>Amplifier<br>550 max<br>2200 max<br>220 max<br>77 max<br>22 max<br>6 max | volts<br>volts<br>volts<br>mA<br>mA<br>watts |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------|
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance: For fixed-bias operation For cathode-bias operation For grid-resistor-bias operation                                                        | 2.2 max<br>2.2 max<br>2.2 max                                                       | 1.0 max n<br>2.5 max n                                                                |                                              |

# The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

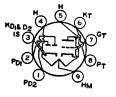




### TWIN DIODE— HIGH-MU TRIODE

6CN7
Related type:
8CN7

Miniature type used as combined horizontal phase detector and reactance tube in television receivers employing series-connected heater strings. The triode unit is used in sync-separator, sync-amplifier, or au-



9FN

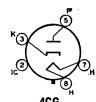
dio amplifier circuits. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For typical operation of triode unit as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Type 8CN7 is identical with type 6CN7 except for the heater ratings, as shown below.

| as snown below.                                                                          |                             |                                |                             |
|------------------------------------------------------------------------------------------|-----------------------------|--------------------------------|-----------------------------|
| Heater Voltage (ac/dc): Series Parallel                                                  | 6CN7<br>6.3<br>3.15         | 8CN7<br>8.4<br>4.2             | volts<br>volts              |
| Heater Current: Series                                                                   | 0.3<br>0.6<br>11<br>200 max | 0.225<br>0.45<br>11<br>200 max | ampere<br>ampere<br>seconds |
| • The dc component must not exceed 100 volts.                                            | 200•max                     | 200-max                        | volts                       |
| Triode Unit as Class A,                                                                  | Amplifier                   |                                |                             |
| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid Voltage. Positive-bias value |                             | 330 max<br>0 max               | volts<br>volts              |

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid Voltage, Positive-bias value Plate Dissipation |          | 330 max<br>0 max<br>1.1 max | volts<br>volts<br>watt |
|------------------------------------------------------------------------------------------------------------|----------|-----------------------------|------------------------|
| CHARACTERISTICS:                                                                                           |          |                             | •                      |
| Plate Voltage                                                                                              | 100      | 250                         | volts                  |
| Grid Voltage                                                                                               | <b>1</b> | <b>—3</b>                   | volts                  |
| Amplification Factor                                                                                       | 70       | 70                          |                        |
| Plate Resistance (Approx.)                                                                                 | 54000    | 58000                       | ohms                   |
| Transconductance                                                                                           | 1300     | 1200                        | μmhos                  |
| Plate Current                                                                                              | 0.8      | 1                           | mA                     |

#### **Diode Units**

| MAXIMUM RATINGS (Design-Maximum Values): |         |    |
|------------------------------------------|---------|----|
| Plate Current (Each Unit)                | 5.5 max | mA |



### HALF-WAVE VACUUM RECTIFIER

Octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 13G, Outlines section. Tube requires octal socket and may be mounted in any position. Socket terminals 1, 2, 4, and 6 should

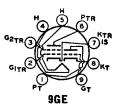
**6CQ4** 

not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 6.3; amperes, 1.6.

#### **Damper Service**

| Peak Inverse Plate Current  Peak Plate Current | 5500 max | volts |
|------------------------------------------------|----------|-------|
|                                                |          |       |
|                                                | 1200 max | mA    |
| DC Plate Current                               | 190 max  | mA    |
| Plate Dissipation                              | 6.5 max  | watts |
| Peak Heater-Cathode Voltage:                   |          |       |
| Heater negative with respect to cathode        | 5500 max | volts |
| Heater positive with respect to cathode        | 300□max  | volts |

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- The dc component must not exceed 900 volts.
- □ The dc component must not exceed 100 volts.



### MEDIUM-MU TRIODE— SHARP-CUTOFF TETRODE

Miniature type used in a wide variety of applications in color and black-and-white television receivers employing series-connected heater strings. Especially useful as combined vhf oscillator and mixer in tuners of

6CQ8
Related type:
5CQ8

television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. The tetrode unit is used as a mixer, video if amplifier, or sound if amplifier tube. The triode unit is used in vhf oscillator, phase-splitter, sync-clipper, sync-separator, and rf amplifier circuits. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 5CQ8 is identical with type 6CQ8 except for the heater ratings, as shown below.

|                                         | 5CQ8    | 6CQ8    |         |
|-----------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                  | 4.7     | 6.3     | volts   |
| Heater Current                          | 0.6     | 0.45    | ampere  |
| Heater Warm-up Time (Average)           | 11      | 11      | seconds |
| Peak Heater-Cathode Voltage:            |         |         |         |
| Heater negative with respect to cathode | 200 max | 200 max | volts   |
| Heater positive with respect to cathode | 200△max | 200△max | voits   |
|                                         |         |         |         |

A The dc component must not exceed 100 volts.

|                                                           | Without<br>External | With<br>External |    |
|-----------------------------------------------------------|---------------------|------------------|----|
| Direct Interelectrode Capacitances:                       | Shield              | Shield.          |    |
| Triode Unit:                                              |                     |                  |    |
| Grid to Plate                                             | 1.8                 | 1.8              | рF |
| Grid to Cathode and Heater                                | 2.7                 | 2.7              | pF |
| Plate to Cathode and Heater                               | 0.4                 | 1.2              | ρF |
| Tetrode Unit:                                             | •••                 |                  | PI |
| Grid No.1 to Plate                                        | 0.019 max           | 0.015 max        | рF |
| Grid No.1 to Cathode, Heater, Grid No.2                   | OTO X7 IIIII        | O.O.D Mills      | PI |
| and Internal Shield                                       | 5.0                 | 5.0              | pF |
| Plate to Cathode, Heater, Grid No.2,                      |                     | 2.0              | P  |
| and Internal Shield                                       | 2.5                 | 3.3              | рF |
| Tetrode Plate to Triode Plate                             | 0.07 max            | 0.01 max         | pF |
| Heater to Cathode (Each Unit)                             | 3.0                 | 3.01             | pF |
| • With external shield connected to cathode of unit under |                     | 5.01             | P. |
| - With external shield connected to cathode of unit under | test.               |                  |    |

## Class A. Amplifier

| Ciass A <sub>1</sub> Ampiner                            |                        |                |             |
|---------------------------------------------------------|------------------------|----------------|-------------|
| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage  | Triode Unit<br>330 max | Tetrode Uni    | it<br>volts |
| Grid-No.2 (Screen-Grid) Supply Voltage                  | _                      | 330 max        | volts       |
| Grid-No.2 Voltage                                       |                        |                | e page 80   |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value   | 0 max                  | 0 max          | volts       |
| Plate Dissipation                                       | 3.1 max                | 3.2 max        | watts       |
| Grid-No.2 Input:                                        | 3.1 max                | 5.2 Illax      | watts       |
| For grid-No.2 voltages up to 165 volts                  |                        | 0.7 max        | **          |
|                                                         |                        |                | watt        |
| For grid-No.2 voltages between 165 and 330 volts.       |                        | See curv       | e page 80   |
| Grid Input                                              | 0.55 max               | _              | watt        |
| CHARACTERISTICS:                                        | •                      |                |             |
|                                                         |                        |                |             |
| Plate-Supply Voltage                                    | 125                    | 125            | volts       |
| Grid-No.2 Supply Voltage                                | -                      | 125            | volts       |
| Grid-No.1 Voltage                                       |                        | 1              | volts       |
| Cathode-Bias Resistor                                   | 56                     | . <del>-</del> | ohms        |
| Amplification Factor                                    | 40                     | _              |             |
| Plate Resistance (Approx.)                              | 5000                   | 140000         | ohms        |
| Transconductance                                        | 8000                   | 5800           | $\mu$ mhos  |
| Grid-No.1 Voltage (Approx.) for plate current of 100 μA | <b>—7</b>              | <b>—7</b>      | volts       |
| Plate Current                                           | 15                     | 12             | mA          |
| Grid-No.2 Current                                       | _                      | 4.2            | mA          |
|                                                         |                        |                |             |
| MAXIMUM CIRCUIT VALUES:                                 |                        |                |             |
| Grid-No.1-Circuit Resistance:                           |                        |                |             |
| For fixed-bias operation                                | 0.5 max                | 0.25 max       | megohm      |
| For cathode-bias operation                              | 1.0 max                | 1.0 max        | megohm      |

### DIODE-REMOTE-CUTOFF PENTODE

Related type: 12CR6

Miniature type used as combined detector and audio amplifier in automobile and ac-operated radio receivers. The diode unit is used as an AM detector, and the pentode unit as an automatic-volume-controlled audio

amplifier. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 12CR6 is identical with type 6CR6 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc)                                                                                         | 6CR6<br>6.3<br>0.3 | 12.6<br>0.15 | volts<br>ampere |
|----------------------------------------------------------------------------------------------------------------|--------------------|--------------|-----------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode | 100 max            | 100 max      | volts           |
|                                                                                                                | 100 max            | 100 max      | volts           |

<sup>†</sup> With external shield connected to ground.

| Pentode   | Unit  | as | Class | Δ. | Amplifier |
|-----------|-------|----|-------|----|-----------|
| * CIILUUC | VIIIL | 03 | Oless | т. | MINDING   |

| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 300 max       | volts         |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | See curv      | ve page 80    |
| Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 300 max       | volts         |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0 max         | volts         |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2.5 max       | watts         |
| Grid-No.2 Input:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2.5 mus       | WELLE         |
| For grid-No.2 voltages up to 150 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.3 max       | watt          |
| For grid-No.2 voltages between 150 and 300 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               | ve page 80    |
| Tot gird-170.2 Totages between 150 and 500 Volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | See curv      | re page 60    |
| CHARACTERISTICS:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |               |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 250           | volts         |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 100           | volts         |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <del></del> 2 | volts         |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.8           | megohm        |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2200          | umhos         |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               | μιπιος<br>m A |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9.6           |               |
| Grid No.1 Voltage (Annual) for the state of | 2.6           | mA            |
| Grid-No.1 Voltage (Approx.) for transconductance of 10 µmhos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -32           | volts         |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |               |
| Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |               |
| For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.25          | manahm        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0.25 max      |               |
| For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1.0 max       | megohm        |
| Diode Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |               |
| MAXIMUM RATING (Design-Center Value):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |               |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 max         | mA            |
| anto Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | I max         | шА            |



Heater Voltage (ac/dc)

MAXIMUM RATINGS (Design-Center Values):

Plate Voltage .....

#### PENTAGRID AMPLIFIER

Miniature type used as a gated amplifier in television receivers. In such service, it may be used as a combined sync separator and sync clipper. Outline 5C, Outlines section. Tube requires miniature seven-contact socket

6CS6
Related types: 3CS6, 4CS6

volts

volts

**6CS6** 

300 max

and may be mounted in any position. Types 3CS6 and 4CS6 are identical with type 6CS6 except for the heater ratings, as shown below.

**3CS6** 

4CS6

| ricator voltage (ac/uc/                          | 3.13     | 7.2     | 0.5            | 10162      |
|--------------------------------------------------|----------|---------|----------------|------------|
| Heater Current                                   | 0.6      | 0.45    | 0.3            | ampere     |
| Heater Warm-up Time (Average)                    | 11       | 11      | _              | seconds    |
| Peak Heater-Cathode Voltage:                     |          |         |                |            |
| Heater negative with respect to cathode          | 200 max  | 200 max | 200 max        | voits      |
| Heater positive with respect to cathode          | 200=max  | 200=max | 200 max        | volts      |
| riouter positive with respect to camous          | 200 max  | 200 max | 200 111411     | 10115      |
| • The dc component must not exceed 100 volts.    |          |         |                |            |
| Class A, A                                       | mplifier |         |                |            |
| CHARACTERISTICS:                                 |          |         |                |            |
| Plate Voltage                                    |          | 100     | 100            | volts      |
| Grids-No.2-and-No.4 Voltage                      |          | 30      | 30             | volts      |
| Grid-No.3 Voltage                                |          | -1      | ő              | volt       |
|                                                  |          | ô       | _ĭ             | volt       |
| Grid-No.1 Voltage                                |          | -       | -1             |            |
| Plate Resistance (Approx.)                       |          | 0.7     | 1              | megohm     |
| Grid-No.3-to-Plate Transconductance              |          | 1500    |                | $\mu$ mhos |
| Grid-No.1-to-Plate Transconductance              |          |         | 1100           | μmhos      |
| Plate Current                                    |          | 0.8     | 1.0            | mA         |
| Grids-No.2-and-No4 Current                       |          | 5.5     | 1.3            | mA         |
| Grid-No.3 Voltage (Approx.) for plate current of | 50 μA    | -2.2    | ~ <del>-</del> | volts      |
| Grid-No.1 Voltage (Approx.) for plate current of |          |         | 2.5            | volts      |
| Card from Counge (suppliess) and plant that the  |          |         |                |            |

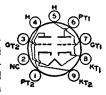
**Gated Amplifier Service** 

| Grids-No.2-and-No.4 Supply Voltage Grids-No.2-and-No.4 Voltage | 300 max volts<br>See curve page 80 |
|----------------------------------------------------------------|------------------------------------|
| Plate Dissipation                                              | 1 max watt                         |
| Grids-No.2-and-No.4 Input:                                     |                                    |
| For grids-No.2-and-No.4 voltages up to 150 volts               | 1 max watt                         |
| For grids-No.2-and-No.4 voltages between 150 and 300 volts     | See curve page 80                  |
| Cathode Current                                                | 14 max mA                          |
| MAXIMUM CIRCUIT VALUES:                                        |                                    |
| Grid-No.1-Circuit Resistance                                   | 0.47 max megohm                    |
| Grid-No.3-Circuit Resistance                                   | 2.2 max megohms                    |

### MEDIUM-MU DUAL TRIODE

6CS7
Related type:

Miniature type used as combined vertical deflection oscillator and vertical deflection amplifier in television receivers employing series-connected heater strings. Unit No.1 is used as a conventional blocking oscillator in



9EF

vertical deflection circuits, and unit No.2 as a vertical deflection amplifier. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 8CS7 is identical with type 6CS7 except for the heater ratings, as shown below.

|                                             | 6CS7    | 8CS7    |         |
|---------------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                      | 6.3     | 8.4     | volts   |
| Heater Current                              | 0.6     | 0.45    | ampere  |
| Heater Warm-up Time (Average)               | 11      | 11      | seconds |
| Peak Heater-Cathode Voltage:                |         |         |         |
| Heater negative with respect to cathode     | 200 max | 200 max | volts   |
| Heater positive with respect to cathode     | 200 max | 200•max | volts   |
| The dc component must not exceed 100 volts. |         |         |         |

### Class A, Amplifier

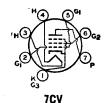
| CHARACTERISTICS:                                       | Unit No.1 | Unit No.2 |       |
|--------------------------------------------------------|-----------|-----------|-------|
| Plate Voltage                                          | 250       | 250       | volts |
| Grid Voltage                                           | 8.5       | -10.5     | volts |
| Amplification Factor                                   | 17        | 15.5      |       |
| Plate Resistance (Approx.)                             | 7700      | 3450      | ohms  |
| Transconductance                                       | 2200      | 4500      | μmhos |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A | 24        |           | voits |
| Grid Voltage (Approx.) for plate current of 50 $\mu A$ |           | -22       | volts |
| Plate Current                                          | 10.5      | 19        | mA    |
| Plate Current for grid voltage of -16 volts            |           | 3         | mA    |

### Vertical Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

|                                                       | Unit No.1  | Unit No.2 |        |
|-------------------------------------------------------|------------|-----------|--------|
| MAXIMUM RATINGS (Design-Center Values):               | Oscillator | Amplifier |        |
| DC Plate Voltage                                      | 500 max    | 500 max   | volts  |
| Peak Positive-Pulse Plate Voltage† (Absolute Maximum) | -          | 2200△max  | voits  |
| Peak Negative-Pulse Grid Voltage                      | -400 max   | -250 max  | volts  |
| Peak Cathode Current                                  | 70 max     | 105 max   | mA     |
| Average Cathode Current                               | 20 max     | 30 max    | mA     |
| Plate Dissipation                                     | 1,25 max   | 6.5 max   | watts  |
| MAXIMUM CIRCUIT VALUES:                               |            |           |        |
| Grid-Circuit Resistance                               | 2.2 max    | 2.2 max m | egohms |

<sup>†</sup> The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds. a Under no circumstances should this absolute value be exceeded.



#### **BEAM POWER TUBE**

Miniature type used in the audio output stage of television receivers. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Types 12CU5/12C5 and 17CU5 are

# **6CU5**

Related types: 12CU5/12C5, 17CU5

identical with type 6CU5 except for the heater ratings, as shown below.

|                                                 |            | 12CU5/    |           |          |
|-------------------------------------------------|------------|-----------|-----------|----------|
|                                                 | 6CU5       | 12C5      | 17CU5     |          |
| Heater Voltage (ac/dc)                          | 6.3        | 12.6      | 16.8      | volts    |
|                                                 |            | 0.6       | 0.45      | ampere   |
| Heater Current                                  | 1.2        |           |           |          |
| Heater Warm-up Time (Average)                   | _          | 11        | 11        | seconds  |
| Peak Heater-Cathode Voltage:                    |            |           |           |          |
| Heater negative with respect to cathode         | 200 max    | 200 max   | 200 max   | volts    |
| Heater positive with respect to cathode.        | 200 • max  | 200 • max | 200 • max | volts    |
| Direct Interelectrode Capacitances (Approx.):   |            |           |           |          |
| Grid No.1 to Plate                              |            |           | 0.6       | рF       |
| Grid No.1 to Cathode, Heater, Grid No.2,        | and Grid   | No.3      | 13        | pF       |
| Plate to Cathode, Heater, Grid No.2, and C      |            |           | 8.5       | ρF       |
|                                                 | JII. 110.5 |           |           | -        |
| ■ The dc component must not exceed 100 volts.   |            |           |           |          |
|                                                 |            |           |           |          |
| Class A, I                                      | Amplifier  |           |           |          |
| MAXIMUM RATINGS (Design-Maximum Valu            | ee/.       |           |           |          |
|                                                 |            |           | 150 max   | volts    |
| Plate Voltage                                   |            |           | 130 max   | volts    |
| Grid-No.2 (Screen-Grid) Voltage                 |            |           |           | volts    |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias |            |           | 0 max     |          |
| Plate Dissipation                               |            |           | 7 max     | watts    |
| Grid-No.2 Input                                 |            |           | 1.4 max   | watts    |
| Bulb Temperature (At hottest point)             |            |           | 220 max   | °C       |
|                                                 |            |           |           |          |
| TYPICAL OPERATION:                              |            |           | 100       |          |
| Plate Voltage                                   |            |           | 120       | volts    |
| Grid-No.2 Voltage                               |            |           | 110       | volts    |
| Grid-No.1 Voltage                               |            |           | -8        | volts    |
| Peak AF Grid-No.1 Voltage                       |            |           | 8         | volts    |
| Zero-Signal Plate Current                       |            |           | 49        | mA       |
| Maximum-Signal Plate Current                    |            |           | 50        | mA       |
| Zero-Signal Grid-No.2 Current                   |            |           | 4         | mA       |
| Maximum-Signal Grid-No.2 Current                |            |           | 8.5       | mA       |
| Plate Resistance (Approx.)                      |            |           | 10000     | ohms     |
| Transconductance                                |            |           | 7500      | µmhos    |
| Load Resistance                                 |            |           | 2500      | ohms     |
| Total Harmonic Distortion                       |            |           | 10        | per cent |
|                                                 |            |           | 2.3       | watts    |
| Maximum-Signal Power Output                     |            |           | 2.3       | Watts    |
| MAXIMUM CIRCUIT VALUES:                         |            |           |           |          |
| Grid-No.1-Circuit Resistance:                   |            |           |           |          |
| For fixed-bias operation                        |            |           | 0.1 max   | megohm   |
| For cathode-bias operation                      |            |           |           | megohm   |
| 1.01 camoue-bias operation                      |            |           | U.J IIIAA | ogomi    |

Refer to type 6BQ6GTB/6CU6

**6CU6** 



### MEDIUM-MU TRIODE... SHARP-CUTOFF PENTODE

Miniature type used in a wide variety of applications in color and blackand-white television receivers employing series-connected heater strings. The pentode unit is used as an if amplifier, a video amplifier, an age am-

**6CU8** 

plifier, and a reactance tube. The triode unit is used in low-frequency oscillator, sync-separator, sync-clipper, and phase-splitter circuits. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc)                                          | 6.3<br>0.45 | voits<br>ampere                         |
|-----------------------------------------------------------------|-------------|-----------------------------------------|
| Peak Heater-Cathode Voltage:                                    | •••-        | • • • • • • • • • • • • • • • • • • • • |
| Heater negative with respect to cathode                         | 200 max     | volts                                   |
| Heater positive with respect to cathode                         | 200 max     | volts                                   |
| Direct Interelectrode Capacitances:                             | 200 1110-1  |                                         |
| Triode Unit:                                                    |             |                                         |
| Grid to Plate                                                   | 1.6         | pF                                      |
| Grid to Cathode, Heater, Pentode Grid No.3, and Internal Shield | 1.9         | υF                                      |
|                                                                 | 1.6         | pF                                      |
| Plate to Cathode, Heater, Pentode Grid No.3 and Internal Shield | 1.0         | þr.                                     |
| Pentode Unit:                                                   |             | _                                       |
| Grid No.1 to Plate                                              | 0.025 max   | рF                                      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, Triode      |             |                                         |
| Cathode, and Internal Shield                                    | 7           | pF                                      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, Triode          |             | -                                       |
| Cathode, and Internal Shield                                    | 2.4         | pF                                      |
| Pentode Grid No.1 to Triode Plate                               | 0.03 max    | pF                                      |
|                                                                 |             | ρF                                      |
| Pentode Plate to Triode Plate                                   | 0.07 max    | þr                                      |
| • The dc component must not exceed 100 volts.                   |             |                                         |

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Pentode Unit |         |
|--------------------------------------------------------|-------------|--------------|---------|
| Plate Voltage                                          | 330 max     | 330 max      | volts   |
| Grid-No.2 Supply Voltage                               | -           | 330 max      | volts   |
| Grid-No.2 (Screen-Grid) Voltage                        | _           | See curve    | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value. | 0 max       | 0 max        | volts   |
| Plate Dissipation                                      | 2.8 max     | 2.3 max      | watts   |
| Grid-No.2 Input:                                       |             |              |         |
| For grid-No.2 voltages up to 165 volts                 |             | 0.55 max     | watt    |
| For grid-No.2 voltages between 165 and 330 volts .     | -           | See curve    | page 80 |
| CHARACTERISTICS:                                       |             |              |         |
| Plate Supply Voltage                                   | 125         | 125          | volts   |
| Grid-No.2 Supply Voltage                               |             | 125          | volts   |
| Grid-No.1 Voltage                                      | -1          | _            | volts   |
| Cathode-Bias Resistor                                  | <b></b> '   | 56           | ohms    |
| Amplification Factor                                   | 24          | _            |         |
| Plate Resistance (Approx.)                             | 4100        | 170000       | ohms    |
| Transconductance                                       | 5800        | 7800         | μmhos   |
| Grid-No.1 Voltage (Approx.) for plate current of 20 µA | -19         | 8            | volts   |
| Plate Current                                          | 17          | 12           | mA      |
| Plate Current for grid-No.1 voltage of -3 volts and    |             |              |         |
| cathode-bias resistor of 0 ohms                        | -           | -1.6         | mA      |
| Grid-No.2 Current                                      |             | 3.8          | mA      |
|                                                        |             |              |         |

### HIGH-MU TRIODE

Related types: 2CW4, 13CW4 Nuvistor type used as a grounded-cathode, neutralized rf amplifier in vhf tuners of television and FM receivers. Outline 1, Outlines section. Tube requires nuvistor socket and may be operated in any position.

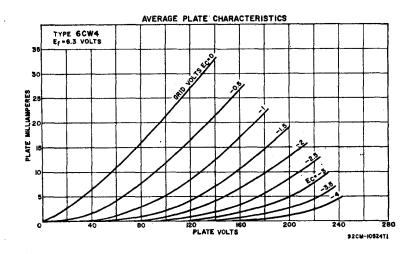
12AQ

Types 2CW4 and 13CW4 are identical with type 6CW4 except for the heater ratings, as shown below. COSSIA

|                               | 2CW4 | 6CW4  | 13CW4    |         |
|-------------------------------|------|-------|----------|---------|
| Heater Voltage (ac/dc)        | 2.1  | 6.3   | 13.5     | volts   |
| Heater Current                | 0.45 | 0.135 | 0.06     | ampere  |
| Heater Warm-up Time (Average) | 8    | _     | <u> </u> | seconds |

| Heater negative with respect to cathode                | 00 max  | 6CW4<br>100 max<br>100 max | 13C<br>100<br>100 | max   | volts<br>volts |
|--------------------------------------------------------|---------|----------------------------|-------------------|-------|----------------|
| Direct Interelectrode Capacitances (Approx.)           |         |                            | 0.92              |       | -E             |
| Grid to Plate                                          |         |                            | 4.3               |       | pF<br>pF       |
| Plate to Cathode, Heater, and Shell                    |         |                            | 1.8               |       | pF             |
| Plate to Cathode                                       |         |                            | 0.18              |       | pF             |
| Heater to Cathode                                      |         |                            | 1.6               |       | ρF             |
| Trouble to Cuthous                                     |         |                            |                   |       | •              |
| Class A, Am                                            | plifier |                            |                   |       |                |
| MAXIMUM RATINGS (Design-Maximum Values)                | -       |                            |                   |       |                |
| Plate Supply Voltage                                   |         |                            | 3000              | max   | volts          |
| Plate Voltage                                          |         |                            |                   | max   | volts          |
| Grid Voltage:                                          |         |                            |                   | 24720 |                |
| Negative-bias value                                    |         |                            | 55                | max   | volts          |
| Peak positive value                                    |         |                            | 0                 | max   | volts          |
| Plate Dissipation                                      |         |                            | 1.5               | max   | watt           |
| Cathode Current                                        |         |                            | 15                | max   | mA             |
| CHARACTERISTICS AND TYPICAL OPERATION                  | N:      |                            |                   |       |                |
| Plate Supply Voltage                                   |         | 110                        | 70                |       | volts          |
| Grid Supply Voltage                                    |         | 0                          | 0                 |       | volts          |
| Cathode-Bias Resistor                                  |         | 130                        | _                 |       | ohms           |
| Grid Resistor                                          |         |                            | 47000             |       | ohms           |
| Amplification Factor                                   |         | 65                         | 68                |       |                |
| Plate Resistance (Approx.)                             |         | 6600                       | 5440              |       | ohms           |
| Transconductance                                       |         | 9800                       | 12500             |       | μmhos          |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A |         | 4                          |                   |       | volts          |
| Plate Current                                          |         | 7                          | 7.2               |       | mA             |
| MAXIMUM CIRCUIT VALUES:                                |         |                            |                   |       |                |
| Grid-Circuit Resistance:                               |         |                            |                   |       |                |
| For fixed-bias operation                               |         |                            |                   |       | megohm         |
| For cathode-bias operation                             |         |                            | 2.2               | max   | megohms        |
|                                                        |         |                            |                   |       |                |

<sup>A plate supply voltage of 300 volts may be used provided that a sufficiently large resistor is used in the plate circuit to limit the plate dissipation to 1.5 watts under any condition of operation.
For operation at metal-shell temperatures up to 135° C.</sup> 



### **POWER PENTODE**

8CW5, 10CW5, 15CW5, 15CW5/PL84

Miniature types with frame-grid used for vertical-deflection amplifier service in television receivers. Outline 6G, Outlines section. Tubes require miniature nine-contact socket and may be mounted in any position. Types 8CW5,

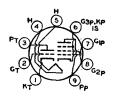


10CW5, 15CW5, and 15CW5/PL84 are identical with type 6CW5 except for the heater ratings, as shown below.

|                                                        |           |             |               | 15CW5             |               |
|--------------------------------------------------------|-----------|-------------|---------------|-------------------|---------------|
|                                                        | 6CW5      | 8CW5        | 10CW5         | 15CW5/PL84        |               |
| Heater Voltage (ac/dc)                                 | 6.3       | 8           | 10.6          | 15                | volts         |
| Heater Current                                         | 0.6       | 0.6         | 0.45          | 0.3               | ampere        |
| Heater Warm-up Time                                    |           | _           | 11            |                   | seconds       |
| Peak Heater-Cathode Voltage:                           |           |             |               |                   |               |
| Heater negative with respect to                        |           |             |               |                   |               |
| cathode                                                | 330*max   | 330*max     | 330*max       | 330*max           | volt <b>s</b> |
| Heater positive with respect to                        |           |             | ***           | 2224              | 14-           |
| cathode                                                | 330*max   | 330*max     | 330*max       | 330*max           | volts         |
| Direct Interelectrode Capacitances: Grid No.1 to Plate |           |             |               | 0.6 max           | pΓ            |
| Grid No.1 to Heater                                    |           |             |               | 0.25 max          | pF            |
| Grid No.1 to Cathode, Heater, (                        |           |             |               | 13                | pF            |
| Plate to Cathode, Heater, Grid I                       | No.2. and | Grid No.3   |               | 6.8               | pF            |
| * The dc component must not exceed                     |           |             |               |                   | -             |
| The de component must not exceet                       |           |             |               |                   |               |
| Class A                                                | a or Cla  | ass AB, A   | mplifier      |                   |               |
| MAXIMUM RATINGS (Design-Max                            | cimum V   | alues):     |               |                   |               |
| Plate Voltage                                          |           | •           |               | 275 max           | volts         |
| Plate Supply Voltage                                   |           |             |               | 600 max           | volts         |
| Grid-No.2 Voltage                                      |           |             |               | 220 max           | volts         |
| Grid-No.2 (Screen-Grid) Supply Volt                    |           |             |               | 600 max           | volts         |
| Plate Dissipation                                      |           |             |               | 14 max            | watts         |
| Grid-No.2 Input                                        |           |             |               | 2.1 max           | watts         |
| Peak Grid-No.2 Input                                   |           |             |               | 7 max             | watts<br>mA   |
| Cathode Current                                        |           |             |               | 110 max           | ша            |
| CHARACTERISTICS:                                       | 1         |             |               |                   |               |
| Plate Voltage                                          |           |             |               | 170               | volts         |
| Grid-No.2 Voltage                                      |           |             |               | 170               | volts         |
| Grid-No.1 (Control-Grid) Voltage                       |           |             |               | <b>12.5</b>       | volts         |
| Amplification Factor                                   |           |             |               | 8<br>26000        | ohms          |
| Plate Resistance                                       |           |             |               | 11000             | umhos         |
| Plate Current                                          |           |             |               | 70                | mA.           |
| Grid-No.2 Current                                      |           |             |               | 3.5               | mA            |
|                                                        |           | *********** |               |                   |               |
| MAXIMUM CIRCUIT VALUES:                                |           |             |               | 4                 |               |
| Grid-No.1-Circuit Resistance                           |           |             |               | ı max             | megohm        |
| Vertic                                                 | al Defle  | ection Am   | nlifier       |                   |               |
|                                                        |           |             | frame system  |                   |               |
| MAXIMUM RATINGS (Design-Ma                             |           |             | iranie bystom |                   |               |
| Plate Voltage                                          |           |             | <b></b> .     | 275 max           | volts         |
| Peak Positive-Pulse Plate Voltage#                     |           |             |               | 2200 max          | volts         |
| Grid-No.2 Voltage                                      |           |             |               | 275 max           | volts         |
| Peak Negative-Pulse Grid-No.1 Volt                     | age       |             |               | -250 max          | volts         |
| Peak Cathode Current                                   |           |             |               | 240 max           | mA            |
| Average Cathode Current                                |           |             |               | 110 max<br>12 max | mA<br>watts   |
| Plate Dissipation                                      |           |             |               | 2.1 max           | watts         |
| Grid-No.2 Input                                        |           |             |               | A. A. Ellan       | ** ******     |
| MAXIMUM CIRCUIT VALUES:                                |           |             |               |                   |               |
| Collaboration Desiration                               |           |             |               | 7 7 mar           |               |

Grid-No.1-Circuit Resistance .....

2.2 max megohms # The duration of the voltage pulse must not exceed 6 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 6 per cent of one vertical scanning cycle is 1.2 milliseconds.



### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

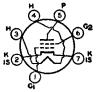
Miniature type used in television receiver applications. Pentode unit is used as video amplifier; triode unit is used in sound intermediate-frequency amplifier, sweep-oscillator, sync-separator, sync-amplifier, and sync-clip-

6CX8
Related type:
8CX8

9DX

per circuits. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 8CX8 is identical with type 6CX8 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average) Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode  The dc component must not exceed 100 volts.                                                                    | 6CX8<br>6.3<br>0.75<br>—<br>200 max<br>200=max     | 8CX8<br>8<br>0.6<br>11<br>200 max<br>200•max                                            | volts<br>ampere<br>volts<br>volts<br>volts                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Class A, Amplifier                                                                                                                                                                                                                                                                               |                                                    |                                                                                         |                                                              |
| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 165 volts For grid-No.2 voltages between 165 and 330 volts | Triode Unit<br>330 max<br>—<br>0 max<br>2 max      | Pentode Ur<br>330 max<br>330 max<br>See curve<br>0 max<br>5 max<br>1.1 max<br>See curve | volts volts e page 80 volts watts                            |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) Transconductance Grid-No.1 (Voltage Approx.) for plate current of 100 µA Plate Current Grid-No.2 Current                                                    | 150<br>—<br>150<br>40<br>8700<br>4600<br>—5<br>9.2 | 200<br>125<br>68<br>                                                                    | volts<br>volts<br>ohms<br>ohms<br>µmhos<br>volts<br>mA<br>mA |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation                                                                                                                                                                                        | 0.5 max<br>1 max                                   | 0.25 max<br>1 max                                                                       | megohm<br>megohm                                             |



### SHARP-CUTOFF TETRODE

Miniature type used as rf amplifier in whf tuners of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Types 2CY5, 3CY5, and 4CY5 are

6CY5
Related types:
2CY5, 3CY5, 4CY5

identical with type 6CY5 except for the heater ratings, as shown below.

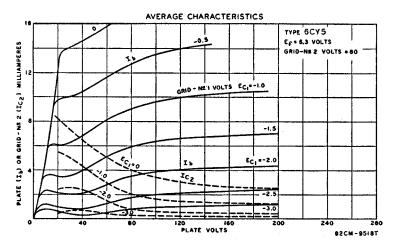
|                               | CY5 | 3CY5 | 4CY5 | 6CY5 |         |
|-------------------------------|-----|------|------|------|---------|
| Heater Voltage (ac/dc)        | 2.4 | 2.9  | 4.5  | 6.3  | volts   |
| Heater Current                | 0.6 | 0.45 | 0.3  | 0.2  | ampere  |
| Heater Warm-up Time (Average) | 11  | 11   | 11   |      | seconds |

| Peak Heater-Cathode Voltage: Heater negative with respect to cathode | 100     |       |
|----------------------------------------------------------------------|---------|-------|
| reducer negative with respect to caulode                             | 100 max | volts |
| Heater positive with respect to cathode                              | 100 max | volts |
| Direct Interelectrode Capacitances (Approx.):                        |         |       |
|                                                                      |         | _     |
| Grid-No.1 to Plate                                                   | 0.03    | pF    |
| Grid-No.1 to Cathode, Heater, Grid No.2, and Internal Shield         | 4.5     | pF    |
|                                                                      | 7.3     |       |
| Plate to Cathode, Heater, Grid No.2, and Internal Shield             | 3       | ρF    |
|                                                                      |         |       |

With external shield connected to cathode.

| Class A, Amplifier                                     |      |                   |         |
|--------------------------------------------------------|------|-------------------|---------|
| MAXIMUM RATINGS (Design-Maximum Values):               |      |                   |         |
| Plate Voltage                                          | 180  | max               | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | 180  | max               | volts   |
| Grid-No.2 Voltage                                      | See  | curve             | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value  | 0    | max               | volts   |
| Cathode Current                                        | 20   | max               | mA      |
| Grid-No.2 Input:                                       |      |                   |         |
| For grid-No.2 voltages up to 90 volts                  |      | max               | watt    |
| For grid-No.2 voltages between 90 and 180 volts        |      | See curve page 80 |         |
| Plate Dissipation                                      | 2 1  | max               | watts   |
| CHARACTERISTICS:                                       |      |                   |         |
| Plate Voltage                                          | 125  |                   | volts   |
| Grid-No.2 Voltage                                      | 80   |                   | volts   |
| Grid-No.1 Voltage                                      | -1   |                   | volt    |
| Plate Resistance (Approx.)                             | 0.1  | n                 | negohm  |
| Transconductance                                       | 8000 |                   | μmhos   |
| Plate Current                                          | 10   |                   | mA      |
| Grid-No.2 Current                                      | 1.5  |                   | mA      |
| Grid-No.1 Voltage (Approx.) for plate current of 20 μA | 6    |                   | volts   |
| MAXIMUM CIRCUIT VALUES:                                |      |                   |         |

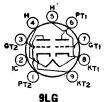




## **DUAL TRIODE**

11CY7

Miniature type used as combined vertical oscillator and vertical deflection amplifier in television receivers. Unit No.1 is a high-mu triode unit used as a blocking oscillator in vertical deflection circuits, and unit No.2 is a



low-mu triode unit used as a vertical deflection amplifier. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 11CY7 is identical with type 6CY7 except for the heater ratings, as shown below.

|                                               | 6CY7    | 11CY7   |         |
|-----------------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                        | 6.3     | 11      | volts   |
| Heater Current                                | 0.75    | 0.45    | ampere  |
| Heater Warm-up Time (Average)                 | -       | 11      | seconds |
| Peak Heater-Cathode Voltage:                  |         |         |         |
| Heater negative with respect to cathode       | 200 max | 200 max | volts   |
| Heater positive with respect to cathode       | 200=max | 200 max | volts   |
| • The dc component must not exceed 100 volts. |         |         |         |

#### Class A, Amplifier

| CHARACTERISTICS:                                        | Unit No.1 | Unit No.2 |       |
|---------------------------------------------------------|-----------|-----------|-------|
| Plate Supply Voltage                                    | 250       | 150       | volts |
| Grid Voltage                                            | -3        |           | volts |
| Cathode-Bias Resistor                                   |           | 620       | ohms  |
| Amplification Factor                                    | 68        | 5         |       |
| Plate Resistance (Approx.)                              | 52000     | 920       | ohms  |
| Transconductance                                        | 1300      | 5400      | μmhos |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A  | 5.5       | _         | volts |
| Grid Voltage (Approx.) for plate current of 200 $\mu A$ |           | -40       | volts |
| Plate Current                                           | 1.2       | 30        | mA    |
| Plate Current for grid voltage of -30 volts             |           | 3.5       | mA    |

### Vertical Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): | Unit No.1<br>Oscillator | Unit No.2 Amplifier |       |
|------------------------------------------|-------------------------|---------------------|-------|
| DC Plate Voltage                         | 350 max                 | 350 max             | volts |
| Peak Positive-Pulse Plate Voltage#       |                         | 1800 max            | volts |
| Peak Negative-Pulse Grid Voltage         | -400 max                | -250 max            | volts |
| Peak Cathode Current                     | _                       | 120 max             | mA    |
| Average Cathode Current                  | _                       | 35 max              | mA    |
| Plate Dissipation                        | 1 max                   | 5.5 max             | watts |
|                                          |                         |                     |       |

#### 

# The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In

2.2 max

a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

† For cathode-bias operation.



### **BEAM POWER TUBE**

Miniature type used as a vertical deflection amplifier in high-efficiency deflection circuits of television receivers utilizing picture tubes having diagonal deflection angles of 110 degrees and operating at ultor voltages up to

6CZ5
Related type: 5CZ5

2.2†max megohms

18 kilovolts. Also used in the audio output stage of television and radio receivers. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Outline 6G, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 5CZ5 is identical with type 6CZ5 except for the heater ratings, as shown below.

|                                                                                                                                                               | 5CZ5    | 6CZ5            |                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------|--------------------|
| Heater Voltage (ac/dc)                                                                                                                                        | 4.7     | 6.3             | volts              |
| Heater Current                                                                                                                                                | 0.6     | 0.45            | атреге             |
| Heater Warm-up Time (Average)                                                                                                                                 | 11      | 11              | seconds            |
| Peak Heater-Cathode Voltage:                                                                                                                                  |         |                 |                    |
| Heater negative with respect to cathode                                                                                                                       | 200 max | 200 max         | volts              |
| Heater positive with respect to cathode                                                                                                                       | 200*max | 200⁴max         | volts              |
| Direct Interelectrode Capacitances:                                                                                                                           |         |                 |                    |
| Grid No.1 to Plate                                                                                                                                            |         | 0.4 max         | рF                 |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid N                                                                                                           | Vo.3    | 9               | рF                 |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3                                                                                                            |         | 6               | pF                 |
| Plate Resistance (Approx.)*                                                                                                                                   |         | 0.073           | megohm             |
| Transconductance*                                                                                                                                             |         | 4800            | μ <b>mhos</b>      |
| Direct Interelectrode Capacitances: Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, and Grid N Plate to Cathode, Heater, Grid No.2, and Grid No.3 | Vo.3    | 9<br>6<br>0.073 | pF<br>pF<br>megohm |

<sup>\*</sup> Plate and grid-No.2 volts, 250; grid-No.1 volts, -14; plate mA, 46; grid-No.2 mA, 4.6.

#### **Vertical Deflection Amplifier**

For operation in a 525-line, 30-frame system

| MAXIMUM KATINGS (Design-Maximum Values):             |      |     |       |
|------------------------------------------------------|------|-----|-------|
| DC Plate Voltage                                     | 350  | max | volts |
| Peak Positive-Pulse Plate Voltage#                   | 2200 | max | volts |
| Grid-No.2 (Screen-Grid) Voltage                      | 315  | max | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage | -275 | max | volts |
| Peak Cathode Current                                 | 155  | max | mA    |
| Average Cathode Current                              |      | max | mA    |
| Plate Dissipation                                    |      | max | watts |
| Grid-No.2 Input                                      |      | max | watts |
| Bulb Temperature (At hottest point)                  | 250  | max | °C    |

#### **MAXIMUM CIRCUIT VALUES:**

| Grid-No.1-Circuit Resistance: |         |        |
|-------------------------------|---------|--------|
| For fixed-bias operation      | 0.5 max | megohm |
| For cathode-bias operation    | 1.0 max | megohm |

#The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

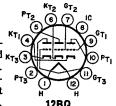
The dc component must not exceed 100 volts.

## HIGH-MU TRIPLE TRIODE

6D10

Duodecar type used in oscillatormixer, grounded-grid amplifier, and KT3(3
automatic-frequency-control circuits.

Outline 8A, Outlines section. Type requires duodecar twelve-contact socket and may be mounted in any position.



and may be mounted in any position. 12BQ Heater volts (ac/dc), 6.3; amperes, 0.45; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

Class A, Amplifier

| oldoo vii viii piilloi                                     |       |     |            |
|------------------------------------------------------------|-------|-----|------------|
| MAXIMUM RATINGS (Design-Maximum Values, Each Triode Unit): |       |     |            |
| Plate Voltage                                              | 330   | max | volts      |
| Grid Voltage:                                              |       |     |            |
| Positive-bias value                                        | 0     | max | volts      |
| Negative-bias value                                        | 50    | max | volts      |
| Plate Dissipaption                                         | 2     | max | watts      |
| Total Plate Dissipation (All plates)                       | 6     | max | watts      |
| CHARACTERISTICS (Each Triode Unit);                        |       |     |            |
| Plate Voltage                                              | 125   |     | volts      |
| Grid Voltage                                               | —1    |     | volts      |
| Amplification Factor                                       | 57    |     |            |
| Plate Resistance (Approx.)                                 | 13600 |     | ohms       |
| Transconductance                                           | 4200  |     | $\mu$ mhos |
| Plate Current                                              | 4.2   |     | mA         |
| Grid Voltage (Approx.) for plate current of 20 $\mu$ A     | -4    |     | volts      |



### HALF-WAVE VACUUM RECTIFIER

Glass octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 13D, Outlines section. Tube requires octal socket and may be mounted in any position. May be supplied with pin

6DA4
Related type:

No.1 omitted. Socket terminals 1, 2, 4, and 6 should not be used as tie points. It is important that this tube, like other power-handling tubes, be adequately ventilated. Type 17D4 is identical with type 6DA4 except for the heater ratings, as shown below.

|                                                               | 6DA4       | 17D4             |           |
|---------------------------------------------------------------|------------|------------------|-----------|
| Heater Voltage (ac/dc)                                        | 6.3        | 16.8             | volts     |
| Heater Current                                                | 1.2        | 0.45             | ampere    |
| Heater Warm-up Time (Average)                                 |            | 11               | seconds   |
| Damper Service                                                |            |                  |           |
| For operation in a 525-line, 30-fra                           | ame system |                  |           |
| MAXIMUM RATINGS (Design-Maximum Values):                      |            |                  |           |
| Peak Inverse Plate Current.                                   |            | 4400 max         | volts     |
| Peak Plate Current                                            |            | 900 max          | mA        |
| DC Plate Current                                              |            | 155 max          | mA        |
| Plate Dissipation                                             |            | 5.5 max          | watts     |
| Peak Heater-Cathode Voltage:                                  |            |                  |           |
| Heater negative with respect to cathode                       |            | 4400 = max       | volts     |
| Heater positive with respect to cathode                       |            | 3004max          | volts     |
| • The duration of the voltage pulse must not exceed 15 per    |            | orizontal scanni | ng cycle. |
| In a 525-line, 30-frame system, 15 per cent of one horizontal |            |                  |           |
| • The dc component must not exceed 900 volts.                 |            |                  |           |
| A The do component must not exceed 100 volts                  |            |                  |           |



Cathode-Bias Resistor .....

### **BEAM POWER TUBE**

fa Miniature type used as vertical-deflection-amplifier tube in television receivers. Outline 6F, Outlines section. Tube requires miniature nine-contact socket and may be operated in any position. Type 12DB5 is identical

6DB5
Related type: 12DB5

180

8.5

46

47

2.2

8.5

ohms

volts

mA

mA

mΑ

mΑ

| Juk                   | position.       | rype         | 12000    | ıs   | identicai |          |         |
|-----------------------|-----------------|--------------|----------|------|-----------|----------|---------|
| with type 6DB5 ex     | cept for the    | heater       | ratings, | as   | shown t   | elow.    |         |
|                       | _               |              |          |      | 6DB5      | 12DB5    |         |
| Heater Voltage (ac/de | :)              |              |          |      | 6.3       | 12.6     | volts   |
| Heater Current        |                 |              |          |      | 1.2       | 0.6      | ampere  |
| Heater Warm-up Tim    | e (Average) .   |              |          |      | _         | 11       | seconds |
| Peak Heater-Cathode \ | oltage:         |              |          |      |           | _        |         |
| Heater negative wi    | th respect to c | athode .     |          |      | 200 ma    | x 200 ma | t volts |
| Heater positive wi    |                 |              |          |      | 200°ma    |          |         |
| • The dc component m  | ust not exceed  | 100 volts    | •        |      |           |          |         |
|                       |                 | Class A      | A, Ampli | fier |           |          |         |
| MAXIMUM RATING        |                 |              |          |      |           |          |         |
| Plate Voltage         |                 | <sup>.</sup> |          |      |           | 300 mar  | volts   |
| Grid-No.2 (Screen-Gri | d) Voltage .    |              |          |      |           | 150 max  | volts   |
| Grid-No.2 Input       |                 |              |          |      |           | 1.25 max |         |
| Plate Dissipation     |                 |              |          |      |           | 10 max   |         |
| TYPICAL OPERATION     | N:              |              |          |      |           |          |         |
| Plate Supply Voltage  |                 |              |          |      |           | 200      | volts   |
| Grid-No.2 Supply Vol  | tage            |              |          |      |           | 125      | volts   |
|                       |                 |              |          |      |           |          |         |

Peak AF Grid-No.1 Voltage .....

Zero-Signal Grid-No.2 Current .....

Maximum-Signal Grid-No.2 Current .....

Zero-Signal Plate Current .....

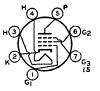
Maximum-Signal Plate Current .....

| Plate Resistance (Approx.) Transconductance Load Resistance Total Harmonic Distortion Maximum-Signal Power Output                                                                                                                                                     | 28000<br>8000<br>4000<br>10<br>3.8 | ohms  µmhos ohms per cent watts |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|---------------------------------|
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                               |                                    |                                 |
| Grid-No.1 Circuit Resistance:  For fixed-bias operation  For cathode-bias operation                                                                                                                                                                                   |                                    | megohm<br>megohms               |
|                                                                                                                                                                                                                                                                       | 2.2 1110/                          | megonins                        |
| Vertical-Deflection Amplifier For operation in a 525-line, 30-frame system                                                                                                                                                                                            |                                    |                                 |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                               |                                    |                                 |
| DC Plate Voltage                                                                                                                                                                                                                                                      | 300 max                            | volts                           |
| Peak Positive-Pulse Plate Voltage (Absolute Maximum)                                                                                                                                                                                                                  | 2000=max                           | volts                           |
| DC Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                    | 150 max                            |                                 |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage                                                                                                                                                                                                                  | 250 max                            |                                 |
| Peak Cathode Current                                                                                                                                                                                                                                                  | 200 max                            |                                 |
| Average Cathode Current                                                                                                                                                                                                                                               | 55 max                             |                                 |
| Grid-No.2 Input                                                                                                                                                                                                                                                       | 1.25 max                           |                                 |
| Plate Dissipation                                                                                                                                                                                                                                                     | 10 max                             | watts                           |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                               |                                    |                                 |
| Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                         |                                    |                                 |
| For fixed-bias operation                                                                                                                                                                                                                                              | 0.1 max                            | megohm                          |
| For cathode-bias operation                                                                                                                                                                                                                                            | 2.2 max                            | megohms                         |
| <ul> <li><sup>▲</sup> The duration of the voltage pulse must not exceed 15 per cent of one ve a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.</li> <li>Under no circumstances should this absolute maximum value be exceeded</li> </ul> | 5 milliseconds                     |                                 |

### SHARP-CUTOFF PENTODE

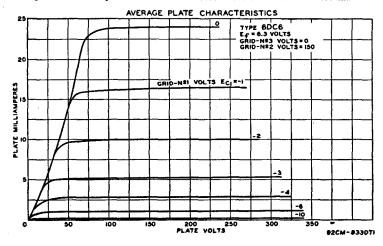
6DC6

Miniature type used in the gain-controlled picture if stages of color television receivers. It is also used as a radio-frequency amplifier in the tuners of such receivers. Outline 5C, Outlines section. Tube requires seven-



7CM

| contact miniature socket and may be mounted in any position. |         |        |
|--------------------------------------------------------------|---------|--------|
| Heater Voltage (ac/dc)                                       | 6.3     | volts  |
| Heater Current                                               | 0.3     | ampere |
| Peak Heater-Cathode Voltage:                                 |         |        |
| Heater negative with respect to cathode                      | 200 max | volts  |
| Heater positive with respect to cathode                      | 200 max | volts  |



| Direct Interelectrode Capacitances:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.02 max                                                                                                                                               | pF                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.02 max                                                                                                                                               | рг                                                                             |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6.5                                                                                                                                                    | pF                                                                             |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | _                                                                                                                                                      |                                                                                |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2                                                                                                                                                      | pF                                                                             |
| • The dc component must not exceed 100 volts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                        |                                                                                |
| Class A, Amplifier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                        |                                                                                |
| MAXIMUM RATINGS (Design-Center Values): Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 300 max                                                                                                                                                | volts                                                                          |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0 max                                                                                                                                                  | volts                                                                          |
| Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 300 max                                                                                                                                                | volts                                                                          |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | See curve                                                                                                                                              | page 80 volts                                                                  |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0 max<br>2 max                                                                                                                                         | watts                                                                          |
| Grid-No.2 Input:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                        |                                                                                |
| For grid-No.2 voltages up to 150 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.5 max                                                                                                                                                | watt                                                                           |
| For grid-No.2 voltages between 150 and 300 volts  CHARACTERISTICS:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | See curve                                                                                                                                              | page 80                                                                        |
| Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 200                                                                                                                                                    | volts                                                                          |
| Grid No.3 Connected                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | to cathode                                                                                                                                             | at socket                                                                      |
| Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 150                                                                                                                                                    | volts                                                                          |
| Cathode-Bias Resistor Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 180<br>0.5                                                                                                                                             | ohms<br>megohm                                                                 |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 5500                                                                                                                                                   | μmhos                                                                          |
| Grid-No.1 Voltage (Approx.) for transconductance of 50 μmhos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -12.5                                                                                                                                                  | volts                                                                          |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 9<br>3                                                                                                                                                 | mA<br>mA                                                                       |
| Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3                                                                                                                                                      | mA                                                                             |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                        |                                                                                |
| For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.25 max                                                                                                                                               | megohm                                                                         |
| For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                        | megohm                                                                         |
| TWIN DIODE—                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                        |                                                                                |
| I WIN DIODE—                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                        |                                                                                |
| CEMIDEMOTE CUITOFE DENTONE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                        |                                                                                |
| SEMIREMOTE-CUTOFF PENTODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                        |                                                                                |
| Miniature types used as rf- and if-am-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                        |                                                                                |
| Miniature types used as rf- and if-am-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b></b>                                                                                                                                                |                                                                                |
| Miniature types used as rf- and if-amplifier tubes in radio and television                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6DC8                                                                                                                                                   | 3/                                                                             |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines sec-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                        |                                                                                |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 6DC8                                                                                                                                                   |                                                                                |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                        |                                                                                |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EBF8                                                                                                                                                   | 9                                                                              |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                        |                                                                                |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EBF8                                                                                                                                                   | yolts ampere                                                                   |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.3<br>0.3<br>100 max                                                                                                                                  | volts ampere                                                                   |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | EBF8                                                                                                                                                   | yolts ampere                                                                   |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6.3<br>0.3<br>100 max<br>100 max                                                                                                                       | volts ampere volts volts                                                       |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc)  Heater Current  Peak Heater-Cathode Voltage:  Heater positive with respect to cathode  Heater positive with respect to cathode  Direct Interelectrode Capacitances:  Pentode Unit:  Grid No.1 to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6.3<br>0.3<br>100 max<br>100 max                                                                                                                       | volts ampere volts volts                                                       |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to All Other Electrodes Except Plate Plate to All Other Electrodes Except Grid No.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 6.3<br>0.3<br>100 max<br>100 max<br>5 5.2                                                                                                              | volts ampere volts volts                                                       |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater positive with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to All Other Electrodes Except Plate Plate to All Other Electrodes Except Grid No.1 Grid No.1 to Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 6.3<br>0.3<br>100 max<br>100 max<br>0.0025 max<br>5<br>5.2<br>0.05 max                                                                                 | volts ampere volts volts                                                       |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to Plate Grid No.1 to Heater Plate of Each Diode Unit No.1 to Plate of Diode Unit No.1 to All other Electrodes Plate of Diode Unit No.1 to Plate of Diode Unit No.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 6.3<br>0.3<br>100 max<br>100 max<br>0.0025 max<br>5<br>5.2<br>0.05 max<br>2.5                                                                          | volts ampere volts volts pF pF pF pF pF pF                                     |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc)  Heater Current  Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode  Direct Interelectrode Capacitances:  Pentode Unit:  Grid No.1 to All Other Electrodes Except Plate  Plate of Each Diode Unit No.1 to Plate of Diode Unit No.1 to Plate | 6.3<br>0.3<br>100 max<br>100 max<br>0.0025 max<br>5<br>5.2<br>0.05 max                                                                                 | volts ampere volts volts volts ppr ppr ppr ppr ppr ppr ppr ppr ppr pp          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to Heater Plate of Each Diode Unit No.1 to Plate of Diode Unit No.1 to Plate of Diode Unit No.1 to Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5 5.2 0.05 max 0.015 max 0.015 max 0.015 max                                                                | volts ampere volts volts volts pF          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current  Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to Plate Grid No.1 to Heater Plate of Each Diode Unit to All Other Electrodes Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.1 to Plate of Diode Unit No.2 to Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5 5.2 0.05 max 2.5 0.25 max 0.015 max 0.003 max 0.0008 max                                                  | volts ampere volts volts volts ppr ppr ppr ppr ppr ppr ppr ppr ppr pp          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to All Other Electrodes Except Plate Plate to All Other Electrodes Except Grid No.1 Grid No.1 to Heater Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5.2 0.05 max 2.5 0.25 max 0.015 max 0.003 max 0.0008 max                                                    | volts ampere volts volts volts pF          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current  Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to Plate Grid No.1 to Heater Plate of Each Diode Unit to All Other Electrodes Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.1 to Plate of Diode Unit No.2 to Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5 5.2 0.05 max 2.5 0.25 max 0.015 max 0.003 max 0.0008 max                                                  | volts ampere volts volts volts ppr ppr ppr ppr ppr ppr ppr ppr ppr pp          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to All Other Electrodes Except Plate Plate to All Other Electrodes Except Grid No.1 Grid No.1 to Heater Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.2 to Heater Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5 5.2 0.05 max 0.015 max 0.015 max 0.003 max 0.001 max 0.001 max                                            | volts ampere volts volts volts ppr ppr ppr ppr ppr ppr ppr ppr ppr pp          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to Plate Grid No.1 to Heater Plate of Bach Diode Unit to All Other Electrodes Except Plate Plate of Diode Unit No.1 to Plate of Diode Unit No.2 to Heater Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.2 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Plate Plate of Diode Unit No.1 to Pentode Plate Plate of Diode Unit No.2 to Pentode Plate Plate of Diode Unit No.2 to Pentode Plate Pentode Unit as Class A, Amplifier MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5 5.2 0.05 max 0.015 max 0.015 max 0.003 max 0.001 max 0.001 max                                            | volts ampere volts volts volts ppr ppr ppr ppr ppr ppr ppr ppr ppr pp          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to All Other Electrodes Except Plate Plate to All Other Electrodes Except Grid No.1 Grid No.1 to Heater Plate of Each Diode Unit to All Other Electrodes Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.2 to Heater Plate of Diode Unit No.2 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Plate Plate of Diode Unit No.2 to Pentode Plate Plate Supply Voltage  Pentode Unit as Class A, Amplifier MAXIMUM RATINGS (Design-Center Values): Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5.2 0.05 max 2.5 0.25 max 0.015 max 0.003 max 0.000 max 0.15 max 0.000 max 0.55 max 0.55 max                | volts ampere volts volts volts pf          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to All Other Electrodes Except Plate Plate to All Other Electrodes Except Grid No.1 Grid No.1 to Heater Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.2 to Pentode Plate Plate Supply Voltage Plate Voltage Plate Voltage Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5 5.2 0.05 max 2.5 0.25 max 0.015 max 0.003 max 0.0003 max 0.001 max 0.15 max 0.005 max                     | volts ampere volts volts volts ppr ppr ppr ppr ppr ppr ppr ppr ppr pp          |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to All Other Electrodes Except Plate Plate to All Other Electrodes Except Grid No.1 Grid No.1 to Heater Plate of Each Diode Unit to All Other Electrodes Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.2 to Heater Plate of Diode Unit No.2 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Plate Plate of Diode Unit No.2 to Pentode Plate Plate of Diode Unit No.2 to Pentode Plate Plate of Diode Unit No.2 to Pentode Plate Plate Supply Voltage Plate Voltage Plate Voltage Plate Voltage: With plate current greater than 8 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5 5.2 0.05 max 2.5 0.25 max 0.015 max 0.003 max 0.001 max 0.001 max 0.005 max 0.001 max 0.001 max 0.001 max | volts ampere volts |
| Miniature types used as rf- and if-amplifier tubes in radio and television receivers. Outline 6E, Outlines section. Tubes require nine-contact socket and may be mounted in any position.  Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode Direct Interelectrode Capacitances: Pentode Unit: Grid No.1 to Plate Grid No.1 to All Other Electrodes Except Plate Plate to All Other Electrodes Except Grid No.1 Grid No.1 to Heater Plate of Diode Unit No.1 to Plate of Diode Unit No.2 Plate of Diode Unit No.1 to Heater Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.1 to Pentode Grid No.1 Plate of Diode Unit No.2 to Pentode Plate Plate Supply Voltage Plate Voltage Plate Voltage Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6.3 0.3 100 max 100 max 100 max 0.0025 max 5.2 0.05 max 2.5 0.25 max 0.015 max 0.003 max 0.000 max 0.15 max 0.000 max 0.55 max 0.55 max                | volts ampere volts volts volts pf          |

| Cathode Current                                     |                         | 16.5 max       | mA      |
|-----------------------------------------------------|-------------------------|----------------|---------|
| Grid-No.2 Input                                     |                         | 0.45 max       | watts   |
| Plate Dissipation                                   | · · · · · · · · · · · · | 2.25 max       | watts   |
| CHARACTERISTICS:                                    |                         |                |         |
| Plate Voltage                                       | 200                     | 250            | volts   |
| Grid No.3                                           | Connec                  | ted to cathode |         |
| Grid-No.2 Voltage                                   | 100                     | 100            | volts   |
| Grid-No.1 Voltage                                   | -1.5                    | -2             | volts   |
| Mu Factor, Grid No.2 to Grid No.1                   | 20                      | 20             |         |
| Plate Resistance (Approx.)                          | 0.6                     | 1              | megohm  |
| Transconductance                                    | 4500                    | 3800           | μmhos.  |
| Plate Current                                       | 11                      | 9              | mA      |
| Grid-No.2 Current                                   | 3.3                     | 2.7            | mA      |
| Transconductance, at grid-No.1 voltage of -20 volts | 120                     | 200            | μmhos   |
| MAXIMUM CIRCUIT VALUES:                             |                         |                |         |
|                                                     |                         | •              |         |
| Grid-No.1-Circuit Resistance                        |                         | 3 max          | megohms |
| Diode Units (Each U                                 | nit)                    |                |         |
| MAXIMUM RATINGS (Design-Center Values):             |                         |                |         |
| Peak Inverse Plate Voltage                          |                         | 200 max        | volts   |
| Peak Plate Current                                  |                         | 5 max          | mA      |
| Average Plate Current                               |                         | 0.8 max        | mA      |
| •                                                   |                         | 270 111111     |         |

## HALF-WAVE VACUUM RECTIFIER

6DE4
Related types: 17DE4, 22DE4

Glass octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 13G, Outlines section. Tube requires octal socket and may be operated in any position. Socket terminals 1, 2, 4, and



4CG

6 should not be used as tie points. It is important that this tube, like other power-handling tubes, be adequately ventilated. Types 17DE4 and 22DE4 are identical with type 6DE4 except for the heater ratings, as shown below.

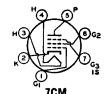
|                                               | 6DE4       | 17DE4        | 22DE4          |          |
|-----------------------------------------------|------------|--------------|----------------|----------|
| Heater Voltage (ac/dc)                        | 6.3        | 17           | 22.4           | volts    |
| Heater Current                                | 1.6        | 0.6          | 0.45           | ampere   |
| Heater Warm-up Time (Average)                 | _          | 11           | 11             | seconds  |
| Direct Interelectrode Capacitances (Approx.): |            |              |                |          |
| Plate to Cathode and Heater                   |            |              | 8.5            | pF       |
| Cathode to Plate and Heater                   |            |              | 11.5           | pF       |
| Heater to Cathode                             |            |              | 4              | pF       |
| Damper                                        | Service    |              |                |          |
| For operation in a 525                        | -line, 30- | frame system |                |          |
| MAXIMUM RATINGS (Design-Maximum Valu          | -6).       |              |                |          |
| Peak Inverse Plate Voltage#                   |            |              | 5500 max       | volts    |
| Peak Plate Current                            |            |              | 1100 max       | mA       |
| DC Plate Current                              |            |              | 180 max        | mA       |
| Plate Dissipation                             |            |              | 6.5 max        | watts    |
| -                                             |            |              | Q.5 IIIux      | watto    |
| Peak Heater-Cathode Voltage:                  |            |              |                |          |
| Heater negative with respect to cathode       |            |              | 5500 max       | volts    |
| Heater positive with respect to cathode       |            |              | 300•max        | volts    |
| CHARACTERISTICS, Instantaneous Value:         |            |              |                |          |
| Tube Voltage Drop for plate current of 350 m  | A          |              | 34             | volts    |
| # The duration of the voltage pulse must not  | exceed 15  | per cent of  | one horizontal | scanning |

cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10

microseconds.

<sup>•</sup> The dc component must not exceed 900 volts.

<sup>•</sup> The dc component must not exceed 100 volts.



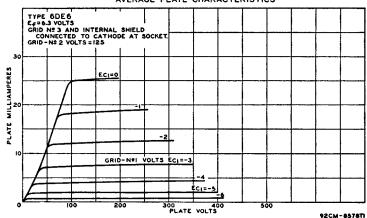
#### SHARP-CUTOFF PENTODE

Miniature type used in the gain-controlled picture if stages of television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. Also used as an rf amplifier in vhf television tuners. This

6DE6
Related type:
4DE6

tube features very high transconductance combined with low interelectrode capacitance values, and is provided with separate base pins for grid No.3 and cathode to permit the use of an unbypassed cathode resistor to minimize the effects of regeneration. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 4DE6 is identical with type 6DE6 except for the heater ratings, as shown below.

| ODEO except for the heater ratings, as shown below                                                                  |           |           |         |
|---------------------------------------------------------------------------------------------------------------------|-----------|-----------|---------|
|                                                                                                                     | 4DE6      | 6DE6      |         |
| Heater Voltage (ac/dc)                                                                                              | 4.2       | 6.3       | volts   |
| Heater Current                                                                                                      | 0.45      | 0.3       | ampere  |
| Heater Warm-up Time (Average)                                                                                       | 11        | _         | seconds |
| Heater negative with respect to cathode                                                                             | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode                                                                             | 200=max   | 200 = max | volts   |
|                                                                                                                     | Without   | With      |         |
|                                                                                                                     | External  | External  |         |
| Direct Interelectrode Capacitances:                                                                                 | Shield    | Shield*   |         |
| Grid No.1 to Plate                                                                                                  | 0.025 max | 0.015 max | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid                                                                       |           |           |         |
| No.3, and Internal Shield                                                                                           | 6.5       | 6.5       | рF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3,                                                                     |           |           |         |
| and Internal Shield                                                                                                 | 2         | 3         | рF      |
| <ul> <li>The dc component must not exceed 100 volts.</li> <li>With external shield connected to cathode.</li> </ul> |           |           |         |
| Class A, Amplifie                                                                                                   | r         |           |         |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                            | •         |           |         |
| Plate Voltage                                                                                                       |           | 330 max   | volts   |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value                                                                 |           | 0 max     | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                                                                              |           | 330 max   | volts   |
| Grid-No.2 Voltage                                                                                                   |           | See curve |         |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                               |           | 0 max     | volts   |
| Plate Dissipation                                                                                                   |           | 2.3 max   | watts   |
| Grid-No.2 Input:                                                                                                    |           | 2.5 max   | watts   |
| For grid-No.2 voltages up to 165 volts                                                                              |           | 0.55 max  | watt    |
| For grid-No.2 voltages between 165 and 330 volts                                                                    |           | See curve |         |
| AVERAGE PLATE CHARACT                                                                                               |           | See curve | page ou |
| AVERAGE PLATE CHARACT                                                                                               | ERISTICS  |           |         |



| CHARACTERISTICS:  Plate Supply Voltage Grid No.3 Connected Grid-No.2 Supply Voltage Cathode-Bias Resistor Plate Resistance (Approx.)  Transconductance Transconductance for grid-No.1 volts of -5.5 and cathode resistor of 0 ohms  Grid No.1 Voltage (Approx.) for plate current of 20 and | 125<br>to cathode<br>125<br>56<br>0.25<br>8000 | volts<br>at socket<br>volts<br>ohms<br>megohm<br>µmhos |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------|
| Grid-No.1 Voltage (Approx.) for plate current of 20 µA                                                                                                                                                                                                                                      | 15.5<br>4.2                                    | mA<br>mA                                               |

#### **DUAL TRIODE**

6DE7
Related types: 10DE7, 13DE7

Miniature type used as combined ver-672(3) tical oscillator and vertical-deflection amplifier in television receivers. Unit No.1 is a medium-mu triode unit used as a blocking oscillator in vertical-deflection circuits, and unit No.2 is a



low-mu triode unit used as a vertical-deflection amplifier. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For curve of average plate characteristics, Unit No.2, refer to type 6DR7. Types 10DE7 and 13DE7 are identical with type 6DE7 except for the heater ratings, as shown below.

|                                               | 6DE7    | 10DE7     | 13DE7     |         |
|-----------------------------------------------|---------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                        | 6.3     | 9.7       | 13        | volts   |
| Heater Current                                | 0.9     | 0.6       | 0.45      | ampere  |
| Heater Warm-up Time (Average)                 | _       | 11        | 11        | seconds |
| Peak Heater-Cathode Voltage:                  |         |           |           |         |
| Heater negative with respect to cathode       | 200 max | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode       | 200=max | 200=max   | 200•max   | volts   |
| Direct Interelectrode Capacitances (Approx.): | τ       | Jnit No.1 | Unit No.2 |         |
| Grid to Plate                                 |         | 4         | 8.5       | pF      |
| Grid to Cathode and Heater                    |         | 2.2       | 5.5       | pF      |
| Plate to Cathode and Heater                   |         | 0.52      | 1         | pF      |
| The dc component must not exceed 100 volts.   |         |           |           | _       |

Class A, Amplifier

| CHARACTERISTICS:                                       | Unit No.1   | Unit No.2  |               |
|--------------------------------------------------------|-------------|------------|---------------|
| Plate Voltage                                          | 250         | 150        | volts         |
| Grid Voltage                                           | 11          | -17.5      | volts         |
| Amplification Factor                                   | 17.5        | 6          |               |
| Plate Resistance (Approx.)                             | 8750        | 925        | ohms          |
| Transconductance                                       | 2000        | 6500       | μ <b>mhos</b> |
| Plate Current                                          | 5.5         | 35         | mA            |
| Plate Current for grid voltage of -24 volts            | <del></del> | 10         | mA            |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A | -20         |            | volts         |
| Grid Voltage (Approx.) for plate current of 50 $\mu$ A | _           | <b>—44</b> | volts         |

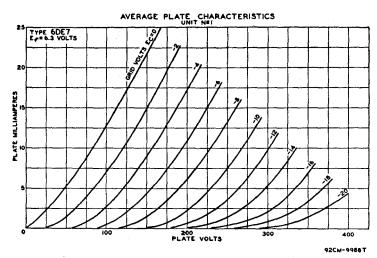
# Vertical-Deflection Oscillator and Amplifier For operation in a 525-line, 30-frame system

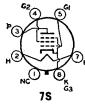
Unit No.1 Unit No.2 MAXIMUM RATINGS (Design-Maximum Values): Oscillator Amplifier DC Plate Voltage . 330 max 275 max volts Peak Positive-Pulse Plate Voltage# ...... 1500 max volts Peak Negative-Pulse Grid Voltage ..... -400 max -250 max volts Peak Cathode Current ..... 77 max 175 max mA Average Cathode Current ...... 22 max 50 max mA Plate Dissipation ..... 1.5 max 7 max watts

#### **MAXIMUM CIRCUIT VALUES:**

Grid-Circuit Resistance:

For grid-resistor bias or cathode-bias operation ..... 2.2 max megohms # The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.





### **BEAM POWER TUBE**

Glass octal type used as output tube in audio-amplifier applications. Outline 13D, Outlines section. Tube requires octal socket and may be mounted in any position. This type may be supplied with pin 1 omitted.

# 6DG6GT

| * *************************************                         |                     |            |         |
|-----------------------------------------------------------------|---------------------|------------|---------|
| Heater Voltage (ac/dc)                                          |                     | 6.3        | volts   |
| Heater Current                                                  |                     | 1.2        | amperes |
| reak Heater-Cathode Voltage:                                    |                     |            |         |
| Heater negative with respect to cathode                         |                     | 200 max    | volts   |
| Heater positive with respect to cathode                         |                     | 200-max    | volts   |
| Direct Interelectrode Capacitances (Approx.):                   |                     |            |         |
| Grid No.1 to Plate                                              |                     | 0.6        | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2 and Grid                | No.3                | 15         | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3              |                     | 10         | pF      |
| <ul> <li>The dc component must not exceed 100 volts.</li> </ul> |                     |            |         |
| ·                                                               |                     |            |         |
| Class A, Audio-Frequency Pow                                    | er Amnlific         | ar .       |         |
| MAXIMUM RATINGS (Design-Center Values):                         | o. Ampini           | <b>,</b> , |         |
| Plate Voltage                                                   |                     | 200        |         |
| Grid-No.2 (Screen-Grid) Voltage                                 |                     | 200 max    | volts   |
| Plate Dissipation                                               | • • • • • • • • • • | 125 max    | volts   |
| Grid-No.2 Input                                                 | • • • • • • • • • • | 10 max     | watts   |
| TYPICAL OPERATION:                                              |                     | 1.25 max   | watts   |
|                                                                 |                     |            |         |
| Plate Supply Voltage                                            | 110                 | 200        | voits   |
| Grid-No.2 Supply Voltage                                        | 110                 | 125        | volts   |
| Grid-No.1 (Control-Grid) Supply Voltage                         | <b>7.5</b>          |            | volts   |
| Peak AF Grid-No.1 Voltage                                       | 7.5                 | 8.5        | volts   |
| Cathode-Bias Resistor                                           |                     | 180        | ohms    |
| Zero-Signal Plate Current                                       | 49                  | 46         | mA      |
| Maximum-Signal Plate Current                                    | 50                  | 47         | mA      |
| Zero-Signal Grid-No.2 Current                                   | 4                   | 2.2        | mÀ      |
| Maximum-Signal Grid-No.2 Current                                | 10                  | 8.5        | mA      |
| Plate Resistance (Approx.)                                      | 13000               | 28000      | ohms    |
| Transconductance                                                | 8000                | 8000       | μmhos   |
| Load Resistance                                                 | 2000                | 4000       | ohms    |

10

2.1

10

3.8

per cent

watts

Total Harmonic Distortion

Maximum-Signal Power Output .....

#### **MAXIMUM CIRCUIT VALUES:**

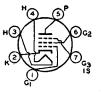
| ATLENDED | CIVE CHE   | CUII   | AWDO    | E.O. |
|----------|------------|--------|---------|------|
| Grid-No. | 1-Circuit  | Resist | ance:   |      |
| For      | fixed-blas | s oper | ation   |      |
| For      | cathode-   | bias o | peratio | n.   |

|         | peration  | 0.1 | max | megohm |  |
|---------|-----------|-----|-----|--------|--|
| le-bias | operation | 0.5 | max | megohm |  |

### SHARP-CUTOFF PENTODE

# 6DK6

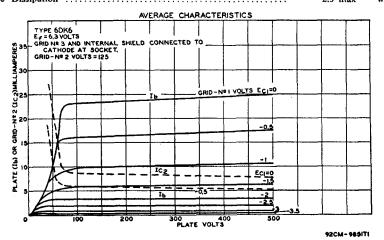
Related types: 3DK6, 4DK6, 12DK6 Miniature type used as intermediate-frequency amplifier tube in television receivers. This tube features high transconductance at low plate and grid-No.2 voltages, combined with low interelectrode capacitances. Out-



7CM

line 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Types 3DK6, 4DK6, and 12DK6 are identical with type 6DK6 except for the heater ratings, as shown below.

|                                          | 3DK6    | 4DK6        | 6DK6      | 12DK6     |         |
|------------------------------------------|---------|-------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                   | 3.15    | 4.2         | 6.3       | 12.6      | volts   |
| Heater Current                           | 0.6     | 0.45        | 0.3       | 0.15      | ampere  |
| Heater Warm-up Time (Average)            | 11      | 11          |           | -         | seconds |
| Peak Heater-Cathode Voltage:             |         |             |           |           |         |
| Heater negative with respect             |         |             |           |           |         |
| to cathode                               | 300 n   | 1ax 200 max | c 200 max | 200 max   | volts   |
| Heater postive with respect              |         |             |           | -oo mun   | .0113   |
| to cathode                               | 200en   | 19x 200 max | x 200 max | 200 * max | volts   |
| Direct Interelectrode Capacitances:      | 200 1   | in 200 mar  | . 200 man | 200-IIIAX | VOILS   |
| Grid No.1 to Plate                       |         |             |           | 0.025 max | pF      |
| Grid No.1 to Cathode, Heater, Grid       | 1 No 2  | Grid No 3   | and       | U.UZJ MAX | pr.     |
| Internal Shield                          |         |             |           | 6.3       | pF      |
| Plate to Cathode, Heater, Grid No.2      |         |             |           | 0.3       | pr      |
| Internal Shield                          |         |             |           | 1.9       | 17      |
| The dc component must not exceed 100     |         |             |           | 1.9       | pF      |
| - The de component must not exceed 100   | voits.  |             |           |           |         |
| Cla                                      | ss A, A | mplifier    |           |           |         |
| MAXIMUM RATINGS (Design-Maxima           | um Val  | nes).       |           |           |         |
| Plate Voltage                            |         |             |           | 330 max   | volts   |
| Grid-No.3 (Suppressor-Grid) Voltage, P   |         |             |           | 0 max     | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage   |         |             |           | 330 max   | volts   |
|                                          |         |             |           |           |         |
| Grid-No.2 Voltage                        |         |             |           | See curve |         |
| Grid-No.1 (Control-Grid) Voltage, Positi |         |             |           | 0 max     | volts   |
| Plate Dissipation                        |         |             |           | 2.3 max   | watts   |



| Grid-No.2 Input:  For grid-No.2 voltages up to 165 volts  For grid-No.2 voltages between 165 and 330 volts | 0.55 max<br>See curve pa | watt<br>ge 80 |
|------------------------------------------------------------------------------------------------------------|--------------------------|---------------|
| CHARACTERISTICS: Plate Supply Voltage                                                                      | 125                      | volts         |
| Grid No.3                                                                                                  | to cathode at s          | ocket         |
| Grid-No.2 Supply Voltage                                                                                   | 125                      | volts         |
| Cathode-Bias Resistor                                                                                      | 56                       | ohms          |
| Plate Resistance (Approx.)                                                                                 | 0.35 me                  | gohm          |
| Transconductance                                                                                           | 9800 µ                   | mhos          |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A                                                | 6.5                      | volts         |
| Plate Current                                                                                              | 12                       | mA            |
| Grid-No.2 Current                                                                                          | 3.8                      | mA            |



#### HALF-WAVE VACUUM RECTIFIER

Glass octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 13G, Outlines section. Tube requires octal socket and may be operated in any position. Socket terminals 1, 2, 4, and

# 6DM4A

Related types: 12DM4A, 17DM4A

6 should not be used as tie points. It is important that this tube, like other power-handling tubes, be adequately ventilated. Types 12DM4A and 17DM4A are identical with type 6DM4A except for the heater ratings, as shown below.

|                                               | 6DM4A | 12DM4A | 17DM4A |         |
|-----------------------------------------------|-------|--------|--------|---------|
| Heater Voltage (ac/dc)                        | 6.3   | 12.6   | 16.8   | volts   |
| Heater Current                                | 1.2   | 0.6    | 0.45   | ampere  |
| Heater Warm-up Time (Average)                 |       | 11     | 11     | seconds |
| Direct Interelectrode Capacitances (Approx.): |       |        |        |         |
| Plate to Cathode and Heater                   |       |        | 8.5    | pF      |
| Cathode to Plate and Heater                   |       |        | 11.5   | pF      |
| Heater to Cathode                             |       |        | 4      | pF      |

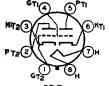
#### **Damper Service**

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |            |       |
|------------------------------------------|------------|-------|
| Peak Inverse Plate Voltage <sup>e</sup>  | 5000 max   | volts |
| Peak Plate Current                       | 1200 max   | mA    |
| DC Plate Current                         | 200 max    | mA    |
| Plate Dissipation                        | 6.5 max    | watts |
| Peak Heater-Cathode Voltage:             |            |       |
| Heater negative with respect to cathode  | 5000 • max | volts |
| Heater positive with respect to cathode  | 300 • max  | volts |

The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

<sup>•</sup> The dc component must not exceed 100 volts.



# MEDIUM-MU DUAL TRIODE

Glass octal type used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers. Outline 13B, **Outlines** section. Tube requires octal socket and may be mounted in any position.

6DN7

Heater volts (ac/dc), 6.3; amperes, 0.9; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

The dc component must not exceed 900 volts.

2.2 max

2.2 max

| Class A, Amplifie                                                   | r          |           |       |
|---------------------------------------------------------------------|------------|-----------|-------|
| CHARACTERISTICS:                                                    | Unit No.1  | Unit No.2 |       |
| Plate Voltage                                                       | 250        | 250       | volts |
| Grid Voltage                                                        | <b>—8</b>  | -9.5      | volts |
| Amplification Factor                                                | 22.5       | 15.4      |       |
| Plate Resistance (Approx.)                                          | 9000       | 2000      | ohms  |
| Transconductance                                                    | 2500       | 7700      | μmhos |
| Plate Current                                                       | 8          | : 41      | mA    |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A              | -18        | · —       | volts |
| Grid Voltage (Approx.) for plate current of 50 $\mu$ A              | _          | -23       | volts |
| Vertical-Deflection Oscillator<br>For operation in a 525-line, 30-f |            | Unit No.2 |       |
| MAXIMUM RATINGS (Design-Maximum Values):                            | Oscillator | Amplifier |       |
| DC Plate Voltage                                                    | 350 max    | 550 max   | voits |
| Peak Positive-Pulse Plate Voltage#                                  | _          | 2500 max  | volts |
| Peak Negative-Pulse Grid Voltage                                    | 400 max    | 250 max   | mA    |
| Peak Cathode Current                                                | _          | 150 max   | mA    |
| Average Cathode Current                                             | _          | 50 max    | mA    |
| Plate Dissipation                                                   | 1 max      | 10 max    | watts |
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance:                    |            |           |       |

# The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical cycle is 2.5 milliseconds.

# HALF-WAVE VACUUM RECTIFIER

6DQ4

Glass octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 13F, Outlines section. Tube requires octal socket and may be mounted in any position. Socket terminals 1, 2, 4, and



2.2 max megohms

megohms

4CG

6 should not be used as tie points. Heater volts (ac/dc), 6.3; amperes, 1.2.

Damper Service

| Damper Service                                |          |       |
|-----------------------------------------------|----------|-------|
| For operation in a 525-line, 30-frame system  |          |       |
| MAXIMUM RATINGS (Design-Maximum Values):      |          |       |
| Peak Inverse Plate Voltage#                   | 5500 max | volts |
| Peak Plate Current                            | 1000 max | mA    |
| DC Plate Current                              | 175 max  | mA    |
| Plate Dissipation                             | 6 max    | watts |
| Peak Heater-Cathode Voltage:                  |          |       |
| Heater negative with respect to cathode       | 5500=max | volts |
| Heater positive with respect to cathode       | 300□max  | volts |
| CHARACTERISTICS, Instantaneous Value:         |          |       |
| Tube Voltage Drop for plate current of 250 mA | 32       | volts |
|                                               |          |       |

# The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

The dc component must not exceed 900 volts.

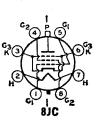
For fixed-bias operation ......

For cathode-bias operation .....

#### **BEAM POWER TUBE**

6DQ5

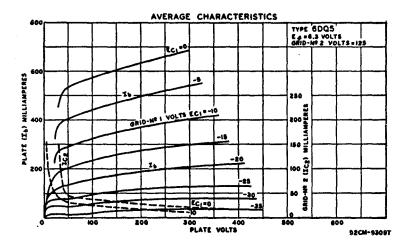
Glass octal type used as horizontal deflection amplifier in color television receivers. Outline 21B, Outlines section. Tube requires octal socket and may be mounted in any position.

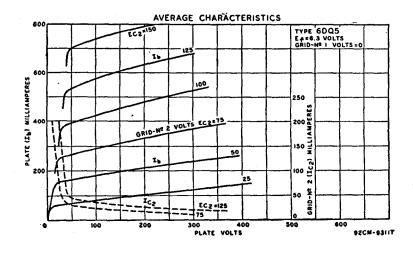


The dc component must not exceed 100 volts.

| Heater Voltage (ac/dc)                                 | 6.3     | volts   |
|--------------------------------------------------------|---------|---------|
| Heater Current                                         | 2.5     | amperes |
| Peak Heater-Cathode Voltage:                           |         | amperes |
| Heater negative with respect to cathode                | 200 max | volts   |
| Heater positive with respect to cathode                | 200 max | volts   |
| Direct Interelectrode Capacitances (Approx.):          | 200 max | 70163   |
| Grid No.1 to Plate                                     | 0.5     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 23      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 11      | pF      |
| Plate Resistance (Approx.)*                            | 5500    | ohms    |
| Transconductance*                                      | 10500   | µmhos   |
| Mu-Factor, Grid No.2 to Grid No.1**                    | 3.3     | μπιιοι  |

<sup>\*\*</sup> For plate and grid-No.2 volts, 125; grid-No.1 volts, -25.





<sup>The dc component must not exceed 100 volts.
For plate volts, 175; grid-No.2 volts, 125; grid-No.1 volts, -25; plate mA, 110; grid-No.2</sup> 

#### Horizontal Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values):             |           |       |
|------------------------------------------------------|-----------|-------|
| DC Plate Voltage                                     | 990 max   | volts |
| Peak Positive-Pulse Plate Voltaget                   | 6500 max  | volts |
| Peak Negative-Pulse Plate Voltage                    | -1100 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage                   | 190 max   | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage | 250 max   | volts |
| Peak Cathode Current                                 | 1100 max  | mA    |
| Average Cathode Current                              | 315 max   | mA    |
| Grid-No.2 Input                                      | 3.2 max   | watts |
| Plate Dissipation#                                   | 24 max    | watts |
| Bulb Temperature (At hottest point)                  | 220 max   | •C    |

#### **MAXIMUM CIRCUIT VALUE:**

Grid-No.1-Circuit Resistance: For grid-resistor-bias operation ......

0.47 max megohm

† The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds. # An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

# **BEAM POWER TUBE**

Related types: 12DQ6B, 17DQ6B Glass octal type used as horizontaldeflection-amplifier tube in high-efficiency deflection circuits of television receivers. Outline 20, Outlines section. Tube requires octal socket and



volts

volts

may be mounted in any position. This type may be supplied with pin 1 omitted. Types 12DQ6B and 17DQ6B are identical with type 6DQ6B except for the heater ratings, as shown below.

| •                                            | andon     | 12DQ6B  | 1/DQ6B  |         |
|----------------------------------------------|-----------|---------|---------|---------|
| Heater Voltage (ac/dc)                       | 6.3       | 12.6    | 16.8    | volts   |
| Heater Current                               | 1.2       | 0.6     | 0.45    | ampere  |
| Heater Warm-up Time (Average)                | _         | 11      | 11      | seconds |
| Peak Heater-Cathode Voltage:                 |           |         |         |         |
| Heater negative with respect to cathode      | 200 max   | 200 max | 200 max | volts   |
| Heater positive with respect to cathode      | 200□max   | 200□max | 200□max | volts   |
| Direct Interelectrode Capacitances (Approx.) |           |         |         |         |
| Grid No.1 to Plate                           |           |         | 0.5     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2      |           |         | 15      | pF      |
| Plate to Cathode, Heater, Grid No.2, and     |           |         | 7       | ρF      |
| The dc component must not exceed 100 volts   |           | :       | ·       |         |
| Class A,                                     | Amplifier |         |         |         |

| 60         | 250                   | volts                                               |
|------------|-----------------------|-----------------------------------------------------|
| 150        | 150                   | volts                                               |
| - 0        | -22.5                 | volts                                               |
| _          | 18000                 | ohms                                                |
| <b>—</b> . | 7300                  |                                                     |
| 345°       | 65                    | mA                                                  |
| 27°        | 1.8                   | mA                                                  |
|            |                       |                                                     |
|            |                       |                                                     |
| _          | 42                    | volts                                               |
| -          | -100                  | volts                                               |
|            | 150<br>0<br>—<br>345° | 150 150<br>0 -22.5<br>- 18000<br>345° 65<br>27° 1.8 |

<sup>\*</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):                   |                     |
|------------------------------------------------------------|---------------------|
| DC Plate-Supply Voltage Peak Positive-Pulse Plate Voltage= | 770 max<br>6500 max |

| Peak Negative-Pulse Plate Voltage DC Grid-No.2 (Screen-Grid) Voltage Peak Negative-Pulse Grid-No.1 Voltage Peak Cathode Current Average Cathode Current Grid-No.2 Input | 175 max<br>3.6 max           | volts<br>volts<br>volts<br>mA<br>mA<br>watts |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------------------------------------|
| Grid-No.2 Input Plate Dissipation Bulb Temperature (At hottest point)                                                                                                   | 3.6 max<br>18 max<br>220 max | watts<br>°C                                  |

MAXIMUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance for grid-resistor-bias operation ...... 1 max megohm

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### **DUAL TRIODE**

GT, Miniature type containing high-mu and low-mu triodes; used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers. Outline 6E, Outlines section. Tube requires miniature nine-

6DR7
Related types:
10DR7, 13DR7

contact socket and may be operated in any position. Types 10DR7 and 13DR7 are identical with type 6DR7 except for the heater ratings, as shown below.

|                                               | 6DR7      | 10DR7     | 13DR7     |         |
|-----------------------------------------------|-----------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                        | 6.3       | 9.7       | 13        | volts   |
| Heater Current                                | 0.9       | 0.6       | 0.45      | атреге  |
| Heater Warm-up Time (Average)                 | _         | 11        | 11        | seconds |
| Peak Heater-Cathode Voltage:                  |           |           |           |         |
| Heater negative with respect to cathode       | 200 ma    | x 200 max | 200 max   | volts   |
| Heater positive with respect to cathode       | 2004ma    | x 2004max | 200*max   | volts   |
| Direct Interelectrode Capacitances (Approx.): |           | Unit No.1 | Unit No.2 |         |
| Grid to Plate                                 |           | 4.5       | 8.5       | pF      |
| Grid to Cathode and Heater                    |           | 2.2       | 5.5       | рF      |
| Plate to Cathode and Heater                   | . <b></b> | 0.34      | 1         | pF      |
| A The dc component must not exceed 100 volts. |           |           |           | -       |

Class A Amplifica

| Class A, Ampline                                       | <b>?T</b> |           |       |
|--------------------------------------------------------|-----------|-----------|-------|
| CHARACTERISTICS:                                       | Unit No.1 | Unit No.2 |       |
| Plate Voltage                                          | 250       | 150       | volts |
| Grid Voltage                                           | 3         | -17.5     | volts |
| Amplification Factor                                   | 68        | 6         |       |
| Plate Resistance (Approx.)                             | 40000     | 925       | ohms  |
| Transconductance                                       | 1600      | 6500      | μmhos |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A | -5.5      | -         | volts |
| Grid Voltage (Approx.) for plate current of 50 $\mu$ A |           | 44        | volts |
| Plate Current                                          | 1.4       | 35        | mA    |
| Plate Current for grid voltage of -24 volts            | _         | 10        | mA    |
|                                                        |           |           |       |

### Vertical-Deflection Oscillator and Amplifier

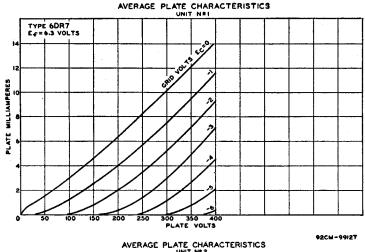
For operation in a 525-line, 30-frame system

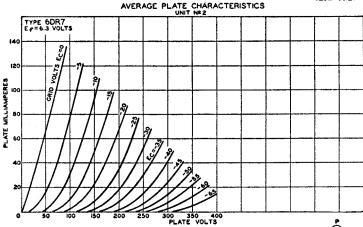
| MAXIMUM RATINGS (Design-Maximum Values): |          |          |       |
|------------------------------------------|----------|----------|-------|
| DC Plate Voltage                         | 330 max  | 275 max  | volts |
| Peak Positive-Pulse Plate Voltage#       | _        | 1500 max | volts |
| Peak Negative-Pulse Grid Voltage         | -400 max | -250 max | volts |
| Peak Cathode Current                     | 70 max   | 175 max  | mA    |
| Average Cathode Current                  | 20 max   | 50 max   | mA    |
| Plate Dissipation                        | 1 max    | 7 max    | watts |
|                                          |          |          |       |

#### MAXIMUM CIRCUIT VALUE:

Grid-Circuit Resistance:

For grid-resistance-bias or cathode-bias operation. 2.2 max megohms #The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.





# HIGH-MU TRIODE

6DS4

Related type: 2DS4

Nuvistor type used as grounded-cathode, neutralized rf amplifier in vhf tuners of television and FM receivers. Because of its cutoff characteristics, the 6DS4 is used in circuits to reduce cross-modulation distortion. Outline

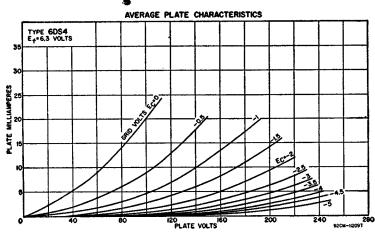
(4)
G
INDEX=LARGE LUG
F PIN CUT OFF

12AQ

1, Outlines section. Tube requires nuvistor socket and may be operated in any position. Type 2DS4 is identical with type 6DS4 except for the heater ratings, as shown below.

|                               | 2DS4 | 6DS4 |         |
|-------------------------------|------|------|---------|
| Heater Voltage (ac/dc)        | 2.1  | 6.3  | volts   |
| Heater Current                | 0.45 | 1.35 | ampere  |
| Heater Warm-up Time (Average) | 8    |      | seconds |

| Peak Heater-Cathode Voltage:                                 |                 |          |            |
|--------------------------------------------------------------|-----------------|----------|------------|
| Heater negative with respect to cathode                      | 100 max         | 100 max  | volts      |
| Heater positive with respect to cathode                      | 100 max         | 100 max  | volts      |
| Direct Interelectrode Capacitances (Approx.):                |                 |          | _          |
| Grid to Plate                                                |                 | 0.92     | p <u>F</u> |
| Grid to Cathode, Heater, and Shell                           |                 | 4.3      | рF         |
| Plate to Cathode, Heater, and Shell                          |                 | 1.8      | рF         |
| Plate to Cathode                                             |                 | 0.18     | pF         |
| Heater to Cathode                                            | • • • • • • • • | 1.6      | рF         |
| Class A, Amplifier                                           |                 |          |            |
| MAXIMUM RATINGS (Design-Maximum Values):                     |                 |          |            |
| Plate Supply Voltage                                         |                 | 300°max  | volts      |
| Plate Voltage                                                |                 | 135 max  | volts      |
| Grid Voltage, Negative-bias value                            |                 | 55 max   | volts      |
| Grid Voltage, Peak Positive value                            |                 | 0 max    | volts      |
| Plate Dissipation                                            |                 | 1.5 max  | watt       |
| Cathode Current                                              |                 | 15 max   | mA         |
| CHARACTERISTICS:                                             |                 |          |            |
| Plate Supply Voltage                                         |                 | 110      | volts      |
| Grid Supply Voltage                                          |                 | Õ        | volts      |
| Cathode-Bias Resistor                                        |                 | 130      | ohms       |
| Amplification Factor                                         |                 | 63       |            |
| Plate Resistance (Approx.)                                   |                 | 7000     | ohms       |
| Transconductance                                             |                 | 9000     | μmhos      |
| Plate Current                                                |                 | 6.5      | mA         |
| Grid Voltage (Approx.) for plate current of 100 $\mu$ A      |                 | <b>5</b> | volts      |
| Grid Voltage (Approx.) for plate current of $10 \mu A \dots$ | · · · · · · •   | 6.8      | volts      |
| TYPICAL OPERATION:                                           |                 |          |            |
| Plate Voltage                                                |                 | 70       | volts      |
| Grid Supply Voltage                                          |                 | ő        | volts      |
| Grid Resistor                                                |                 | 47000    | ohms       |
| Amplification Factor                                         |                 | 68       | Oline,     |
| Plate Resistance (Approx.)                                   |                 | 5440     | ohms       |
| Transconductance                                             |                 | 12500    | μmhos      |
| Plate Current                                                |                 | 7        | mA         |
|                                                              |                 |          |            |



#### **MAXIMUM CIRCUIT VALUES:**

Grid-Circuit Resistance:

For fixed-bias operation 0.5 max megohii. For cathode-bias operation 2.2 max megohii.

<sup>A plate supply voltage of 300 volts may be used provided a sufficiently large resistor is used in the plate circuit to limit the plate dissipation to 1.5 watts under any condition of operation.
For operation at metal-shell temperatures up to 125°C.</sup> 

# **BEAM POWER TUBE**

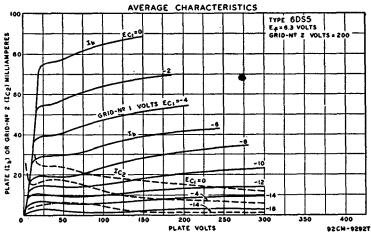
# **6DS5**

Miniature type used in the audio output stages of television and radio receivers. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

| H4 3P    |
|----------|
| M3 662   |
|          |
| Ke Color |
| G()      |

7BZ

| Heater Voltage (ac/dc)                                 | 6.3     | volts  |
|--------------------------------------------------------|---------|--------|
| Heater Current                                         | 0.8     | ampere |
| Peak Heater-Cathode Voltage:                           |         |        |
| Heater negative with respect to cathode                | 200 max | volts  |
| Heater positive with respect to cathode                | 200 max | volts  |
| Direct Interelectrode Capacitances (Approx.):          |         |        |
| Grid No.1 to Plate                                     | 0.19    | рF     |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 9.5     | pF     |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 6.3     | pF     |
| Class A, Amplifier                                     |         |        |
| MAXIMUM RATINGS (Design-Maximum Values):               |         |        |
| Plate Voltage                                          | 275 max | volts  |
| Grid-No.2 (Screen-Grid) Voltage                        | 275 max | volts  |
| Grid-No.1 (Control-Grid) Voltage, Positive bias value  | 0 max   | volts  |
| Plate Dissipation                                      | 9 max   | watts  |
| Grid-No,2 Input                                        | 2.2 max | watts  |
| Bulb Temperature (At hottest point)                    | 250 max | °C     |
|                                                        |         |        |



| TYPICAL OPERATION                | Catho | ode-Bias | Fixed-l     | Bias         |          |
|----------------------------------|-------|----------|-------------|--------------|----------|
| AND CHARACTERISTICS:             | Ope   | eration  | Opera       | tio <b>n</b> |          |
| Plate Supply Voltage             | 200   | 200      | 200         | 250          | volts    |
| Grid-No.2 Supply Voltage         | 200   | 250      | 200         | 200          | volts    |
| Grid-No.1 Voltage                | _     | _        | <b></b> 7.5 | <b>—8.5</b>  |          |
| Cathode-Bias Resistor            | 180   | 270      | _           | _            | ohms     |
| Peak AF Grid-No.1 Voltage        | 7.5   | 9.2      | 7.5         | 8.5          | volts    |
| Zero-Signal Plate Current        | 34.5  | 27       | 35          | 29           | mA       |
| Maximum-Signal Plate Current     | 32.5  | 25       | 36          | 32           | mA       |
| Zero-Signal Grid-No.2 Current    | 3.5   | 3        | 3           | 3            | mA       |
| Maximum-Signal Grid-No.2 Current | 9     | 9        | 9           | 10           | mA       |
| Plate Resistance (Approx.)       | 28000 | 28000    | 28000       | 28000        | ohms     |
| Transconductance                 | 6000  | 5800     | 6000        | 5800         | μmhos    |
| Load Resistance                  | 6000  | 8000     | 6000        | 8000         | ohms     |
| Total Harmonic Distortion        | 10    | 10       | 9           | 10           | per cent |
| Maximum-Signal Power Output      | 2.8   | 3.6      | 3           | 3.8          | watts    |

#### **MAXIMUM CIRCUIT VALUES:**

| Grid-No.1-Circuit Resistance: |         | _      |
|-------------------------------|---------|--------|
| For fixed-bias operation      | 0.1 max |        |
| For cathode-bias operation    | 1.0 max | megohm |



### **BEAM POWER TUBE**

Miniature type used as a vertical-deflection-amplifier tube in television receivers employing 110-degree picture-tube systems. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be operated

6DI5
Related type
12DT5

in any position. Type 12DT5 is identical with type 6DT5 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average)                                                               | 6DT5<br>6.3<br>1.2 | 12DT5<br>12.6<br>0.6<br>11 | volts<br>ampere<br>seconds |
|-----------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------|----------------------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode  Transconductance* | 200 max<br>200*max | 200 max<br>2004max<br>6200 | volts<br>volts<br>μmhos    |

<sup>&</sup>lt;sup>▲</sup> The dc component must not exceed 100 volts.

#### **Vertical-Deflection Amplifier**

For operation in a 525-line, 30-frame system

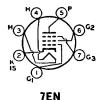
| MAXIMUM RATINGS (Design-Maximum Values):             |          |       |
|------------------------------------------------------|----------|-------|
| DC Plate Voltage                                     | 315 max  | volts |
| Peak Positive-Pulse Plate Voltage#                   | 2200 max | volts |
| Grid-No.2 (Screen-Grid) Voltage                      | 285 max  | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage | -250 max | volts |
| Peak Cathode Current                                 | 190 max  | mA    |
| Average Cathode Current                              | 55 max   | mA    |
| Plate Dissipation                                    | 9 max    | watts |
| Grid-No.2 Input                                      |          | watts |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance: For fixed-bias operation

For fixed-bias operation ... 0.5 max megohm
For cathode-bias operation ... 1 max megohm

#The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.



# SHARP-CUTOFF PENTODE

Miniature type used as FM detector in television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Types 3DT6A and 4DT6A are identical with

6DT6A
Related types:
3DT6A, 4DT6A

type 6DT6A except for the heater ratings, as shown below.

|                                         | 3DT6A    | 4DT6A     | 6DT6A            |         |
|-----------------------------------------|----------|-----------|------------------|---------|
| Heater Voltage (ac/dc)                  | 3.15     | 4.2       | 6.3              | volts   |
| Heater Current                          | 0.6      | 0.45      | 0.3              | ampere  |
| Heater Warm-up Time (Average)           | 11       | 11        | -                | seconds |
| Peak Heater-Cathode Voltage:            |          |           |                  |         |
| Heater negative with respect to cathode | 200 ma   | x 200 max | 200 max          | volts   |
| Heater positive with respect to cathode | 200 • ma | x 200 max | 200 <b>•</b> max | volts   |

<sup>•</sup> For plate and grid-No.2 volts, 250; grid-No.1 volts, -16.5; plate mA, 44; grid-No.2 mA, 1.5.

volts

volts

| Direct Interelectrode Capacitances (Approx.)*                    |      |    |
|------------------------------------------------------------------|------|----|
| Grid No.1 to Plate                                               | 0.02 | pF |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal |      | •  |
| Shield                                                           | 5.8  | pF |
| Grid No.3 to Plate                                               | 1.7  | pF |
| Grid No.1 to Grid No.3                                           | 0.1  | pF |
| Grid No.3 to Cathode, Heater, Grid No.1, Grid No.2, and Internal | 6.1  | pF |
| Shield                                                           |      |    |

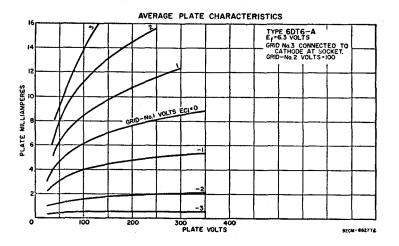
<sup>•</sup> The dc component must not exceed 100 volts.

### Class A, Amplifier

| CHARACTERISTICS:                       |          |              |
|----------------------------------------|----------|--------------|
| Plate Supply Voltage                   | <br>150  | volts        |
| Grid No.3 (Suppressor-Grid)            |          | le at socket |
| Grid-No.2 (Screen-Grid) Supply Voltage |          | volts        |
| Cathode-Bias Resistor                  |          | ohms         |
| Plate Resistance (Approx.)             |          | megohm       |
| Transconductance, Grid No.1 to Plate   | 1350     | μmhos        |
| Transconductance, Grid No.3 to Plate   | 515      | μmhos        |
| Plate Current                          | <br>1.55 | mA           |
| Grid-No 2 Current                      | 10       | m A          |

Grid-No.1 Voltage (Approx.) for plate current of 10  $\mu$ A ......

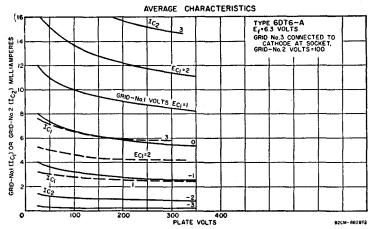
Grid-No.3 Voltage (Approx.) for plate current of 10 µA .....



#### **FM** Detector

| MAXIMUM RATINGS (Design-Maximum Values):              |                   |
|-------------------------------------------------------|-------------------|
| Plate Voltage                                         | 330 max volts     |
| Grid-No.3 Voltage                                     | 28 max volts      |
| Grid-No.2 Supply Voltage                              | 330 max volts     |
| Grid-No.2 Voltage                                     | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max volts       |
| Plate Dissipation                                     | 1.7 max watts     |
| Grid-No.2 Input:                                      |                   |
| For grid-No.2 voltages up to 165 volts                | 1.1 max watts     |
| For grid-No.2 voltages between 165 and 330 volts      | See curve page 80 |
| MAXIMUM CIRCUIT VALUES:                               |                   |
| Grid-No.1-Circuit Resistance:                         |                   |
| For fixed-bias operation                              | 0.25 max megohm   |
| For cathode-bias operation                            | 0.5 max megohm    |

<sup>\*</sup> External shield connected to cathode.





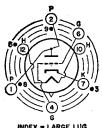
# HIGH-MU TWIN TRIODE

Miniature type used in a wide variety of applications in radio and television receivers. Especially useful in pushpull rf amplifiers or as frequency converter in FM tuners. Outline 6B. Outlines section. Tube requires min-

Related type: 12DT8

iature nine-contact socket and may be mounted in any position. Type 12DT8 is identical with type 6DT8 except for the heater ratings. Except for heater and heater-cathode ratings, interelectrode capacitances, and basing arrangement, these types are identical with miniature type 12AT7.

| typos wie teeminen with mining type manner type         | 6DT8      | 12DT8        |        |
|---------------------------------------------------------|-----------|--------------|--------|
| Heater Voltage (ac/dc)                                  | 6.3       | 12.6         | volts  |
| Heater Current                                          | 0.3       | 0.15         | ampere |
| Peak Heater-Cathode Voltage:                            |           |              |        |
| Heater negative with respect to cathode                 | 200 max   | 200 max      | volts  |
| Heater positive with respect to cathode                 | 200 max   | 200 • max    | volts  |
| Direct Interelectrode Capacitances (Approx., Each Unit  | Except as |              |        |
| Noted):                                                 |           |              |        |
| Grid to Plate                                           |           | 1.6*         | рF     |
| Grid to Cathode, Heater, and Internal Shield            |           | 2.7*         | рF     |
| Plate to Cathode, Heater, and Internal Shield           |           | 1.6*         | рF     |
| Heater to Cathode                                       |           | 3∙           | рF     |
| Cathode to Grid, Heater, and Internal Shield (Unit No.2 | 3)        | <b>5.</b> 3† | pF     |
| Plate to Grid, Heater, and Internal Shield (Unit No.2)  |           | 2.8†         | pF     |
|                                                         |           |              |        |



INDEX = LARGE LUG

- \* The dc component must not exceed 100 volts.
- With external shield connected to grid of unit under test.
- With external shield connected to ground.
- \* With external shield connected to cathode of unit under test.

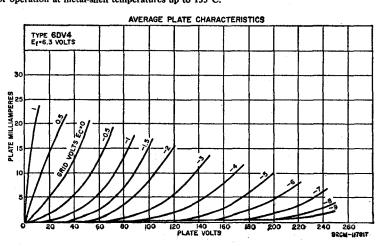
#### HIGH-MU TRIODE

Nuvistor type used at frequencies up to 1000 megacycles in uhf oscillator stages of television receivers. Outline 1, Outlines section. Tube requires nuvistor socket and may be mounted in any position. Type 2DV4 is identical

6DV4 Related type: 2DV4

with type 6DV4 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average) Peak Heater-Cathode Voltage:                                                            | 2DV4<br>2.1<br>0.45<br>8 | 6DV4<br>6.3<br>0.135                    | volts<br>ampere<br>seconds         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------------------|------------------------------------|
| Heater negative with respect to cathode                                                                                                                     | 100 max<br>100 max       | 100 max<br>100 max                      | volts<br>volts                     |
| Grid to Plate Grid to Cathode, Heater, and Shell Plate to Cathode, Heater, and Shell Plate to Cathode Heater to Cathode Grid to Cathode                     |                          | 1.8<br>4.4<br>1.9<br>0.25<br>1.4<br>3.7 | pF<br>pF<br>pF<br>pF<br>pr         |
| Class A, Amplifier                                                                                                                                          |                          |                                         |                                    |
| MAXIMUM RATINGS (Design-Maximum Values): Plate Supply Voltage Plate Voltage Grid Voltage:                                                                   |                          | 300 max<br>125 max                      | volts<br>volts                     |
| Negative-bias value Peak positive value Plate Dissipation Cathode Current                                                                                   |                          | -55 max<br>2 max<br>1 max<br>15 max     | volts<br>volts<br>watt<br>mA       |
| CHARACTERISTICS: Plate Supply Voltage                                                                                                                       |                          | 75                                      | volts                              |
| Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.)                                                                                       |                          | 100<br>35                               | ohms                               |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A                                                                                                      |                          | 3100<br>11500<br>—7                     | ohms<br>µmhos<br>volts             |
| Plate Current  TYPICAL OPERATION AS OSCILLATOR AT 950 Mc/s:                                                                                                 | ••••••                   | 10.5                                    | mA                                 |
| Plate Voltage Grid Voltage Grid Resistor Plate Current Grid Current                                                                                         |                          | 60<br>2<br>5600<br>8<br>350             | volts<br>volts<br>ohms<br>mA<br>µA |
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance: For fixed-bias operation For cathode-bias operation For operation at metal-shell temperatures up to 135°C. |                          | 0.1 max<br>0.2 max                      |                                    |





# HALF-WAVE VACUUM RECTIFIER

Novar types used as damper tubes in horizontal-deflection circuits of color and black-and-white television receivers. Outlines 11D and 30B, respectively, Outlines section. Tubes require novar nine-contact socket and may be

# 6DW4 6DW4B

mounted in any position. Socket terminals 1, 3, 6, and 8 should not be used as tie points; it is recommended that socket clips for these pins be removed to reduce the possibility of arc-over and to minimize leakage. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated.

| Heater Voltage (ac/dc)                          | 6.3      | volts   |
|-------------------------------------------------|----------|---------|
| Heater Current                                  | 1.2      | amperes |
| Direct Interelectrode Capacitances (Approx.):   |          |         |
| Plate to Cathode and Heater:                    | 6.5      | рF      |
| Cathode to Plate and Heater                     | 9 .      | pF      |
| Heater to Cathode                               | 2.8      | pF      |
| Damper Service                                  |          |         |
| For operation in a 525-line, 30-frame system    |          |         |
| MAXIMUM RATINGS (Design-Maximum Values):        |          |         |
| Peak Inverse Plate Voltage <sup>o</sup> (6DW4)  | 5000 max | volts   |
|                                                 |          |         |
| Peak Inverse Plate Voltage <sup>o</sup> (6DW4B) | 5000 max | volts   |
| Peak Plate Current                              | 1300 max | mA      |
| DC Plate Current                                | 250 max  | mA      |
| Plate Dissipation                               | 8.5 max  | watts   |
| Peak Heater-Cathode Voltage:                    |          |         |
| Heater negative with respect to cathode         | 5000 max | volts   |
|                                                 | 300°max  | volts   |
| Heater positive with respect to cathode         | 300°max  | VOILS   |
| CHARACTERISTICS, Instantaneous Value:           |          |         |
| Tube Voltage Drop for plate current of 350 mA   | 25       | volts   |

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- The dc component must not exceed 900 volts.
  The dc component must not exceed 100 volts.



### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in television-receiver applications. The triode unit is used as a sync-separator, sync-amplifier, keyed-agc, or noise-suppressor tube. The pentode unit is used as a video-output tube. Outline 6E, Out-

6DX8
Related type:

10040

lines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 10DX8 is identical with type 6DX8 except for the heater ratings, as shown below.

KINVO

| Heater Voltage (ac/dc)                  | 6.3<br>0.72 | 10.2<br>0.45 | volts<br>ampere |
|-----------------------------------------|-------------|--------------|-----------------|
| Peak Heater-Cathode Voltage:            | ****        |              |                 |
| Heater negative with respect to cathode | 200 max     | 200 max      | volts           |
| Heater positive with respect to cathode | 200 max     | 200 max      | volts           |
| Class A <sub>1</sub> Amplifier          |             |              |                 |
|                                         | Triode      | Pentode      |                 |
| MAXIMUM RATINGS (Design-Center Values): | Unit        | Unit         |                 |
| Plate Supply Voltage                    | 550 max     | 550 max      | volts           |

| Peak Plate Voltage, with maximum pla     | te cur      | rent of  | •      |                      |             |       |         |
|------------------------------------------|-------------|----------|--------|----------------------|-------------|-------|---------|
| 0.1 mA                                   |             |          |        | 600 max              | _           |       | volts   |
| Plate Voltage                            |             |          |        | 300 max              | 300         | max   | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage   |             |          |        |                      | 550         | max   | volts   |
| Grid-No.2 Voltage                        |             |          |        | _                    | 300         | max   | volts   |
| Cathode Current                          |             |          |        | 12 max               | 40          | max   | mA      |
| Grid-No.2 Input                          | <b></b>     |          |        |                      |             | max   | watts   |
| Plate Dissipation                        | • • • • • • |          |        | 1 max                |             | max   | watts   |
|                                          | Triode      |          |        |                      |             |       |         |
| CHARACTERISTICS:                         | Unit        |          |        | Pentode I            | Jnit        |       |         |
| Plate Voltage                            | 200         |          | 170    | 200                  | 220         |       | volts   |
| Grid-No.2 Voltage                        | -           |          | 170    | 200                  | 220         |       | volts   |
| Grid-No.1 Voltage                        | -1.7        |          | -2.1   | -2.9                 | -3.4        |       | volts   |
| Amplification Factor                     | 65          |          |        |                      | -           |       | , , , , |
| Mu-Factor, Grid-No.2 to Grid-No.1        | _           |          | 36     | 36                   | 36          |       |         |
| Plate Resistance (Approx.)               | _           |          | 0.1    | 0.13                 | 0.15        |       | megohm  |
| Fransconductance                         | 4000        |          | 11000  | 10400                | 10000       |       | µmhos   |
| Plate Current                            | 3           |          | 18     | 18                   | 18          |       | mA      |
| Grid-No.2 Current                        | _           |          | 3      | 3                    | 3           |       | mA      |
| TYPICAL OPERATION OF PENTODE             | INTER A     | A G T/TV | PA A   | i inclusi inc nes    | 10 <b>.</b> |       |         |
| Plate Supply Voltage                     | OTABE 1     | 170      | EU U   | 200                  | 220         |       | volts   |
| Series Plate Resistor                    |             | 3000     |        | 3000                 | 3000        |       | ohms    |
| Grid-No.2 Voltage                        |             | 170      | -      | 200                  | 220         |       | volts   |
| Grid-No.1 Voltage                        |             | -2       | _      | -2.8                 | -3.3        |       | volts   |
| Transconductance                         |             | 10400    |        | 000                  | 9700        |       | μmhos   |
| Plate Current                            |             | 18       |        | 18                   | 18          |       | mΑ      |
| Grid-No.2 Current                        |             | 3.2      |        | 3.1                  | 3.1         |       | mA      |
| MAXIMUM CIRCUIT VALUES:                  |             |          |        |                      |             |       |         |
| Grid-No.1-Circuit Resistance:            |             |          |        | Triode Uni           | Danta       | I. T. | -14     |
| For fixed-bias operation                 |             |          |        | i riode Uni<br>1 max |             |       |         |
| For cathode-bias operation               |             |          |        |                      |             |       | megohm  |
|                                          |             |          |        | 3 max                |             |       | megohms |
| * With maximum duty factor of 0.18 and n | naximui     | n pulse  | durati | on of 18 m           | icrosecon   | 18.   |         |

# **MEDIUM-MU TRIODE**

6DZ4
Related types: 2DZ4, 3DZ4

Miniature type used as a local-oscillator tube in uhf television receivers covering the frequency range from 470 to 890 megacycles. Outline 5B, Outlines section. Tube requires miniature seven-contact socket and may be



7DK

mounted in any position. For curve of average plate characteristics, refer to type 6AF4A. Types 2DZ4 and 3DZ4 are identical with type 6DZ4 except for the heater ratings, as shown below.

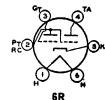
|                                               | 2DZ4    | 3 <b>DZ4</b> | 6DZ4  |         |
|-----------------------------------------------|---------|--------------|-------|---------|
| Heater Voltage (ac/dc)                        | 2.35    | 3.2          | 6.3   | volts   |
| Heater Current                                | 0.6     | 0.45         | 0.225 | ampere  |
| Heater Warm-up Time (Average)                 | 11      | 11           | _     | seconds |
| Peak Heater-Cathode Voltage:                  |         |              |       |         |
| Heater negative with respect to cathode       | 180 max | 180 max      | 50    | volts   |
| Heater positive with respect to cathode       | 180°max | 180*max      | 50=   | volts   |
| Direct Interelectrode Capacitances (Approx.): |         |              |       |         |
| Grid to Plate                                 | <i></i> |              | 1.8   | pF      |
| Grid to Cathode and Heater                    |         |              | 2.2   | pF      |
| Plate to Cathode and Heater                   |         |              | 1.3   | pF      |
|                                               |         |              |       |         |

- \* The dc component must not exceed 100 volts.
- The dc component must not exceed 25 volts.
- \* With external shield connected to cathode.

#### Class A, Amplifier

| CHARACTERISTICS:     |      |       |
|----------------------|------|-------|
| Plate Supply Voltage | 80   | volts |
| Plate Resistor       | 2700 | ohms  |
| Amplification Factor | 14   |       |

| Plate Resistance (Approx.)  Transconductance  Plate Current  Grid Voltage (Approx.) for plate current of 20 µA | 2000<br>6700<br>15<br>—11 | ohms<br>µmhos<br>mA<br>volts |
|----------------------------------------------------------------------------------------------------------------|---------------------------|------------------------------|
| UHF Oscillator                                                                                                 |                           |                              |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                       |                           |                              |
| Plate Voltage                                                                                                  | 135 ma                    | x volts                      |
| Grid Voltage. Negative-bias value                                                                              | —50 ma                    | x volts                      |
| Grid Current                                                                                                   | 2 ma                      | k mA                         |
| Cathode Current                                                                                                | 20 ma                     | x mA                         |
| Plate Dissipation                                                                                              | 2.3 ma                    | x watts                      |
| TYPICAL OPERATION AS OSCILLATOR AT 1000 Mc/s:                                                                  |                           |                              |
| Plate Supply Voltage                                                                                           | 135                       | volts                        |
| Plate-Circuit Resistance                                                                                       | 2700                      | ohms                         |
| Grid Resistor                                                                                                  | 10000                     | ohms                         |
| Plate Current                                                                                                  | 15.5                      | mA                           |
| Grid Current (Approx.)                                                                                         | 800                       | μΑ                           |
| MAXIMUM CIRCUIT VALUES:                                                                                        |                           |                              |
| Grid-Circuit Resistance:                                                                                       |                           |                              |
| For fixed-bias operation                                                                                       | Not rec                   | commended                    |
| For cathode-bias operation                                                                                     |                           | x megohm                     |



#### **ELECTRON-RAY TUBE**

Glass type used to indicate visually by means of a fluorescent target the effects of a change in a controlling voltage. It is used as a convenient means of indicating accurate radio-receiver tuning. Outline 13H, Outlines

**6E5** 

section. Tube requires six-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.3. For additional considerations, refer to Tuning Indication with Electron-Ray Tubes in Electron Tube Applications section.

Tuning Indicator MAXIMUM AND MINIMUM RATINGS (Design-Center Values): Plate-Supply Voltage ..... 250 max volts [250 max volte Target Voltage ..... 125 min volts TYPICAL OPERATION: Plate and Target Supply Voltage ..... 200 250 volts Series Triode-Plate Resistor ..... 1 megohm Target Current\*† mA Triode-Plate Current\* 0.19 0.24 mA Triode-Grid Voltage (Approx.): For shadow angle of 0° -8.0volts For shadow angle of 90° volts \* For zero triode-grid voltage. † Subject to wide variations.



# SHARP-CUTOFF TETRODE

Miniature type used as rf amplifier in vhf tuners of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be operated in any position. Type 3EA5 is identical with type

6EA5 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) | 2.9 |
| Heater Current | 0.45 |
| Heater Warm-up Time (Average) | 11 |

6EA5
Related type: 3EA5

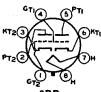
6EA5
6.3 volts
0.2 ampere
seconds

| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode  Direct Interelectrode Capacitances:  Grid No.1 to Plate  Grid No.1 to Cathode, Heater, Grid No.2, and | 200 max<br>200*max<br>Without<br>External<br>Shield<br>0.06 max | 200 max<br>200=max<br>With<br>External<br>Shield°<br>0.05 max |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|--------|
| Internal Shield                                                                                                                                                                                                       | 3.8                                                             | 4.5                                                           | pF     |
| Plate to Cathode, Heater, Grid No.2, and<br>Internal Shield                                                                                                                                                           | 2.3                                                             | 3                                                             | pF     |
| <ul> <li>The dc component must not exceed 100 volts.</li> <li>With external shield connected to cathode.</li> </ul>                                                                                                   |                                                                 |                                                               |        |
| Class A, Amplifier MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                           | r .                                                             |                                                               |        |
| Plate Voltage                                                                                                                                                                                                         |                                                                 | 250 max                                                       | volts  |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                       |                                                                 | 150 max                                                       | volts  |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                                                 |                                                                 | 0 max                                                         | volts  |
| Cathode Current                                                                                                                                                                                                       |                                                                 | 20 max                                                        | mA     |
| Grid-No.2 Input                                                                                                                                                                                                       |                                                                 | 0.5 max                                                       | watt   |
| Plate Dissipation                                                                                                                                                                                                     |                                                                 | 3.25 max                                                      | watts  |
| CHARACTERISTICS:                                                                                                                                                                                                      |                                                                 |                                                               |        |
| Plate Voltage                                                                                                                                                                                                         |                                                                 | 250                                                           | volts  |
| Grid-No.2 Voltage                                                                                                                                                                                                     |                                                                 | 140                                                           | volts  |
| Grid-No.1 Voltage                                                                                                                                                                                                     |                                                                 | -1                                                            | volt   |
| Plate Resistance (Approx.)                                                                                                                                                                                            |                                                                 | 0.15                                                          | megohm |
| Transconductance                                                                                                                                                                                                      |                                                                 | 8000                                                          | µmhos  |
| Plate Current                                                                                                                                                                                                         |                                                                 | 10                                                            | mA     |
| Grid-No.2 Current                                                                                                                                                                                                     |                                                                 | 0.95                                                          | mA     |
| Grid-No.1 Voltage (Approx.) for transconductance of 100                                                                                                                                                               |                                                                 |                                                               |        |
| or less                                                                                                                                                                                                               |                                                                 | 6                                                             | volts  |

# **DUAL TRIODE**

# **6EA7**

Glass octal type containing high-mu triode and high-perveance, low-mu triode in same envelope. Used as a prace combined vertical deflection oscillator and vertical deflection amplifier in television receivers. Outline 13B, Out-



8BD

lines section. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 1.05; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

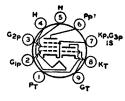
| Class A, Amplifie                | <b>)</b> [ |      |        |       |
|----------------------------------|------------|------|--------|-------|
| CHARACTERISTICS:                 | Unit No.1  | Uni  | t No.2 | 2     |
| Plate Voltage                    | 250        | 60   | 175    | volts |
| Grid Voltage                     | -3         | 0    | -25    | volts |
| Amplification Factor             | 66         | _    | 5.5    |       |
| Plate Resistance (Approx.)       | 30000      | _    | 920    | ohms  |
| Transconductance                 | 2200       | _    | 6000   | μmhos |
| Grid Voltage (Approx.):          |            |      |        |       |
| For plate current of 20 µA       | -5.3       | _    | _      | volts |
| For plate current of 200 $\mu$ A | _          | -    | 45     | volts |
| Plate Current                    | 2          | 100• | 40     | mA    |
| - mark                           |            |      |        |       |

• This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Vertical-Deflection Oscillator and Amplifier For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): | Oscillator | Amplifier |       |
|------------------------------------------|------------|-----------|-------|
| DC Plate Voltage                         | 350 max    | 550 max   | volts |
| Peak Positive-Pulse Plate Voltage°       | _          | 1500 max  | volts |

|                                                            | Unit No.1<br>Oscillator | Unit No.2<br>Amplifier |           |
|------------------------------------------------------------|-------------------------|------------------------|-----------|
| Peak Negative-Pulse Grid Voltage                           | 400 max                 | -250 max               | volts     |
| Peak Cathode Current                                       | _                       | 175 max                | mA        |
| Average Cathode Current                                    | _                       | 50 max                 | mA        |
| Plate Dissipation                                          | 1 max                   | 10 max                 | watts     |
| MAXIMUM CIRCUIT VALUES:                                    |                         |                        |           |
| Grid-Circuit Resistance:                                   |                         |                        |           |
| For grid-resistor-bias operation                           | 1 max                   | 1 max                  | megohm    |
| For cathode-bias operation                                 | 2.2 max                 | 2.2 max                | megohms   |
| The duration of the voltage pulse must not exceed 15 per   | r cent of one           | vertical scanni        | ng cycle. |
| In a 525-line, 30-frame system, 15 per cent of one vertice |                         |                        |           |



# MEDIUM-MU TRIODE-SHARP-CUTOFF PENTODE

Miniature type used as combined oscillator and mixer in television receivers utilizing an intermediate frequency in the order of 40 megacycles per Related types: second. Outline 6B, Outlines section. Related types:

Related types:

Tube requires miniature nine-contact

socket and may be mounted in any position. Types 5EA8, 9EA8, and 19EA8 are identical with type 6EA8 except for the heater ratings, as shown below.

|                                        | 5EA8         | 6EA8      | 9EA8      | 19EA8    |         |
|----------------------------------------|--------------|-----------|-----------|----------|---------|
| Heater Voltage (ac/dc)                 | 4.7          | 6.3       | 9.5       | 18.9     | volts   |
| Heater Current                         | 0.6          | 0.45      | 0.3       | 0.15     | ampere  |
| Heater Warm-up Time (Average)          | 11           | 11        | 11        | 11       | seconds |
| Peak Heater-Cathode Voltage:           |              |           |           |          |         |
| Heater negative with respect           |              |           |           |          |         |
| to cathode                             | 200 m        | ax 200 ma | x 200 max | 200 max  | volts   |
| Heater positive with respect           |              |           |           |          |         |
| to cathode                             | 200°m        | x 200°ma  | x 200°max | 200•max  | volts   |
|                                        |              |           | Without   | With     |         |
| Direct Interelectrode Capacitances:    |              |           | External  | External |         |
| Triode Unit:                           |              |           | Shield    | Shield*  |         |
| Grid to Plate                          |              |           | 1.7       | 1.7      | рF      |
| Grid to Cathode, Heater, Pentode (     | Cathode.     |           |           |          |         |
| Pentode Grid No.3, and Internal        |              |           | 3         | 3.2      | рF      |
| Plate to Cathode, Heater, Pentode (    |              |           |           |          |         |
| Pentode Grid No.3, and Internal        | Shield .     |           | 1.4       | 1.9      | рF      |
| Cathode to Heater                      | <b>.</b>     |           | 3         | 3■       | рF      |
| Pentode Unit:                          |              |           |           |          |         |
| Grid No.1 to Plate                     | <b></b>      |           | 0.02 max  | 0.01 max | рF      |
| Grid No.1 to Cathode, Heater, Grid     | No.2,        |           |           |          |         |
| Grid No.3, and Internal Shield         | <del>.</del> |           | 5         | 5        | рF      |
| Plate to Cathode, Heater, Grid No.2,   | Grid No      | 0.3,      |           |          |         |
| and Internal Shield                    |              |           | 2.6       | 3.4      | pF      |
| Heater to Cathode                      | <b></b>      |           | 3         | 3•       | pF      |
| • The dc component must not exceed 100 | volte.       |           |           |          |         |

The dc component must not exceed 100 volts.

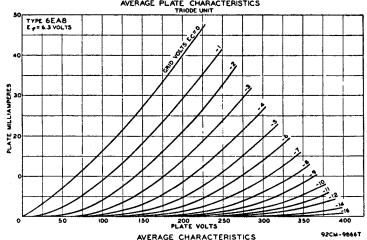
#### Class A, Amplifier

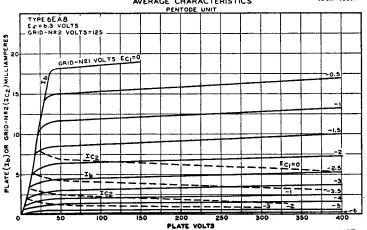
|                                                         | Triode      | Pentode   |         |
|---------------------------------------------------------|-------------|-----------|---------|
| MAXIMUM RATINGS (Design-Maximum Values):                | Unit        | Unit      |         |
| Plate Voltage                                           | 330 max     | 330 max   | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                  | · —         | 330 max   | volts   |
| Grid-No.2 Voltage                                       | _           | See curve | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value . | 0 max       | 0 max     | volts   |
| Plate Dissipation                                       | 2.5 max     | 3.1 max   | watts   |
| Grid-No.2 Input:                                        |             |           |         |
| For grid-No.2 voltages up to 165 volts                  |             | 0.55 max  | watt    |
| For grid-No.2 voltages between 165 and 330 volts.       |             | See curve | page 80 |
| CHARACTERISTICS:                                        |             |           |         |
| Plate Supply Voltage                                    | 150         | 125       | volts   |
| Grid-No.2 Voltage                                       | <del></del> | 125       | volts   |

With external shield connected to cathode of unit under test except as noted.

With external shield connected to ground.

|                                              | Triod <b>e</b><br>Unit | Pentode<br>Unit |       |
|----------------------------------------------|------------------------|-----------------|-------|
| Grid-No.1 Voltage                            | _                      | -1              | volt  |
| Cathode-Bias Resistor                        | 56                     |                 | ohms  |
| Amplification Factor                         | 40                     |                 |       |
| Plate Resistance (Approx.)                   | 5000                   | 200000          | ohms  |
| Transconductance                             | 8500                   | 6400            | umhos |
| Plate Current                                | 18                     | 12              | mA    |
| Grid-No.2 Current                            |                        | 4               | mA    |
| Grid-No.1 Voltage for plate current of 10 µA | -12                    | -9              | volts |
| AVERAGE DI ATE CHARACTER                     | ISTICS                 | -               |       |

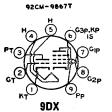




# HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

6EB8
Related type: 8EB8

Miniature type used in color and black-and-white television receivers. Pentode unit is used as video output amplifier; triode unit is used in syncseparator, sync-clipper, and phase-inverter circuits. Outline 6E, **Outlines** 



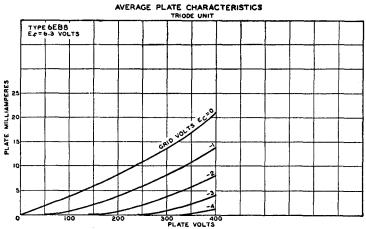
section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 8EB8 is identical with type 6EB8 except for the heater ratings, as shown below.

|                                                    | 6EB8    | 8EB8      |         |
|----------------------------------------------------|---------|-----------|---------|
| Heater Voltage (ac/dc)                             | 6.3     | 8         | volts   |
| Heater Current                                     | 0.75    | 0.6       | ampere  |
| Heater Warm-up Time (Average)                      | _       | 11        | seconds |
| Peak Heater-Cathode Voltage:                       |         |           |         |
| Heater negative with respect to cathode            | 200 max | 200 max   | volts   |
| Heater positive with respect to cathode            | 200°max | 200°max   | volts   |
| Direct Interelectrode Capacitances:                |         |           |         |
| Triode Unit:                                       |         | 4.4       | pF      |
| Grid to Plate                                      |         | 2.4       | pF      |
| Grid to Cathode and Heater                         |         | 0.36      | pF      |
| Plate to Cathode and Heater                        |         |           | _       |
| Pentode Unit:                                      |         |           |         |
| Grid No.1 to Plate                                 |         | 0.1 max   | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3 |         |           | -       |
| Internal Shield                                    |         | 11        | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, an |         |           | _       |
| Internal Shield                                    |         | 4.2       | pF      |
| Triode Grid to Pentode Plate                       |         | 0.018 max | pF      |
| Pentode Grid No.1 to Triode Plate                  |         | 0.005 max | pF      |
| Pentode Plate to Triode Plate                      |         | 0.17 max  | рF      |
|                                                    |         |           | _       |

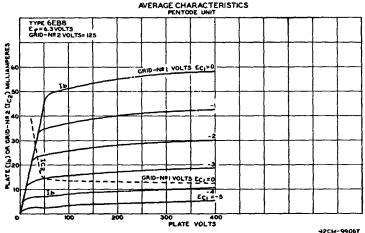
<sup>\*</sup> The dc component must not exceed 100 volts.

# Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Disispation Grid-No.2 Input: For grid-No.2 voltages up to 165 volts For grid-No.2 voltages between 165 and 330 volts | Triode Unit 330 max — 0 max 1 max — | Pentode Unit 330 max 330 max See curve 0 max 5 max  1.1 max See curve | volts<br>watts<br>watts         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------|---------------------------------|
| CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Grid Voltage Cathode-Bias Resistor Amplification Factor                                                                                                                                                         | 250<br>                             | 200<br>125<br>—<br>68                                                 | volts<br>volts<br>volts<br>ohms |



| Plate Resistance (Approx.)                             | 37000<br>2700 | 75000<br>12500 | ohms<br>umhos |
|--------------------------------------------------------|---------------|----------------|---------------|
| Grid Voltage (Approx.) for plate current of 20 $\mu$ A | 5             | -              | volts         |
| Grid-No. 1 Voltage (Approx.) for plate current of      |               | _              |               |
| 100 μΑ                                                 |               | <b>_9</b>      | volts         |
| Plate Current                                          | 2             | 25             | mA            |
| Grid-No.2 Current                                      | _             | 7              | mA            |
| MAXIMUM CIRCUIT VALUES:                                |               |                |               |
| Grid-No.1-Circuit Resistance:                          |               |                | _             |
| For fixed-bias operation                               | 0.5 max       |                | ax megohm     |
| For cathode-bias operation                             | 1.0 max       | 1.0 m          | ax megohm     |
|                                                        |               |                |               |



### **POWER PENTODE**

6EH5
Related types:
12EH5, 25EH5, 50EH5

Miniature type used in the audio output stage of radio and television receivers and in phonographs. This type has unusually high power sensitivity and is capable of providing relatively high power output at low plate and #@ @GI #@ #@ Oc2 #@ ## Oc2

7CV

screen-grid voltages with a low af grid-No. 1 driving voltage. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Types 12EH5, 25EH5, and 50EH5 are identical with type 6EH5 except for the heater ratings, as shown below.

| <del>-</del> -                            | 6EH5       | 12EH5     | 25EH5    | 50EH5   |         |
|-------------------------------------------|------------|-----------|----------|---------|---------|
| Heater Voltage (ac/dc)                    | 6.3        | 12.6      | 25       | 50      | volts   |
| Heater Current                            |            | 0.6       | 0.3      | 0.15    | ampere  |
| Heater Warm-up Time (Average)             | _          | 11        |          |         | seconds |
| Peak Heater-Cathode Voltage:              |            |           |          |         |         |
| Heater negative with respect              |            |           |          |         |         |
| to cathode                                | 200 max    | 300 max   | 200 max  | 200 max | volts   |
| Heater positive with respect              |            |           |          |         |         |
| to cathode                                | 200=max    | 200 max   | 200=max  | 200=max | volts   |
| Direct Interelectrode Capacitances (Appro | ox.):      |           |          |         | _       |
| Grid No.1 to Plate                        |            |           |          | 0.65    | pF      |
| Grid No.1 to Cathode, Heater, Grid        | No.2, an   | d Grid No | .3       | 17      | pF      |
| Plate to Cathode, Heater, Grid No.2,      | , and Gric | 1 No.3    | <i>.</i> | 9       | pF      |
| 771 - 1 100                               | 14         |           |          |         |         |

■ The dc component must not exceed 100 volts.

| Glass A, Ampinier                        |         |       |
|------------------------------------------|---------|-------|
| MAXIMUM RATINGS (Design-Maximum Values): | 450     | volts |
| Plate Voltage                            | 150 max | volts |
| Grid-No.2 (Screen-Grid) Voltage          | 130 max | VOIES |

Amplifier

| Plate Dissipation<br>Grid-No.2 Input | 5.5 max<br>2 max | watts    |
|--------------------------------------|------------------|----------|
| Bulb Temperature (at hottest point)  | 220 max          | °C       |
| TYPICAL OPERATION:                   |                  |          |
| Plate Supply Voltage                 | 110              | volts    |
| Grid-No.2 Supply Voltage             | 115              | volts    |
| Cathode-Bias Resistor                | 62               | ohms     |
| Peak AF Grid-No.1 Voltage            | 3                | volts    |
| Zero-Signal Plate Current            | 42               | mA       |
| Maximum-Signal Plate Current         | 42               | mA       |
| Zero-Signal Grid-No.2 Current        | 11.5             | mA       |
| Maximum-Signal Grid-No.2 Current     | 14.5             | mA       |
| Plate Resistance (Approx.)           | 11000            | ohms     |
| Transconductance                     | 14600            | μmhos    |
| Load Resistance                      | 3000             | ohms     |
| Total Harmonic Distortion            | 7                | per cent |
| Maximum-Signal Power Output          | 1.4              | watts    |
| MAXIMUM CIRCUIT VALUES:              |                  |          |
| Grid-No.1-Circuit Resistance:        |                  |          |
| For fixed-bias operation             | 01 max           | megohm   |
| For cathode-bias operation           |                  | megohm   |
|                                      | J.J IIIUA        | Bourn    |
|                                      |                  |          |

### Push-Pull Class AB, Audio-Frequency Power Amplifier

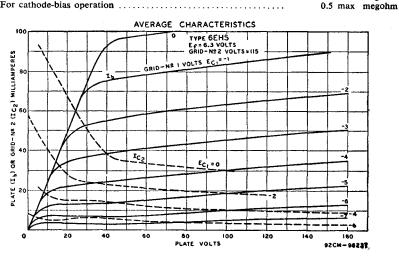
MAXIMUM RATINGS: (Same as for class A1 audio-frequency power amplifier)

#### TYPICAL OPERATION (Values are for 2 tubes):

| (. wides are for 2 tables).                |      |          |
|--------------------------------------------|------|----------|
| Plate Supply Voltage                       | 140  | volts    |
| Grid-No.2 Supply Voltage                   | 120  | volts    |
| Cathode-Bias Resistor                      | 68   | ohms     |
| Peak AF Grid-No.1 Voltage                  | 9.4  | volts    |
| Zero-Signal Plate Current                  | 47   | mA       |
| Maximum-Signal Plate Current               | 51   | mA       |
| Zero-Signal Grid-No.2 Current              | 11   | mA       |
| Maximum-Signal Grid-No.2 Current           | 17.7 | mA       |
| Effective Load Resistance (Plate-to-plate) | 6000 | ohms     |
| Total Harmonic Distortion                  | 5    | per cent |
| Maximum-Signal Power Output                | 3.8  | watts    |

#### **MAXIMUM CIRCUIT VALUES:**

| Grid-No.1-Circuit Resistance:    |         |        |
|----------------------------------|---------|--------|
| For fixed-bias operation         | 0.1 max | megohm |
| The seath and take a second to a |         |        |



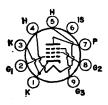
# 6EH7

# 6EH7/ EF183

Related types: 3EH7, 4EH7

# SEMIREMOTE-CUTOFF PENTODE

Miniature types used as if-amplifier tubes in television receivers. Outline 6C, Outlines section. Tubes require miniature nine-contact socket and may be mounted in any position. Types 3EH7 and 4EH7 are identical with



9AQ

types 6EH7 and 6EH7/EF183 except for the heater ratings, as shown below.

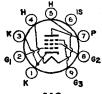
|             |                                                                                                                                                                    | 6EH7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                   |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
|             |                                                                                                                                                                    | 6EH7/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                   |
| 3EH7        | 4EH7                                                                                                                                                               | EF183                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                   |
| 3.4         |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | volts                                                                                                                                             |
| 0.6         | 0.45                                                                                                                                                               | 0.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ampere                                                                                                                                            |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   |
| 150 max     | 150 max                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | volt <b>s</b>                                                                                                                                     |
| 150 max     | 150 max                                                                                                                                                            | 150 max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | volts                                                                                                                                             |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   |
|             |                                                                                                                                                                    | 0.005 max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | p <b>F</b>                                                                                                                                        |
|             | nd .                                                                                                                                                               | _                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                   |
|             |                                                                                                                                                                    | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | pF                                                                                                                                                |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | _                                                                                                                                                 |
|             |                                                                                                                                                                    | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | pF                                                                                                                                                |
| Amulifiar   |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   |
|             |                                                                                                                                                                    | ***                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                   |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | volts                                                                                                                                             |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | mA                                                                                                                                                |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | watt                                                                                                                                              |
|             |                                                                                                                                                                    | 2.5 max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | watts                                                                                                                                             |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | _                                                                                                                                                 |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | volts                                                                                                                                             |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | volts                                                                                                                                             |
|             |                                                                                                                                                                    | _                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | volts                                                                                                                                             |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | megohm                                                                                                                                            |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | μmhos                                                                                                                                             |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | mA                                                                                                                                                |
|             | · · · · · · · · · · ·                                                                                                                                              | 4.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | mA                                                                                                                                                |
|             |                                                                                                                                                                    | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                   |
| 200         | 200                                                                                                                                                                | 200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | volts                                                                                                                                             |
| nected to c | athode at soc                                                                                                                                                      | :ket                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                   |
| 200         | 200                                                                                                                                                                | 200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | volts                                                                                                                                             |
| 22000       | 22000                                                                                                                                                              | 22000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ohms                                                                                                                                              |
| 9.5         | 6.5                                                                                                                                                                | -2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | volts                                                                                                                                             |
| 625         | 1250                                                                                                                                                               | 12500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | $\mu$ mhos                                                                                                                                        |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   |
| 160         | 100                                                                                                                                                                | _                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | mV                                                                                                                                                |
|             |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   |
|             |                                                                                                                                                                    | 1 max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | megohm                                                                                                                                            |
|             | 3.4<br>0.6<br>150 max<br>150 max<br>No.3, and<br>No.3, and<br>Amplifier:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>:<br>: | 3.4 4.4 0.6 0.45  150 max 150 | 3EH7 4EH7 EF183 3.4 4.4 6.3 0.6 0.45 0.3  150 max |

**6EJ7** 

# SHARP-CUTOFF PENTODE

6EJ7/ EF184

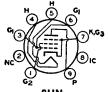
Related types: 3EJ7, 4EJ7 Miniature types used as if-amplifier tubes in television receivers. Outline 6C, Outlines section. Tubes require miniature nine-contact socket and may be mounted in any position. Types 3EJ7 and 4EJ7 are identical



9AQ

with types 6EJ7 and 6EJ7/EF184 except for the heater ratings, as shown below.

|                                             |           |              | 6EJ7            |           |
|---------------------------------------------|-----------|--------------|-----------------|-----------|
|                                             |           |              | 6EJ7/           |           |
|                                             | 3EJ7      | 4EJ7         | EF184           |           |
| Heater Voltage (ac/dc)                      | 3.4       | 4.4          | 6.3             | volts     |
| Heater Current Peak Heater-Cathode Voltage: | 0.6       | 0.45         | 0.3             | ampere    |
| Heater negative with respect to cathode     | 150 max   | 150 max      | 150 max         | volts     |
| Heater positive with respect to cathode     | 150 max   | 150 max      | 150 max         | volts     |
| Direct Interelectrode Capacitances:         |           |              |                 |           |
| Grid No.1 to Plate                          |           |              | 0.005 max       | pF        |
| Grid No.1 to Cathode, Heater, Grid No.2,    |           |              |                 | -         |
| Internal Shield                             |           |              | 10              | pF        |
| Plate to Cathode, Heater, Grid No.2, Grid N | lo.3. and |              |                 | ,-        |
| Internal Shield                             |           |              | 3               | pF        |
|                                             |           |              | -               | •         |
| _ · ·                                       |           |              |                 |           |
| Class A, A                                  | mplifier  |              |                 |           |
| MAXIMUM RATINGS (Design-Center Values):     |           |              |                 |           |
| Plate Supply Voltage                        |           |              | 550 max         | volts     |
| Plate Voltage                               |           |              | 250 max         | volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage      |           |              | 550 max         | volts     |
| Grid-No.2 Voltage                           |           |              | 250 max         | volts     |
| Cathode Current                             |           |              | 25 max          | mA        |
| Grid-No.2 Input                             |           |              | 0.9 max         |           |
| Plate Dissipation                           |           |              | 2.5 max         | watts     |
|                                             |           |              |                 |           |
| CHARACTERISTICS:                            |           |              |                 |           |
| Plate Voltage                               |           | 1 <b>9</b> 0 | 200             | volts     |
| Grid No.3                                   |           |              | cted to cathode | at socket |
| Grid-No.2 Voltage                           |           | 190          | 200             | volts     |
| Grid-No.1 Voltage                           |           | 2.35         | -2.5            | volts     |
| Plate Resistance (Approx.)                  |           | 0.35         | 0.35            | megohm    |
| Transconductance                            |           | 15000        | 15000           | μmhos     |
| Plate Current                               |           | 10           | 10              | mA        |
| Grid-No.2 Current                           |           | 4.1          | 4.1             | mA        |
| MAXIMUM CIRCUIT VALUES:                     |           |              |                 |           |
| Grid-No.1-Circuit Resistance                |           |              | 1 max           | megohm    |
|                                             |           |              |                 |           |



# **BEAM POWER TUBE**

flection amplifier in television receivers utilizing picture tubes having diagonal deflection angles of 110 degrees. Outline 6G, Outlines section.

6EM5
Related type:
8EM5

9HN Tube requires miniature nine-contact socket and may be mounted in any position. Type 8EM5 is identical with type

6EM5 except for the heater ratings, as shown below.

|                                                     | 6EM5      | 8EM5    |         |
|-----------------------------------------------------|-----------|---------|---------|
| Heater Voltage (ac/dc)                              | 6.3       | 8.4     | volts   |
| Heater Current                                      | 0.8       | 0.6     | ampere  |
| Heater Warm-up Time (Average)                       |           | 11      | seconds |
| Peak Heater-Cathode Voltage:                        |           |         |         |
| Heater negative with respect to cathode             | 200 max   | 200 max | volts   |
| Heater positive with respect to cathode             | 200 = max | 200 max | volts   |
| Direct Interelectrode Capacitances:                 |           |         |         |
| Gride No.1 to Plate                                 |           | 0.7 max | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid 1 | No.3      | 10      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3  |           | 5.1     | ρF      |
| Plate Resistance (Approx.)*                         |           | 0.05    | megohm  |
| Transconductance*                                   |           | 5100    | µmhos   |
| -                                                   |           |         | •       |

<sup>•</sup> The dc component must not exceed 100 volts.

<sup>\*</sup> For plate and grid-No.2 volts, 250; grid-No.1 volts, -18; plate mA, 40; grid-No.2 mA, 3.

#### **Vertical Deflection Amplifier**

For operation in a 525-line, 30-frame system

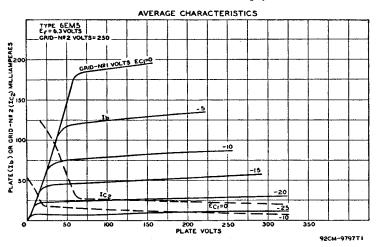
| MAXIMUM RATINGS (Design-Center Values):               |          |       |
|-------------------------------------------------------|----------|-------|
| DC Plate Voltage                                      | 315 max  | volts |
| Peak Positive-Pulse Plate Voltaget (Absolute Maximum) | 22004max | volts |
| Grid-No.2 (Screen-Grid) Voltage                       | 285 max  | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage  | -250 max | volts |
| Peak Cathode Current                                  | 210 max  | mA    |
| Average Cathode Current                               | 60 max   | mA    |
| Plate Dissipation                                     | 10 max   | watts |
| Grid-No.2 Input                                       | 1.5 max  | watts |
| Bulb Temperature (at hottest point)                   | 250 max  | °C    |

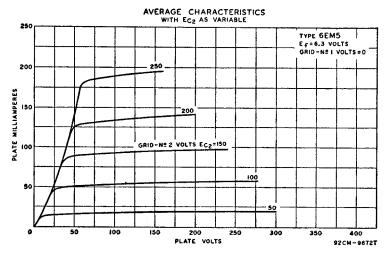
#### **MAXIMUM CIRCUIT VALUES:**

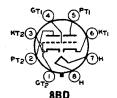
Grid-No.1-Circuit Resistance 2.2 max megohm

• Under no circumstances should this absolute value be exceeded.

† The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.







#### **DUAL TRIODE**

Glass octal type containing high-mu triode and high-perveance, low-mu triode in same envelope. Used as combined vertical-deflection amplifier and vertical-deflection oscillator in television receivers employing picture tubes

6EM7 Related types: 10EM7, 13EM7

having 110-degree deflection angles and high ultor voltages. Outline 13A, Outlines section. Tube requires octal socket and may be mounted in any position. For curve of average plate characteristics, Unit No.1, refer to type 6DR7 (Unit No.1). Types 10EM7 and 13EM7 are identical with type 6EM7 except for the heater ratings, as shown below.

|                                               | 6EM7    | 10EM7     | 13EM7     |         |
|-----------------------------------------------|---------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                        | 6.3     | 9.7       | 13        | volts   |
| Heater Current                                |         | 0.6       | 0.45      | ampere  |
| Heater Warm-up Time (Average)                 |         | 11        | 11        | seconds |
| Peak Heater-Cathode Voltage:                  |         |           |           |         |
| Heater negative with respect to cathode       | 200 max | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode       | 200=max | 200 = max | 200 • max | volts   |
| Direct Interelectrode Capacitances (Approx.): |         | Unit No.1 | Unit No.2 |         |
| Grid to Plate                                 |         | 4.8       | 10        | рF      |
| Grid to Cathode and Heater                    |         | 2.2       | 7         | рF      |
| Plate to Cathode and Heater                   |         | 0.6       | 1.8       | pF      |

<sup>•</sup> The dc component must not exceed 100 volts.

#### Class A, Amplifier

| CHARACTERISTICS:                                 | Unit No.1  | Unit No.2 |       |
|--------------------------------------------------|------------|-----------|-------|
| Plate Voltage                                    | 250        | 150       | volts |
| Grid Voltage                                     | 3          | -20       | volts |
| Amplification Factor                             | 64         | 5.4       |       |
| Plate Resistance (Approx.)                       | 40000      | 750       | ohms  |
| Transconductance                                 | 1600       | 7200      | μmhos |
| Grid Voltage (Approx.):                          |            |           |       |
| For plate current of 10 µA                       | <b>5.5</b> |           | volts |
| For plate current of 100 $\mu$ A                 | _          | -45       | volts |
| Plate Current                                    | 1.4        | 50        | mA    |
| Plate Current, for plate voltage of 60 volts and |            |           |       |
| zero grid voltage                                | _          | 10        | mA    |
| Plate Current, for grid votlage of -28 volts     | _          | 95        | mA    |

#### Vertical-Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

TT-44 NT- 4

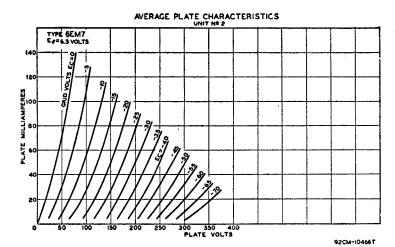
TIME NI. O

|                                          | Unit No.1  | Unit No.2 |       |
|------------------------------------------|------------|-----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values): | Oscillator | Amplifier |       |
| DC Plate Voltage                         | 330 max    | 330 max   | volts |
| Peak Positive-Pulse Plate Voltage#       | _          | 1500 max  | volts |
| Peak Negative-Pulse Grid Voltage         | -400 max   | -250 max  | volts |
| Peak Cathode Current                     | 77 max     | 175 max   | mA    |
| Average Cathode Current                  | 22 max     | 50 max    | mA    |
| Plate Dissipation                        | 1.5 max    | 10 max    | watts |

# The duration of the voltage pulse must not exceed 15 per cent of one vertical-scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical-scanning cycle is 2.5 milliseconds.

### MAXIMUM CIRCUIT VALUES:

| Grid-Circuit Resistance:         | Unit No.1          | Unit No.2                          |
|----------------------------------|--------------------|------------------------------------|
| For grid-resistor-bias operation | 2.2 max<br>2.2 max | 2.2 max megohms<br>2.2 max megohms |



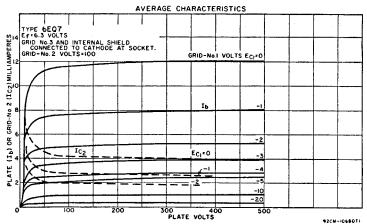
# DIODE— REMOTE-CUTOFF PENTODE

6EQ7
Related type: 12EQ7

Miniature type used as combined if amplifier and AM detector in AM and AM/FM radio receivers. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be operated in any position. Type

| 12EQ7 is identical with type 6EQ7 except for the   | heater ratings<br>6EQ7 | as sl<br>12EQ | own   | below.                |
|----------------------------------------------------|------------------------|---------------|-------|-----------------------|
| Heater Voltage (ac/dc)                             | 6.3                    | 12.6          |       | volts                 |
| Heater Current                                     | 0.3                    | 0.15          |       | ampere                |
| Peak Heater-Cathode Voltage:                       |                        |               |       |                       |
| Heater negative with respect to cathode            | 200 max                | 200           | max   | volts                 |
| Heater positive with respect to cathode            | 200-max                | 200           | max   | volts                 |
| The dc component must not exceed 100 volts.        |                        |               |       |                       |
| Direct Interelectrode Capacitances:                |                        |               |       |                       |
| Pentode Unit:                                      |                        |               |       |                       |
| Grid No.1 to Plate                                 |                        | 0.002         | max   | pF                    |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3 | 3, and                 |               |       |                       |
| Internal Shield                                    |                        | 5.5           |       | pF                    |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, an | nd                     |               |       |                       |
| Internal Shield                                    |                        | 5             |       | pF                    |
| Pentode Grid No.1 to Diode Plate                   |                        | 0.0015        | max   | pF                    |
| Pentode Plate to Diode Plate                       |                        | 0.095         |       | pF                    |
| Pentode Unit as Class A,                           | Amplifier              |               |       |                       |
| MAXIMUM RATINGS (Design-Maximum Values):           | •                      |               |       |                       |
| Plate Voltage                                      |                        | 300           | max   | volts                 |
| Grid-No.3 (Suppressor-Grid) Voltage:               |                        |               |       |                       |
| Positive value                                     |                        | 300           | max   | volts                 |
| Negative value                                     |                        | 300           | max   | volts                 |
| Grid-No.2 (Screen-Grid) Supply Voltage             |                        | 300           | max   | volts                 |
| Grid-No.2 Voltage                                  |                        | See           | curve | page 80               |
| Grid-No.1 (Control-Grid) Voltage:                  |                        |               |       |                       |
| Positive-bias value                                |                        | 0             | max   | volts                 |
| Negative-bias value                                |                        | 50            | max   | volts                 |
| Plate Dissipation                                  |                        | 3             | max   | watts                 |
| Grid-No.3 Input                                    |                        | 0.2           | max   | watt                  |
| Grid-No.2 Input:                                   |                        |               |       |                       |
| For grid-No.2 voltages up to 150 volts             |                        |               |       |                       |
|                                                    |                        | 0.6           | max   | watt                  |
| For grid-No.2 voltages between 150 and 300 volts   |                        |               |       | watt<br>page 80<br>°C |

| CHARACTERISTICS: Plate Voltage                                     | 100     |         | volts      |
|--------------------------------------------------------------------|---------|---------|------------|
| Grid No.3                                                          | to cau  | ode at  | cocket     |
| Internal Shield                                                    | 100 Cau | loue at | volts      |
| Grid-No.2 Voltage                                                  |         |         |            |
| Grid-No.1 Supply Voltage                                           | 0       |         | volts      |
| Grid-No.1 Resistor (Bypassed)                                      | 2.2     |         | egohms     |
| Plate Resistance (Approx.)                                         | 0.25    |         | negohm     |
| Transconductance                                                   | 3800    |         | $\mu$ mhos |
| Plate Current                                                      | 9       |         | mΑ         |
| Grid-No.2 Current                                                  | 3.5     |         | mΑ         |
| Grid-No.1 Voltage (Approx.) for transconductance of 40 \(\mu\)mhos | 20      |         | volts      |
| Diode Unit                                                         |         |         |            |
| MAXIMUM RATINGS (Design-Maximum Values):                           |         |         |            |
| Plate Current CHARACTERISTICS, Instantaneous Value:                | 1       | max     | mA         |
| Tube Voltage Drop for plate current of 2 mA                        | 10      |         | volts      |





# HIGH-MU TRIODE

Miniature type with frame grid used in vhf tuners of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Types 2ER5 and 3ER5 are identical

6ER5
Related types:
2ER5, 3ER5

with type 6ER5 except for the heater ratings, as shown below.

2ER5 3ER5 6ER5

|                                                   | ZEKS    | 3EK3     | OEKS     |        |
|---------------------------------------------------|---------|----------|----------|--------|
| Heater Voltage (ac/dc)                            | 2.3     | 2.8      | 6.3      | volts  |
| Heater Current                                    | 0.6     | 0.45     | 0.18     | ampere |
| Peak Heater-Cathode Voltage:                      |         |          |          |        |
| Heater negative with respect to cathode           | 100 max | 100 max  | 100 max  | volts  |
| Heater positive with respect to cathode           | 100 max | 100 max  | 100 max  | volts  |
|                                                   |         | Without  | With     |        |
|                                                   |         | External | External |        |
| Direct Interelectrode Capacitances:               |         | Shield   | Shield°  |        |
| Grid to Plate                                     |         | 0.38     | 0.36     | рF     |
| Grid to Cathode, Heater, and Internal Shield      |         | 4.4      | 4.4      | pF     |
| Plate to Cathode, Heater, and Internal Shield     |         | 3        | 4        | pF     |
| Grid to Heater                                    |         | 0.28 max | 0.28 max | pF     |
| Plate to Cathode                                  |         | 0.24     | 0.2△     | pF     |
| Cathode to Grid                                   |         | 3.1      | 3.1₄     | ρF     |
| Heater to Cathode                                 |         | 2.5      | 2.5△     | pF     |
| * With external shield connected to cathode excen |         | 4.       |          |        |

<sup>\*</sup>With external shield connected to cathode except as noted.

A With external shield connected to ground.

| Class A, Amplifier                                       |         |        |
|----------------------------------------------------------|---------|--------|
| MAXIMUM RATINGS (Design-Center Values):                  |         |        |
| Plate Voltage                                            | 250 max | volts  |
| Grid Voltage, Negative-bias value                        | 50 max  | volts  |
| Cathode Current                                          | 20 max  | mA     |
| Plate Dissipation                                        | 2.2 max | watts  |
| CHARACTERISTICS:                                         |         |        |
| Plate Voltage                                            | 200     | volts  |
| Grid Voltage                                             | -1.2    | volts  |
| Amplification Factor                                     | 80      |        |
| Plate Resistance Approx.)                                | 8000    | ohms   |
| Transconductance                                         | 10500   | umhos  |
| Plate Current                                            | 10      | mA     |
| Grid Voltage (Approx.) for transconductance of 500 µmhos | -3.8    | volts  |
| Grid Voltage (Approx.) for transconductance of 100 µmhos | -5.6    | volts  |
| MAXIMUM CIRCUIT VALUES:                                  |         |        |
| Grid Circuit Resistance                                  | 1 max   | megohm |

### HIGH-MU TRIODE

**6ES5** 

Heater Voltage (ac/dc) ......

Miniature type used as groundedcathode rf amplifier in vhf television receivers. Outline 5C, Outlines section. Tube requires miniature sevencontact socket and may be operated in any position.

| "(3) (3) (4) (4) (4) (4) (4) (4) (4) (4) (4) (4 | )<br>(6) is<br>70 <sub>K</sub> |
|-------------------------------------------------|--------------------------------|
|                                                 | 160                            |
| 6.3                                             | volts                          |
| 0.2                                             | ampere                         |
| 100 max                                         | volts                          |
| 100 max                                         | volts                          |
| With                                            |                                |
| External                                        |                                |
| Shiri                                           |                                |

| Heater negative with respect to cathode       |          | 100 max<br>100 max | volts<br>volts |
|-----------------------------------------------|----------|--------------------|----------------|
| •                                             | Without  | With               |                |
|                                               | External | External           |                |
| Direct Interelectrode Capacitances:           | Shield   | Shield             |                |
| Grid to Plate                                 | 0.5 max  | 0.5 max            | рF             |
| Grid to Cathode, Heater, and Internal Shield  | 3.2      | 3.2                | ρF             |
| Plate to Cathode, Heater, and Internal Shield | 3.2      | 4                  | pF             |
| Class A. Amplifier                            | •        |                    |                |
| MAXIMUM RATINGS (Design-Maximum Values):      |          |                    |                |
| Plate Voltage                                 |          | 250 max            | volt <b>s</b>  |
| Grid Voltage, Positive-bias value             |          | 0 max              | volts          |
| Cathode Current                               |          | 22 max             | mA             |
| Plate Dissipation                             |          | 2.2 max            | watts          |
| CHARACTERISTICS:                              |          |                    |                |
| Plate Voltage                                 |          | 200                | volts          |
| Grid Voltage                                  |          | 1                  | volt           |
| Amplification Factor                          |          | 75                 |                |
| Plate Resistance (Approx.)                    |          | 8000               | ohms           |
|                                               |          | 9000               | umhos          |
| Transconductance                              |          | 9000               | μmho <b>s</b>  |

Plate Current .....

Grid-Circuit Resistance ...

1 max megohm

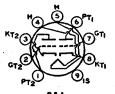
mA

volts

# VARIABLE-MU TWIN TRIODE

6ES8
Related type: 4ES8

Miniature type with high transconductance, variable mu, and low noise; used as cascode-type amplifier in tuners of television receivers. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and



9AJ

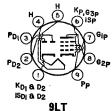
may be operated in any position. Type 4ES8 is identical with type 6ES8 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average)  Direct Interelectrode Capacitances: Grid to Plate (Each Unit) Plate to Cathode (Each Unit) Heater to Cathode (Each Unit) Plate of Unit No.2 to Plate of Unit No.1 Plate of Unit No.2 to Grid of Unit No.1 Grid of Unit No.1 to Cathode of Unit No.2  * With external shield connected to cathode of unit under A with external shield connected to ground. | 4ES8 4 0.6 11 Without External Shield 1.9 0.18 3 0.04 max 0.003 max 0.002 max test except as | 6ES8 6.3 0.365                                 | volts<br>ampere<br>seconds<br>pF<br>pF<br>pF<br>pF<br>pF |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                              |                                                |                                                          |
| Class A, Amplifier (Each                                                                                                                                                                                                                                                                                                                                                                                                        | Unit)                                                                                        |                                                |                                                          |
| CHARACTERISTICS:           Plate Voltage         90           Grid Voltage         -1.2           Plate Resistance (Approx.)         2500           Transconductance         12500           Plate Current         15                                                                                                                                                                                                           | 90<br>—5<br>—625                                                                             | 90<br>-9<br>-<br>125                           | volts<br>volts<br>ohms<br>μmhos<br>mA                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                              | _                                              | шл                                                       |
| Cascode-Type Amplif                                                                                                                                                                                                                                                                                                                                                                                                             | ier                                                                                          |                                                |                                                          |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                              |                                                |                                                          |
| Plate Supply Voltage with plate current of 0 mA Plate Voltage (Each unit) Grid Voltage, Negative-bias value (Each unit) Cathode Current (Each unit) Plate Dissipation (Each unit) Heater-Cathode Voltage: Unit No.1:°                                                                                                                                                                                                           |                                                                                              | 550 max<br>130 max<br>-50 max<br>22 max<br>1.8 | volts<br>volts<br>volts<br>mA<br>watts                   |
| RMS voltage between cathode and heater                                                                                                                                                                                                                                                                                                                                                                                          | • • • • • • • • • • • • • • • • • • • •                                                      | 50 max                                         | volts                                                    |
| Unit No.2:  RMS voltage between cathode and heater  DC voltage between cathode and heater                                                                                                                                                                                                                                                                                                                                       |                                                                                              | 50 max<br>130 max                              | volts<br>volts                                           |
| TYPICAL OPERATION: In a cascode-type circuit with the output unit connected to a voltage                                                                                                                                                                                                                                                                                                                                        |                                                                                              |                                                |                                                          |
| Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                              | 180                                            | volts                                                    |
| Plate Current Transconductance Noise Figure* Grid Voltage (Approx.) for transconductance of 125 μmhos Input Voltage for cross-modulation factor of 0.01 and transconductance of 125 μmhos                                                                                                                                                                                                                                       |                                                                                              | 15<br>12500<br>6.5<br>—9                       | mA<br>μmhos<br>dB<br>volts                               |
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance (Each unit)  Grounded-cathode input unit—pins 6, 7, and 8. Grounded-grid output unit—pins 1, 2, and 3.                                                                                                                                                                                                                                                                          |                                                                                              |                                                | megohm                                                   |

- Cathode positive with respect to heater.

In order not to exceed the maximum-rated plate voltage when the cascode-type amplifier is controlled it is necessary to use a voltage divider for the grid of the grounded-grid output unit.

\* Measured with tube operating in a television tuner.



# TWIN DIODE-SHARP-CUTOFF PENTODE

Miniature type used in television receivers. The pentode unit is used as a video amplifier and the diodes are used as a horizontal phase inverter. Outline 6E, Outlines section. Tube requires miniature nine-contact socket

Related type: 8ET7

and may be operated in any position. Type 8ET7 is identical with type 6ET7 except for the heater ratings, as shown below.

|                               | 6E17 | 8ET7 |         |
|-------------------------------|------|------|---------|
| Heater Voltage (ac/dc)        | 6.3  | 8    | volts   |
| Heater Current                | 0.75 | 0.6  | ampere  |
| Heater Warm-up Time (Average) | _    | 11   | seconds |

| Peak Heater-Cathode Voltage:                            |                 |              |             |
|---------------------------------------------------------|-----------------|--------------|-------------|
| Heater negative with respect to cathode                 | 200             | 200          | volts       |
| Heater positive with respect to cathode                 | 200*            | 200*         | volts       |
| * The dc component must not exceed 100 volts.           |                 |              | , 0410      |
| Pentode Unit as Class A.                                | Amplifier       |              |             |
| MAXIMUM RATINGS (Design-Maximum Values):                |                 |              |             |
| Plate Voltage                                           |                 | 330 ma:      | x voits     |
| Grid-No.2 (Screen-Grid) Supply Voltage                  |                 | 330 ma       |             |
| Grid-No.2 Voltage                                       |                 |              | rve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value   |                 | 0 ma         |             |
| Grid-No.2 Input:                                        |                 |              |             |
| For grid-No. 2 voltages up to 165 volts                 |                 | 1.1 ma:      |             |
| For grid-No.2 voltages between 165 and 330 volts        |                 |              | ve page 80  |
| Plate Dissipation                                       | • • • • • • • • | 5 max        | x watts     |
| CHARACTERISTICS:                                        |                 |              |             |
| Plate Supply Voltage                                    | 60              | 200          | voits       |
| Grid-No.2 Supply Voltage                                | 150             | 150          | volts       |
| Grid-No.1 Voltage                                       | 0               | _            | volts       |
| Cathode-Bias Resistor                                   | _               | 100          | ohms        |
| Plate Resistance (Approx.)                              | _               | 60000        | ohms        |
| Transconductance                                        |                 | 11500        | μmhos       |
| Plate Current                                           | 55=             | 25           | mA          |
| Grid-No.2 Current                                       | 18=             | 5.5          | mA          |
| Grid-No.1 Voltage (Approx.) for plate current of 100 μA |                 | -10          | volts       |
| MAXIMUM CIRCUIT VALUES:                                 |                 |              |             |
| Grid-No.1-Circuit Resistance:                           |                 |              |             |
| For fixed-bias operation                                |                 | 0.1 ma:      | x megohm    |
| For cathode-bias operation                              |                 | 0.25 ma:     | x megohm    |
| This value can be measured by a method involving a rec  | urrent wavefo   | orm such tha | t the maxi- |
| mum ratings of the tube will not be exceeded.           |                 |              |             |
| Diode Units (Each U                                     | nit)            |              |             |
| MAXIMUM RATINGS (Design-Maximum Values):                | -               |              |             |
|                                                         |                 |              |             |

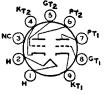
# HIGH-MU TWIN TRIODE

6EU7

CHARACTERISTICS, Instantaneous Value:
Tube Voltage Drop for plate current of 1.5 mA ....

DC Plate Current

Miniature type used in high-gain, resistance-coupled, low-level audio-amplifier applications where low-hum and non-microphonic characteristics are important considerations, such as in microphone amplifiers and in pre-



3 max

mA

volts

volts

9LS

amplifiers for mono- and stereophonic phonographs. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section.

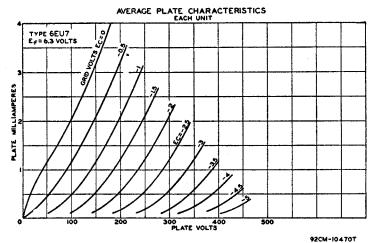
| 12-mpiller overlon.                                               |           |           |
|-------------------------------------------------------------------|-----------|-----------|
| Heater Voltage (ac/dc)                                            | 6.3       | volts     |
| Heater Current                                                    | 0.3       | ampere    |
| Peak Heater-Cathode Voltage:                                      |           | -         |
| Heater negative with respect to cathode                           | 200 max   | volts     |
| Heater positive with respect to cathode                           | 200 ■ max | volts     |
| Direct Interelectrode Capacitances (Each Unit, Approx.):          |           |           |
| Grid to Plate                                                     | 1.5       | pF        |
| Grid to Cathode and Heater                                        | 1.6       | pΓ        |
| Plate to Cathode and Heater                                       | 0.2       | pF        |
| Equivalent Noise and Hum Voltage (Referenced to Grid, Each Unit): |           | -         |
| Average Value*                                                    | 1.8 micro | volts rms |
|                                                                   |           |           |

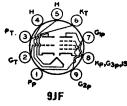
• The dc component must not exceed 100 volts.

\* Measured in "true rms" units under the following conditions: Heater volts (ac), 6.3; center-tap of heater transformer grounded; plate supply volts, 250; plate load resistor, 100000 ohms; cathode resistor, 2700 ohms; cathode bypass capacitor, 100  $\mu$ F; grid resistor, 0 ohms; amplifier frequency range, 25 to 10000 c/s.

# Class A, Amplifier (Each Unit)

| Grid Voltage:              |       |         |       |
|----------------------------|-------|---------|-------|
| Negative-bias value        |       | -55 max | volts |
| Positive-bias value        |       | 0 max   | watts |
| Plate Dissipation          |       | 1.2 max | watts |
| CHARACTERISTICS:           |       |         |       |
| Plate Voltage              | 100   | 250     | volts |
| Grid Voltage               | -1    | -2      | volts |
| Amplification Factor       | 100   | 100     | 70103 |
| Plate Resistance (Approx.) | 80000 | 62500   | ohms  |
| I ransconductance          | 1250  | 1600    | µmhos |
| Plate Current              | 0.5   | 1.2     | mA    |





# MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used as combined triode oscillator and pentode mixer in television receivers. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be operated in any position. Type 5EU8 is

6EU8
Related type:
5EU8

identical with type 6EU8 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current                                               | 5EU8<br>4.7 | 6EU8<br>6.3 | volts   |
|-------------------------------------------------------------------------------------|-------------|-------------|---------|
| Hoston Warm on The Change                                                           | 0.6         | 0.45        | ampere  |
| Heater Warm-up Time (Average) Peak Heater-Cathode Voltage:                          | 11          | 11          | seconds |
| Heater negative with respect to cathode                                             | 200 max     | 200 max     | volts   |
| Heater positive with respect to cathode The dc component must not exceed 100 volts. | 200°max     | 200°max     | volts   |
| MAXIMUM RATINGS (Design-Center Values):                                             | Triode Unit | Pentode Un  | it      |
| Plate Voltage                                                                       | 330 max     | 330 max     | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                                              | _           | 330 max     | volts   |
| Grid-No.2 Voltage                                                                   |             | See curve   |         |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                               | 0 max       | 0 max       |         |
| Plate Dissipation                                                                   |             |             | volts   |
| Grid-No.2 Input:                                                                    | 3 max       | 3.1 max     | watts   |
| For grid-No.2 voltages up to 165 volts                                              |             | 0.55 max    | watt    |
| For grid-No.2 voltages between 165 and 330 volts                                    |             | See curve   |         |
| CHARACTERISTICS:                                                                    |             | See carve   | bage oo |
| Plate Supply Voltage                                                                | 150         | 125         | volts   |
| Grid-No.2 Supply Voltage                                                            |             | 125         | volts   |
| Grid-No.1 Voltage                                                                   | _           |             |         |
| Cathode-Bias Resistor                                                               |             | -1          | volt    |
| 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                                               | 56          | _           | ohms    |
|                                                                                     |             |             |         |

| Amplification Factor                                        | 40      | _       |            |
|-------------------------------------------------------------|---------|---------|------------|
| Plate Resistance (Approx.)                                  | 5000    | 80000   | ohms       |
| Transconductance                                            | 8500    | 6400    | $\mu$ mhos |
| Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A | 12      | 9       | volts      |
| Plate Current                                               | 18      | 12      | · mA       |
| Grid-No.2 Current                                           | _       | 4       | mA         |
| Cathode Warm-up Time                                        | 35      | _       | seconds    |
| MAXIMUM CIRCUIT VALUES:                                     |         |         |            |
| Grid-No.1-Circuit Resistance                                | 0.1 max | 0.1 max | megohm     |

• The cathode warm-up time is defined as the time required for the transconductance to reach 6500  $\mu$ mhos when the tube is operated from a cold start with dc plate volts = 100, grid volts = 0, and heater volts = 5.5.

### SHARP-CUTOFF TETRODE

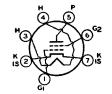
# 6EV5

Heater Voltage (ac/dc) ...

Peak Heater-Cathode Voltage:

Heater Current

Miniature type used as rf amplifier in vhf tuners of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be operated in any position.



0.2

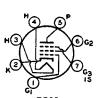
volts

атреге

| Heater negative with respect to cathode                             | 100 max   | volts     |
|---------------------------------------------------------------------|-----------|-----------|
| Heater positive with respect to cathode                             | 100°max   | volts     |
| Direct Interelectrode Capacitances: A                               |           |           |
| Grid No.1 to Plate                                                  | 0.035 max | рF        |
| Grid No.1 to Cathode, Heater, Grid No.2, and Internal Shield        | 4.5       | pF        |
| Plate to Cathode, Heater, Grid No.2, and Internal Shield            | 2.9       | pF        |
| • The dc component must not exceed 50 volts.                        |           | •         |
| A With external shield connected to cathode.                        |           |           |
| Olass & Amuliffan                                                   |           |           |
| Class A, Amplifier                                                  |           |           |
| MAXIMUM RATINGS (Design-Maximum Values):                            |           |           |
| Plate Voltage                                                       | 275 max   | volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                              | 180 max   | volts     |
| Grid-No.2 Voltage                                                   |           | e page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value               | 0 max     | volts     |
| Cathode Current                                                     | 20 max    | mA        |
| Grid-No.2 Input:                                                    |           |           |
| For grid-No.2 voltages up to 90 volts                               | 0.2 max   | watt      |
| For grid-No.2 voltages between 90 and 180 volts                     | See curve | e page 80 |
| Plate Dissipation                                                   | 3.25 max  | watts     |
| CHARACTERISTICS:                                                    |           |           |
| Plate Voltage                                                       | 250       | volts     |
| Grid-No.2 Voltage                                                   | 80        | volts     |
| Grid-No.1 Voltage                                                   | -1        | megohm    |
| Plate Resistance (Approx.)                                          | 0.15      | megohm    |
| Transconductance                                                    | 8800      | μmhos     |
| Plate Current                                                       | 11.5      | mA.       |
| Grid-No.2 Current                                                   | 0.9       | mA        |
| Grid-No.1 Voltage (Approx.) for transconductance of 100 \(\mu\)mhos | 4.5       | volts     |
| MAXIMUM CIRCUIT VALUE:                                              | -         |           |
| Grid-No.1-Circuit Resistance                                        | 0.5 max   | megohm    |
|                                                                     |           | -         |

#### SHARP-CUTOFF PENTODE

6EW6 Related types: 4EW6, 5EW6 Miniature type used in the gain-controlled picture-if stages of vhf television receivers operating at an intermediate frequency in the order of 40 megacycles per second. This tube features controlled plate-current cutoff

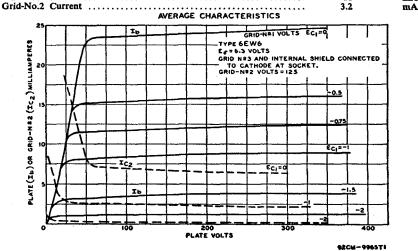


7CM

and high transconductance (1400 µmhos) combined with low interelectrode

capacitance values. Tube is provided with separate base pins for grid No.3 and cathode to permit the use of an unbypassed cathode resistor to minimize changes in input conductance and input capacitance with bias, without causing oscillation. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Types 4EW6 and 5EW6 are identical with type 6EW6 except for the heater ratings, as shown below.

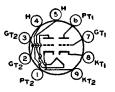
| <del>-</del>                                                   | 4EW6              | 5EW6              | 6EW6      |         |
|----------------------------------------------------------------|-------------------|-------------------|-----------|---------|
| Heater Voltage (ac/dc)                                         | 4.2               | 5.6               | 6.3       | volts   |
| Heater Current                                                 | 0.6               | 0.45              | 0.4       | ampere  |
| Heater Warm-up Time (Average)                                  | 11                | 11                |           | seconds |
| Peak Heater-Cathode Voltage:                                   |                   |                   |           |         |
| Heater negative with respect to cathode                        | 200 max           | 200 max           | 200 max   | volts   |
| Heater positive with respect to cathode                        | 200 max           |                   | 200 max   | volts   |
| Houter positive with respect to outside the                    |                   | Without           | With      |         |
|                                                                |                   | External          | External  |         |
| Direct Interelectrode Capacitances:                            |                   | Shield            | Shield*   |         |
| Grid No.1 to Plate                                             |                   | 0.04 max          | 0.03 max  | ρF      |
| Grid No.1 to Cathode, Heater, Grid No.2,                       |                   | 0.04 IIIax        | 0.05 max  | Pr.     |
|                                                                |                   | 10                | 10        | pF      |
| No.3 and Internal Shield                                       |                   | 10                | 10        | pr      |
| Plate to Cathode, Heater, Grid No.2, Grid                      |                   | 2.4               | 3.4       | -17     |
| and Internal Shield                                            |                   | 2.4               | 3.4       | рF      |
| • The dc component must not exceed 100 volts.                  |                   |                   |           |         |
| <ul> <li>With external shield connected to cathode.</li> </ul> |                   |                   |           |         |
| Class A, A                                                     | mnlifier          |                   |           |         |
| MAXIMUM RATINGS (Design-Maximum Values)                        |                   |                   |           |         |
|                                                                |                   |                   | 330 max   | volts   |
| Plate Voltage                                                  |                   |                   | 0 max     | volts   |
| Grid No.3 (Suppressor-Grid) Voltage, Positive val              |                   |                   | 330 max   | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                         |                   |                   |           |         |
| Grid-No.2 Voltage                                              |                   |                   | See curve |         |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias va             |                   |                   | 0 max     | volts   |
| Plate Dissipation                                              | • • • • • • • • • | • • • • • • •     | 3.1 max   | watts   |
| Grid-No.2 Input:                                               |                   |                   |           |         |
| For grid-No.2 voltages up to 165 volts                         |                   |                   | 0.65 max  | watt    |
| For grid-No.2 voltages between 165 and 330                     | volts             | · · · · · · · · · | See curve | page 80 |
| CHARACTERISTICS:                                               |                   |                   |           |         |
| Plate Supply Voltage                                           |                   |                   | 125       | volts   |
| Grid No.3                                                      |                   |                   |           |         |
| Grid-No.2 Supply Voltage                                       |                   |                   | 125       | volts   |
| Cathode-Bias Resistor                                          |                   |                   | 56        | ohms    |
| Plate Resistance (Approx.)                                     |                   |                   | 0.2       | megohm  |
| Transconductance                                               |                   |                   | 14000     | μmhos   |
| Grid-No.1 Voltage (Approx.) for plate current of               |                   |                   | 3.5       | volts   |
| Plate Current                                                  | • • • • • • • • • |                   | 11        | mA      |
|                                                                |                   |                   |           |         |



## **DUAL TRIODE**

## **6EW7**

Neonoval type used as combined verticaltical-deflection oscillator and verticaldeflection amplifier in television receivers. Outline 10C, Outlines section. Tube requires neonoval nine-contact socket and may be operated in any



9HF

Timis No. 2

position. For curve of average plate characteristics, Unit No.1, refer to type 6DE7 (Unit No.1).

| Heater Voltage (ac/dc)                        |     | 6.3       | volts  |
|-----------------------------------------------|-----|-----------|--------|
| Heater Current                                |     | 0.9       | атреге |
| Peak Heater-Cathode Voltage:                  |     |           |        |
| Heater negative with respect to cathode       |     | 200 max   | volts  |
| Heater positive with respect to cathode       |     | 200° max  | volts  |
| Direct Interelectrode Capacitances (Approx.): |     | Unit No.2 |        |
| Grid to Plate                                 | 4.2 | 9         | pF     |
| Grid to Cathode and Heater                    | 2.2 | 7         | pF     |
| Plate to Cathode and Heater                   | 0.4 | 1.2       | рF     |
|                                               |     |           |        |

• The dc component must not exceed 100 volts.

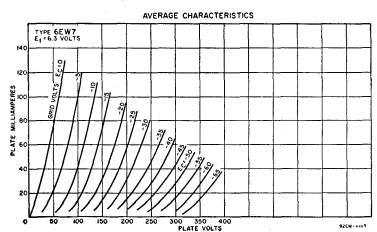
#### Class A. Amplifier

| CHARACTERISTICS:                                        | Unit No.1 | Unit No.2 |            |
|---------------------------------------------------------|-----------|-----------|------------|
| Plate Voltage                                           | 250       | 150       | volts      |
| Grid Voltage                                            | -11       | 17.5      | volts      |
| Amplification Factor                                    | 17.5      | 6         |            |
| Plate Resistance (Approx.)                              | 8750      | 800       | ohms       |
| Transconductance                                        | 2000      | 7500      | $\mu$ mhos |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A  | 20        |           | volts      |
| Grid Voltage (Approx.) for plate current of 100 $\mu A$ |           | 40        | volts      |
| Plate Current                                           | 5.5       | 45        | mA         |
| Plate Current for plate voltage of 60 volts and zero    |           |           |            |
| grid voltage                                            | _         | 95        | mĄ         |
| Plate Current for grid voltage of -25 volts             | _         | 8         | mA         |

## Vertical-Deflection Oscillator and Amplifier

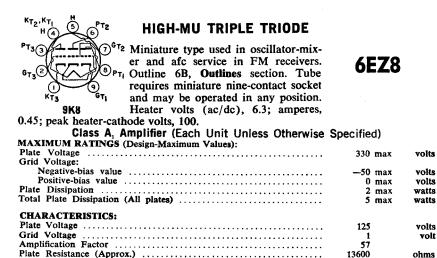
For operation in a 525-line, 30-frame system

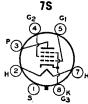
| MAXIMUM RATINGS (Design-Maximum Values): | Oscillator | Amplifier | 4.    |
|------------------------------------------|------------|-----------|-------|
| DC Plate Voltage                         | 330 max    | 330 max   | volts |
| Peak Positive-Pulse Plate Voltage        | _          | 1500 max  | volts |



| Peak Negative-Pulse Grid Voltage Peak Cathode Current Average Cathode Current Plate Dissipation              | Unit No.1 Oscillator -400 max 77 max 22 max 1.5 max | Unit No.2<br>Amplifier<br>—250 max<br>175 max<br>50 max<br>10 max | volts<br>mA<br>mA<br>watts |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------|----------------------------|
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance: For cathode-bias operation For grid-resistor-bias operation | 2.2 max<br>2.2 max                                  | 2.2 max n<br>2.2 max n                                            |                            |
| The department of the malters makes much not award 15 m                                                      | on cont of one                                      |                                                                   | •                          |

• The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.





Transconductance ...

#### POWER PENTODE

Grid Voltage (Approx.) for plate current of 20 µA .....

Plate Current .....

Metal type used in the audio output stage of ac receivers. This tube is capable of large power output with relatively small input voltage. Outline 2B, Outlines section. Tube requires octal socket and may be

**6F6** 

µmhos

volts

mA

4200

\_4

4.2

mounted in any position. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 6.3; amperes, 0.7; peak heater-cathode volts, 90.

Class A, Amplifier Pentode Triode MAXIMUM RATINGS (Design-Maximum Values): Connection Connection<sup>\*</sup> 350 max volts Plate Voltage ..... 375 max Grid-No.2 (Screen-Grid) Voltage ..... 285 max volts 11 max 10 max watts Plate Dissipation ..... Grid-No.2 Input 3.75 max watts TYPICAL OPERATION: 285 250 Plate Voltage ..... 250 volts Grid-No.2 Voltage 250 285 volts Grid-No.1 (Control-Grid) Voltage ..... -16.5--20 volts

|                                                                       |         | tode<br>ection | Triode<br>Connection |          |
|-----------------------------------------------------------------------|---------|----------------|----------------------|----------|
| Peak AF Grid-No.1 Voltage                                             | 16.5    | 20             | 20                   | volts    |
| Zero-Signal Plate Current                                             | 34      | 38             | 31                   | mA       |
| Maximum-Signal Plate Current                                          | 36      | 40             | 34                   | mA       |
| Zero-Signal Grid-No.2 Current                                         | 6.5     | . 7            | _                    | mA       |
| Maximum-Signal Grid-No.2 Current                                      | 10.5    | . 13           | _                    | mA       |
| Amplification Factor                                                  |         |                | 6.8                  |          |
| Plate Resistance (Approx.)                                            | 80000   | 78000          | 2600                 | ohms     |
| Transconductance                                                      | 2500    | 2550           | 2600                 | μmhos    |
| Load Resistance                                                       | 7000    | 7000           | 4000                 | ohms     |
| Total Harmonic Distortion                                             | 8       | 9              | 6.5                  | per cent |
| Maximum-Signal Power Output                                           | 3.2     | 4.8            | 0.85                 | watts    |
| Push-Pull Class MAXIMUM RATINGS: (Same as for class A <sub>1</sub> as | -       | plifier        |                      |          |
| TYPICAL OPERATION (Values are for two t                               | ubes):  |                |                      |          |
| Plate Voltage                                                         |         |                | 315                  | volts    |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage                                |         |                | 285                  | volts    |
| Zero-Signal Plate Current                                             |         |                | 24                   | volts    |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage                                | <i></i> |                | 48                   | volts    |
| Zero-Signal Plate Current                                             |         |                | 62                   | mA       |
| Maximum-Signal Plate Current                                          |         |                | 80                   | mA       |
| Zero-Signal Grid-No.2 Current                                         |         |                | 12                   | mA       |
| Maximum-Signal Grid-No.2 Current                                      |         |                | 19.5                 | mA       |
| Effective Load Resistance (Plate-to-plate)                            |         |                | 10000                | ohms     |
| Total Harmonic Distortion                                             |         |                | 4                    | per cent |
| Maximum-Signal Power Output                                           |         |                | 11                   | watts    |

## DIODE—SHARP-CUTOFF, TWIN-PLATE TETRODE

For fixed-bias operation .....

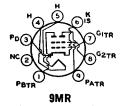
For cathode-bias operation ......

# 6FA7

Heater Voltage (ac/dc)

MAXIMUM CIRCUIT VALUES: Grid-No.1 Circuit Resistance:

Miniature type used in frequencydivider and complex-wave generator circuits of electronic musical instruments. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be operated in any position.



0.1 max megohm 0.5 max megohm

| Tiontot voltage (ac/dc/                                      | 0.3       | VOILS  |
|--------------------------------------------------------------|-----------|--------|
| Heater Current                                               | 0.3       | ampere |
| Peak Heater-Cathode Voltage:                                 | 4.0       | umpere |
| Heater negative with respect to cathode                      | 200 max   | volts  |
| Heater positive with respect to cathode                      | 200 max   | volts  |
| Direct Interelectrode Capacitances:                          | 200 mux   | 10163  |
| Tetrode Unit:                                                |           |        |
| Grid No.1 to Plate A                                         | 0.040     | pF     |
| Grid No.1 to Plate B                                         | 0.030 max | pF     |
| Grid No.1 to Cathode, Heater, Grid No.2, and Internal Shield | 5.5       | pF     |
| Plate A to Cathode, Heater, Grid No.2, and Internal Shield   | 1.8       | ρF     |
| Plate B to Cathode, Heater, Grid No.2, and Internal Shield   | 1.8       | pF     |
| Tetrode Grid No.1 to Diode Plate                             | 0.022     | pF     |
| Tetrode Plate A to Diode Plate                               | 0.020 max | pF     |
| Tetrode Plate B to Diode Plate                               | 0.055     | pF     |
|                                                              |           |        |

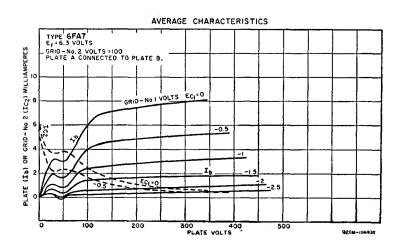
<sup>•</sup> The dc component must not exceed 100 volts.

#### Class A. Amplifier

| Class A <sub>1</sub> Ampliner                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|
| CHARACTERISTICS (Tetrode Unit):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |             |
| Plate A and Plate B connected together                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |             |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 100      | volts       |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 100      | volts       |
| Grid-No.1 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0        | volts       |
| Grid-No.1 Resistor (Bypassed)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2.2      | megohms     |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 90000    | ohms        |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3200     | umhos       |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3.8      | mA          |
| Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1.7      | mA          |
| Grid-No.1 Voltage (Approx.) for plate current of 20 µA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | volts       |
| One from voicege (approxi) for place current of 20 per                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | 7010        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |             |
| Using either Plate A or B, with unused plate ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |             |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 100      | volts       |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 100      | volts       |
| Grid-No.1 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0        | volts       |
| Grid-No.1 Resistor (Bypassed)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2.2      | megohms     |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 130000   | ohms        |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1900     | μmhos       |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2.2      | mA          |
| Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3        | mA          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |             |
| Processor Builds A. A. C. Louise and Assess                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |             |
| Frequency Divider & Complex-Wave Genera                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | itor     |             |
| Tetrode Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |             |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |             |
| Plate-A Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 330 m    | ax voits    |
| Plate-B Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 330 m    | ax volts    |
| Grid-No.2 (Screen-Grid) Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 330 m    |             |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          | rve page 80 |
| Grid-No.1 (Control-Grid) Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 500 00   | are page of |
| Negative-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 50 ma    | ax volts    |
| Positive-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0 m      |             |
| Plate-A Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.5 m    |             |
| Plate-B Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.5 m    |             |
| Grid-No.2 Input:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.5 1116 |             |
| For grid-No.2 voltages up to 165 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.65 ma  | ax watt     |
| For grid-No.2 voltages between 165 and 330 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          | rve page 80 |
| TO BOTH TOTAL TOTA | See cu   | THE PARC OF |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1 Circuit Resistance:



#### Diode Unit

| MAXIMUM RATINGS (Design-Maximum Values): Plate Current                            | 1 max | mA    |
|-----------------------------------------------------------------------------------|-------|-------|
| CHARACTERISTICS, Instantaneous Value: Tube Voltage Drop for plate current of 2 mA | 10    | volts |

## **DUAL TRIODE**

6FD7
Related type:

Glass type containing high-mu and low-mu triode units used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers. Outline 10B, Outlines section. Tube requires miniature nine-



contact socket and may be mounted in any position. Type 13FD7 is identical with type 6FD7 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average)                                                                                          | 6FD7<br>6.3<br>0.925 | 13FD7<br>13<br>0.45<br>11 | volts<br>ampere<br>seconds |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------|----------------------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode  • The dc component must not exceed 100 volts | 200 max              | 200 max                   | volts                      |
|                                                                                                                                                              | 200•max              | 200°max                   | volts                      |

#### Class A, Amplifier

| CHARACTERISTICS:                             | Unit No.1 | Unit | No.2  |       |
|----------------------------------------------|-----------|------|-------|-------|
| Plate Voltage                                | 250       | 60   | 150   | volts |
| Grid Voltage                                 | -3        | 0    | -17.5 | volts |
| Amplification Factor                         | 64        | _    | 6     |       |
| Plate Resistance (Approx.)                   | 40000     | _    | 800   | ohms  |
| Transconductance                             | 1600      |      | 7500  | μmhos |
| Plate Current                                | 1.5       | 95□  | 40    | mA    |
| Grid Voltage (Approx.):                      |           |      |       |       |
| For plate current of 10 $\mu$ A              | 5.5       | _    | _     | volts |
| For plate current of 100 $\mu$ A             | _         | -    | 40    | volts |
| Transconductance, for plate current of 1 mA  | _         | _    | 500   | μmhos |
| Plate Current, for grid voltage of -25 volts | _         | _    | 6     | mA    |

<sup>□</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Vertical-Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

|                                          | Unit No.1  | Unit No.2 |       |
|------------------------------------------|------------|-----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values): | Oscillator | Amplifier |       |
| DC Plate Voltage                         | 330 max    | 330 max   | volts |
| Peak Positive-Pulse Plate Voltage        |            | 1500 max  | volts |
| Peak Negative-Pulse Grid Voltage         | -400       | -250 max  | volts |
| Peak Cathode Current                     | 70 max     | 175 max   | mA    |
| Average Cathode Current                  | 20 max     | 50 max    | mA    |
| Plate Dissipation                        | 1.5 max    | 10 max    | watts |
| •                                        |            |           |       |

#### MAXIMUM CIRCUIT VALUES:

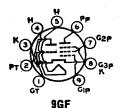
Grid-Circuit Resistance:

For grid-resistor-bias or cathode-bias operation . 2.2 max megohms

<sup>•</sup> The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

Refer to type EM84/6FG6.

6FG6



## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used as combined oscillator and mixer tube in vhf television receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be

6FG7
Related type:

mounted in any position. Type 5FG7 is identical with type 6FG7 except for the heater ratings, as shown below.

|                                         | 5FG7    | 6FG7    |         |
|-----------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                  | 4.7     | 6.3     | volts   |
| Heater Current                          | 0.6     | 0.45    | атреге  |
| Heater Warm-up Time (Average)           | 11      | 11      | seconds |
| Peak Heater-Cathode Voltage:            |         |         |         |
| Heater negative with respect to cathode | 200 max | 200 max | volts   |
| Heater positive with respect to cathode | 200°max | 200°max | volts   |
| •                                       |         |         |         |

<sup>\*</sup> The dc component must not exceed 100 volts.

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Pentode Un       | it         |
|--------------------------------------------------------|-------------|------------------|------------|
| Plate Voltage                                          | 330 max     | 330 max          | volts      |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | _           | 330 max          | volts      |
| Grid-No.2 Voltage                                      | <del></del> | See curve        | page 80    |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value. | 0 max       | 0 max            | volts      |
| Grid-No.2 Input:                                       |             |                  |            |
| For grid-No.2 voltages up to 165 volts                 |             | 0.55 max         | watt       |
| For grid-No.2 voltages between 165 and 330 volts.      | _           | See curve        | page 80    |
| Plate Dissipation                                      | 2.5 max     | 3 max            | watts      |
| CHARACTERISTICS:                                       |             |                  |            |
| Plate Voltage                                          | 125         | 100 125          | volts      |
| Grid-No.2 Voltage                                      | _ '         | 100 125          | volts      |
| Grid-No.1 Voltage                                      | -1          | 0 -1             | volts      |
| Amplification Factor                                   | 43          |                  |            |
| Plate Resistance (Approx.)                             | 5700        | <b>— 180000</b>  | ohms       |
| Transconductance                                       | 7500        | 7400 6000        | $\mu$ mhos |
| Plate Current                                          | 13          | - 11             | mA         |
| Grid-No.2 Current                                      |             | - 4              | mA         |
| Grid-No.1 Voltage (Approx.) for plate current          |             |                  |            |
| of 30 μA                                               | <b>6.5</b>  | <del>-</del> 7.5 | volts      |



## HIGH-MU TRIODE

Miniature type used as an rf amplifier in vhf tuners of television receivers. Outline 5C, **Outlines** section. Tube requires seven-contact socket and may be mounted in any position. Types 2FH5 and 3FH5 are identical

6FH5
Related types:
2FH5, 3FH5

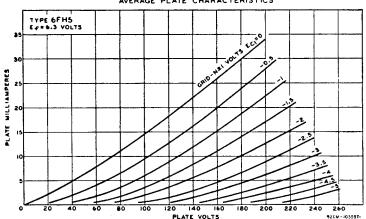
7FP

with type 6FH5 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average) | 0.6     | 3FH5<br>3<br>0.45<br>11 | 6FH5<br>6.3<br>0.2 | volts<br>ampere<br>seconds |
|---------------------------------------------------------------------|---------|-------------------------|--------------------|----------------------------|
| Peak Heater-Cathode Voltage:                                        |         |                         |                    |                            |
| Heater negative with respect to cathode                             | 100 max | 100 max                 | 100 max            | volts                      |
| Heater positive with respect to cathode                             | 100 max | 100 max                 | 100 max            | volts                      |

| Grid to Cathode, Heater, and Internal Shield                                                                                            | Without<br>External<br>Shield<br>0.52<br>3.2 | With<br>External<br>Shield•<br>0.52<br>3.2 | pF<br>p <u>F</u>                               |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------------------------------|------------------------------------------------|
| Plate to Cathode, Heater, and Internal Shield                                                                                           | 3.2                                          | 4                                          | pF                                             |
| Class A, Amplifier                                                                                                                      | r                                            |                                            |                                                |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                |                                              |                                            |                                                |
| Plate Voltage Grid Voltage, Positive-bias value Cathode Current Plate Dissipation                                                       |                                              | 150 max<br>0 max<br>22 max<br>2.2 max      | volts<br>volts<br>mA<br>watts                  |
| CHARACTERISTICS:                                                                                                                        |                                              |                                            |                                                |
| Plate Voltage Grid Voltage Plate Resistance (Approx.) Transconductance Plate Current Grid Voltage (Approx.) for plate current of 100 µA |                                              | 135<br>—1<br>5600<br>9000<br>11<br>—5.5    | volts<br>volts<br>ohms<br>µmhos<br>mA<br>volts |
| MAXIMUM CIRCUIT VALUES:                                                                                                                 |                                              |                                            |                                                |
| Grid-Circuit Resistance: For cathode-bias operation                                                                                     |                                              | 1 max                                      | megohm                                         |

#### AVERAGE PLATE CHARACTERISTICS



## MEDIUM-MU TRIODE— THREE-PLATE TETRODE

## **6FH8**

Miniature type used in complex-wave generator applications. Sharp-cutoff tetrode unit has pair of additional plates. Outline 6B, Outlines section. Tube requires nine-contact socket and may be mounted in any position.

| H.K 5 6 TR  |  |
|-------------|--|
| PT 3 7 G2TR |  |
| GT BPIATR   |  |
| PIBTR P2TR  |  |
| 01/0        |  |

| Heater Voltage (ac/dc)              | 6.3  | volts    |
|-------------------------------------|------|----------|
| Heater Current                      | 0.45 | ampere   |
| Direct Interelectrode Capacitances: | 0.10 | - mpore  |
| Triode Unit:                        |      |          |
| Grid to Plate                       | 1.4  | nF       |
| Grid to Cathode and Heater          | 2.6  | pF       |
| Plate to Cathode and Heater         | 2.0  | pF<br>pF |
| The to Californ and House           |      | рг       |

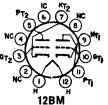
| Tetrode Unit:                                                        |                   |                    |                |
|----------------------------------------------------------------------|-------------------|--------------------|----------------|
| Grid No.1 to Plate No.2                                              | o.iA, and         | 0.06 max           | pF<br>_        |
| Plate No.1B  Plate No.2 to Cathode, Heater, Grid No.2, Plate N       | o.1A, and         | 4.5                | pF             |
| Plate No.1B                                                          |                   | 1.4<br>0.35 max    | pF<br>pF       |
| Tetrode Grid No.1 to Triode Plate Tetrode Plate No.2 to Triode Plate |                   | 0.008 max          | pF             |
| ° With external shield connected to cathode.                         |                   |                    |                |
|                                                                      |                   |                    |                |
| Class A, Amplifier                                                   |                   |                    |                |
| CHARACTERISTICS: Triode Unit                                         |                   | 100                | volts          |
| Plate Voltage                                                        |                   | <b>-1</b>          | volt           |
| Amplification Factor                                                 |                   | 40                 |                |
| Plate Resistance (Approx.)                                           |                   | 7400<br>5400       | ohms           |
| Transconductance                                                     |                   | 5400<br>7.9        | μmhos<br>m A   |
| Plate Current                                                        |                   | -7                 | volts          |
| Old voltage (Approx.) for place current of 100 place                 |                   | ·                  |                |
| Tetrode Unit with Plates No.1A and No.1B Conne                       | acted to Catho    | le at Socket       |                |
|                                                                      |                   | 250                | volts          |
| Plate-No.2 Voltage                                                   |                   | 250                | volts          |
| Grid-No.1 Voltage                                                    |                   | -2                 | volts          |
| Plate-No 2 Resistance (Approx.)                                      |                   | 0.75               | megohm         |
| Transconductance, Grid No.1 to Plate No.2                            |                   | 4400               | μmhos          |
| Plate-No.2 Current                                                   |                   | 7.3<br>1.4         | mA<br>mA       |
| Grid-No.2 Current                                                    | μ <b>A</b>        | <u>-7</u>          | volts          |
| Old-10.1 Votage (hpprom) to plant to a transfer                      |                   |                    |                |
| Compley Ways Conors                                                  | tar               |                    |                |
| Complex-Wave Genera                                                  | Triode Unit       | Tetrode U          | lmit           |
| MAXIMUM RATINGS (Design-Maximum Values):                             | 275 max           | Tettode C          | volts          |
| Plate Voltage                                                        | 275 max           | 200 max            |                |
| Plate-No.1B Voltage                                                  | _                 | 200 max            |                |
| Plate-No.2 Voltage                                                   |                   | 275 max            |                |
| Grid-No.2 (Screen-Grid) Supply Voltage                               |                   | 275 max            |                |
| Grid-No.2 Voltage                                                    | _                 | See curv           | e page 80      |
| Grid-No.1 (Control-Grid) Voltage: Negative-bias value                | -40 max           | -40 ma             | volts          |
| Positive-bias value                                                  | 0 max             | 0 mar              |                |
| Plate Dissipation                                                    | 1.7 max           | _                  | watts          |
| Plate-No.1A Dissipation                                              |                   | 0.3 max            |                |
| Plate-No.1B Dissipation                                              |                   | 0.3 max<br>2.3 max |                |
| Plate-No.2 Dissipation                                               |                   | 2.5 IIIa)          | watts          |
| For grid-No.2 voltages up to 137.5 volts                             | _                 | 0.45 max           |                |
| For grid-No.2 voltages between 137.5 and 275 volts                   | _                 | See curv           | e page 80      |
|                                                                      |                   |                    |                |
| TYPICAL OPERATION WITH SEPARATE PLATE OP                             | ERATION:          |                    |                |
|                                                                      |                   | Tetrode Un         |                |
| Plates-No.1A, No.1B, and No.2 Voltage                                |                   | 100                | volts          |
| Grid-No.2 Voltage Grid-No.1 Voltage                                  | • • • • • • • • • | 50<br>—1           | volts<br>volts |
| Plate-No.1A Current                                                  |                   | 0.04               | mA             |
| Plate-No.1B Current                                                  |                   | 0.04               | mA             |
| Plate-No.2 Current                                                   |                   | 1.6                | mA             |
| Grid-No.2 Current Transconductance (Approx.):                        |                   | 0.3                | mA             |
| Grid No.1 to Plate No.1A                                             |                   | 70                 | μmhos          |
| Grid No.1 to Plate No.1B                                             |                   | 70                 | μmhos          |
| Grid No.1 to Plate No.2                                              |                   | 2500               | μmhos          |
|                                                                      |                   |                    |                |
| MAXIMUM CIRCUIT VALUES:                                              |                   |                    |                |
| Grid-No.1-Circuit Resistance:                                        | Triode Unit       | Tetrode L          | Init           |
| For fixed-bias operation                                             | 0.5 max           | 0.5 mai            | megohm         |
|                                                                      | U.J IIIAA         | U.J IIIu           | . шовоши       |

## MEDIUM-MU DUAL TRIODE

6FJ7

Duodecar type used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers. Outline 8B, Outlines section.

Tube requires duodecar twelve-contact socket and may be mounted in



any position. Heater volts (ac/dc), 6.3; amperes, 0.9; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

| Class A, Amplifie                                      | r         |             |            |            |
|--------------------------------------------------------|-----------|-------------|------------|------------|
| CHARACTERISTICS:                                       | Unit No.1 | Unit        | No.2       |            |
| Plate Voltage                                          | . 250     | 150         | 250        | volts      |
| Grid Voltage                                           | 8         | 0           | 9.5        | volts      |
| Amplification Factor                                   | 22.5      | _           | 15.4       |            |
| Plate Resistance (Approx.)                             | 9000      | <del></del> | 2000       | ohms       |
| Transconductance                                       | 2500      |             | 7700       | $\mu$ mhos |
| Plate Current                                          | 8         | 68•         | 41         | mA         |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A | 18        | _           | _          | volts      |
| Grid Voltage (Approx.) for plate current of 50 $\mu$ A | _         | _           | <b>—23</b> | volts      |

• This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

## Vertical-Deflection Oscillator and Amplifier

| For operation in a 525-line, 20-fr       | ame system |           |         |
|------------------------------------------|------------|-----------|---------|
|                                          | Unit No.1  | Unit No.2 |         |
| MAXIMUM RATINGS (Design-Maximum Values): | Oscillator | Amplifier |         |
| DC Plate Voltage                         | 350 max    | 550 max   | volts   |
| Peak Positive-Pulse Plate Voltage        |            | 2500 max  | volts   |
| Peak Negative-Pulse Grid Voltage         | -400 max   | -250 max  | volts   |
| Peak Cathode Current                     | <u></u>    | 150 max   | mA      |
| Average Cathode Current                  | _          | 50 max    | mA      |
| Plate Dissipation                        | 1 max      | 10 max    | watts   |
| MAXIMUM CIRCUIT VALUES:                  |            |           |         |
| Grid-Circuit Resistance:                 |            |           |         |
| For fixed-bias operation                 | 2.2 max    | 2.2 max   | megohms |
| For cathode-bias operation               | 2.2 max    | _         | megohms |

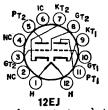
• The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

## DUAL TRIODE

6FM7

Related types: 13FM7, 15FM7

Duodecar type used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers. The high-mu triode unit No.1 is used as an oscillator, and the low-mu triode unit No.2 is used as an am-



plifier. Outline 8B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Types 13FM7 and 15FM7 are identical with type 6FM7 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average)                                          | 6FM7<br>6.3<br>1.05 | 13FM7<br>13<br>0.45<br>11 | 15FM7<br>14.8<br>0.45<br>11 | volts<br>ampere<br>seconds |
|--------------------------------------------------------------------------------------------------------------|---------------------|---------------------------|-----------------------------|----------------------------|
| Peak Heater-Cathode Voltage: Heater negative with respect to cathode Heater positive with respect to cathode | 200 max             | 200 max                   | 200 max                     | volts                      |
|                                                                                                              | 200 max             | 200=max                   | 200=max                     | volts                      |

<sup>•</sup> The dc component must not exceed 100 volts.

|                                                           | ••                    |           |       |
|-----------------------------------------------------------|-----------------------|-----------|-------|
| CHARACTERISTICS:                                          | Unit No.1             | Unit No.2 |       |
| Plate Voltage                                             | 250                   | 175       | volts |
| Grid Voltage                                              | -3                    | 25        | volts |
| Amplification Factor                                      | 66                    | 5.5       |       |
| Plate Resistance (Approx.)                                | 30000                 | 920       | ohms  |
| Transconductance                                          | 2200                  | 6000      | μmhos |
| Grid Voltage (Approx.) for plate current of 20 $\mu$ A    | -5.3                  |           | volts |
| Grid Voltage (Approx.) for plate current of 200 $\mu$ A   | _                     | 45        | volts |
| Plate Current                                             | 2                     | 40        | mA    |
| Vertical-Deflection Oscillator                            | and Amplif            | ier       |       |
| For operation in a 525-line, 30-                          | frame system          |           |       |
| <b>,</b>                                                  | Unit No.1             | Unit No.2 |       |
| MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage | Oscillator<br>350 max | Amplifier | volts |

Class A. Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): | Oscillator | Amplifier |
|------------------------------------------|------------|-----------|
| DC Plate Voltage                         | 350 max    | 550 max   |
| Peak Positive-Pulse Plate Voltage#       |            | 1500 max  |
| Dools Moneting Dules Dieta Voltage       | 400 mar    | 250 may   |

 Peak Positive-Pulse Plate Voltage#
 1500 max
 volts

 Peak Negative-Pulse Plate Voltage
 -400 max
 -250 max
 volts

 Peak Cathode Current
 175 max
 mA

 Average Cathode Current
 50 max
 mA

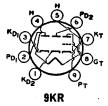
 Plate Dissipation†
 1 max
 10 max
 watts

#### MAXIMUM CIRCUIT VALUES:

Grid-Circuit Resistance:

| For fixed-bias operation | 1 max<br>2.2 max | 1 max megohm<br>2.2 max megohms |
|--------------------------|------------------|---------------------------------|
|                          |                  |                                 |

- # The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.
- $\dagger$  An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



## TWIN DIODE— HIGH-MU TRIODE

Miniature type used as combined FM detector and af voltage amplifier in FM receivers. Outline 6B, Outlines section. Tube requires miniature ninecontact socket and may be operated in any position. Heater volts (ac/dc),

6FM8

volts

6.3; amperes, 0.45; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

#### Triode Unit as Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid Voltage, Positive-bias value Plate Dissipation                 | 330 max<br>0 max<br>1.1 max           | volts<br>volts<br>watts               |
|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------|
| CHARACTERISTICS: Plate Voltage Grid Voltage Amplification Factor Plate Resistance (Approx.) Transconductance Plate Current | 250<br>-3<br>70<br>58000<br>1200<br>1 | volts<br>volts<br>ohms<br>µmhos<br>mA |
| Diode Units (Each Unit)  MAXIMUM RATINGS (Design-Maximum Values): Plate Current  CHARACTERISTICS, Instantaneous Value:     | 5 max                                 | mA                                    |

Tube Voltage Drop for plate current of 20 mA ......

#### HIGH-MU TRIODE

# 6FQ5A

Miniature type with frame grid used as rf-amplifier tube in vhf tuners of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

Heater Voltage (ac/dc) .....

| <b>_</b>  |
|-----------|
| HO - OB   |
|           |
| e Company |
| 7FP       |

6.3

volts

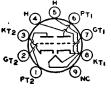
| Total total (act act)                                       | 0.40    |        |
|-------------------------------------------------------------|---------|--------|
| Heater Current                                              | 0.18    | ampere |
| Peak Heater-Cathode Voltage:                                | 400     |        |
| Heater negative with respect to cathode                     | 100 max | volts  |
| Heater positive with respect to cathode                     | 100 max | volts  |
| Direct Interelectrode Capacitances:                         |         | _      |
| Grid to Plate                                               | 0.52    | pF     |
| Grid to Cathode, Heater, and Internal Shield                | 5       | pF     |
| Plate to Cathode, Heater, and Internal Shield               | 3.5     | рF     |
| Heater to Cathode                                           | 2.5△    | pF     |
| *With external shield connected to cathode except as noted. |         |        |
| ▲ With external shield connected to ground.                 |         |        |
| Class A, Amplifier                                          |         |        |
| MAXIMUM RATINGS (Design-Maximum Values):                    |         |        |
| Plate Voltage                                               | 200 max | volts  |
| Grid Voltage, Negative-bias value                           | 50 max  | volts  |
| Average Cathode Current                                     | 22 max  | mA     |
| Plate Dissipation                                           | 2.5 max | watts  |
| CHARACTERISTICS:                                            |         |        |
| Plate Voltage                                               | 135     | volts  |
| Grid Voltage                                                | -1.2    | volts  |
| Amplification Factor                                        | 74      |        |
| Plate Resistance (Approx.)                                  | 6300    | ohms   |
| Transconductance                                            | 12000   | umhos  |
| Plate Current                                               | 8.9     | mA     |
| Grid Voltage (Approx.) for plate current of 100 $\mu$ A     | -4.5    | volts  |
| MAXIMUM CIRCUIT VALUES:                                     |         | . 0.11 |
| Grid-Circuit Resistance:                                    |         |        |
|                                                             |         |        |

6FQ7/ 6CG7 Related type:

8FQ7/8CG7

## MEDIUM-MU TWIN TRIODE

Miniature type used as combined vertical- and horizontal-deflection oscillator in television receivers. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be operated in any position. Type



1 max megohm

9LP

8FQ7/8CG7 is identical with type 6FQ7/6CG7 except for the heater ratings. For typical operation as a resistance-coupled amplifier, refer to **Resistance-Coupled Amplifier** section.

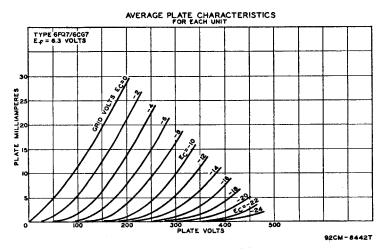
| Ampinier section.                                                                                              | 6FQ7/6CG7          | 8FQ7/8CG7          | ,              |
|----------------------------------------------------------------------------------------------------------------|--------------------|--------------------|----------------|
| Heater Voltage (ac/dc)                                                                                         | 6.3                | 8.4                | volts          |
| Heater Current                                                                                                 | 0.6                | 0.45               | ampere         |
| Heater Warm-up Time (Average)                                                                                  | 11                 |                    | seconds        |
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode | 200 max<br>200=max | 200 max<br>200=max | volts<br>volts |
| Direct Interelectrode Capacitances (Approx.):                                                                  | Unit No.1          | Unit No.2          |                |
| Grid to Plate                                                                                                  | 3.6                | 3.8                | рF             |
| Grid to Cathode and Heater                                                                                     | 2.4                | 2.4                | рF             |
| Plate to Cathode and Heater                                                                                    | 0.34               | 0.26               | рF             |
| Plate of Unit No.1 to Plate of Unit No.2                                                                       | 1                  |                    | pF             |

<sup>•</sup> The dc component must not exceed 100 volts.

For cathode-bias operation .....

| Class A. Amplifier (Each                          | Unit)      |           |        |
|---------------------------------------------------|------------|-----------|--------|
| MAXIMUM RATINGS (Design-Maximum Values):          |            |           |        |
| Plate Voltage                                     |            | 330 max   | volts  |
| Grid Voltage, Positive-bias value                 |            | 0 max     | volts  |
| For either plate                                  |            | 4 max     | watts  |
| For both plates with both units operating         |            | 5.7 max   | watts  |
| Cathode Current                                   |            | 22 max    | mA     |
| CHARACTERISTICS:                                  |            |           |        |
| Plate Voltage                                     | 90         | 250       | volts  |
| Grid Voltage                                      | 0          | -8        | volts  |
| Amplification Factor                              | 20         | 20        |        |
| Plate Resistance (Approx.)                        | 6700       | 7700      | ohms   |
| Transconductance                                  | 3000       | 2600      | μmhos  |
| Grid Voltage (Approx.) for plate current of 10 μA | <b></b> 7  | -18       | volts  |
| Plate Current for grid voltage of -12.5 volts     |            | 1.3       | mA.    |
| Plate Current                                     | 10         | 9         | mA     |
| MAXIMUM CIRCUIT VALUE: Grid-Circuit Resistance:   |            |           |        |
| For fixed-bias operation                          |            | 1.0 max   | megohm |
| Oscillator                                        |            |           |        |
| For operation in a 525-line, 30-fr                | ame system |           |        |
| •                                                 | Vertical   | Horizonta | 1      |

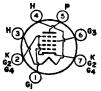
| Oscillator                                |             |            |         |
|-------------------------------------------|-------------|------------|---------|
| For operation in a 525-line, 30-fe        | rame system |            |         |
| •                                         | Vertical    | Horizontal |         |
| MAXIMUM RATINGS (Design-Maximum Values,   | Deflection  | Deflection | ı       |
| Each Unit):                               | Oscillator  | Oscillator |         |
| DC Plate Voltage                          | 330 max     | 330 max    | volts   |
| Peak Negative-Pulse Grid Voltage          | 440 max     | 660 max    | volts   |
| Peak Cathode Current                      | 77 max      | 330 max    | mA      |
| Average Cathode Current                   | 22 max      | 22 max     | mA      |
| Plate Dissipation:                        |             |            |         |
| For either plate                          | 4 max       | 4 max      | watts   |
| For both plates with both units operating | 5.7 max     | 5.7 max    | watts   |
| MAXIMUM CIRCUIT VALUE:                    |             |            |         |
| Grid-Circuit Resistance                   | 2.2 max     | 2.2 max    | megohms |
|                                           |             |            |         |



## **BEAM HEXODE**

6FS5
Related type: 2FS5

Miniature type used as rf-amplifier tube in vhf television receivers. In this tube, grid No.1 is the control grid, grid No.2 is a focusing grid, grid No.3 is the screen grid, and grid No.4 is the suppressor grid. Grid No.2 is inter-



7GA

nally connected to the cathode and grid No.4, and aligned with grid No.3. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 2FS5 is identical with type 6FS5 except for the heater ratings, as shown below.

| for the heater ratings, as shown below.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                       |            |         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------|---------|
| <u> </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2FS5                                  | 6FS5       |         |
| Heater Voltage (ac/dc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.4                                   | 6.3        | volts   |
| Heater Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.6                                   | 0.2        | ampere  |
| Heater Warm-up Time (Average)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 11                                    | -          | seconds |
| Peak Heater-Cathode Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                       |            | Becomes |
| Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 200 max                               | 200 max    | volts   |
| Heater positive with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 200°max                               | 200°max    | volts   |
| The state of the s | 200 11182                             | 200 Illax  | VOICS   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Without                               | With       |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | External                              | External   |         |
| Direct Interelectrode Capacitances:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Shield                                | Shield.    |         |
| Grid No.1 to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.03                                  | 0.016      | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.05                                  | 0.010      | DI.     |
| No.3, and Grid No.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4.8                                   | 4.8        | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 4.0                                   | 7.0        | pr.     |
| and Grid No.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2                                     | 2.8        | pF      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                                     | 2.0        | pı.     |
| • The dc component must not exceed 100 volts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                       |            |         |
| • With external shield connected to pin 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                       |            |         |
| •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       |            |         |
| Class A, Amplifie                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | r                                     |            |         |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                       |            |         |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                       | 300 max    | volts   |
| Grid-No.3 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | · · · · · · · · · · · · · · · · · · · | 150 max    | volts   |
| Grid-No.1 (Control-Grid) Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | · · · · · · · · · · · · · · · · · · · | 150 max    | VOILS   |
| Negative-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                       | -50 max    | volts   |
| Positive-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                       | 0 max      | volts   |
| Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                       | 20 max     | mA      |
| Grid-No.3 Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                       | 0.15 max   | watt    |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | 3.25 max   | watts   |
| Time Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       | J.ZJ IIIAX | watts   |
| CHARACTERISTICS:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       |            |         |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                       | 275        | volts   |
| Grid-No.3 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | 135        | volts   |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | -0.2       | volt    |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                       | 0.24       | megohm  |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       | 10000      | μmhos   |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                       | 9          | mA      |
| Grid-No.3 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | 0.17       | mA      |
| Grid-No.1 Voltage (Approx.) for transconductance of 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | umhos                                 | —5         | volts   |
| CITE TOTAL COMMENT OF THE PROPERTY OF THE PROP | m                                     | _3         | TORES   |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                       |            |         |
| Grid-No.1-Circuit Resistance, for fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                       | 0.5 max    | megohm  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                       |            |         |

## SHARP-CUTOFF TETRODE

6FV6

Miniature type used as rf amplifier in vhf tuners of television receivers. Outline 5C, Outlines section. Tube requires seven-contact socket and may be mounted in any position.



7FQ

| Heater Voltage (ac/dc)                                       | 6.3    | volts         |
|--------------------------------------------------------------|--------|---------------|
| Heater Current                                               | 0.2    | ampere        |
| Peak Heater-Cathode Voltage:                                 |        | _             |
| Heater negative with respect to cathode                      | 200 1  | nax volts     |
| Heater positive with respect to cathode                      | 200*1  | nax volts     |
| Direct Interelectrode Capacitances:°                         |        |               |
| Grid No.1 to Plate                                           | 0.03 1 | nax pF        |
| Grid No.1 to Cathode, Heater, Grid No.2, and Internal Shield | 4.5    | pF            |
| Plate to Cathode, Heater, Grid No.2, and Internal Shield     | 3      | ρF            |
| Cathode to Heater                                            | 2.7•   | ρF            |
| Cathour to Heater                                            |        | <b>*</b> -    |
| * The dc component must not exceed 100 volts.                |        |               |
| ° With external shield connected to cathode except as noted. |        |               |
| •                                                            |        |               |
| • With external shield connected to ground.                  |        |               |
| Class A, Amplifier                                           |        |               |
| MAXIMUM RATINGS (Design-Maximum Values):                     |        |               |
| Plate Voltage                                                | 275 1  | nax volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                       | 180    | nax volts     |
| Grid-No.2 Voltage                                            | See    | curve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value        |        | max volts     |
| Cathode Current                                              |        | max mA        |
| Grid-No.2 Input:                                             |        |               |
| For grid-No.2 voltages up to 90 volts                        | 0.5    | max watt      |
| For grid-No.2 voltages between 90 and 180 volts              |        | curve page 80 |
| Plate Dissipation                                            |        | max watts     |
| riate Dissipation                                            |        |               |
| CHARACTERISTICS:                                             |        |               |
| Plate Voltage                                                | 125    | volts         |
| Grid-No.2 Voltage                                            | 80     | volts         |
| Grid-No.1 Voltage                                            | -1     | volt          |
| Plate Resistance (Approx.)                                   | 0.1    | megohm        |
| Transconductance                                             | 8000   | μmhos         |
|                                                              |        |               |

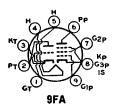


Plate Current ...

Grid-No.2 Current .

**MAXIMUM CIRCUIT VALUES:** 

Grid-No.1-Circuit Resistance .....

### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Grid-No. 1 Voltage (Approx.) for plate current of 20  $\mu$ A .....

Miniature type used in television receivers as combined oscillator and amplifier. Triode is used as vertical deflection oscillator; pentode is used as if or general-purpose amplifier. Outline 6B, **Outlines** section. Tube

6FV8A
Related type:
5FV8

0.5 max megohm

10

1.5

mA

mA

volts

requires nine-contact socket and may be operated in any position. Type 5FV8 is identical with type 6FV8A except for the heater ratings, as shown below.

|                                                   | 5FV8     | 6FV8A    |         |
|---------------------------------------------------|----------|----------|---------|
| Heater Voltage (ac/dc)                            | 4.7      | 6.3      | volts   |
| Heater Current                                    | 0.6      | 0.45     | ampere  |
| Heater Warm-up Time (Average)                     | 11       | 11       | seconds |
| Peak Heater-Cathode Voltage:                      |          |          |         |
| Heater negative with respect to cathode           | 200 max  | 200 max  | volts   |
| Heater positive with respect to cathode           | 200°max  | 200°max  | volts   |
|                                                   | Without  | With     |         |
| Direct Interelectrode Capacitances:               | External | External |         |
| Triode Unit:                                      | Shield   | Shield   |         |
| Grid to Plate                                     | 1.8      | 1.8      | рF      |
| Grid to Cathode, Heater, Pentode Cathode, Pentode |          |          |         |
| Grid No.3, and Internal Shield                    | 2.8      | 2.8      | рF      |
| Plate to Cathode, Heater, Pentode Cathode,        |          |          |         |
| Pentode Grid No.3, and Internal Shield            | 1.5      | 2        | pF      |

| Pentode Unit:                                                                                                                                                                                                                                                                                                 | 0.00                                            | 0.04                                                             |                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------|----------------------------------------|
| Grid No.1 to Plate                                                                                                                                                                                                                                                                                            | 0.02 max                                        | 0.01 max                                                         | pF                                     |
| No.3, and Internal Shield                                                                                                                                                                                                                                                                                     | 5                                               | 5                                                                | pF                                     |
| Plate to Cathode, Heater, Grid No.2, Grid No.3,                                                                                                                                                                                                                                                               |                                                 | -                                                                |                                        |
| and Internal Shield                                                                                                                                                                                                                                                                                           | 2                                               | 3                                                                | рF                                     |
| Pentode Plate to Triode Plate  The dc component must not exceed 100 volts.                                                                                                                                                                                                                                    | 0.15 max                                        | 0.03 max                                                         | p <b>F</b>                             |
| The uc component must not exceed 100 voits.                                                                                                                                                                                                                                                                   |                                                 |                                                                  |                                        |
| Class A, Amplifie<br>Pentode Unit                                                                                                                                                                                                                                                                             | er                                              |                                                                  |                                        |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                       |                                                 |                                                                  |                                        |
| Plate Voltage                                                                                                                                                                                                                                                                                                 |                                                 | 330 max                                                          | volts                                  |
| Grid-No.2 (Screen-Grid) Supply Voltage                                                                                                                                                                                                                                                                        |                                                 | 330 max                                                          | volts                                  |
| Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                                                                                                                       |                                                 | See curve<br>0 max                                               | page 80 volts                          |
| Plate Dissipation                                                                                                                                                                                                                                                                                             |                                                 | 2.3 max                                                          | watts                                  |
| Grid-No.2 Input:                                                                                                                                                                                                                                                                                              |                                                 | ***************************************                          |                                        |
| For grid-No.2 voltages up to 165 volts                                                                                                                                                                                                                                                                        |                                                 | 0.55 max                                                         | watt                                   |
| For grid-No.2 voltages between 165 and 330 volts                                                                                                                                                                                                                                                              |                                                 | See curve                                                        | page 80                                |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                       |                                                 |                                                                  |                                        |
| Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                                                                 |                                                 |                                                                  | _                                      |
| For fixed-bias operation                                                                                                                                                                                                                                                                                      |                                                 | 0.25 max                                                         |                                        |
| For cathode-bias operation                                                                                                                                                                                                                                                                                    |                                                 | 1 max                                                            | megohm                                 |
| CHEAD A COMPRESSOR                                                                                                                                                                                                                                                                                            | Triode<br>Unit                                  | Pentode<br>Unit                                                  |                                        |
| CHARACTERISTICS: Plate Voltage                                                                                                                                                                                                                                                                                | 125                                             | 125                                                              | volts                                  |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                             | -                                               | 125                                                              | volts                                  |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                             | -1                                              | -1                                                               | volt                                   |
| Amplification Factor                                                                                                                                                                                                                                                                                          | 45                                              | _                                                                |                                        |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                    | 5600                                            | 200000                                                           | ohms                                   |
| Transconductance                                                                                                                                                                                                                                                                                              | 8000                                            | 6500                                                             | μmhos                                  |
|                                                                                                                                                                                                                                                                                                               |                                                 |                                                                  |                                        |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A                                                                                                                                                                                                                                                   | <b>-7.5</b>                                     | _9<br>12                                                         | volts                                  |
| Plate Current                                                                                                                                                                                                                                                                                                 | -7.5<br>12<br>-                                 | _9<br>12<br><b>4</b>                                             | mA                                     |
|                                                                                                                                                                                                                                                                                                               |                                                 | 12                                                               |                                        |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator                                                                                                                                                                                                                                               | 12<br>—<br>—Triode Uni                          | 12 4                                                             | mA                                     |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f                                                                                                                                                                                                             | 12<br>—<br>—Triode Uni                          | 12 4                                                             | mA                                     |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                    | 12<br>—<br>— <b>Triode Uni</b><br>frame system  | 12<br>4<br>t                                                     | mA<br>mA                               |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage                                                                                                                                                   | 12<br>—<br>— <b>Triode Un</b> i<br>frame system | 12<br>4<br>t                                                     | mA<br>mA                               |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage Peak Negative-Pulse Grid Voltage                                                                                                                  | Triode Uni                                      | 12<br>4<br>t                                                     | mA<br>mA<br>volts                      |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage Peak Negative-Pulse Grid Voltage Peak Cathode Current                                                                                             | —Triode Uni                                     | 12<br>4<br>t<br>330 max<br>-250 max<br>70 max                    | wolts volts mA                         |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage Peak Negative-Pulse Grid Voltage                                                                                                                  | 12<br>—<br>— <b>Triode Uni</b><br>frame system  | 12<br>4<br>t                                                     | mA<br>mA<br>volts                      |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage Peak Negative-Pulse Grid Voltage Peak Cathode Current Average Cathode Current Plate Dissipation                                                   | 12<br>—<br>— <b>Triode Uni</b><br>frame system  | 12<br>4<br>t<br>330 max<br>-250 max<br>70 max<br>20 max          | volts<br>volts<br>mA<br>mA             |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage Peak Negative-Pulse Grid Voltage Peak Cathode Current Average Cathode Current                                                                     | 12<br>—<br>— <b>Triode Uni</b><br>frame system  | 12<br>4<br>t<br>330 max<br>-250 max<br>70 max<br>20 max          | volts<br>volts<br>mA<br>mA             |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage Peak Negative-Pulse Grid Voltage Peak Cathode Current Average Cathode Current Plate Dissipation MAXIMUM CIRCUIT VALUES:                           | Triode Unitrame system                          | 12<br>4<br>t<br>330 max<br>-250 max<br>70 max<br>20 max<br>2 max | volts<br>volts<br>mA<br>mA             |
| Plate Current Grid-No.2 Current  Vertical-Deflection Oscillator. For operation in a 525-line, 30-f MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage Peak Negative-Pulse Grid Voltage Peak Cathode Current Average Cathode Current Plate Dissipation MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance: | Triode Unitrame system                          | 12<br>4<br>t<br>330 max<br>-250 max<br>70 max<br>20 max<br>2 max | volts<br>volts<br>volts<br>mA<br>watts |

## **BEAM POWER TUBE**

6FW5

Glass octal type used as horizontaldeflection amplifier in television receivers. Outline 19B, **Outlines** section. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.2; peak



6CK

heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

#### **Horizontal-Deflection Amplifier**

For operation in a 525-line, 30-frame system

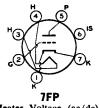
| MAXIMUM RATINGS (Design-Maximum Values): |          |       |
|------------------------------------------|----------|-------|
| DC Plate Voltage                         | 770 max  | volts |
| Peak Positive-Pulse Plate Voltage°       | 6500 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage       | 220 max  | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | -330 max | volts |
| DC Grid-No.1 (Control-Grid) Voltage      | —55 max  | volts |

1 max megohm

| Peak Cathode Current Average Cathode Current Grid-No.2 Input | 610 max<br>175 max<br>3.6 max | mA<br>mA<br>watts |
|--------------------------------------------------------------|-------------------------------|-------------------|
| Plate Dissipation•                                           | 18 max<br>220 max             | watts<br>°C       |
| Bulb Temperature (At hottest point)                          | 220 Hax                       | C                 |

Grid-No.1-Circuit Resistance ..... \* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

· An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



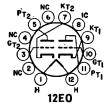
#### HIGH-MU TRIODE

Miniature type with frame grid used for rf-amplifier applications in vhf tuners of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

# 6FY5/ **EC97**

| Heater Voltage (ac/dc)                        |          | 6.3       | volts  |
|-----------------------------------------------|----------|-----------|--------|
| Heater Current                                |          | 0.2       | ampere |
| Peak Heater-Cathode Voltage:                  |          |           | •      |
| Heater negative with respect to cathode       |          | 100 max   | volts  |
| Heater positive with respect to cathode       |          | 100 max   | volts  |
| • • • • • • • • • • • • • • • • • • • •       | Without  | With      | -      |
|                                               | External | External  |        |
| TO A TALL A STATE OF THE                      |          |           |        |
| Direct Interelectrode Capacitances:           | Shield   | Shield    |        |
| Grid to Plate                                 | 0.50     | 0.48      | рF     |
| Grid to Cathode, Heater, and Internal Shield  | 4.75     | 4.75      | pF     |
| Plate to Cathode, Heater, and Internal Shield | 3.3      | 4.3       | pF     |
| Grid to Heater                                | 0.28 max | 0.28 max  | pF     |
| Plate to Cathode                              | 0.25     | 0.21      | pF     |
| Cathode to Grid                               | 3.2      | 3.2       | pF     |
| Heater to Cathode                             | 2.5      | 2.5       | pF     |
| reacti to Camodo                              | 2.3      | 2.3       | pr.    |
| Olace A. Amulific                             |          |           |        |
| Class A, Amplifie                             | er .     |           |        |
| MAXIMUM RATINGS (Absolute-Maximum Values):    |          |           |        |
| Plate Supply Voltage                          |          | 550 max   | volts  |
| Plate Voltage                                 |          | 200 max   | volts  |
| TIME TOTALE                                   |          | 200 Illan | 10113  |

| Plate Supply Voltage              | oou max  | voits  |
|-----------------------------------|----------|--------|
| Plate Voltage                     | 200 max  | volts  |
| Grid Voltage, Negative-bias Value | 50 max   | volts  |
| Cathode Current                   | 20 max   | mA     |
| Plate Dissipation                 | 2.2 max  | watts  |
| CHARACTERISTICS:                  |          |        |
| Plate Voltage                     | 135      | volts  |
| Grid Voltage —1 —3.1 —5           | 4.5      | volts  |
| Transconductance                  |          | μmhos  |
| Amplification Factor 70 — —       |          | •      |
| Plate Current 11 — —              | 0.1      | mA     |
| MAXIMUM CURCUIT VALUE:            |          |        |
| Cathode-Heater Circuit Resistance | 0.02 max | megohm |
| Grid-Circuit Resistance           | 1 max    | megohm |



#### **DUAL TRIODE**

Duodecar type used as combined vertical-deflection oscillator and verticaldeflection amplifier in television receivers. The high-mu triode unit No.1 is used as an oscillator, and the lowmu triode unit No.2 is used as an am-

Related type: 15FY7

plifier. Outline 8D, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 15FY7 is identical with type 6FY7 except for the heater ratings, as shown below.

|                                         | 6FY7    | 15 <b>FY</b> 7 |         |
|-----------------------------------------|---------|----------------|---------|
| Heater Voltage (ac/dc)                  | 6.3     | 14.7           | volts   |
| Heater Current                          | 1.05    | 0.45           | ampere  |
| Heater Warm-up Time (Average)           |         | 11             | seconds |
| Peak Heater-Cathode Voltage:            |         |                |         |
| Heater negative with respect to cathode | 200 max | 200 max        | volts   |
| Heater positive with respect to cathode | 200=max | 200 • max      | voits   |

The dc component must not exceed 100 volts.

#### Class A, Amplifier

| CHARACTERISTICS:                                       | Unit No.1 | Unit No.2 |              |
|--------------------------------------------------------|-----------|-----------|--------------|
| Plate Voltage                                          | 250       | 150       | volts        |
| Grid Voltage                                           | -3        | -17.5     | volts        |
| Amplification Factor                                   | 65        | 6         |              |
| Plate Resistance (Approx.)                             | 40500     | 800       | ohm <b>s</b> |
| Transconductance                                       | 1600      | 7500      | μmhos        |
| Grid Voltage (Approx.) for plate current of 30 $\mu$ A | 5.5       |           | volts        |
| Grid Voltage (Approx.) for plate current of 50 $\mu$ A |           | 55        | volts        |
| Plate Current                                          | 1.4       | 45        | mA           |
| Plate Current (Approx.) for grid voltage of -25 volts. |           | 10        | mA           |

#### Vertical-Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): | Unit No.1<br>Oscillator | Unit No.2<br>Amplifier |        |
|------------------------------------------|-------------------------|------------------------|--------|
| DC Plate Voltage                         | 330 max                 | 275 max                | voits  |
| Peak Positive-Pulse Plate Voltage#       |                         | 2000 max               | volts  |
| Peak Negative-Pulse Plate Voltage        | -400 max                | -250 max               | volts  |
| Peak Cathode Current                     | 70 max                  | 175 max                | mA     |
| Average Cathode Current                  | 20 max                  | 50 max                 | mA     |
| Plate Dissipation                        | 1 max                   | 7†max                  | watts  |
| MAXIMUM CIRCUIT VALUES:                  |                         |                        |        |
| Grid-Circuit Resistance                  | 22 max                  | 22 mar m               | eachme |

<sup>#</sup> The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds. † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

## **BEAM POWER TUBE**

6GB5 Related types: 13GB5, 27GB5/PL500 Neonoval type used as horizontal-deflection amplifier in television receivers.

Outline 10E, **Outlines** section. Tube requires neonoval nine-contact socket and may be mounted in any position.

Typical instantaneous characteristics

9NH

27GR5/

(measured with recurrent waveform such that maximum ratings are not exceeded): plate volts, 75; grid-No.2 volts, 200; grid-No.1 volts, -10; plate mA., 440; grid-No.2 mA, 37. Types 13GB5 and 27GB5/PL500 are identical with type 6GB5 except for heater ratings, as shown below.

| 6GB5    | 13GB5                  | PL500                                   |                                                        |
|---------|------------------------|-----------------------------------------|--------------------------------------------------------|
| 6.3     | 13.3                   | 27                                      | volts                                                  |
| 1.38    | 0.6                    | 0.3                                     | amperes                                                |
| 250°max |                        | 250 max<br>250°max                      | volts<br>volts                                         |
|         | 6.3<br>1.38<br>250 max | 6.3 13.3<br>1.38 0.6<br>250 max 250 max | 6.3 13.3 27<br>1.38 0.6 0.3<br>250 max 250 max 250 max |

#### Horizontal-Deflection Amplifier For operation in a \$25-line 30-frame system

| roi operation in a 323-inie, 30-france system |          |       |
|-----------------------------------------------|----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):      |          |       |
| DC Grid-No.2 (Screen-Grid) Voltage            | 275 max  | volts |
| Peak Positive-Pulse Plate Voltage.            | 7700 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage            | 275 max  | volts |
| Average Cathode Current                       |          | mA    |
| Grid-No.2 Input                               | 5 max    | watts |
| Plate Dissipation                             | 17 max   | watts |
| MAXIMIIM CIDCLIFF VALUES.                     |          |       |

MUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance 2.2 max megohms • The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning

cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

• Grid-No.2 input may reach 6 watts for plate-dissipation values below 11 watts.

An adequate bias resistor or other means is required to protect the tube in the absence of excitation,



### **BEAM POWER TUBE**

Neonoval type used as output tube in audio-amplifier applications. Outline 10D, Outlines section. Tube requires neonoval nine-contact socket and may be mounted in any position.

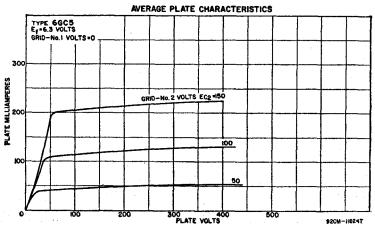
6GC5

| V                                                      |         |            |
|--------------------------------------------------------|---------|------------|
| Heater Voltage (ac/dc)                                 | 6.3     | volts      |
| Heater Current                                         | 1.2     | ampere     |
| Peak Heater-Cathode Voltage:                           |         | •          |
| Heater negative with respect to cathode                | 200 max | volts      |
| Heater positive with respect to cathode                | 200=max | volts      |
| Direct Interelectrode Capacitances (Approx.):          |         |            |
| Grid No.1 to Plate                                     | 0.9     | рF         |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 18      | pF         |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 7       | pF         |
| The dc component must not exceed 100 volts             |         | <b>P</b> - |

The dc component must not exceed 100 volts.

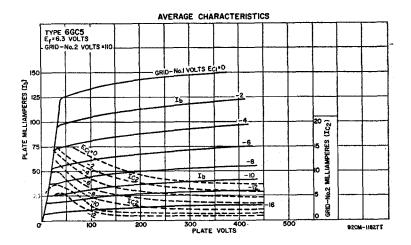
Class A, Amplifier

| MAXIMUM KATINGS (Design-Maximum Values); |         |       |
|------------------------------------------|---------|-------|
| Plate Voltage                            | 220 max | volts |
| Grd-No.2 (Screen-Grid) Voltage           | 140 max | volts |
| Grid-No.2 Input                          | 1.4 max | watts |
| Plate Dissipation                        | 12 max  | watts |



| 110   | 200                                                                             | volts                                                                                             |
|-------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 110   | 125                                                                             | volts                                                                                             |
|       |                                                                                 | volts                                                                                             |
|       |                                                                                 | ohms                                                                                              |
| 75    |                                                                                 | volts                                                                                             |
| 40    |                                                                                 | mA                                                                                                |
|       |                                                                                 | mA                                                                                                |
| 30    |                                                                                 |                                                                                                   |
| 4     |                                                                                 | mA                                                                                                |
|       |                                                                                 | mA                                                                                                |
| 13000 | 28000                                                                           | ohms                                                                                              |
| 8000  | 8000                                                                            | μmhos.                                                                                            |
| 2000  | 4000                                                                            | ohms                                                                                              |
| 10    | 10                                                                              | per cent                                                                                          |
| 2.1   | 3.8                                                                             | watts                                                                                             |
|       |                                                                                 |                                                                                                   |
|       |                                                                                 |                                                                                                   |
|       | 0.1 ma                                                                          | x megohm                                                                                          |
|       |                                                                                 | x megohm                                                                                          |
|       | 110<br>-7.5<br>7.5<br>49<br>50<br>4<br>10<br>13000<br>8000<br>2000<br>10<br>2.1 | 110 125 -7.5 - 180 7.5 8.5 49 46 50 47 4 2.2 10 8.5 13000 28000 8000 8000 2000 4000 10 10 2.1 3.8 |

TYPICAL OPERATION AND CHARACTERISTICS:



## **BEAM POWER TUBE**

6GE5
Related types: 12GE5, 17GE5

Duodecar type used as horizontal-deflection-amplifier tube in television receivers. Outline 15A, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Types 12GE5 and

any position. Types 12GE5 and 12BJ 17GE5 are identical with type 6GE5 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current                                              | 6GE5<br>6.3<br>1.2 | 12GE5<br>12.6<br>0.6 | 17GE5<br>16.8<br>0.45 | volts<br>ampere |
|------------------------------------------------------------------------------------|--------------------|----------------------|-----------------------|-----------------|
| Heater Warm-up Time (Average) Peak Heater-Cathode Voltage:                         |                    | 11                   | 11                    | seconds         |
| Heater negative with respect to cathode<br>Heater positive with respect to cathode | 200 max<br>200•max |                      | 200 max<br>200=max    | volts<br>volts  |

<sup>•</sup> The dc component must not exceed 100 volts.

#### Class A. Amplifier

| CHARACTERISTICS: Plate Voltage                        | - 60 | 250   | volts |
|-------------------------------------------------------|------|-------|-------|
| Grid-No.2 (Screen-Grid) Voltage                       | 150  | 150   | volts |
| Grid-No.1 (Control-Grid) Voltage                      | 0    | -22.5 | volts |
| Triode Amplification Factor*                          | _    | 4.4   |       |
| Plate Resistance (Approx.)                            | _    | 18000 | ohms  |
| Transconductance                                      |      | 7300  | μmhos |
| Plate Current                                         | 345● | 65    | mA    |
| Grid-No.2 Current                                     | 27•  | 1.8   | mA.   |
| Grid-No.1 Voltage (Approx.) for plate current of 1 mA |      | 42    | volts |
|                                                       |      |       |       |

- \* Triode connection (grid No.2 tied to plate); plate and grid-No.2 volts = 150.
- This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system MAXIMUM RATINGS (Design-Maximum Values): 770 max volte DC Plate Supply Voltage Peak Positive-Pulse Plate Voltage# ..... 6500 max volts -1500 max volts Peak Negative-Pulse Plate Voltage ..... DC Grid-No.2 Voltage ... 220 max volts --330 max Peak Negative-Pulse Grid-No.1 Voltage ..... volts -55 max volts DC Grid-No.1 Voltage 550 max mA Peak Cathode Current ..... Average Cathode Current ..... 175 max mA Plate Dissipation† ..... 17.5 max watts Grid-No.2 Input ... 3.5 max watts Bulb Temperature (At hottest point) ...... 200 max °C

#### **MAXIMUM CIRCUIT VALUES:**

1 max megohm

Grid-No.1-Circuit Resistance .... # The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

† An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



CHARACTERISTICS:

### **BEAM POWER TUBE**

Duodecar type used as horizontal-deflection amplifier in television receivers. Outline 8D, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc),

6GF5

6.3; amperes, 1.2; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A, Amplifier

| CHARACTERISTICS:                                                |                |            |        |
|-----------------------------------------------------------------|----------------|------------|--------|
| Plate Voltage                                                   | 60             | 250        | volts  |
| Grid-No.2 (Screen-Grid) Voltage                                 | 150            | 150        | volts  |
| Grid-No.1 (Control-Grid) Voltage                                | 0              | 26.5       | volts  |
| Triode Amplification Factor*                                    | _              | 4.2        |        |
| Plate Resistance (Approx.)                                      | _              | 0.26       | megohm |
| Transconductance                                                | _              | 4700       | μmhos  |
| Plate Current                                                   | 345●           | 34         | mA     |
| Grid-No.2 Current                                               | 33•            | 1.6        | mA     |
| Grid-No.1 Voltage (Approx.) for plate current of 1 mA           |                | <b>—46</b> | volts  |
| # Totale commendate Could No. 2 commended to place to place and | I amid NTa 2 w | -14m 15O   |        |

\* Triode connection (grid No.2 connected to plate); plate and grid-No.2 volts = 150.

• These values can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |          |       |
|------------------------------------------|----------|-------|
| DC Plate Supply Voltage                  | 770 max  | volts |
| Peak Positive-Pulse Plate Voltage#       | 5000 max | volts |

| Peak Negative-Pulse Plate Voltage DC Grid-No.2 Voltage Peak Negative-Pulse Grid-No.1 Voltage Negative DC Grid-No.1 Voltage Peak Cathode Current Average Cathode Current Plate Dissipation† Grid-No.2 Input | 220 max<br>330 max<br>55 max<br>500 max<br>160 max<br>9 max | volts volts volts volts mA mA watts |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------|
| Grid-No.2 Input Bulb Temperature (At hottest point)                                                                                                                                                        | 25 max                                                      | watts                               |

MAXIMUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance .....

1 max megohm

# The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds. † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

# 6GF7 6GF7A

10GF7, 10GF7A, 13GF7, 13GF7A

Hantar Voltage (no./do)

## **DUAL TRIODE**

Novar types containing high-mu and high-perveance, low-mu triode units used as combined vertical-deflection 67,2 oscillator and vertical-deflection amplifiers in television receivers. Outlines 11A and 30A, respectively, Outlines



13GF7A

section. Tubes require novar nine-contact socket and may be mounted in any position. For curves of average plate characteristics for Unit No.1 and Unit No.2, refer to types 6DR7 (Unit No.1) and 6EM7, respectively. Types 10GF7 and 10GF7A and types 13GF7 and 13GF7A are identical with types 6GF7 and 6GF7A except for the heater ratings, as shown below.

| Heater Voltage (ac/dc)                                          | 6.3       | 9.7        | 13         | volts   |
|-----------------------------------------------------------------|-----------|------------|------------|---------|
| Heater Current                                                  | 0.985     | 0.6        | 0.45       | ampere  |
| Heater Warm-up Time (Average)                                   | _         | 11         | 11         | seconds |
| Peak Heater-Cathode Voltage:                                    |           |            |            |         |
| Heater negative with respect to cathode                         | 200 max   | x 200 max  | 200 max    | volts   |
| Heater positive with respect to cathode                         | 200 • ma: | x 200•max  | 200 max    | volts   |
| Direct Interelectrode Capacitances (Approx.)                    | 1         | Unit No.1  | Unit No.2  |         |
| Grid to Plate                                                   |           | 4.6        | 9          | pF      |
| Grid to Cathode and Heater                                      |           | 2.4        | 6.5        | рF      |
| Plate to Cathode and Heater                                     |           | 0.26       | 1.4        | ρF      |
| <ul> <li>The dc component must not exceed 100 volts.</li> </ul> |           |            |            | -       |
| Class A, A                                                      | Amplifier | •          |            |         |
| CHARACTERISTICS:                                                | •         | Unit No.1  | Unit No.2  |         |
| Plate Voltage                                                   |           | 250        | 150        | volts   |
| Grid Voltage                                                    |           | -3         | -20        | volts   |
| Amplification Factor                                            |           | 64         | 5 4        |         |
| Plate Resistance (Approx.)                                      |           | 40000      | 750        | ohms.   |
| Transconductance                                                |           | 1600       | 7200       | μmhos   |
| Grid Voltage (Approx.):                                         |           |            |            | •       |
| For plate current of 10 $\mu$ A                                 |           | <b>5.5</b> | _          | volts   |
| For plate current of 100 μA                                     |           | _          | <b>-45</b> | volts   |
| Plate Current                                                   |           | 1.4        | 50         | mA      |
| For plate voltage of 60 volts and zero grid v                   | oltage    | _          | 95         | mA      |
| For grid voltage of -28 volts                                   |           |            | 10         | mA      |
|                                                                 |           |            |            |         |

#### Vertical-Deflection Oscillator and Amplifier For operation in a 525-line, 30-frame system

| BEAUTHERITE TO A PRODUCT OF A SECOND STATE OF A | Unit No.1  | Unit No.2  |       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Oscillator | Amplifier  |       |
| DC Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 330 max    | 330 max    | volts |
| Peak Positive-Pulse Plate Voltage (Absolute Maximum)#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | _          | 1500 • max | volts |
| Peak Negative-Pulse Grid Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 400 max    | -250 max   | volts |
| Peak Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 77 max     | 175 max    | mA    |
| Average Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 22 max     | 50 max     | mA    |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1.5 max    | 11 max     | watts |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-Circuit Resistance:

For grid-resistor-bias or cathode-bias operation ... 2.2 max 2.2 max megohms

- Under no circumstances should this absolute value be exceeded.
- # The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In
- a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.



## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in multivibratortype horizontal-deflection circuits in television receivers. Also used for agcamplifier or sync-separator applications in such receivers. Outline 6B, Outlines section. Tube requires minia-

6GH8A
Related type:
5GH8

ture nine-contact socket and may be mounted in any position. This type is specially controlled to assure low interelectrode leakage. Type 5GH8 is identical with type 6GH8A except for the heater ratings, as shown below.

|                                                        | 5GH8       | 6GH8A    |         |
|--------------------------------------------------------|------------|----------|---------|
| Heater Voltage (ac/dc)                                 | 4.7        | 6.3      | volts   |
| Heater Current                                         | 0.6        | 0.45     | ampere  |
| Heater Warm-up Time (Average)                          | 11         | 11       | seconds |
| Peak Heater-Cathode Voltage:                           |            |          |         |
| Heater negative with respect to cathode                | 200 max    | 200 max  | volts   |
| Heater positive with respect to cathode                | 200 max    | 200 max  | volts   |
| Direct Interelectrode Capacitances:                    |            |          |         |
| Triode Unit:                                           |            |          |         |
| Grid to Plate                                          |            | 1.7      | pF      |
| Grid to Cathode, Heater, Pentode Grid No.3, Pentode    |            |          |         |
| and Internal Shield                                    |            | 3        | pF      |
| Plate to Cathode, Heater, Pentode Grid No.3, Pentode   |            |          | •       |
| and Internal Shield                                    |            | 1.4      | pF      |
| Heater to Cathode                                      |            | 3        | pF      |
| Pentode Unit:                                          |            |          |         |
| Grid No.1 to Plate                                     |            | 0.02 max | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, an | d Internal |          | •       |
| Shield                                                 |            | 5        | p₽      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, an     |            |          | -       |
| Shield                                                 |            | 2.6      | pF      |
| Heater to Cathode, Grid No.3, and Internal Shield      |            | 3        | ρF      |
| • • •                                                  |            |          | -       |

The dc component must not exceed 100 volts.

#### Class A, Amplifier

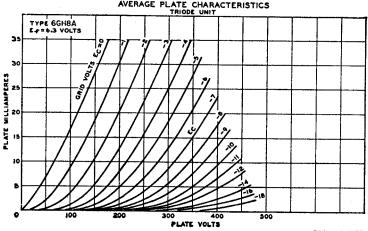
| CHARACTERISTICS:                                            | Triode Unit | Pentode Unit |       |
|-------------------------------------------------------------|-------------|--------------|-------|
| Plate Voltage                                               | 125         | 125          | volts |
| Grid-No.2 Voltage                                           |             | 125          | volts |
| Grid-No.1 Voltage                                           | -1          | -1           | volts |
| Amplification Factor                                        | 46          | -            |       |
| Plate Resistance (Approx.)                                  | 5400        | 200000       | ohms  |
| Transconductance                                            | 8500        | 7500         | μmhos |
| Plate Current                                               | 13.5        | 12           | mA    |
| Grid-No.2 Current                                           |             | . 4          | mA    |
| Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A | -8          | <b>—8</b>    | volts |

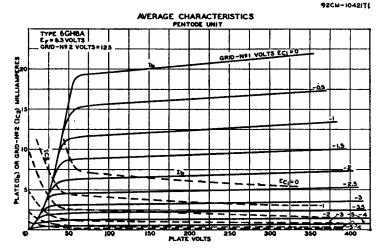
#### Horizontal-Deflection Oscillator

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): | Triode Unit | Pentode Unit |       |
|------------------------------------------|-------------|--------------|-------|
| Plate Voltage                            | 330 max     | 350 max      | volts |
| Grid-No.2 (Screen-Grid) Voltage          | <b></b> -   | 330 max      | volts |
| Grid-No.1 (Control-Grid) Voltage:        |             |              |       |
| Positive-bias value                      | 0 max       | 0 max        | voits |
| Peak negative value                      | _           | —175 max     | voits |
| Peak Cathode Current                     | _           | 300 max      | mA    |

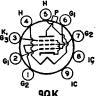
|                                                       | Triode Unit  | Pentode Unit    |
|-------------------------------------------------------|--------------|-----------------|
| Average Cathode Current                               | ****         | 20 max mA       |
| Grid-No.2 Input                                       | <del>-</del> | 0.55 max watt   |
| Plate Dissipation                                     | 2.5 max      | 2.5 max watts   |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: |              |                 |
| For fixed-bias operation                              | 2.2 max      | 2.2 max megohms |
| For cathode-bias operation                            | 2.2 max      | 2.2 max megohms |
| AVERAGE PLATE CHARACT                                 | FRISTICS     |                 |





## **BEAM POWER TUBE**

6GJ5A Related types: 12GJ5A, 17GJ5A Novar type used in high-efficiency 63(3) horizontal-deflection-amplifier circuits of television receivers. Outline 32, 6(2) Outlines section. Tube requires novar nine-contact socket and may be operated in any position. For curve of



average characteristics see type 6GW6. Types 12GJ5A and 17GJ5A are identical

with type 6GJ5A except for the heater ratings, as shown below.

|                                               | 6GJ5A    | 12GJ5A    | 17GJ5A  |         |
|-----------------------------------------------|----------|-----------|---------|---------|
| Heater Voltage (ac/dc)                        | 6.3      | 12.6      | 16.8    | volts   |
| Heater Current                                | 1.2      | 0.6       | 0.45    | ampere  |
| Heater Warm-up Time (Average)                 |          | 11        | 11      | seconds |
| Peak Heater-Cathode Voltage:                  |          |           |         |         |
| Heater negative with respect to cathode       | 200 ma   | x 200 max | 200 max | volts   |
| Heater positive with respect to cathode       | 200 = ma | x 200=max | 200=max | volts   |
| Direct Interelectrode Capacitances (Approx.): |          |           |         |         |
| Grid No.1 to Plate                            |          |           | 0.26    | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, ar   | d Grid N | 0.3       | 15      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Gr.  |          |           | 6.5     | pF      |

The dc component must not exceed 100 volts.

#### Class A, Amplifier

|                                             | Triode     |         |            |       |
|---------------------------------------------|------------|---------|------------|-------|
|                                             | Connection | Pentode | Connection |       |
| Plate Voltage                               | 150        | 60      | 250        | volts |
| Grid-No.2 Voltage                           | 150        | 150     | 150        | volts |
| Grid-No.1 Voltage                           | -22.5      | 0       | -22.5      | volts |
| Mu-Factor, grid No.2 to grid No.1           | 4.4        |         | _          |       |
| Plate Resistance (Approx.)                  |            | _       | 15000      | ohms  |
| Transconductance                            | _          | _       | 7100       | μmhos |
| Plate Current                               | -          | 390□    | 70         | mA    |
| Grid-No.2 Current                           | _          | 32□     | 2.1        | mA    |
| Grid-No.1 Voltage for plate current of 1 mA | _          | _       | 42         | volts |

<sup>☐</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

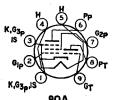
| MAXIMUM RATINGS (Design-Maximum Values): |           |       |
|------------------------------------------|-----------|-------|
| DC Plate Supply Voltage                  | 770 max   | volts |
| Peak Positive-Pulse Plate Voltage*       | 6500 max  | volts |
| Peak Negative-Pulse Plate Voltage        | -1500 max | volts |
| DC Grid-No.2 Voltage                     | 220 max   | volts |
| DC Grid-No.1 Voltage                     | —55 max   | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | -330 max  | volts |
| Peak Cathode Current                     | 550 max   | mA    |
| Average Cathode Current                  | 175 max   | mA.   |
| Plate Dissipation•                       |           | watts |
| Grid-No.2 Input                          | 3.5 max   | watts |
| Bulb Temperature (at hottest point)      | 240 max   | •C    |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

For grid-resistor-bias operation. 1 max megohm. The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds,

 An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used as combined oscillator and mixer tube in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. Outline 6J, Outlines section. Tube requires miniature nine-

**6GJ7** 

contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.41; peak heater-cathode volts, 110.

Class A, Amplifier

| Ciass A <sub>1</sub> Anipinie                          |               |             |            |
|--------------------------------------------------------|---------------|-------------|------------|
| MAXIMUM RATINGS (Design-Maximum Values):               | ` Triode Unit | Pentode Uni | t          |
| Plate-Supply Voltage                                   | 600 max       | 600 max     | volts      |
| DC Plate Voltage                                       | 140 max       | 275 max     | volts      |
| Grid-No.2 (Screen-Grid) Supply Voltage                 |               | 600 max     | volts      |
| DC Grid-No.2 Voltage                                   | _             | 275 max     | volts      |
| DC Grid-No.1 (Control-Grid) Voltage                    | _             | -50 max     | volts      |
| Cathode Current                                        | 22 max        | 20 max      | mA         |
| Plate Dissipation                                      | 1.8 max       | 2.4 max     | watts      |
| Grid-No.2 Input                                        | _             | 0.55 max    | watt       |
| CHARACTERISTICS:                                       |               |             |            |
| DC Plate Voltage                                       | 100           | 170         | volts      |
| DC Grid-No.2 Voltage                                   | -             | 120         | volts      |
| DC Grid-No.1 Voltage                                   | -3            | -1.2        | volts      |
| Amplification Factor                                   | 20            | 55*         |            |
| Plate Resistance (Approx.)                             |               | 0.35        | megohm     |
| Transconductance                                       | 9000          | 11000       | $\mu$ mhos |
| Grid-No.1 Voltage for grid-No.1 current of 0.3 $\mu$ A | —1.3 max      | —1.3 max    | volts      |
| Plate Current                                          | 15            | 10          | mA         |
| Grid-No.2 Current                                      | <del></del> , | 3           | mA         |
| MAXIMUM CIRCUIT VALUES:                                |               |             |            |
| Grid-No.1-Circuit Resistance:                          |               |             |            |
| For fixed-bias operation                               | 0.5 max       | 1 max       | megohm     |
| For cathode-bias operation                             | 0.5 max       | 2.2 max r   | negohms    |
|                                                        |               |             |            |

<sup>\*</sup> Grid No.2 to grid No.1.

#### HIGH-MU TRIODE

6GK5
Related types:
2GK5, 3GK5, 4GK5

Miniature type with frame grid used as grounded-cathode rf-amplifier tube in vhf tuners of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be operated in any position.



7FP

Types 2GK5, 3GK5, and 4GK5 are identical with type 6GK5 except for the heater ratings, as shown below.

| nouter runnigo, us ontown corow.                |          |             |         |         |
|-------------------------------------------------|----------|-------------|---------|---------|
| 2GK5                                            | 3GK5     | 4GK5        | 6GK5    |         |
| Heater Voltage (ac/dc) 2.3                      | 2.8      | 4.0         | 6.3     | volts   |
| Heater Current 0.6                              | 0.45     | 0.3         | 0.18    | ampere  |
| Heater Warm-up Time (Average) 11                | 11       | 11          |         | seconds |
| Peak Heater-Cathode Voltage:                    |          |             |         |         |
| Heater negative with respect to                 |          |             |         |         |
| cathode                                         | ах 100 л | nax 100 max | 100 max | volts   |
| Heater positive with respect to                 |          |             |         |         |
| cathode                                         | ax 100 n | nax 100 max | 100 max | volts   |
| Direct Interelectrode Capacitances (Approx.):   |          |             |         |         |
| Grid to Plate                                   |          |             | 0.52    | pF      |
| Grid to Cathode, Heater, and Internal Shic      |          |             | 5.52    | pF      |
| Plate to Cathode, Heater, and Internal Ship     | eld      |             | 3.5     | pF      |
| Heater to Cathode                               |          |             | 2.5     | pF      |
| With external shield connected to cothodo exact |          | .a          |         |         |

- With external shield connected to cathode, except as noted.
- With external shield and internal shield connected to ground.

#### Class A, Amplifier

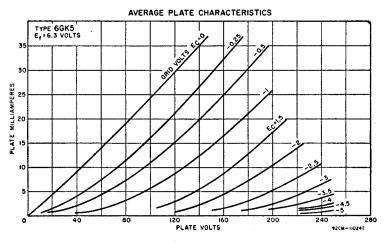
| WARRING THE RESERVE OF THE PROPERTY. |         |       |
|--------------------------------------|---------|-------|
| Plate Voltage                        | 200 max | volts |
| Grid Voltage:                        |         |       |
| Negative-bias value                  | -50 max | volts |
| Positive-bias value                  | 0 max   | volta |
| Average Cathode Current              | 22 max  | mA    |
| Plate Dissipation                    | 2.5 max | watts |
|                                      |         |       |

| CHARACTERISTICS:                                               |       |               |
|----------------------------------------------------------------|-------|---------------|
| Plate Voltage                                                  | 135   | volt <b>s</b> |
| Grid Voltage                                                   | 1     | volts         |
| Amplification Factor                                           | 78    |               |
| Plate Resistance (Approx.)                                     | 5400  | ohms          |
| Transconductance                                               | 15000 | μmhos         |
| Plate Current                                                  | 11.5  | mA            |
| Grid Voltage (Approx.) for transconductance of 150 µmhos       |       | volts         |
| Grid Voltage (Approx.) for transconductance of 1500 \(mu\)mhos | 2.5   | volts         |
| Input Resistance•                                              | 275   | ohms          |
| Input Capacitance.                                             | 11.2  | pF            |
| Noise Figure                                                   | 4.7   | ₫B            |

#### MAXIMUM CIRCUIT VALUES:

Grid-Circuit Resistance:

• Measured at 200 Mc/s with heater volts = 6.3 and plate effectively grounded for rf voltages.  $\Box$  For a neutralized triode amplifier at a frequency of 200 Mc/s with signal source impedance adjusted for minimum noise output.





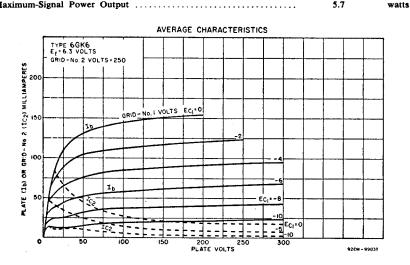
## **POWER PENTODE**

Miniature type used in the output stage of audio amplifying equipment and also in the video output stage of television receivers. Outline 6G, Outlines section. Tube requires miniature nine-contact socket and may be operated in any position.

6GK6
Related type:
16GK6

|                                                       | 6GK6        | 16GK6    |         |
|-------------------------------------------------------|-------------|----------|---------|
| Heater Voltage (ac/dc)                                | 6.3         | 16       | volts   |
| Heater Current                                        | 0.76        | 0.3      | ampere  |
| Heater Warm-up Time (Average)                         | _           | 11       | seconds |
| Peak Heater-Cathode Voltage:                          |             |          |         |
| Heater negative with respect to cathode               | 100 max     | 100 max  | volts   |
| Heater positive with respect to cathode               | 100 max     | 100 max  | volts   |
| Direct Interelectrode Capacitances:                   |             |          |         |
| Grid No.1 to Plate                                    |             | 0.14 max | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, a | nd Internal |          | -       |
| Shield                                                |             | 10       | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, as    | nd Internal |          | -       |
| Shield                                                |             | 7        | pF      |
|                                                       |             |          | _       |

| MAXIMUM RATINGS (Design-Maximum Values):           Plate Supply Voltage         600 max         volts           Plate Voltage         330 max         volts           Grid-No.2 Supply Voltage         605 max         volts           Grid-No.1 (Control-Grid) Voltage, Negative-bias value         -100 max         volts           Cathode Current         65 max         mA           Plate Dissipation         13.2 max         watts           Grid-No.2 Input, Peak         4 max         watts           Grid-No.2 Input, Average         2 max         watts           CHARACTERISTICS AND TYPICAL OPERATION:         Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19         Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos         peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Maximum-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 | Class A, Amplifier                                    |      |     |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------|-----|----------|
| Plate Supply Voltage         600 max         volts           Plate Voltage         330 max         volts           Grid-No.2 Supply Voltage         605 max         volts           Grid-No.2 (Screen-Grid) Voltage         330 max         volts           Grid-No.1 (Control-Grid) Voltage, Negative-bias value         -100 max         volts           Cathode Current         65 max         mA           Plate Dissipation         13.2 max         watts           Grid-No.2 Input, Peak         4 max         watts           Grid-No.2 Input, Average         2 max         watts           CHARACTERISTICS AND TYPICAL OPERATION:         Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         µmhos           Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         5.5         <         | MAXIMUM RATINGS (Design-Maximum Values):              |      |     |          |
| Grid-No.2 Supply Voltage         605 max         volts           Grid-No.2 (Screen-Grid) Voltage         330 max         volts           Grid-No.1 (Control-Grid) Voltage, Negative-bias value         -100 max         volts           Cathode Current         65 max         mA           Plate Dissipation         13.2 max         watts           Grid-No.2 Input, Peak         4 max         watts           Grid-No.2 Input, Average         2 max         watts           CHARACTERISTICS AND TYPICAL OPERATION:         Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19         Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos         peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms      | Plate Supply Voltage                                  | 600  | max | volts    |
| Grid-No.2 Supply Voltage         605 max         volts           Grid-No.2 (Screen-Grid) Voltage         330 max         volts           Grid-No.1 (Control-Grid) Voltage, Negative-bias value         -100 max         volts           Cathode Current         65 max         mA           Plate Dissipation         13.2 max         watts           Grid-No.2 Input, Peak         4 max         watts           Grid-No.2 Input, Average         2 max         watts           CHARACTERISTICS AND TYPICAL OPERATION:         Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19         Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos         peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms      |                                                       | 330  | max | volts    |
| Grid-No.1 (Control-Grid) Voltage, Negative-bias value         —100 max         volts           Cathode Current         65 max         mA           Plate Dissipation         13.2 max         watts           Grid-No.2 Input, Peak         4 max         watts           Grid-No.2 Input, Average         2 max         watts           CHARACTERISTICS AND TYPICAL OPERATION:         Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos           Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Grid-No.2 Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                       | Grid-No.2 Supply Voltage                              | 605  | max | volts    |
| Cathode Current         65 max mA           Plate Dissipation         13.2 max watts           Grid-No.2 Input, Peak         4 max watts           Grid-No.2 Input, Average         2 max watts           CHARACTERISTICS AND TYPICAL OPERATION:           Plate Supply Voltage         250 volts           Grid-No.2 Supply Voltage         250 volts           Cathode-Bias Resistor         135 ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000 ohms           Transconductance         11300 μmhos           Peak AF Grid-No.1 Voltage         7.3 volts           Zero-Signal Plate Current         48 mA           Maximum-Signal Plate Current         50.6 mA           Zero-Signal Grid-No.2 Current         5.5 mA           Maximum-Signal Grid-No.2 Current         10 mA           Effective Load Resistance         5200 ohms           Total Harmonic Distortion         10 per cent                                                                                                                                                                                                                                                                                                        | Grid-No.2 (Screen-Grid) Voltage                       | 330  | max | volts    |
| Cathode Current         65 max mA           Plate Dissipation         13.2 max watts           Grid-No.2 Input, Peak         4 max watts           Grid-No.2 Input, Average         2 max watts           CHARACTERISTICS AND TYPICAL OPERATION:           Plate Supply Voltage         250 volts           Grid-No.2 Supply Voltage         250 volts           Cathode-Bias Resistor         135 ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000 ohms           Transconductance         11300 μmhos           Peak AF Grid-No.1 Voltage         7.3 volts           Zero-Signal Plate Current         48 mA           Maximum-Signal Plate Current         50.6 mA           Zero-Signal Grid-No.2 Current         5.5 mA           Maximum-Signal Grid-No.2 Current         10 mA           Effective Load Resistance         5200 ohms           Total Harmonic Distortion         10 per cent                                                                                                                                                                                                                                                                                                        | Grid-No.1 (Control-Grid) Voltage, Negative-bias value | -100 | max | volts    |
| Grid-No.2 Input, Peak         4 max or max or max         watts           Grid-No.2 Input, Average         2 max watts           CHARACTERISTICS AND TYPICAL OPERATION:           Plate Supply Voltage         250 volts           Grid-No.2 Supply Voltage         250 volts           Cathode-Bias Resistor         135 ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000 ohms           Transconductance         11300 μmhos           Peak AF Grid-No.1 Voltage         7.3 volts           Zero-Signal Plate Current         48 mA           Maximum-Signal Plate Current         50.6 mA           Zero-Signal Grid-No.2 Current         5.5 mA           Maximum-Signal Grid-No.2 Current         10 mA           Effective Load Resistance         5200 ohms           Total Harmonic Distortion         10 per cent                                                                                                                                                                                                                                                                                                                                                                                 |                                                       | 65   | max | mA       |
| Grid-No.2 Input, Average         2 max         watts           CHARACTERISTICS AND TYPICAL OPERATION:           Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         µmhos           Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                   | Plate Dissipation                                     | 13.2 | max | watts    |
| CHARACTERISTICS AND TYPICAL OPERATION:           Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos           Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                       | 4 :  | max | watts    |
| Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos           Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Grid-No.2 Input, Average                              | 2    | max | watts    |
| Plate Supply Voltage         250         volts           Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos           Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CHADACTEDISTICS AND TYPICAL OPERATION.                |      |     |          |
| Grid-No.2 Supply Voltage         250         volts           Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos           peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                       | 250  |     | wolte    |
| Cathode-Bias Resistor         135         ohms           Mu-Factor, Grid No.2 to Grid No.1         19           Plate Resistance (Approx.)         38000         ohms           Transconductance         11300         μmhos           Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                       |      |     |          |
| Mu-Factor, Grid No.2 to Grid No.1       19         Plate Resistance (Approx.)       38000       ohms         Transconductance       11300       μmhos         Peak AF Grid-No.1 Voltage       7.3       volts         Zero-Signal Plate Current       48       mA         Maximum-Signal Plate Current       50.6       mA         Zero-Signal Grid-No.2 Current       5.5       mA         Maximum-Signal Grid-No.2 Current       10       mA         Effective Load Resistance       5200       ohms         Total Harmonic Distortion       10       per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                       |      |     |          |
| Plate Resistance (Approx.)         38000 ohms           Transconductance         11300 μmhos           Peak AF Grid-No.1 Voltage         7.3 volts           Zero-Signal Plate Current         48 mA           Maximum-Signal Plate Current         50.6 mA           Zero-Signal Grid-No.2 Current         5.5 mA           Maximum-Signal Grid-No.2 Current         10 mA           Effective Load Resistance         5200 ohms           Total Harmonic Distortion         10 per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                       |      |     | OHMIS    |
| Transconductance         11300         μmhos           Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                       |      |     | ohme     |
| Peak AF Grid-No.1 Voltage         7.3         volts           Zero-Signal Plate Current         48         mA           Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                       |      |     | 0 20     |
| Zero-Signal Plate Current         48 mA           Maximum-Signal Plate Current         50.6 mA           Zero-Signal Grid-No.2 Current         5.5 mA           Maximum-Signal Grid-No.2 Current         10 mA           Effective Load Resistance         5200 ohms           Total Harmonic Distortion         10 per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                       |      |     |          |
| Maximum-Signal Plate Current         50.6         mA           Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                       |      |     |          |
| Zero-Signal Grid-No.2 Current         5.5         mA           Maximum-Signal Grid-No.2 Current         10         mA           Effective Load Resistance         5200         ohms           Total Harmonic Distortion         10         per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                       | 50.6 |     | mA       |
| Maximum-Signal Grid-No.2 Current10mAEffective Load Resistance5200ohmsTotal Harmonic Distortion10per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Zero-Signal Grid-No.2 Current                         |      |     |          |
| Effective Load Resistance5200ohmsTotal Harmonic Distortion10per cent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                       |      |     | mA       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                       | 5200 |     | ohms     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                       | 10   |     | per cent |
| Maximum-signal Power Output 3.7 watts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Maximum-Signal Power Output                           | 5.7  |     | watts    |



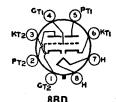
# Push-Pull Class AB, and B Amplifier MAXIMUM RATINGS: (Same as for class A1 amplifier)

| TYPICAL OPERATION, (Values are for two tubes): | Class A | В    | Class | s B   |          |
|------------------------------------------------|---------|------|-------|-------|----------|
| Plate Voltage                                  | 250     | 300  | 250   | 300   | volts    |
| Grid-No.2 Voltage                              | 250     | 300  | 250   | 300   | volts    |
| Grid-No.1 Voltage                              | 11      | 17   | 11    | —14.7 | volts    |
| Cathode-Bias Resistor                          | _       | _    | 11.6  | _     | ohms     |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage         | 130     | 130  |       | 28    | volts    |
| Zero-Signal Plate Current                      | 22.4    | 28   | 22.4  | 15    | mA       |
| Maximum-Signal Plate Current                   | 62      | 72   | .20   | 92    | mA       |
| Zero-Signal Grid-No.2 Current                  | 75      | 92   | 75    | 1.6   | mA       |
| Maximum-Signal Grid-No.2 Current               | 7       | 8 .  | 2.2   | 22    | mA       |
| Effective Load Resistance (plate to plate)     | 15      | 22   | 15    | 8000  | ohms     |
| Total Harmonic Distortion                      | 8000    | 8000 | 8000  | 4     | per cent |
| Maximum-Signal Power Output                    | 3       | 4    | 3     | 17    | watts    |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

| For fix | ed-bias operation    | 0.3 | max | megohm |
|---------|----------------------|-----|-----|--------|
| For car | thode-bias operation | 1   | max | megohm |



#### **DUAL TRIODE**

Glass type containing high-mu triode and high-perveance, low-mu triode in same envelope. Used as combined vertical-deflection-oscillator and verticaldeflection-amplifier tube in television receivers. Outline 13B, Outlines sec-

6GL7

Linit No. 2

tion. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.05; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

Class A, Amplifier

| CHARACTERISTICS:                 | Unit No.1 | Unit No.2 |       |
|----------------------------------|-----------|-----------|-------|
| Plate Voltage                    | 250       | 175       | volts |
| Grid Voltage                     | -3        | 25        | volts |
| Amplification Factor             | 66        | 5         |       |
| Plate Resistance (Approx.)       | 30000     | 780       | ohms  |
| Transconductance                 | 2200      | 6400      | μmhos |
| Grid Voltage (Approx.):          |           |           |       |
| For plate current of 20 $\mu A$  | -5.3      | _         | volts |
| For plate current of 200 $\mu$ A |           | 60        | volts |
| Plate Current                    | 2         | 46        | mA    |

## Vertical-Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

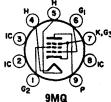
Unit No 1

| MAXIMUM RATINGS (Design-Maximum Values): | Oscillator | Amplifier |       |
|------------------------------------------|------------|-----------|-------|
| DC Plate Voltage                         | 350 max    | 550 max   | volts |
| Peak Positive-Pulse Plate Voltage        |            | 1500□max  | volts |
| Peak Negative-Pulse Grid Voltage         | -400 max   | -250 max  | volts |
| Peak Cathode Current                     | _          | 175 max   | mA    |
| Average Cathode Current                  | <b>—</b>   | 50 max    | mA    |
| Plate Dissipation.                       | 1 max      | 10 max    | watts |
| MAXIMUM CIRCUIT VALUES:                  |            |           |       |

Grid-Circuit Resistance:

For fixed-bias operation ...... 1 max 1 max megohm For cathode-bias operation ..... 2.2 max 2.2 max megohms

- ☐ The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.
- An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



#### **POWER PENTODE**

(,63 Neonoval type used as power amplifier in radio receivers and audio amplifiers. Outline 10D, Outlines section. Tube requires neonoval ninecontact socket and may be mounted in any position. Heater volts (ac/dc),

**6GM5** 

6.3; amperes, 0.8; peak heater-cathode volts, 200 max (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

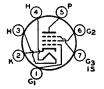
#### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): |         |          |
|------------------------------------------|---------|----------|
| Plate Voltage                            | 550 max | volts    |
| Grid-No.2 (Screen-Grid) Voltage          | 440 max | volts    |
| Cathode Current                          | 85 max  | mA       |
| Plate Dissipation                        | 19 max  | watts    |
| Grid-No.2 Input                          | 3.3*max | watts    |
| TYPICAL OPERATION AND CHARACTERISTICS:   |         |          |
| Plate Voltage                            | 300     | volts    |
| Grid-No.2 Voltage                        | 300     | volts    |
| Grid-No.1 (Control-Grid) Voltage         | -10     | volts    |
| Peak AF Grid-No.1 Voltage                | 10      | volts    |
| Zero-Signal Plate Current                | 60      | mA       |
| Maximum-Signal Plate Current             | 75      | mA       |
| Zero-Signal Grid-No.2 Current            | 8       | mA       |
| Maximum-Signal Grid-No.2 Current         | 15      | mA       |
| Plate Resistance (Approx.)               | 29000   | ohms     |
| Transconductance                         | 10200   | μmhos    |
| Load Resistance                          | 3000    | ohms     |
| Total Harmonic Distortion                | 13      | per cent |
| Maximum-Signal Power Output              | 11      | watts    |

<sup>•</sup> Grid-No.2 input may reach 6 watts during peak levels of speech and music signals.

### SEMIREMOTE-CUTOFF PENTODE

6GM6 Related types: 4GM6, 5GM6 Miniature type used in gain-controlled picture-if stages of television receivers operating at intermediate frequencies in the order of 40 megacycles. Tube features high transconductance and relatively low capacitances. Outline



7CM

5C, Outlines section. Tube requires seven-contact socket and may be mounted in any position. Types 4GM6 and 5GM6 are identical with type 6GM6 except for the heater ratings, as shown below.

|                                            | 4GM6    | 5GM6      | 6GM6      |         |
|--------------------------------------------|---------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                     | 4.2     | 5.6       | 6.3       | volts   |
| Heater Current                             | 0.6     | 0.45      | 0.4       | ampere  |
| Heater Warm-up Time (Average)              | 11      | 11        | _         | seconds |
| Peak Heater-Cathode Voltage:               |         |           |           |         |
| Heater negative with respect to cathode    | 200 max | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode    | 200 max | 200 max   | 200 max   | volts   |
| •                                          |         | Without   | With      |         |
|                                            |         | External  | External  |         |
| Direct Interelectrode Capacitances:        |         | Shield    | Shield    |         |
| Grid No.1 to Plate                         |         | 0.036 max | 0.026 max | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2,   |         |           |           | *-      |
| Grid No.3, and Internal Shield             |         | 10        | 10        | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid  |         |           |           |         |
| and Internal Shield                        |         | 2.4       | 3.4       | pF      |
| The de component must not exceed 100 volts |         |           |           |         |

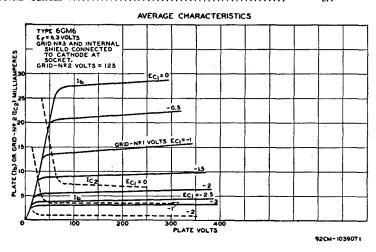
The dc component must not exceed 100 volts.

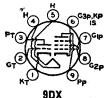
#### Class A<sub>1</sub> Amplifier

| MAXIMUM KATINGS (Design-Maximum Values):              |      |       |         |
|-------------------------------------------------------|------|-------|---------|
| Plate Voltage                                         | 330  | max   | volts   |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value   | 0    | max   | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                | 330  | max   | volts   |
| Grid-No.2 Voltage                                     | See  | curve | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0    | max   | volts   |
| Plate Dissipation                                     | 3.1  | max   | watts   |
| Grid-No.2 Input:                                      |      |       |         |
| For grid-No.2 voltages up to 165 volts                | 0.65 | max   | watt    |
| For grid-No.2 voltages between 165 and 330 volts      | See  | curve | page 80 |

<sup>\*</sup> With external shield connected to cathode.

| CHARACTERISTICS:                                             |       |              |
|--------------------------------------------------------------|-------|--------------|
| Plate Supply Voltage                                         | 125   | volts        |
| Grid No.3                                                    |       | de at socket |
| Grid-No.2 Supply Voltage                                     | 125   | volts        |
| Cathode-Bias Resistor                                        | 56    | ohms         |
| Plate Resistance (Approx.)                                   | 0.2   | megohm       |
| Transconductance                                             | 13000 | μmhos        |
| Grid-No.1 Voltage (Approx.) for transconductance of 60 µmhos | 15    | volts        |
| Plate Current                                                | 14    | mA           |
| Grid-No.2 Current                                            | 3.4   | mA           |





## HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in color and black-and-white television receivers. Triode unit is used as sync-separator, sync-clipper, phase inverter, or soundif amplifier. Pentode unit is used in output stage of video amplifier. Out-

6GN8
Related types:
8GN8, 10GN8

line 6E, Outlines section. Tube requires miniature nine-contact socket and may be operated in any position. For direct interelectrode capacitances, refer to type 6EB8; curve for average plate characteristics of triode unit is same as for type 6EB8. Types 8GN8 and 10GN8 are identical with type 6GN8 except for the heater ratings, as shown below.

|                                                            | 6GN8    | 8GN8    | 10GN8   |         |
|------------------------------------------------------------|---------|---------|---------|---------|
| Heater Voltage (ac/dc)                                     | 6.3     | 8       | 10.5    | volts   |
| Heater Current                                             | 0.75    | 0.6     | 0.45    | ampere  |
|                                                            | 6GN8    | 8GN8    | 10GN8   | •       |
| Heater Warm-up Time (Average) Peak Heater-Cathode Voltage: |         | 11      | 11      | seconds |
| Heater negative with respect to cathode                    | 200 max | 200 max | 200 max | volts   |
| Heater positive with respect to cathode                    | 200°max | 200°max | 200°max | volts   |
| * The dc component must not exceed 100 volts.              |         |         |         |         |

#### Class A. Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              | Triode Unit | Pentode Unit      |
|-------------------------------------------------------|-------------|-------------------|
| Plate Voltage                                         | 330 max     | 330 max volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                |             | 330 max volts     |
| Grid-No.2 Voltage                                     | -           | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max       | 0 max volt        |

Triode Unit Pentode Unit

0.25 max megohm

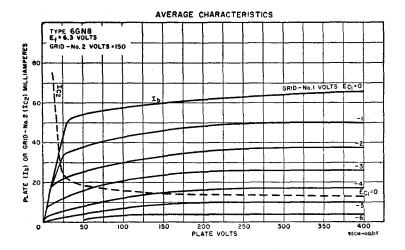
1 max megohm

0.5 max

1 max

| Plate Dissipation                                                                   | •••••       | 1 max | 5       | max          | watts            |
|-------------------------------------------------------------------------------------|-------------|-------|---------|--------------|------------------|
| For grid-No.2 voltages up to 165 volts<br>For grid-No.2 voltages between 165 and 33 |             | Ξ,    |         | max<br>curve | watts<br>page 80 |
| CHARACTERISTICS:                                                                    | Triode Unit | Pento | đe Unit |              |                  |
| Plate Supply Voltage                                                                | 250         | 60    | 200     |              | volts            |
| Grid-No.2 Supply Voltage                                                            |             | 150   | 150     |              | volts            |
| Grid-No.1 Voltage                                                                   | 2           | 0     | _       |              | volts            |
| Cathode-Bias Resistor                                                               |             | _     | 100     |              | ohms             |
| Amplification Factor                                                                | 100         | _     | -       |              |                  |
| Plate Resistance (Approx.)                                                          | 37000       | _     | 60000   |              | ohms             |
| Transconductance                                                                    | 2700        | _     | 11500   |              | μmhos            |
| Grid Voltage (Approx.) for plate current of                                         |             |       |         |              |                  |
| 20 μΑ                                                                               | <b>-</b> 5  |       | _       |              | volts            |
| Grid-No.1 Voltage (Approx.) for plate current                                       |             |       |         |              |                  |
| of 100 μA                                                                           | _           | _     | -10     |              | volts            |
| Plate Current                                                                       | 2           | 55=   | 25      |              | mA               |
| Grid-No.2 Current                                                                   | <b>—</b> .  | 18=   | 5.5     |              | mA               |
|                                                                                     |             |       |         |              |                  |

• This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.



# 6GT5 6GT5A

**MAXIMUM CIRCUIT VALUES:** 

For fixed-bias operation .....

For cathode-bias operation .....

Grid-No.1-Circuit Resistance:

Related types: 12GT5, 12GT5A, 17GT5, 17GT5A

## **BEAM POWER TUBE**

Novar types used as horizontal-deflection amplifiers in television receivers. Outlines 17B and 31A, respectively, Outlines section. Tubes require novar nine-contact socket and may be mounted in any position. For curve



9NZ

of average characteristics, refer to type 6GW6. Types 12GT5 and 12GT5A and types 17GT5 and 17GT5A are identical with types 6GT5 and 6GT5A except for the heater ratings, as shown below.

|                                               | 6GT5<br>6GT5A | 12GT5<br>12GT5A | 17GT5<br>17GT5A |         |
|-----------------------------------------------|---------------|-----------------|-----------------|---------|
| Heater Voltage (ac/dc)                        | 6.3           | 12.6            | 16.8            | volts   |
| Heater Current                                | 1.2           | 0.6             | 0.45            | ampere  |
| Heater Warm-up Time (Average)                 |               | 11              | 11              | seconds |
| Peak Heater-Cathode Voltage:                  |               |                 |                 |         |
| Heater negative with respect to cathode       | 200 max       | 200 max         | 200 max         | volts   |
| Heater positive with respect to cathode       | 200□max       | 200□max         | 200□max         | volts   |
| Direct Interelectrode Capacitances (Approx.): |               |                 |                 |         |
| Grid No.1 to Plate                            |               |                 | 0.26            | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, an   | d Grid No     | .3              | 15              | pF      |
| Plate to Cathode, Heater, Grid No.2, and G    | rid No.3 .    |                 | 6.5             | pF      |
| m m                                           |               |                 |                 | -       |

□ The dc component must not exceed 100 volts.

#### Class A, Amplifier

|                                              | Triode     | Pe   | ntode    |               |
|----------------------------------------------|------------|------|----------|---------------|
| CHARACTERISTICS:                             | Connection | Con  | nection, |               |
| Plate Voltage                                | 150        | 60   | 250      | volts         |
| Grid-No.2 (Screen-Grid) Voltage              |            | 150  | 150      | volts         |
| Grid-No.1 (Control-Grid) Voltage             |            | 0    | -22.5    | volts         |
| Mu Factor, grid No.2 to grid No.1            | 4.4        |      | _        |               |
| Plate Resistance (Approx.)                   |            |      | 15000    | ohms          |
| Transconductance                             |            |      | 7100     | μ <b>mhos</b> |
| Plate Current                                |            | 390* | 70       | m <b>A</b>    |
| Grid-No.2 Current                            |            | 32*  | 2.1      | mA            |
| Grid-No.1 Voltage (Approx.) for plate mA = 1 |            | _    | -42      | volts         |
| - · · · · · · · · · · · · · · · · · · ·      |            | _    |          |               |

\* These values can be measured by a method involving a recurrent waveform such that the plate dissipation and grid-No.2 input will will not exceed their maximum ratings.

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |           |       |
|------------------------------------------|-----------|-------|
| DC Plate Supply Voltage                  | 770 max   | volts |
| Peak Positive-Pulse Plate Voltage        | 6500 max  | volts |
| Peak Negative-Pulse Plate Voltage        | -1500 max | volts |
| DC Grid-No.2 Voltage                     | 220 max   | volts |
| DC Grid-No.1 Voltage                     | 55 max    | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | -330 max  | volts |
| Peak Cathode Current                     | 550 max   | mA    |
| Average Cathode Current                  | 175 max   | mA    |
| Grid-No.2 Input                          | 3.5 max   | watts |
| Plate Dissipation.                       | 17.5 max  | watts |
| Bulb Temperature (At hottest point)      | 240 max   | °C    |

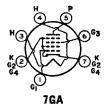
#### MAXIMUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance:

For grid-resistor-bias operation• .....

max megohm

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



#### BEAM HEXODE

Miniature type used as rf amplifier in vhf television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 2GU5 is identical with type 6GU5 ex-

6GU5
Related type:

cept for heater ratings, as shown below.

|                               | 2G U3 | 6603 |         |
|-------------------------------|-------|------|---------|
| Heater Voltage (ac/dc)        | 2.4   | 6.3  | volts   |
| Heater Current                | 0.6   | 0.22 | ampere  |
| Heater Warm-up Time (Average) | 11    | _    | seconds |

| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  |               |                |
|------------------------------------------------------------------------|---------------|----------------|
| Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, | 0.018         | pF             |
| and Grid No.4                                                          | 7             | pF             |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and Grid No.4          | 3.2           | ₽F             |
| • The dc component must not exceed 100 volts.                          |               |                |
| Class A, Amplifier                                                     |               |                |
| MAXIMUM RATINGS (Design-Maximum Values):                               |               |                |
| Plate Voltage                                                          | 300 r         | nax volts      |
| Grid-No.2 (Screen-Grid) Voltage                                        | 150 r         | nax volts      |
| DC Grid-No.1 (Control-Grid) Voltage:                                   |               |                |
| Positive bias value                                                    | 0 m           | ax volts       |
| Negative-bias value                                                    | 50 n          | nax volts      |
| DC Cathode Current                                                     | 20 m          | nax mA         |
| Plate Dissipation                                                      |               | nax watts      |
| Grid-No.2 Input                                                        | 0.5 r         | nax megohm     |
| CHARACTERISTICS:                                                       |               |                |
| Plate Voltage                                                          | 275           | volts          |
| Grid-No.2 Voltage                                                      | 135           | volts          |
| Grid-No.1 Voltage                                                      | -0.4          | volts          |
|                                                                        | ected to catl | hode at socket |
| Plate Resistance (Approx.) 0.67                                        | 0.165         | megohms        |
| Transconductance                                                       | 15500         | μmhos          |
| Plate Current 9                                                        | 10            | mA             |
| Grid-No.2 Current 0.25                                                 | 0.17          | mA             |
| Grid-No.1 Voltage (Approx.) for transconductance of                    |               |                |
| 100 μmhos—6.2                                                          | -6.5          | volts          |
| MAXIMUM CIRCUIT VALUE:                                                 |               |                |
| Grid-No.1-Circuit Resistance:                                          | 0.5 r         | nax megohm     |
|                                                                        |               |                |
|                                                                        |               |                |

# MEDIUM-MU TWIN TRIODE

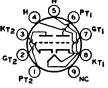
# 6GU7

Plate Dissipation .....

CHARACTERISTICS: Plate Voltage ......

Grid Voltage .....

Miniature type used in the matrixing KT2(3) circuits of color television receivers employing series-connected heater cT2(2) strings. Also used in phase-inverter, multivibrator, and general purpose amplifier applications. Outline 6E.



3 max

volts

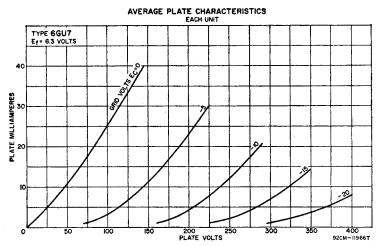
volts

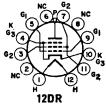
250

-10.5

| amplifier applications. Outline 6E,                           | 9LP          |         |
|---------------------------------------------------------------|--------------|---------|
| Outlines section. Tube requires miniature nine-contact socket | and may be r | nounted |
| in any position.                                              | -            |         |
| Heater Voltage (ac/dc)                                        | 6.3          | volts   |
| Heater Current                                                | 0.6          | атреге  |
| Heater Warm-up Time (Average)                                 | 11           | seconds |
| Peak Heater-Cathode Voltage:                                  |              |         |
| Heater negative with respect to cathode                       | 200 max      | volts   |
| Heater positive with respect to cathode                       | 200 max      | volts   |
| Direct Interelectrode Capacitances (Approx.): Unit No.1       | Unit No.2    |         |
| Grid to Plate                                                 | 3            | pF      |
| Grid to Cathode and Heater 3.4                                | 3.6          | рF      |
| Plate to Cathode and Heater 0.44                              | 0.34         | pF      |
| Plate of Unit No.1 to Plate of Unit No.2                      |              | pF      |
| • The dc component must not exceed 100 volts.                 |              |         |
| Class A. Amplifier (Each Unit)                                |              |         |
| MAXIMUM RATINGS (Design-Maximum Values):                      |              |         |
| Plate Voltage                                                 | 330 max      | volts   |
| Grid Voltage, Positive-bias value                             | 0 max        | volts   |

| Amplification Factor                                   | 17         |        |
|--------------------------------------------------------|------------|--------|
| Plate Resistance (Approx.)                             | 5500       | ohms   |
| Transconductance                                       | 3100       | μmhos  |
| Grid Voltage (Approx.) for plate current of 50 $\mu$ A | <b>—23</b> | volts  |
| Plate Current                                          | 11.5       | mA     |
| Plate Current for grid voltage of -14 volts            | 4          | mA     |
| MAXIMUM CIRCUIT VALUES:                                |            |        |
| Grid-Circuit Resistance:                               |            |        |
| For fixed-bias operation                               | 1 max      | megohm |





## **BEAM POWER TUBE**

Duodecar type used as horizontal-de-63 ers. Outline 16A, Outlines section. <sup>6</sup>2 Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 17GV5 is identical

17GV5

| ••                                                      |                   |          |          |
|---------------------------------------------------------|-------------------|----------|----------|
| with type 6GV5 except for the heater ratings            | s, as shown be    | low.     |          |
|                                                         | 6GV5              | 17GV5    |          |
| Heater Voltage (ac/dc)                                  | 6.3               | 16.8     | volts    |
| Heater Current                                          | 1.2               | 0.45     | ampere   |
| Heater Warm-up Time (Average)                           | <b>–</b>          | 11       | seconds  |
| Peak Heater-Cathode Voltage:                            |                   |          |          |
| Heater negative with respect to cathode                 | 200 max           | 200 max  | volts    |
| Heater positive with respect to cathode                 | 200•max           | 200•max  | volts    |
| • The dc component must not exceed 100 volts.           |                   |          |          |
| Class A, Ampi                                           | lifier            |          |          |
| CHARACTERISTICS:                                        |                   |          |          |
| Plate Voltage 500                                       | 00 60             | 250      | volts    |
|                                                         | 50 150            | 150      | volts    |
| Grid-No.1 (Control-Grid) Voltage                        | 0                 | -22.5    | volts    |
| Plate Resistance (Approx.)                              |                   | 18000    | ohms     |
| Transconductance                                        |                   | 7300     | μmhos    |
| Triode Amplification Factor                             |                   | 4.4*     | •        |
| Plate Current                                           | - 345=            | 65       | mA       |
| Grid-No.2 Current                                       | _ 27•             | 1.8      | mA       |
| Grid-No.1 Voltage (Approx.) for plate current           |                   |          |          |
| of 1 mA —10                                             | 00 —              | 42       | volts    |
| * Grid No.2 tied to plate; plate and grid-No.2 volts, 1 | 150; grid-No.1 vo | its22.5. |          |
| This value can be measured by a method involving        |                   |          | he maxi- |

This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

**Horizontal-Deflection Amplifier** 

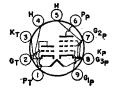
| For operation in a 525-line, 30-frame system |           |       |
|----------------------------------------------|-----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):     |           |       |
|                                              | 770       | 14    |
| DC Plate Supply Voltage                      | 770 max   | volts |
| Peak Positive-Pulse Plate Voltage#           | 6500 max  | volts |
| Peak Negative-Pulse Plate Voltage            | -1500 max | volts |
| DC Grid-No.2 Voltage                         | 220 max   | volts |
| Peak Negative-Pulse Grid-No.1 Voltage        | -330 max  | volts |
| DC Grid-No.1 Voltage                         | -55 max   | volts |
| Peak Cathode Current                         | 550 max   | mA    |
| Average Cathode Current                      | 175 max   | mA    |
| Plate Dissipation†                           | 17.5 max  | watts |
| Grid-No.2 Input                              | 3.5 max   | watts |
| Bulb Temperature (At hottest point)          | 200 max   | *C    |
| MAXIMUM CIRCUIT VALUES:                      |           |       |
| Grid No. 1 Circuit Desistance                | 1         |       |

Grid-No.1-Circuit Resistance 1 max megohm # The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds. † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

#### 

6GV8
Related type:

Miniature type used for sync-amplifier and video-output applications in television receivers. Outline 6G, **Outlines** section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 9GV8



9LY

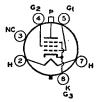
is identical with type 6GV8 except for the heater ratings, as shown below.

|                                            | 0G V 8      | 9G V 8      |        |
|--------------------------------------------|-------------|-------------|--------|
| Heater Voltage (ac/dc)                     | 6.3         | 9.5         | volts  |
| Heater Current                             | 0.9         | 0.6         | ampere |
| Peak Heater-Cathode Voltage:               | •••         |             |        |
| Heater negative with respect to cathode    | 220 max     | 220 max     | volts  |
|                                            | 220 max     | 220 max     | volts  |
| Heater positive with respect to cathode    | 220 max     | 220 max     | VOILS  |
| Class A, Amplifier                         |             |             |        |
| MAXIMUM RATINGS (Absolute-Maximum Values): | Triode Unit | Pentode Uni | t      |
| Plate Supply Voltage                       | 550 max     | 550 max     | volts  |
| Peak Plate Voltage                         |             | 2000 max    | volts  |
| DC Plate Voltage                           | 250 max     | 250 max     | volts  |
|                                            | 250 maa     | 550 max     | volts  |
| Grid-No.2 (Screen-Grid) Supply Voltage     |             |             |        |
| Grid-No.2 Voltage                          |             | 250 max     | volts  |
| Peak Cathode Current                       | 200 max     | _           | mA     |
| Average Cathode Current                    | 15 max      | 75 max      | mA     |
| Grid-No.2 Input                            |             | 2 max       | watts  |
| Plate Dissipation                          | 0.5 max     | 7 max       | watts  |
| I med Dissipation                          | 010 111414  |             |        |
|                                            |             | 6AM         |        |
|                                            |             | Go          | G.     |

## BEAM POWER TUBE

6GW6
Related types:
12GW6/12DQ6B,
17GW6

Glass octal type used as horizontaldeflection amplifier in high-efficiency deflection circuits of television receivers. Outline 20, **Outlines** section. Tube requires octal socket and may be operated in any position. Types



12GW6/12DQ6B and 17GW6 are identical with type 6GW6 except for the neater ratings, as shown below.

|                               | 6GW6 | 12DQ6B | 17GW6 |         |
|-------------------------------|------|--------|-------|---------|
| Heater Voltage (ac/dc)        | 6.3  | 12.6   | 16.8  | volts   |
| Heater Current                | 1.2  | 0.6    | 0.45  | ampere  |
| Heater Warm-up Time (Average) |      | 11     | 11    | seconds |

| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode 200 max 200 max  Heater positive with respect to cathode 200 max 200 max | 200 max<br>200□max | volts<br>volts |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|
| Direct Interelectrode Capacitances (Approx.):                                                                                                  |                    |                |
| Grid No.1 to Plate                                                                                                                             | 0.5                | pF             |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3                                                                                         | 17                 | pF             |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3                                                                                             | 7                  | pF             |
| □ The dc component must not exceed 100 volts.                                                                                                  |                    |                |

### Class A, Amplifier

### CHARACTERISTICS:

| Plate Voltage                                         | 60   | 250   | volts |
|-------------------------------------------------------|------|-------|-------|
| Grid-No.2 Voltage                                     | 150  | 150   | volts |
| Grid-No.1 Voltage                                     | 0    | -22.5 | volts |
| Plate Resistance (Approx.)                            |      | 15000 | ohms  |
| Transconductance                                      |      | 7100  | μmhos |
| Plate Current                                         | 390* | 70    | mA    |
| Grid-No.2 Current                                     | 32*  | 2.1   | mA    |
| Grid-No.1 Voltage (Approx.) for plate current of 1 mA |      | -42   | volts |

<sup>\*</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

#### MAXIMUM RATINGS (Design-Maximum Values):

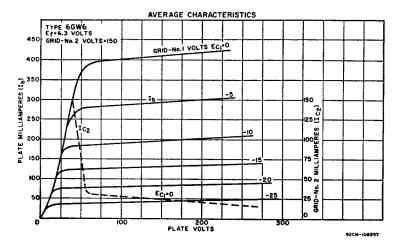
| DC Plate Supply Voltage               | 770 max   | volts |
|---------------------------------------|-----------|-------|
| Peak Positive-Pulse Plate Voltage     | 6500 max  | volts |
| Peak Negative-Pulse Plate Voltage     | -1500 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage    | 220 max   | volts |
| DC Grid-No.1 (Control-Grid) Voltage   | —55 max   | volts |
| Peak Negative-Pulse Grid-No.1 Voltage | -330 max  | volts |
| Peak Cathode Current                  | 550 max   | mA    |
| Average Cathode Current               | 175 max   | mA    |
| Grid-No.2 Input                       | 3.5 max   | watts |
| Plate Dissipation•                    | 17.5 max  | watts |
| Bulb Temperature (At hottest point)   | 240 max   | •C    |

#### MAXIMUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance:
For grid resistor-bias operation ......

1 max megohm

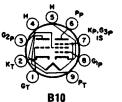
- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

## 6GW8/ ECL86

Miniature type used in preamplifier <sup>62</sup>P 3 and audio output stages of audio equipment and television receivers. K<sub>7</sub> 2 Outline 6G, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.



Heater volts (ac/dc), 6.3; amperes, 0.7; peak heater-cathode volts, 100.

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Center Values):               | Triode Unit | Pentode Unit |       |
|-------------------------------------------------------|-------------|--------------|-------|
| Plate Supply Voltage                                  | 550 max     | 550 max      | volts |
| Plate Voltage                                         | 300 max     | 300 max      | volts |
| Grid-No.2 (Screen-Grid) Supply Voltage                |             | 550 max      | voits |
| Grid-No.2 Voltage                                     | -           | 300 max      | volts |
| Grid-No.1 (Control-Grid) Voltage, Negative-bias value | -1.3 max    | -1.3 max     | volts |
| Cathode Current                                       | 55 max      | 8 max        | mA    |
| Plate Dissipation                                     | 0.5 max     | 9 max        | watts |
| Grid-No.2 Input                                       |             | 1.5 max      | watts |
| CHARACTERISTICS:                                      |             |              |       |
| Plate Voltage                                         | 250         | 250          | volts |
| Grid-No.2 Voltage                                     | _           | 250          | volts |
| Grid-No.1 Voltage                                     | -1.7        | -7           | volts |
| Amplification Factor                                  | 100         | 21*          |       |
| Plate Resistance (Approx.)                            | _           | 45000        | ohms  |
| Transconductance                                      | 1600        | 10000        | µmhos |
| Plate Current                                         | 1.2         | 36           | mA    |
| Grid-No.2 Current • Grid No.2 to grid No.1.           | _           | 5.5          | mA    |

#### SHARP-CUTOFF PENTODE

6GX6
Related type:
5GX6

Miniature type used for FM sounddetector service in locked-oscillator, quadrature-grid FM detector circuits, as combined detector, limiter, and audio-voltage driver. Tube has two independent control grids, and has



7EN

CCV6

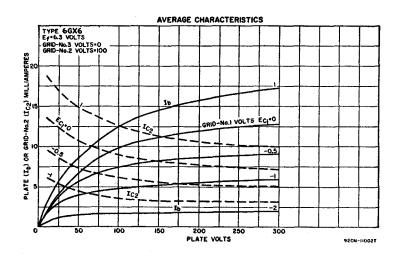
SCVE

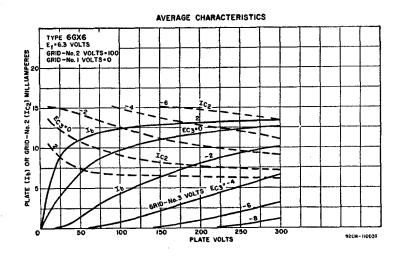
controlled heater warm-up time for use in circuits employing series-connected heater strings. Outline 5C, **Outlines** section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 5GX6 is identical with type 6GX6 except for the heater ratings, as shown below.

|                                                         | <b>3GA</b> 0      | OUAO      |         |
|---------------------------------------------------------|-------------------|-----------|---------|
| Heater Voltage (ac/dc)                                  | 4.7               | 6.3       | volts   |
| Heater Current                                          | 0.6               | 0.45      | ampere  |
| Heater Warm-up Time (Average)                           | 11                | 11        | seconds |
| Peak Heater-Cathode Voltage:                            |                   |           |         |
| Heater negative with respect to cathode                 | 200 max           | 200 max   | volts   |
| Heater positive with respect to cathode                 | 200 = max         | 200 • max | volts   |
| Direct Interelectrode Capacitances (Approx.):           |                   |           |         |
| Grid No.1 to Plate                                      |                   | 0.026     | ρF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and | l Internal        |           | -       |
| Shield                                                  | · · · · · · · · · | 8         | pF      |
| Grid No.1 to Grid No.3                                  |                   | 0.12      | pF      |
| Grid No.3 to Plate                                      |                   | 1.6       | pF      |
| Grid No.3 to Cathode, Heater, Grid No.1, Grid No.2, I   | late, and         |           | -       |
| Internal Shield                                         |                   | 6.5       | ₽F      |
|                                                         |                   |           |         |

<sup>•</sup> The dc component must not exceed 100 volts.

| CHARACTERISTICS:                                                   |      | •.         |
|--------------------------------------------------------------------|------|------------|
| Plate Supply Voltage                                               | 150  | volts      |
| Grid-No.3 Supply Voltage                                           | 0    | volts      |
| Grid-No.2 Supply Voltage                                           | 100  | volts      |
| Grid-No.1 Supply Voltage                                           | 0    | voits      |
| Cathode-Bias Resistor                                              | 180  | ohms       |
| Plate Resistance (Approx.)                                         | 0.14 | megohm     |
| Transconductance, grid No.1 to plate                               | 3700 | $\mu$ mhos |
| Transconductance, grid No.3 to plate                               | 750  | umhos      |
|                                                                    | 3.7  | mA         |
| Plate Current                                                      | 2.1  | mA         |
| Grid-No.2 Current                                                  | 7    | volts      |
| Grid-No.3 Supply Voltage (Approx.) for plate current of 20 $\mu$ A | •    |            |
| Grid-No.1 Supply Voltage (Approx.) for plate current of 20 $\mu$ A | 4.5  | volts      |





| Sound |  |
|-------|--|
|       |  |

| im dound Dotcotol                                |      |       |         |
|--------------------------------------------------|------|-------|---------|
| MAXIMUM RATINGS (Design-Maximum Values):         |      |       |         |
| Plate Voltage                                    | 300  | max   | volts   |
| Grid-No.3 (Control-Grid) Voltage:                |      |       |         |
| Negative value (dc and peak ac)                  | -100 | max   | volts   |
| Positive value (dc and peak ac)                  |      | max   | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage           |      | max   | volts   |
| Grid-No.2 Voltage                                |      |       | page 80 |
| Grid-No.1 (Control-Grid) Voltage:                | -    |       | page 00 |
| Negative-bias value                              | 50   | max   | volts   |
| Positive-bias value                              |      | max   | volts   |
| Plate Dissipation                                |      | max   | watts   |
| Grid-No.3 Input                                  |      | max   | watt    |
| Grid-No.2 Input:                                 | V.1  | IIIGA | ******* |
| For grid-No.2 voltages up to 150 volts           | 1.0  | max   | watt    |
| For grid-No.2 voltages between 150 and 300 volts |      |       | page 80 |
| MAXIMUM CIRCUIT VALUES:                          | bcc  | carre | page 60 |
| Grid-No.3-Circuit Resistance                     | 0.68 | mar   | megohm  |
| Grid-No.1-Circuit Resistance:                    | 0.00 | IIIua | megomin |
| For fixed-bias operation                         | 0.22 | may   | megohm  |
| For cathode-bias operation                       |      |       |         |
|                                                  | 0.47 | IIIAX | megohm  |
|                                                  |      |       |         |

### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

6GX7

Related types: 4GX7, 5GX7

Miniature type used as combined oscillator-mixer tube in vhf tuner circuits of television receivers. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

K,G<sub>3p</sub>,JS (1) (9<sub>CT</sub>)

9QA

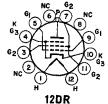
Types 4GX7 and 5GX7 are identical with type 6GX7 except for the heater ratings, as shown below.

4GX7 5GX7 6GX7

| Heater Voltage (ac/dc)                                          | 4.2       | 5.6        | 6.3     | volts  |
|-----------------------------------------------------------------|-----------|------------|---------|--------|
| Heater Current                                                  | 0.6       | 0.45       | 0.4     | ampere |
| Heater Warm-up Time                                             | 11        | 11         | _       |        |
| Peak Heater-Cathode Voltage:                                    |           |            |         |        |
| Heater negative with respect to cathode                         | 200       | 200        | 200 max | volts  |
| Heater positive with respect to cathode                         | 200*      | 200*       | 200*max | volts  |
| Direct Interelectrode Capacitances:**                           |           |            |         |        |
| Triode Unit:                                                    |           |            |         |        |
| Grid to Plate                                                   |           |            | 1.2     | pF     |
| Grid to Cathode, Heater, Pentode Cathode,                       |           |            |         |        |
| Grid No. 3, and Internal Shield                                 |           | <i></i>    | 2.3     | рF     |
| Plate to Cathode, Heater, Pentode Cathode,                      |           |            |         |        |
| Grid No. 3, and Internal Shield                                 |           |            | 1.9     | p₽     |
| Pentode Unit:                                                   |           |            |         |        |
| Grid No. 1 to Plate                                             |           |            | 0.005   | p₽     |
| Grid No. 1 to Cathode, Heater, Grid No. 2                       | 2, Grid l | No. 3, and |         |        |
| Internal Shield                                                 |           |            | 5.4     | рF     |
| Plate to Cathode, Heater, Grid No. 2, Grid                      |           |            |         |        |
| Internal Shield                                                 |           |            | 3.3     | ₽F     |
| Grid No. 1 to Grid No. 2                                        |           |            | 1.6     | p₽     |
| <ul> <li>The dc component must not exceed 100 volts.</li> </ul> |           |            |         |        |
| ** With external shield connected to cathode.                   |           |            |         |        |
| Class A. A                                                      | molifier  |            |         |        |

| Viass At Ampinici                            |             |                   |
|----------------------------------------------|-------------|-------------------|
| MAXIMUM RATINGS (Design-Maximum Values):     | Triode Unit | Pentode Unit      |
| Plate Voltage                                | 275 max     | 275 max volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage       |             | 275 max volts     |
| Grid-No.2 Voltage                            | _           | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage;            |             |                   |
| Positive-bias Value                          | 0           | 0                 |
| Negative-bias Value                          | 40          | 40 max volts      |
| Cathode Current                              | 20          | 20 max mA         |
| Plate Dissipation                            | 1.5         | 2.2 max watts     |
| Grid-No.2 Input:                             |             |                   |
| For Grid-No.2 voltages up to 137.5 volts     | _           | 0.45 max watts    |
| For Grid-No.2 voltages between 137.5 and 275 |             |                   |
| volte                                        |             | See curve page 80 |

| CHARACTERISTICS:                    |         |      |         |          |        |
|-------------------------------------|---------|------|---------|----------|--------|
| Plate Voltage                       | 100     | 125  | 120     | 125      | volts  |
| Grid-No.2 Voltage                   | _       | _    | 90      | 125      | volts  |
| Grid-No.1 Voltage                   | _       | 1    |         | 1        | volt   |
| Grid-No.1-Circuit Resistance        | 0.1     | _    | 0.1     | _        | megohm |
| Amplification Factor                | 40      | _    | _       | _        | •      |
| Plate Resistance                    |         | 4700 | _       | 200000   | ohms   |
| Transconductance                    | 8700    | 8500 | 13000   | 11000    | μmhos  |
| Plate Current                       | 12.5    | 13   | 8.5     | 8.0      | mA     |
| Grid-No.2 Current                   | _       |      | 2.8     | 2.5      | mA     |
| Grid-No.1 Voltage for plate current |         |      |         |          |        |
| of 20 μA                            | 6       | _    | 2.5     |          | volts  |
| MAXIMUM CIRCUIT VALUES:             |         |      |         |          |        |
| Grid-No.1-Circuit Resistance:       |         |      |         |          |        |
| For fixed-bias operation            | <b></b> |      | 0.5 max | 0.25 max | megohm |
| For cathode-bias operation          |         |      | 1.0 max | 0.5 max  | megohm |
| • • • • • • • • • • • • • • • • •   |         |      |         |          |        |



### BEAM POWER TUBE

Duodecar type used as horizontaldeflection amplifier in television receivers. Outline 16A, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 21GY5 is identical with

21GY5

220 max

type 6GY5 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (average) Peak Heater-Cathode Voltage:                                | 6GY5<br>6.3<br>1.5 | 21GY5<br>21<br>0.45<br>11 | volts<br>amperes<br>seconds |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------|-----------------------------|
| Heater negative with respect to cathode  Heater positive with respect to cathode  * The dc component must not exceed 100 volts. | 200 max            | 200 max                   | volts                       |
|                                                                                                                                 | 200*max            | 200*max                   | volts                       |

#### Class A, Amplifier

| CHARACTERISTICS:                              |     |               |       |       |
|-----------------------------------------------|-----|---------------|-------|-------|
| Plate Voltage                                 |     | 60            | 130   | volts |
| Grid-No.2 (Screen-Grid) Voltage               | 130 | 130           | 130   | volts |
| Grid-No.1 (Control-Grid) Voltage              | _   | 0             | 20    | volts |
| Plate Resistance (approx.)                    | _   | _             | 11000 | ohms  |
| Transconductance                              |     | · <del></del> | 9100  | μmhos |
| Plate Current                                 |     | 410**         | 50    | mA.   |
| Grid-No.2 Current                             |     | 24**          | 1.75  | mA    |
| Grid-No.1 Voltage (Approx.) for plate current |     |               |       |       |
| of 1 μA                                       | 66  |               | -33   | volts |
| Triode Amplification Factor†                  | _   |               | 4.7   |       |

\*\* This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

† Triode connection (grid No.2 tied to plate).

#### Horizontal-Deflection Amplifier For operation in a 525-line, 30-frame system

MAXIMUM RATINGS (Design-Maximum Values): DC Plate Supply Voltage 770 max volts Peak Positive-Pulse Plate Voltage . 6500 max volts Peak Negative-Pulse Plate Voltage ..... -1500 max volts DC Grid-No.2 Voltage ..... 220 max volts DC Grid-No.1 Voltage -55 max volts Peak Negative-Pulse Grid-No.1 Voltage ..... -330 max volts Peak Cathode Current 800 max mA Average Cathode Current ..... 230 max mA Plate Dissipation†† 18 max watts 3.5 max Grid-No.2 Input . watts Bulb Temperature (At hottest point) ......

#### **MAXIMUM CIRCUIT VALUES:**

### SHARP-CUTOFF PENTODE

6GY6

Grid-No.2 Input:

For grid-No.2 voltages up to 150 volts

For grid-No.2 voltages between 150 and 300 volts .....

Miniature type used in gated-agc-amplifier circuits and as a noise-inverter tube in television receivers. Tube has two independent control grids, and has controlled heater warm-up time for use in circuits employing series-



7EN

1 max watt See curve page 80

connected heater strings. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. For curves of average characteristics, refer to type 6GX6.

| Heater Voltage (ac/dc)                                                                                                                                                                                                                                                                               | 6.3                                                     | volts                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------|
| Heater Current                                                                                                                                                                                                                                                                                       | 0.45                                                    | ampere                                                            |
| Heater Warm-up Time (Average)                                                                                                                                                                                                                                                                        | 11                                                      | seconds                                                           |
| Peak Heater-Cathode Voltage:                                                                                                                                                                                                                                                                         |                                                         |                                                                   |
| Heater negative with respect to cathode                                                                                                                                                                                                                                                              | 200 max                                                 | volts                                                             |
| Heater positive with respect to cathode                                                                                                                                                                                                                                                              | 200•max                                                 | volts                                                             |
| Grid No.1 to Plate                                                                                                                                                                                                                                                                                   | 0.026                                                   | pF                                                                |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal                                                                                                                                                                                                                                     |                                                         | •                                                                 |
| Shield                                                                                                                                                                                                                                                                                               | 8                                                       | pF                                                                |
| Grid No.1 to Grid No.3                                                                                                                                                                                                                                                                               | 0.12                                                    | pF                                                                |
| Grid No.3 to Plate                                                                                                                                                                                                                                                                                   | 1.6                                                     | pF                                                                |
| Grid No.3 to Cathode, Heater, Plate, Grid No.1, Grid No.2, and                                                                                                                                                                                                                                       |                                                         | -                                                                 |
| Internal Shield                                                                                                                                                                                                                                                                                      | 6.5                                                     | pF                                                                |
| • The dc component must not exceed 100 volts.                                                                                                                                                                                                                                                        |                                                         | -                                                                 |
| Class A, Amplifier                                                                                                                                                                                                                                                                                   |                                                         |                                                                   |
|                                                                                                                                                                                                                                                                                                      |                                                         |                                                                   |
| CHARACTERISTICS:                                                                                                                                                                                                                                                                                     |                                                         |                                                                   |
| CHARACTERISTICS:                                                                                                                                                                                                                                                                                     | 150                                                     | volts                                                             |
| CHARACTERISTICS: Plate Supply Voltage                                                                                                                                                                                                                                                                | 150<br>0                                                | volts<br>volts                                                    |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 Supply Voltage                                                                                                                                                                                                                                       |                                                         |                                                                   |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 Supply Voltage Grid-No.2 Supply Voltage                                                                                                                                                                                                              | 0                                                       | volts                                                             |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Supply Voltage                                                                                                                                                                                     | 0                                                       | volts<br>volts                                                    |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Supply Voltage Cathode-Bias Resistor                                                                                                                                                               | 0<br>100<br>0                                           | volts<br>volts<br>volts                                           |
| CHARACTERISTICS:  Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Supply Voltage Grid-No.1 Supply Voltage Cathode-Bias Resistor Plate Resistance (Approx.)                                                                                                                                   | 0<br>100<br>0<br>180                                    | volts<br>volts<br>volts<br>ohms                                   |
| CHARACTERISTICS:  Plate Supply Voltage Grid-No.3 Supply Voltage Grid-No.1 Supply Voltage Grid-No.1 Supply Voltage Grid-No.1 Supply Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance, Grid No.1 to Plate                                                                     | 0<br>100<br>0<br>180<br>0.14                            | volts<br>volts<br>volts<br>ohms<br>megohm                         |
| CHARACTERISTICS:  Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Supply Voltage Grid-No.1 Supply Voltage Cathode-Bias Resistor Plate Resistance (Approx.)                                                                                                                                   | 0<br>100<br>0<br>180<br>0.14<br>3700                    | volts<br>volts<br>volts<br>ohms<br>megohm<br>µmhos                |
| CHARACTERISTICS:  Plate Supply Voltage Grid-No.3 Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Supply Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance, Grid No.1 to Plate Transconductance, Grid No.3 to Plate Plate Current                                           | 0<br>100<br>0<br>180<br>0.14<br>3700<br>750             | volts<br>volts<br>volts<br>ohms<br>megohm<br>µmhos<br>µhmos       |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 Supply Voltage Grid-No.1 Supply Voltage Grid-No.1 Supply Voltage Grid-No.1 Supply Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance, Grid No.1 to Plate Transconductance, Grid No.3 to Plate Plate Current Grid-No.2 Current | 0<br>100<br>0<br>180<br>0.14<br>3700<br>750<br>3.7      | volts volts volts ohms megohm  µmhos µhmos mA                     |
| CHARACTERISTICS:  Plate Supply Voltage Grid-No.3 Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Supply Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance, Grid No.1 to Plate Transconductance, Grid No.3 to Plate Plate Current                                           | 0<br>100<br>0<br>180<br>0.14<br>3700<br>750<br>3.7<br>3 | volts<br>volts<br>volts<br>ohms<br>megohm<br>μmhos<br>μhmos<br>mA |

### Gated AGC Amplifier and Noise Inverter

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |           |               |
|------------------------------------------|-----------|---------------|
| Plate Voltage                            | 300 max   | volts         |
| Peak Positive-Pulse Plate Voltage        | 600 max   | volts         |
| Grid-No.3 (Control-Grid) Voltage:        |           |               |
| Negative-bias value                      | 100 max   | volt <b>s</b> |
| Positive-bias value                      | 0 max     | volts         |
| Grid-No.2 (Screen-Grid) Supply Voltage   | 300 max   | volts         |
| Grid-No.2 Voltage                        | See curve | e page 80     |
| Grid-No.1 (Control-Grid) Voltage:        |           |               |
| Negative-bias value                      | −50 max   | volts         |
| Positive-bias value                      | 0 max     | volts         |
| Plate Dissipation                        | 1.7 max   | watts         |

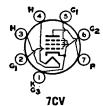
voits

0.5 max megohm

1 max megohm

| Grid-No.3-Circuit Resistance                                                        | 0.68 max             | megohm |
|-------------------------------------------------------------------------------------|----------------------|--------|
| Grid-No.1-Circuit Resistance:  For fixed-bias operation  For cathode-bias operation | 0.22 max<br>0.47 max |        |

The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.



MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation

Bypassed.

Heater Voltage (ac/dc) .....

### POWER PENTODE

Miniature type used in audio output stages of radio and television receivers employing series-connected heater strings. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any

6GZ5
Related types
4GZ5

6GZ5

position. Type 4GZ5 is identical with type 6GZ5 except for the heater ratings, as shown below.

4GZ5

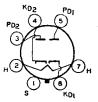
| Heater Current Heater Warm-up Time (Average)          | 0.6<br>11 | 0.38       | ampere<br>seconds |
|-------------------------------------------------------|-----------|------------|-------------------|
| Peak Heater-Cathode Voltage:                          |           |            |                   |
| Heater negative with respect to cathode               | 200 max   | 200 max    | volts             |
| Heater positive with respect to cathode               | 200•max   | 200=max    | volts             |
| • The dc component must not exceed 100 volts.         |           |            |                   |
| Class A, Amplifier                                    | •         |            |                   |
| MAXIMUM RATINGS (Design-Maximum Values):              |           |            |                   |
| · · · · · · · · · · · · · · · · · · ·                 |           | 300 max    | volts             |
| Plate Voltage Grid-No.2 (Screen-Grid) Voltage         |           | 300 max    | volts             |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value |           | 0 max      | volts             |
| Average Cathode Current                               |           | 30 max     | mA                |
| Plate Dissipation                                     |           | 4.8 max    | watts             |
| Grid-No.2 Input                                       |           | 1.1 max    | watts             |
| Bulb temperature (At hottest point)                   |           | 200 max    | °C                |
| TYPICAL OPERATION:                                    |           |            |                   |
|                                                       | 250       | 250        | volts             |
| Plate Supply Voltage Grid-No.2 Supply Voltage         | 250       | 250<br>250 | volts             |
| Cathode-Bias Resistor                                 | 270       | 270•       | ohms              |
| Peak AF Grid-No.1 Voltage                             | 9.8       | 2          | volts             |
| Zero-Signal Plate Current                             | 16        | 16         | mA                |
| Maximum-Signal Plate Current                          | 16        | 16         | mA                |
| Zero-Signal Grid-No.2 Current                         | 2.7       | 2.7        | mA                |
| Maximum-Signal Grid-No.2 Current                      | 5         | 5          | mA                |
| Plate Resistance (Approx.)                            | _         | 0.15       | megohm            |
| Transconductance                                      | _         | 8400       | μmhos             |
| Load Resistance                                       | 15000     | 15000      | ohms              |
| Total Harmonic Distortion                             | 10        | 10         | per cent          |
| Maximum-Signal Power Output                           | 1.8       | 1.1        | watts             |
| •                                                     |           |            |                   |

For cathode-bias operation .....

### TWIN DIODE

6H6
Related type

Metal type used as detector, low-voltage rectifier, and avc tube. Except for the common heater, the two diode units are independent of each other. For diode detector considerations, refer to Electron Tube Applica-



7Q

tions section. Type 12H6 is identical with type 6H6 except for the heater ratings, as shown below.

| ** . ** *                                                                      | 6Н6                             | 12H6      |        |
|--------------------------------------------------------------------------------|---------------------------------|-----------|--------|
| Heater Voltage (ac/dc)                                                         | 6.3                             | 12.6      | volts  |
| Heater Current Peak Heater-Cathode Voltage:                                    | 0.3                             | 0.15      | ampere |
| Heater negative with respect to cathode                                        | 330 max                         | 330 max   | volts  |
| Heater positive with respect to cathode                                        | 330 max                         | 330 max   | volts  |
| Rectifier or Double                                                            | er                              |           |        |
| MAXIMUM RATINGS:                                                               |                                 |           |        |
| Peak Inverse Plate Voltage                                                     |                                 | 420 max   | volts  |
| Peak Plate Current (Per Plate)                                                 |                                 | 48 max    | mA     |
| DC Output Current (Per Plate)                                                  | · · · · · · · · · · · · · · · · | 8 max     | mA     |
| TYPICAL OPERATION AS HALF-WAVE                                                 |                                 |           |        |
| RECTIFIER*:                                                                    |                                 |           |        |
| AC Plate Voltage (Per Plate, rms)  Min. Total Effective Plate-Supply Impedance | 117                             | 150       | volts  |
| (Per Plate)°                                                                   | 15                              | 40        | ohms   |
| DC Output Current (Per Plate)                                                  | 8                               | . 8       | mA     |
| TYPICAL OPERATION AS VOLTAGE DOUBLER:                                          | Half-Wave                       | Full-Wave |        |
| AC Plate Voltage (Per Plate, rms)                                              | 117                             | 117       | volts  |
| (Per Plate)°                                                                   | 30                              | 15        | ohms   |
| DC Output Current                                                              | 8                               | 8         | mA     |

<sup>\*</sup> In half-wave service, the two units may be used separately or in parallel.

### Installation and Application

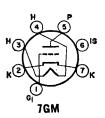
Type 6H6 requires an octal socket and may be mounted in any position. Outline 29B, Outlines section.

For detection, the diodes may be utilized in a full-wave circuit or in a half-wave circuit. In the latter case, one plate only, or the two plates in parallel, may be employed. For the same signal voltage, the use of the half-wave arrangement will provide approximately twice the rectified voltage as compared with the full-wave arrangement.

For automatic volume control, the 6H6 may be used in circuits similar to those employed for any of the twin-diode types of tubes. The only difference is that the 6H6 is more adaptable because each diode has its own separate cathode.

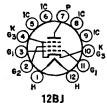
#### HIGH-MU TRIODE

6HA5 Related types: 2HA5, 3HA5, 4HA5 Miniature type used as rf-amplifier tube in vhf television tuners. Outline 5A, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 6HA5 and related type 3HA5



 $<sup>^{\</sup>circ}$  When a filter-input capacitor larger than 40  $\mu F$  is used, it may be necessary to use more plate-supply impedance than the value shown to limit the peak plate current to the rated value.

are electrically identical with types 6HM5/6HA5 and 3HM5/3HA5, respectively. Related types 2HA5 and 4HA5 are electrically identical with type 6HA5 except for heater voltages of 2.2 and 3.9 volts and heater currents of 0.6 and 0.3 ampere, respectively.



### **BEAM POWER TUBE**

Duodecar type used as horizontal-deflection amplifier in television receivers. Outline 15B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 21HB5 is identical

6HB5

6HB5
Related type:
21HB5

21HB5

with type 6HB5 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc)                        |          | 6.3     | 21      | volts   |
|-----------------------------------------------|----------|---------|---------|---------|
| Heater Current Heater Warm-up Time (Average)  |          | 1.5     | 0.45    | amperes |
|                                               |          | _       | 11      | seconds |
| Peak Heater-Cathode Voltage:                  |          |         |         |         |
| Heater negative with respect to cathode       |          | 200 max | 200 max | volts   |
| Heater positive with respect to cathode       |          | 200*max | 200*max | volts   |
| * The dc component must not exceed 100 volts. |          |         |         |         |
| Class A, A                                    | mplifier |         |         |         |
| CHARACTERISTICS;                              |          |         |         |         |
| Plate Voltage                                 | 5000     | 60      | 130     | volts   |
| Grid-No.2 (Screen-Grid) Voltage               | 130      | 130     | 130     | volts   |
| Grid-No.1 (Control-Grid) Voltage              | -        | 0       | 20      | volts   |
| Triode Amplification Factor                   | _        | _       | 4.7*    |         |
| Plate Resistance (Approx.)                    |          |         | 11000   | ohms    |
| Transconductance                              |          | -       | 9100    | μmhos   |
| Plate Current                                 | _        | 410=    | 50      | · mA    |
| Grid-No.2 Current                             | _        | 24=     | 1.75    | mA      |
| Grid-No.1 Voltage (Approx.) for plate current |          |         |         |         |
| of 1 mA                                       | 66       | _       | 33      | volts   |

- \* Grid No.2 tied to plate; plate and grid-No.2 volts, 130; grid-No.1 volts, -20.
- This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |           |       |
|------------------------------------------|-----------|-------|
| DC Plate Supply Voltage                  | 770 max   | volts |
| Peak Positive-Pulse Plate Voltage#       | 6000 max  | volts |
| Peak Negative-Pulse Plate Voltage        | -1500 max | volts |
| DC Grid-No.2 Voltage                     | 220 max   | volts |
| DC Grid-No.1 Voltage                     | 55 max    | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | 330 max   | volts |
| Peak Cathode Current                     | 800 max   | mA    |
| Average Cathode Current                  | 230 max   | mA    |
| Plate Dissipation†                       | 18 max    | watts |
| Grid-No.2 Input                          | 3.5 max   | watts |
| Bulb Temperature (At hottest point)      | 220 max   | °C    |

#### MAXIMUM CIRCUIT VALUE:

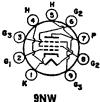
Grid-No.1-Circuit Resistance 1 max megohm

#The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds. † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

### **POWER PENTODE**

6HB6

Related type: 15HB6 Miniature type used as vertical deflection-amplifier tube in television receivers. Outline 6G, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 15HB6 is identical



with type 6HB6 except for the heater ratings, as shown below.

| TVandam TV-thomas (c. 73.)                    |           | 6HB6    | 15HB6          |           |
|-----------------------------------------------|-----------|---------|----------------|-----------|
| Heater Voltage (ac/dc)                        |           | 6.3     | 14.7           | voits     |
| Heater Current                                | • • • • • | 0.76    | 0.3            | ampere    |
| Heater Warm-up Time (Average)                 | • • • • • | _       | 11             | seconds   |
| Heater negative with respect to cathode       |           | 200 max | 200 max        | volts     |
| Heater positive with respect to cathode       |           | 200=max | 200*max        | volts     |
| • The dc component must not exceed 100 volts. |           |         |                |           |
| CHARACTERISTICS:                              |           |         |                |           |
| Plate Supply Voltage                          | 60        | 250     | 250            | volts     |
| Grid No.3                                     |           | Connec  | ted to cathode | at socket |
| Grid-No.2 Supply Voltage                      | 250       | 125     | 250            | volts     |
| Grid-No.1 Voltage                             | 0         | _       | _              | volts     |
| Cathode-Bias Resistor                         | _         | 33      | 100            | ohms      |
| Mu-Factor, Grid No.2 to Grid No.1             | _         | -       | 33             |           |
| Plate Resistance (Approx.)                    |           | 28000   | 24000          | ohms      |
| Transconductance                              | _         | 24000   | 20000          | μmhos     |
| Plate Current                                 | 150•      | 40      | 40             | mA        |
| Grid-No.2 Current                             | 37●       | 4.2     | 6.2            | mA        |
| Grid-No.1 Voltage (Approx.) for plate current |           |         |                |           |
| of 100 μA                                     | _         | -6.4    | 13             | volts     |

• This value can be measured by a method involving a recurrent waveform such that the maximum tube ratings will not be exceeded.

#### Vertical-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values) | MAXIMUM | RATINGS | (Design-Maximum | Values): |
|-----------------------------------------|---------|---------|-----------------|----------|
|-----------------------------------------|---------|---------|-----------------|----------|

| DC Plate Voltage                               | 350 max  | volts |
|------------------------------------------------|----------|-------|
| Peak Positive-Pulse Plate Voltage <sup>e</sup> | 2500 max | volts |
| DC Grid-No.2 (Screen-Grid) Voltage             | 300 max  | volts |
| DC Grid-No.1 (Control-Grid) Voltage            | -100 max | volts |
| Grid-No.2 Input                                | 2 max    | watts |
| Plate Dissipation                              | 10 max   | watts |

#### MAXIMUM CIRCUIT VALUES:

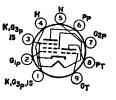
Grid-No.1-Circuit Resistance:

\* The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical-scanning cycle is 2.5 milliseconds.

### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

6HB7
Related type:
5HB7

Miniature type used as combined oscillator and mixer tube in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second, and employing seriesconnected heater strings. Outline 6B,

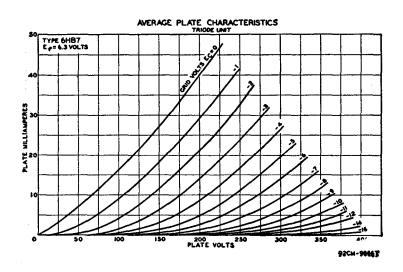


9QA

Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 5HB7 is identical with type 6HB7 except for heater ratings, as shown below.

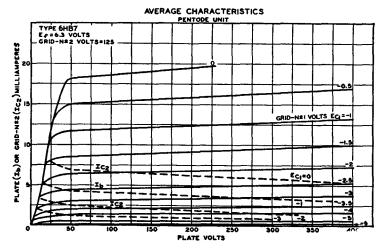
|                                                     | 5HB7          | 6HB7      |         |
|-----------------------------------------------------|---------------|-----------|---------|
| Heater Voltage (ac/dc)                              | 4.7           | 6.3       | volts   |
| Heater Current                                      | 0.6           | 0.45      | ampere  |
| Heater Warm-up Time (Average)                       | 11            | 11        | seconds |
| Peak Heater-Cathode Voltage:                        |               |           |         |
| Heater negative with respect to cathode             |               | 200 max   | volts   |
| Heater positive with respect to cathode             |               | 200°max   | volts   |
| Direct Interelectrode Capacitances:                 |               |           |         |
| Triode Unit:                                        |               |           |         |
| Grid to Plate                                       |               | 1.9       | pF      |
| Grid to Cathode, Heater, Pentode Grid No.3, and In- | ternal Shield | 3         | рF      |
| Plate to Cathode, Heater, Pentode Grid No.3, and In | ternal Shield | 1.9       | pF      |
| Pentode Unit:                                       |               |           |         |
| Grid No.1 to Plate                                  |               | 0.010 max | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid       | No.3, and     |           |         |
| Internal Shield                                     |               | 5         | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3,     | and Internal  |           |         |
| Shield                                              |               | 3.4       | pF      |
| Heater to Cathode                                   |               | 3.8       | pF      |

- The dc component must not exceed 100 volts.
- A With external shield connected to cathode except as noted.
- With external shield connected to ground.



| MAXIMUM RATINGS (Design-Max         | imum Values): | Triode Unit | Pentode Unit |         |
|-------------------------------------|---------------|-------------|--------------|---------|
| Plate Voltage                       |               | 330 max     | 330 max      | volts   |
| Grid-No.2 (Screen-Grid) Supply Volt | age           | _           | 330 max      | volts   |
| Grid-No.2 Voltage                   |               | _           | See curve    | page 80 |

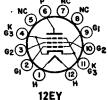
| Grid-No.1 (Control-Grid) Voltage: Positive-bias value       | Triode Unit<br>0 max | Pentode Unit | volts              |
|-------------------------------------------------------------|----------------------|--------------|--------------------|
| Plate Dissipation                                           |                      | 3.1 max      |                    |
| Grid-No.2 Input: For grid-No.2 voltages up to 165 volts     |                      | 0.55 max     |                    |
| For grid-No.2 voltages between 165 and 330 volts            |                      |              | watt<br>ve page 80 |
| -                                                           |                      | See cui      | ve page ou         |
| CHARACTERISTICS:                                            |                      |              |                    |
| Plate Supply Voltage                                        | 150                  | 125          | volts              |
| Grid-No.2 Supply Voltage                                    | _                    | 125          | volts              |
| Grid-No.1 Supply Voltage                                    | 0                    | -1           | volts              |
| Cathode-Bias Resistor                                       | 56                   |              | ohms               |
| Amplification Factor                                        | 40                   |              |                    |
| Plate Resistance (Approx.)                                  | 0.005                | 0.2          | megohm             |
| Transconductance                                            | 8500                 | 6400         | μmhos              |
| Plate Current                                               | 18                   | 12           | mA                 |
| Grid-No.2 Current                                           |                      | 4            | mA                 |
| Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A | -12                  | 9            | volts              |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:       |                      |              |                    |
| For fixed-bias operation                                    | 0.5 max              | 0.25 max     | megohm             |
| For cathode-bias operation                                  | 1 max                |              | megohm             |
|                                                             |                      |              | •                  |



### **BEAM POWER TUBE**

## 6HE5

Duodecar type used as vertical-deflection amplifier in television receivers. Outline 8D, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc),



any position. Heater volts (ac/dc), 12EY 6.3; amperes, 0.8; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

| Class A, Ampline                 | Г     |       |       |
|----------------------------------|-------|-------|-------|
| CHARACTERISTICS:                 |       |       |       |
| Plate Voltage                    | -60   | 250   | volts |
| Grid-No.2 (Screen-Grid) Voltage  | 250   | 250   | volts |
| Grid-No.1 (Control-Grid) Voltage | 0     | -20   | volts |
| Plate Resistance (Approx.)       | _     | 50000 | ohms  |
| Transconductance                 |       | 4100  | μmhos |
| Plate Current                    | -180= | 43    | mA    |

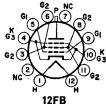
| Grid-No.2 Current                                            | 20=       | 3.5           | mA       |
|--------------------------------------------------------------|-----------|---------------|----------|
| Grid-No.1 Voltage (Approx.) for plate current of 100 $\mu$ A | _         | 50            | volts    |
| • This value can be measured by a method involving a         | recurrent | waveform such | that the |
| maximum ratings of the tube will not be exceeded.            |           |               |          |

### **Vertical Deflection Amplifier**

|  |  | For | operation | in | a | 525-line. | 30-frame | system |
|--|--|-----|-----------|----|---|-----------|----------|--------|
|--|--|-----|-----------|----|---|-----------|----------|--------|

| For operation in a 525-line, 30-frame system |        |     |        |
|----------------------------------------------|--------|-----|--------|
| MAXIMUM RATINGS (Design-Maximum Values):     |        |     |        |
| DC Plate Voltage                             | 350 n  | nax | volts  |
| Peak Positive-Pulse Plate Voltage#           | 2500 m | nax | volts  |
| Grid-No.2 Voltage                            | 300 m  | nax | volts  |
| Peak Cathode Current                         | 260 n  | nax | mA     |
| Average Cathode Current                      | 75 m   | nax | mA     |
| Plate Dissipation†                           | 12 n   | nax | watts  |
| Grid-No.2 Input†                             | 2.75 n | nax | watts  |
| Bulb Temperature (At hottest point)          | 200 n  | nax | °C     |
| MAXIMUM CIRCUIT VALUES:                      |        |     |        |
| Grid-No.1-Circuit Resistance:                |        |     |        |
| For fixed-bias operation                     | 1 m    | nax | megohm |

For cathode-bias operation ..... # The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds. † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### **BEAM POWER TUBE**

Duodecar type used as horizontal-deflection amplifier in color television receivers. Outline 16B, Outlines section. Tube requires duodecar twelvecontact socket and may be mounted in any position. Heater volts (ac/dc),

6HF5

1 max megohm

2.2 max megohms

6.3; amperes, 2.25; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A, Amplifier

| CHARACTERISTICS:                              |      |      |       |       |
|-----------------------------------------------|------|------|-------|-------|
| Plate Voltage                                 | 5000 | 70   | 175   | volts |
| Grid-No.2 (Screen-Grid) Voltage               | 125  | 125  | 125   | volts |
| Grid-No.1 (Control-Grid) Voltage              | _    | 0    | -25   | volts |
| Triode Amplification Factor                   | _    |      | 3*    |       |
| Plate Resistance (Approx.)                    |      | _ •  | 5600  | ohms  |
| Transconductance                              | _    |      | 11300 | μmhos |
| Plate Current                                 | _    | 570• | 125   | mA    |
| Grid-No.2 Current                             | _    | 34"  | 4.5   | mA    |
| Grid-No.1 Voltage (Approx.) for plate current |      |      |       |       |
| of 1 mA                                       | -140 |      | 54    | volts |
| 401131 011 11 11 11 11 11 1                   |      |      | 25    |       |

Grid-No1.-Circuit Resistance

\* Grid No.2 tied to plate; plate and grid-No.2 volts, 125; grid-No.1 volts, -25.

This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

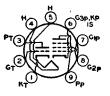
| For operation in a 525-line, 30-frame system          |           |       |
|-------------------------------------------------------|-----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):              |           |       |
| DC Plate Supply Voltage                               | 900 max   | volts |
| Peak Positive-Pulse Plate Voltage# (Absolute Maximum) | 7500*max  | volts |
| Peak Negative-Pulse Plate Voltage                     | -1100 max | volts |
| DC Grid-No.2 Voltage                                  | 190 max   | volts |
| Peak Negative-Pulse Grid-No.1 Voltage                 | -250 max  | volts |
| Peak Cathode Current                                  | 1100 max  | mA    |
| Average Cathode Current                               | 315 max   | mA    |
| Plate Dissipation†                                    | 28 max    | watts |
| Grid-No.2 Input                                       | 5.5 max   | watts |
| Bulb Temperature (At hottest point)                   | 225 max   | °C    |
| MAXIMUM CIRCUIT VALUE:                                |           |       |

- #The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- ▲ Under no circumstances should this absolute value be exceeded.
- † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

6HF8
Related type: 10HF8

Miniature type used in color and black-and-white television receivers. The triode unit is used in high-gain, sound-if stages and in sync-separator, sync-clipper, and phase-inverter circuits; pentode unit is used as video-



9DX

Triode Unit Pentode Unit

output amplifier. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be operated in any position. For curves of average characteristics, refer to type 6AW8A for the triode unit and to type 6EB8 for the pentode unit. Type 10HF8 is identical with type 6HF8 except for the heater ratings, as shown below.

| 6HF8    | 10HF8                                  |                    |
|---------|----------------------------------------|--------------------|
| 6.3     | 10.5                                   | volts              |
| 0.75    | 0.45                                   | ampere             |
|         | 11                                     | seconds            |
|         |                                        |                    |
| 200 max | 200 max                                | volts              |
| 200=max | 200 max                                | volts              |
|         |                                        |                    |
|         |                                        |                    |
|         | 3.5                                    | рF                 |
|         |                                        |                    |
|         | 2.8                                    | рF                 |
|         |                                        | -                  |
| <i></i> | 2.6                                    | pF                 |
|         |                                        | -                  |
|         | 0.1 max                                | pF                 |
|         |                                        | _                  |
|         | 10                                     | pF                 |
|         |                                        | _                  |
|         | 4.2                                    | рF                 |
|         | 0.015 max                              | pF                 |
|         |                                        | -                  |
|         | 6.3<br>0.75<br>—<br>200 max<br>200 max | 6.3 10.5 0.45 0.45 |

#### Class A, Amplifier

MAXIMUM RATINGS (Design-Maximum Values):

| Plate Voltage                                   |          | 330  | max     | 330   | max   | volts      |
|-------------------------------------------------|----------|------|---------|-------|-------|------------|
| Grid-No.2 (Screen-Grid) Supply Voltage          |          | _    |         | 330   | max   | volts      |
| Grid-No.2 Voltage                               |          |      |         | See   | curve | page 80    |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias |          | 0    | max     | 0     | max   | volts      |
| Plate Dissipation                               | <b>.</b> | 1    | max     | 5     | max.  | watts      |
| Grid-No.2 Input:                                |          |      |         |       |       |            |
| For grid-No.2 voltages up to 165 volts          |          | _    |         | 1.1   | max   | watts      |
| For grid-No.2 voltages between 165 and 33       | 0 volts  | _    |         | See   | curve | page 80    |
| CHARACTERISTICS:                                | Triode   | Unit | Pentode | Unit  |       |            |
| Plate Supply Voltage                            | 200      |      | 45      | 200   |       | volts      |
| Grid-No.2 Supply Voltage                        | -        |      | 125     | 125   |       | volts      |
| Grid-No.1 Voltage                               | -2       |      | 0       | _     |       | volts      |
| Cathode-Bias Resistor                           | _        |      | _       | 68    |       | ohms       |
| Amplification Factor                            | 70       |      |         | _     |       |            |
| Plate Resistance (Approx.)                      | 17500    |      |         | 75000 |       | ohms       |
| Transconductance                                | 4000     |      | _       | 12500 |       | $\mu$ mhos |
| Plate Current                                   | 4        |      | 40◆     | 25    |       | mA         |
| Grid-No.2 Current                               | -        |      | 15◆     | 7     |       | mA         |

| Grid-No.1 Voltage (Approx.) for plate current Triode U | Init Pentode Unit      |               |
|--------------------------------------------------------|------------------------|---------------|
| of 100 μA                                              | 9                      | volts         |
| Grid-No.1 Voltage (Approx.) for plate current          |                        |               |
| of 20 μA                                               |                        | volts         |
| MAXIMUM CIRCUIT VALUES:                                |                        |               |
| Grid-No.1-Circuit Resistance:                          | Triode Unit Pentode    | e Unit        |
| For fixed-bias operation                               |                        | max megohm    |
| For cathode-bias operation                             |                        | max megohm    |
| • This value can be measured by a method involving     | a recurrent waveform s | such that the |



### **BEAM POWER TUBE**

Miniature type used in the audio output stages of television receivers. This type has a controlled cathode warm-up time to minimize extraneous sound during receiver warm-up. Outline 5D, Outlines section. Tube requires min-

6HG5

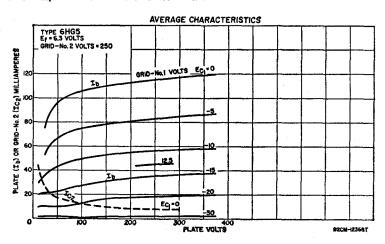
7BZ Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

maximum ratings of the tube will not be exceeded.

Heater Voltage (ac/dc) ..... 6.3 volts Heater Current ... 0.45 ampere Cathode Warm-up Time# .... 14 min seconds Peak Heater-Cathode Voltage: Heater negative with respect to cathode ...... 200 max volts 200 max Heater positive with respect to cathode ...... volts Direct Interelectrode Capacitances: рF Grid No.1 to Plate 0.4 Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 ..... pF

Plate to Cathode, Heater, Grid No.2, and Grid No.3 ......... 8.5 pF #Time interval between application of voltages and rise of plate current to 1 mA; heater volts, 6.3; plate and grid-No.2 volts, 250; cathode-bias resistor, 680 ohms.

<sup>•</sup> The dc component must not exceed 100 volts.



| MAXIMUM RATINGS         | (Design-Maximum Values): |         |       |
|-------------------------|--------------------------|---------|-------|
| Plate Voltage           |                          | 275 max | volts |
| Grid-No.2 (Screen-Grid) | Voltage                  | 275 max | volts |

| Plate Dissipation                      |             | 12 ma  |           |
|----------------------------------------|-------------|--------|-----------|
| Grid-No.2 Input                        |             | 2 ma   |           |
| Bulb Temperature (At hottest point)    |             | 250 ma | x °C      |
| TYPICAL OPERATION AND CHARACTERISTICS: |             |        |           |
| Plate Voltage                          | 180         | 250    | volts     |
| Grid-No.2 Voltage                      | 180         | 250    | volts     |
| Grid-No.1 (Control-Grid) Voltage       | <b>—8.5</b> | -12.5  | volts     |
| Peak AF Grid-No.1 Voltage              | 8.5         | 12.5   | volts     |
| Zero-Signal Plate Current              | 29          | 45     | mA        |
| Maximum-Signal Plate Current           | 30          | 47     | mA        |
| Zero-Signal Grid-No.2 Current          | 3           | 4.5    | mA        |
| Maximum-Signal Grid-No.2 Current       | 4           | 7      | mA        |
|                                        | 58000       | 52000  | ohms      |
| Transconductance                       | 3700        | 4100   | μmhos     |
| Load Resistance                        | 5500        | 5000   | ohms      |
| Total Harmonic Distortion              | 8           | 8      | per cent  |
| Maximum-Signal Power Output            | 2           | 4.5    | watts     |
| MAXIMUM CIRCUIT VALUES:                |             |        |           |
| Grid-No.1-Circuit Resistance:          |             |        |           |
| For fixed-bias operation               |             | 0.1 ma | x megohin |
| For cathode-bias operation             |             |        | x megohm  |

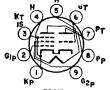
## 6HG8/ 6HG8/ ECF86 Related types:

5HG8, 7HG8

### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature types with frame-grid pentode unit used as combined oscillator and mixer tubes in vhf television receivers. Outline 6B, Outlines section.

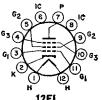
Tubes require miniature nine-contact socket and may be mounted in any



9MP

position. Types 5HG8 and 7HG8 are identical with types 6HG8 and 6HG8/ECF86 except for slightly higher current and dissipation ratings and for heater ratings, as shown below.

| rumgs, as shown below.                  |           |                |        |      |         |
|-----------------------------------------|-----------|----------------|--------|------|---------|
|                                         |           | 6HG8           |        |      |         |
|                                         |           | 6HG8/          |        |      |         |
|                                         | 5HG8      | ECF86          | 7HG8   | 3    |         |
| Heater Voltage (ac/dc)                  | 5.3       | 6.3            | 7.2    |      | volts   |
| Heater Current                          | 0.45      | 0.34           | 0.3    |      | ampere  |
| Heater Warm-up Time (Average)           | 11        | _              |        |      | seconds |
| Peak Heater-Cathode Voltage:            |           |                |        |      |         |
| Heater negative with respect to cathode | 100 max   | 100 max        | 100    | max  | volts   |
| Heater positive with respect to cathode | 100 max   |                | 100    | max  | volts   |
| Class A, A                              | Amplifier |                |        |      |         |
| MAXIMUM RATINGS (Design-Maximum Valu-   | -         | Triode Unit    | Pentoc | ie U | nit     |
| Plate Voltage                           |           | 125 max        | 250    | max  | volts   |
| Grid-No.2 (Screen-Grid) Voltage         |           | _              | 150    | max  | volts   |
| Cathode Current                         |           | 15 max         | 18     | max  | mA      |
| Plate Dissipation                       |           | 1.5 max        |        | max  | watts   |
| Grid-No.2 Input                         |           | _              |        | max  | watt    |
| CHARACTERISTICS:                        |           |                |        |      |         |
| Plate Voltage                           |           | 100            | 170    |      | volts   |
| Grid-No.2 Voltage                       |           | _              | 150    |      | volts   |
| Grid-No.1 (Control-Grid) Voltage        |           | -3             | -1.2   |      | volts   |
| Amplification Factor                    |           | 17             |        |      |         |
| Mu-Factor, Grid No.2 to Grid No.1       |           | <del>-</del> ' | 70     |      |         |
| Plate Resistance (Approx.)              |           |                | 0.35   |      | megohm  |
| Transconductance                        |           | 5500           | 12000  |      | μmhos   |
| Plate Current                           |           | 14             | 10     |      | mA      |
| Grid-No.2 Current                       |           | _              | 3.3    |      | mA      |
| MAXIMUM CIRCUIT VALUES:                 |           |                |        |      |         |
| Grid-No.1-Circuit Resistance:           |           |                |        |      |         |
| For fixed-bias operation                |           |                |        |      | megohm  |
| For cathode-bias operation              |           | 0.5 max        | 0.5    | max  | megohm  |
|                                         |           |                |        |      |         |



#### **BEAM POWER TUBE**

9 62 Duodecar type used as horizontal-deflection amplifier in television receivers. Outline 15C, Outlines section.
Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 21HJ5 is identical

6HJ5
Related type

with type 6HJ5 except for heater ratings, as shown below.

|                                               | 6HJ5    | 21HJ5   |         |
|-----------------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                        | 6.3     | 21.5    | volts   |
| Heater Current                                | 2.25    | 0.6     | amperes |
| Heater Warm-up Time (Average)                 | ****    | 11      | seconds |
| Peak Heater-Cathode Voltage:                  |         |         |         |
| Heater negative with respect to cathode       | 200 max | 200 max | volts   |
| Heater positive with respect to cathode       | 200*max | 200*max | volts   |
| * The dc component must not exceed 100 volts. |         |         |         |

### Class A, Amplifier

|                                  | ,, ,, | minpilio. |            |           |       |
|----------------------------------|-------|-----------|------------|-----------|-------|
| CHARACTERISTICS:                 | -     | •         |            |           |       |
| Plate Voltage                    | 20    | 40        | 60         | 135       | volts |
| Grid-No.2 (Screen-Grid) Voltage  | 110   | 110       | 135        | 135       | volts |
| Grid No.3                        |       | Connected | to cathode | at socket |       |
| Grid-No.1 (Control-Grid) Voltage | 0     | 0         | 0          | 22        | volts |
| Triode Amplification Factor      |       | _         | _          | 4.2       |       |
| Plate Resistance (Approx.)       |       | _         | _          | 5000      | ohms  |
| Transconductance                 |       | _         | _          | 10000     | μmhos |
| Plate Current                    | 240=  | 400=      | 540=       | 80        | mA    |
| Grid-No.2 Current                | 160=  | 42=       | 48•        | 5.5       | mA    |
| Grid-No.1 Voltage (Approx.) for  |       |           |            |           |       |
| plate current of 1 mA            | _     | _         | _          | -70       | volts |

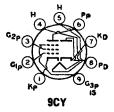
#### Horizontal Deflection Amplifier

For operation in a 525-line, 30-frame system

| 1 of operation in a bab-mile, so maine system |          |         |
|-----------------------------------------------|----------|---------|
| MAXIMUM RATINGS (Design-Maximum Values):      |          |         |
| DC Plate Supply Voltage                       | 770 ma   | x volts |
| Peak Positive-Pulse Plate Voltage#            | 7000 ma  | x volts |
| Peak Negative-Pulse Plate Voltage             | —1500 ma | x volts |
| DC Grid-No.3 Voltage                          | 70 ma    | x volts |
| DC Grid-No.2 Voltage                          | 220 ma   | x volts |
| Peak Negative-Pulse Grid-No.1 Voltage         | 330 ma   | x volts |
| Peak Cathode Current                          | 1000 ma  | x mA    |
| Average Cathode Current                       | 280 ma   | x mA    |
| Plate Dissipation†                            | 24 ma    | x watts |
| Grid-No.2 Input                               | 6 ma     |         |
| Bulb Temperature (At hottest point)           | 240 ma   | x °C    |
| MAXIMUM CIRCUIT VALUE:                        |          |         |

Grid-No.1-Circuit Resistance 1 max megohm
# The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning
cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10
microseconds.

† An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### DIODE— SHARP-CUTOFF PENTODE

Miniature type used as combined video-detector and if-amplifier tube in television receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

**6HJ8** 

| Heater Voltage (ac/dc)  |                                               | 6.3            |                | volts             |
|-------------------------|-----------------------------------------------|----------------|----------------|-------------------|
| Heater Current          |                                               | 0.45           |                | ampere            |
| Heater Warm-up Time     | (Average)                                     | 11             |                | seconds           |
| Peak Heater-Cathode V   | oltage:                                       |                |                |                   |
| Heater negative wi      | th respect to cathode                         |                | max            | volts             |
|                         | h respect to cathode                          | 200            | max            | volts             |
| Direct Interelectrode C | apacitances:                                  |                |                |                   |
| Diode Unit:             | • ••                                          |                |                |                   |
| Plate to Cathode a      | and Heater                                    | 2.4            |                | pF                |
| Postada Unite           | and Heater                                    | 3              |                | pF                |
| Pentode Unit:           |                                               | 0.015          |                | _                 |
| Grid No.1 to Flate      | ode, Heater, Grid No.2, Grid No.3,            | 0.015          | max            | pF                |
| and Internal Chic       | eld                                           | 7              |                | _                 |
| Plate to Cathode        | Heater, Grid No.2, Grid No.3, and Internal    | ,              |                | pF                |
|                         | incater, Grid 140.2, Grid 140.3, and internal | . 3.2          |                | pF                |
| Diode Plate to Pento    | de Grid No.1                                  | 0.005          | mar            | pF<br>pF          |
| Diode Cathode to Per    | ntode Plate                                   | 0.003          | max            | pF                |
| Diode Plate to Pentos   | de Plate                                      | 0.035          |                | pF                |
|                         |                                               | 0.055          | 11144          | pr                |
|                         | Pentode Unit as Class A, Amplifier            |                |                |                   |
| MAXIMIM DATINGS         | (Design-Maximum Values):                      |                |                |                   |
|                         |                                               | 220            |                | 14-               |
| Grid-No 2 (Screen-Grid) | Supply Voltage                                |                | max            | volts             |
| Grid-No.2 Voltage       | vokage                                        |                | max            | volts<br>page 80  |
| Grid-No.1 (Control-Grid | l) Voltage, Positive-bias value               |                | e curve<br>max | page au<br>volts  |
| Grid-No.2 Input:        | y voltage, I ositive-olas value               | U              | max            | voits             |
| For grid-No 2 volta     | ges up to 165 volts                           | 0.55           | max            | watt              |
| For grid-No 2 volta     | ges between 165 and 330 volts                 |                |                | page 80           |
| Plate Dissination       | see octaon 105 and 550 toks                   |                | max            | watts             |
| CHARACTERISTICS:        | ***************************************       | ۵.2            | max            | watts             |
|                         |                                               | 125            |                | volts             |
| Grid No.3               | Connected                                     | to cath        | ode at         | socket            |
| Grid-No.2 Supply Volta  | age                                           | 125            |                | volts             |
| Cathode-Bias Resistor   |                                               | 56             |                | ohms              |
|                         | ox.)                                          | 0.2            | 1              | negohm            |
|                         | *******************************               | 9300           | -              | umhos             |
| Plate Current           |                                               | 11.5           |                | mA                |
| Grid-No.2 Current       | ***************************************       | 3.6            |                | mA                |
| Grid-No.1 Voltage (App  | rox.) for plate current of 20 μA              | 6              |                | volts             |
| Grid-No.1 Voltage (App  | rox.) for plate current of 2 mA and           |                |                |                   |
| no cathode-bias res     | istor                                         | 3              |                | volts             |
|                         | Diada Huit                                    |                |                |                   |
|                         | Diode Unit                                    |                |                |                   |
|                         | (Design-Maximum Values):                      | _              |                |                   |
| DC Plate Current        | , , , , , , , , , , , , , , , , , , ,         | 5              | max            | mA                |
| CHARACTERISTICS,        |                                               |                |                |                   |
| Tube Voltage Drop for   | plate current of 50 mA                        | 10             |                | volts             |
|                         |                                               |                |                |                   |
|                         |                                               | ٦              | ୍ର             |                   |
|                         | HIGH-MU TRIODE                                | - 92           | ~~             |                   |
|                         |                                               | <b>Н</b> 3/    | <u>~</u> `     | (6) <sup>IS</sup> |
|                         | Miniature type with frame grid used           | Υ r.           | }              | ۳                 |
| /111/P                  |                                               | 4/4            | <u> </u>       | L                 |
| 6HK5                    | in vhf tuners of television receivers.        | KOT!           | $\Delta T$     | 7(7) <sub>K</sub> |
| 0                       | Outline 5C, Outlines section. Tube re-        | X              |                | <b>U</b> .,       |
|                         | quires miniature seven-contact socket         | $\mathbf{U}$   |                |                   |
|                         | and may be mounted in any position.           | G <sub>j</sub> | GM             |                   |
|                         | and may be meaned in any position.            | ,              | GIN            |                   |
| Heater Voltage (ac/dc)  |                                               | 6.3            |                | volts             |
| Heater Current          |                                               | 0.19           |                | ampere            |
| Peak Heater-Cathode Ve  |                                               |                |                | _                 |
|                         | h respect to cathode                          | 100            |                | volts             |
|                         | respect to cathode                            | 100            | max            | volts             |
| Direct Interelectrode C |                                               |                |                | . =               |
| Grid to Plate           |                                               | 0.29           |                | pF                |
|                         | leater, and Internal Shield                   | 4.4            |                | pF                |
|                         | Ieater, and Internal Shield                   | 2.6<br>2.5     |                | pF<br>pF          |
| neater to Cathode       |                                               | 2.3            |                | þr.               |
|                         |                                               |                |                |                   |

<sup>•</sup> With external shield.

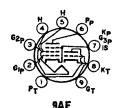
#### Class A<sub>1</sub> Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):                  |         |            |
|-----------------------------------------------------------|---------|------------|
| Plate Voltage                                             | 200 max | volts      |
| Grid Voltage, Negative-bias Value                         | —50 max | volts      |
| Cathode Current                                           | 22 max  | m <b>A</b> |
| Plate Dissipation                                         | 2.3 max | watts      |
| CHARACTERISTICS:                                          |         |            |
| Plate Voltage                                             | 135     | volts      |
| Grid Voltage                                              | 1       | volt       |
| Amplification Factor                                      | 75      |            |
| Plate Resistance (Approx.)                                | 5000    | ohms       |
| Transconductance                                          | 15000   | $\mu$ mhos |
| Plate Current                                             | 12.5    | mA         |
| Grid Voltage (Approx.) for transconductance of 150 μmhos  | 5       | volts      |
| Grid Voltage (Approx.) for transconductance of 1500 µmhos | 2.6     | volts      |
| Input Resistance**                                        | 600     | ohms       |
| Input Capacitance**                                       | 9       | pF         |
| Noise Figure#                                             | 4.2     | dB         |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-Circuit Resistance:

\*\* Measured at 200 Mc/s with plate effectively grounded for rf voltages. # For a neutralized triode amplifier at a frequency of 200 Mc/s with signal source impedance adjusted for minimum noise output.



### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in a wide variety of applications in television receivers employing series-connected heater strings. The triode unit is used as a sync-separator or voltage-amplifier tube, and the pentode unit is used as

6HL8

a video if-amplifier, agc-amplifier, or reactance tube. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.6; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

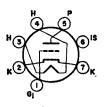
Class A, Amplifier MAXIMUM RATINGS (Design-Maximum Values): Triode Unit Pentode Unit 330 max 330 max volts Plate Voltage .... Grid-No.2 (Screen-Grid) Supply Voltage ..... 330 max volts See curve page 80 Voltage 0 max volts Grid-No.1 (Control-Grid) Voltage, Positive-bias value 0 max 2.5 max Plate Dissipation ..... 2.5 max watts Grid-No.2 Input: 0.55 max For grid-No.2 voltages up to 165 volts ... watt See curve page 80 For grid-No.2 voltages between 165 and 330 volts CHARACTERISTICS: volts 125 125 Plate Voltage ..... 125 volts Grid-No.2 Voltage ..... Grid-No.1 Voltage ..... -1 volt 40 Amplification Factor ...... 5000 150000 ohms Plate Resistance (Approx.) ..... 7000 10000 μmhos Transconductance ...... 12 mA Plate Current Grid-No.2 Current ........... mA volts Grid-No.1 Voltage (Approx.) for plate current of 20 µA MAXIMUM CIRCUIT VALUES: 1 max megohm Grid-No.1-Circuit Resistance .....

### HIGH-MU TRIODE

# 6HM5/ 6HA5

Related type: 3HM5/3HA5

Miniature type used as rf-amplifier tube in vhf television tuners. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 3HM5/3HA5 is identical with



7GM

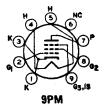
type 6HM5/6HA5 except for heater ratings, as shown below.

| Heater Voltage (ac/dc)  Heater Current  Peak Heater-Cathode Voltage:  Heater negative with respect to cathod Heater positive with respect to cathod | ie                    |        | HM5/3HA5<br>2.7<br>0.45<br>110 max<br>110 max | 6HM5/6HA<br>6.3<br>0.18<br>110 max<br>110 max | volts<br>ampere<br>volts<br>volts |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------|-----------------------------------------------|-----------------------------------------------|-----------------------------------|
| Class                                                                                                                                               | A, Amp                | lifier |                                               |                                               |                                   |
| MAXIMUM RATINGS (Design-Maximum DC Plate Voltage                                                                                                    | Values):              |        |                                               | 220 max                                       | volts                             |
| DC Plate Supply Voltage                                                                                                                             | · · · · · · · · · ·   |        |                                               | 600 max                                       | voits                             |
| Grid Voltage                                                                                                                                        | · · · · · · · · · · · |        |                                               | -50 max                                       | volts                             |
| Cathode Current                                                                                                                                     |                       |        |                                               | 22 max                                        | mA                                |
| Plate Dissipation                                                                                                                                   |                       |        |                                               | 2.6 max                                       | watts                             |
|                                                                                                                                                     |                       |        |                                               | 2.0                                           | atta                              |
| CHARACTERISTICS AND TYPICAL                                                                                                                         |                       |        |                                               |                                               |                                   |
| OPERATION:                                                                                                                                          | Fixed                 | l Bias | Catho                                         | ode Bias                                      |                                   |
| DC Plate Supply Voltage                                                                                                                             | 135                   | 135    | 135                                           | 135                                           | volts                             |
| Plate-Load Resistor                                                                                                                                 |                       | _      | 1000                                          | 5600                                          | ohms                              |
| Internal-Shield Voltage                                                                                                                             | 0                     | 0      | 0                                             | 0                                             | volts                             |
| DC Grid Voltage                                                                                                                                     | -1                    | -2.7   | _                                             | _                                             | volts                             |
| Cathode-Bias Resistor                                                                                                                               | _                     |        | 0                                             | 87                                            | ohms                              |
| Amplification Factor                                                                                                                                | 72                    | -      | 80                                            | 72                                            |                                   |
| Transconductance                                                                                                                                    | 14500                 | 1500   | 20000                                         | 14500                                         | $\mu$ mhos                        |
| Plate Current                                                                                                                                       | 11.5                  | · -    | 19                                            | 11.5                                          | mA                                |
| DC Grid Current                                                                                                                                     | -                     | _      | 10                                            |                                               | $\mu A$                           |
| Grid-No.1 Voltage for one-per-cent                                                                                                                  |                       |        |                                               |                                               |                                   |
| transconductance                                                                                                                                    |                       |        | 5.3                                           | 8.1                                           | volts                             |

### SHARP-CUTOFF PENTODE

6HM6
Related type:
4HM6

Miniature type with frame grid used in the if-amplifier stages of television receivers Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 4HM6 is identical with

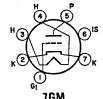


type 6HM6 except for the heater ratings, as shown below.

|                                               | 4HM6    | 6HM6    |         |
|-----------------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                        | 4.2     | 6.3     | volts   |
| Heater Current                                | 0.45    | 0.3     | ampere  |
| Heater Warm-up Time (Average)                 |         | _       | seconds |
| Peak Heater-Cathode Voltage:                  |         |         |         |
| Heater negative with respect to cathode       | 200 max | 200 max | volts   |
| Heater positive with respect to cathode       | 200*max | 200 max | volts   |
| * The dc component must not exceed 100 volts. |         |         |         |
| Class A Amulifian                             |         |         |         |

| MAXIMUM RATINGS (Design-Maximum Values):              |           |         |
|-------------------------------------------------------|-----------|---------|
| Plate Voltage                                         | 250 max   | voits   |
| Grid-No.2 (Screen-Grid) Supply Voltage                | 250 max   | volts   |
| Grid-No.2 Voltage                                     | See curve | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Negative-bias value | —50 max   | volts   |

| Cathode Current                                               |             | max     | mA        |
|---------------------------------------------------------------|-------------|---------|-----------|
| Plate Dissipation                                             | 2.5         | max     | watts     |
| Grid-No.2 Input:                                              |             |         |           |
| For grid-No.2 voltages up to 125 volts                        | 2.5         | max     | watt      |
| For grid-No.2 voltages between 125 and 250 volts              |             | ee curv | e page 80 |
| CHARACTERISTICS:                                              |             |         |           |
| Plate Supply Voltage                                          | 125         | 5       | volts     |
| Grid No.3 (Suppressor Grid)                                   | onnected to | athode  | at socket |
| Grid-No.2 Supply Voltage                                      | 125         | 3       | volts     |
|                                                               |             | -       | ohms      |
| Cathode-Bias Resistor                                         |             | -       | megohm    |
| Plate Resistance (Approx.)                                    | 4.500       |         | umhos     |
| Transconductance                                              |             |         | mA        |
| Plate Current                                                 |             | 2 .     | mA        |
| Grid-No.2 Current                                             |             |         | volts     |
| Grid-No.1 Voltage (Approx.) for transconductance of 100 µmhos |             | ,       | voits     |
| MAXIMUM CIRCUIT VALUES:                                       |             |         |           |
| Grid-No.1-Circuit Resistance:                                 |             |         |           |
| For fixed-bias operation                                      | 0.25        | max     | megohm    |
| For cathode-bias operation                                    |             | max     | megohm    |
| •                                                             |             |         |           |



### HIGH-MU TRIODE

Miniature type used as groundedcathode rf-amplifier tube in vhf tuners of television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be operated in any position. Types 2HO5

6HQ5
Related types:
2HQ5, 3HQ5

7GM operated in any position. Types 2HQ5 and 3HQ5 are identical with type 6HQ5 except for the heater ratings, as shown below.

|                                                | 2HQ5    | 3HQ5 | 6HQ5 |         |
|------------------------------------------------|---------|------|------|---------|
| Heater Voltage (ac/dc)                         | 2.4     | 3    | 6.3  | volts   |
| Heater Current                                 | 0.6     | 0.45 | 0.2  | ampere  |
| Heater Warm-up Time (Average)                  | 11      | 11   |      | seconds |
| Peak Heater-Cathode Voltage:                   |         |      |      |         |
| Heater negative with respect to cathode        | 100     | 100  | 100  | volts   |
| Heater positive with respect to cathode        | 100     | 100  | 100  | volts   |
| Direct Interelectrode Capacitances (Approx.):* |         |      |      |         |
| Grid to Plate                                  | <b></b> |      | 0.52 | pF      |
| Grid to Cathode, Heater, and Internal Shield   | đ       |      | 5    | pF      |
| Plate to Cathode, Heater, and Internal Shield  |         |      | 3.5  | pF      |
| Heater to Cathode                              |         |      | 2.5  | pF      |
|                                                |         |      |      |         |

<sup>•</sup> With external shield connected to cathode.

MAXIMUM RATINGS (Design-Maximum Values):

| 200 max | volts                                                                                                   |
|---------|---------------------------------------------------------------------------------------------------------|
| 50 max  | volts                                                                                                   |
| 22 max  | mA                                                                                                      |
| 2.5 max | watts                                                                                                   |
|         |                                                                                                         |
| 135     | volts                                                                                                   |
| -1      | voit                                                                                                    |
| 78      |                                                                                                         |
| 5400    | ohms                                                                                                    |
| 15000   | μmhos                                                                                                   |
| 11.5    | mA                                                                                                      |
| -4.2    | volts                                                                                                   |
| -2.5    | volts                                                                                                   |
| 275     | ohms                                                                                                    |
| 11.2    | рF                                                                                                      |
| 4.7     | dB                                                                                                      |
|         | -50 max<br>22 max<br>2.5 max<br>135<br>-1<br>78<br>5400<br>15000<br>11.5<br>-4.2<br>-2.5<br>275<br>11.2 |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-Circuit Resistance:

For cathode-bias operation .....

1 max megohm

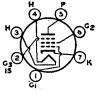
\*\* Measured at 200 Mc/s with heater volts = 6.3 volts and plate effectively grounded for rf voltages.

#For a neutralized triode amplifier at a frequency of 200 Mc/s with signal source impedance adjusted for minimum noise output.

### SEMIREMOTE-CUTOFF PENTODE

6HR6
Related type:

Miniature type used as if-amplifier tube in FM receivers employing seriesconnected heater strings. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type

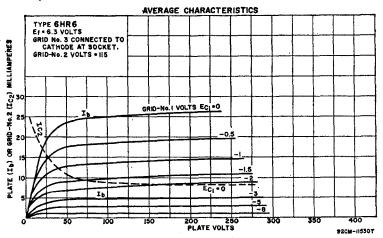


7BK

19HR6 is identical with type 6HR6 except for the heater ratings, as shown below.

| Heater Voltage (ag/de)                                  | 6HR6     | 19HR6<br>18.9 | volts   |
|---------------------------------------------------------|----------|---------------|---------|
| Heater Voltage (ac/dc)                                  | 0.45     | 0.15          |         |
| Heater Current                                          | 0.43     | 0.13          | ampere  |
| Heater Warm-up Time (Average)                           | 11       | 17            | seconds |
| Peak Heater-Cathode Voltage:                            |          |               |         |
| Heater negative with respect to cathode                 | 200 max  | 200 max       | voits   |
| Heater positive with respect to cathode                 | 200 max  | 200=max       | volts   |
| Direct Interelectrode Capacitances:                     |          |               |         |
| Grid No.1 to Plate                                      |          | 0.006 max     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and | Internal |               |         |
| Shield                                                  |          | 8.8           | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and     | Internal |               | -       |
| Shield                                                  |          | 5.2           | pF      |
|                                                         |          |               |         |

• The dc component must not exceed 100 volts.



| MAXIMUM RATINGS (Design-Maximum Values): Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage, Positive value Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage | 300 max volts 0 max volts 300 volts volts See curve page 80 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Grid-No.1 (Control-Grid) Voltage: Negative-bias value Positive-bias value                                                                                                  | -50 max volts 0 max volts                                   |

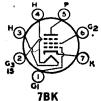
| Plate Dissipation Grid-No.2 Input:                           | 3       | max    | watts     |
|--------------------------------------------------------------|---------|--------|-----------|
| For grid-No.2 voltages up to 150 volts                       |         | max    | watt      |
| For grid-No.2 voltages between 150 and 300 volts             | Se      | e curv | e page 80 |
| CHARACTERISTICS:                                             |         |        |           |
| Plate Supply Voltage                                         | 200     |        | volts     |
| Grid No.3 Connected                                          | l to ca | thode  | at socket |
| Grid-No.2 Supply Voltage                                     | 115     |        | volts     |
| Grid-No.1 Supply Voltage                                     | 0       |        | volts     |
| Cathode-Bias Resistor                                        | 68      |        | ohms      |
| Plate Resistance (Approx.)                                   | 0.5     |        | megohm    |
| Transconductance                                             | 8500    |        | μmhos     |
| Grid-No.1 Voltage (Approx.) for transconductance of 60 μmhos | -15     |        | volts     |
| Plate Current                                                | 13.2    |        | mA        |
| Grid-No.2 Current                                            | 4.3     |        | mA        |
| MAXIMUM CIRCUIT VALUES:                                      |         |        |           |
| Grid-No.1-Circuit Resistance:                                |         |        |           |
| For fixed-bias operation                                     | 0.5     | max    | megohm    |
| For cathode-bias operation                                   | 1       | max    | megohm    |

### SHARP-CUTOFF PENTODE

Related type: 19HS6

Plate Supply Voltage

Miniature type used as if-amplifier and limiter tube in FM receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 19HS6 is identical with type



300 max

0 max

volts

volts

| 6HS6 except | for the | heater 1 | ratings, a | as: | shown | below. |
|-------------|---------|----------|------------|-----|-------|--------|
|-------------|---------|----------|------------|-----|-------|--------|

|                                                     | 6HS6      | 19HS6     |         |
|-----------------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                              | 6.3       | 18.4      | volts   |
| Heater Current                                      | 0.45      | 0.15      | атреге  |
| Heater Warm-up Time (Average)                       | 11        | 17        | seconds |
| Peak Heater-Cathode Voltage:                        |           |           |         |
| Heater negative with respect to cathode             | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode             | 200 = max | 200 max   | volts   |
| Direct Interelectrode Capacitances:                 |           |           |         |
| Grid No.1 to Plate                                  |           | 0.006 max | volts   |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, |           |           |         |
| and Internal Shield                                 |           | 8.8       | рF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3,     |           |           | •       |
| and Internal Shield                                 |           | 5.2       | pF      |
|                                                     |           |           | •       |

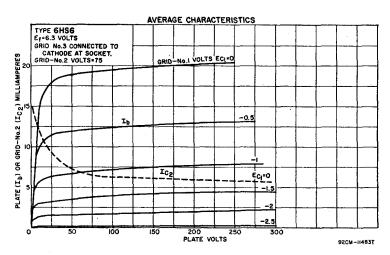
<sup>•</sup> The dc component must not exceed 100 volts.

MAXIMUM RATINGS (Design-Maximum Values):

Grid-No.3 (Suppressor-Grid) Voltage, Positive Value

| Grid-No.2 (Screen-Grid) Supply Voltage           | 300            | max volts       |
|--------------------------------------------------|----------------|-----------------|
| Grid-No.2 Voltage                                | Se             | e curve page 80 |
| Grid-No.1 (Control-Grid) Voltage:                |                |                 |
| Negative-bias value                              | 50             | max volts       |
| Positive-bias value                              | 0              | max volts       |
| Plate Dissipation                                |                | max watts       |
| Grid-No.2 Input;                                 |                |                 |
| For grid-No.2 voltages up to 150 volts           | 1              | max watt        |
| For grid-No.2 voltages between 150 and 300 volts |                | e curve page 80 |
| CHARACTERISTICS:                                 |                |                 |
| Plate Supply Voltage                             | 150            | volts           |
|                                                  | nnected to car | hode at socket  |
| Grid-No.2 Supply Voltage                         | 75             | volts           |
| Grid-No.1 Supply Voltage 0                       | 0              | volts           |
| Cathode-Bias Resistor                            | 68             | ohms            |
| Amplification Factor 50                          | _              |                 |
| Plate Resistance (Approx.)                       | 0.5            | megohm          |

| Transconductance                                            | _ | 9500 | μmhos |
|-------------------------------------------------------------|---|------|-------|
| Plate Current                                               | _ | 8.8  | mA    |
| Grid-No.2 Current                                           | _ | 2.8  | mA    |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A | - | -4   | volts |



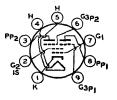
#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

### SHARP-CUTOFF TWIN PENTODE

6HS8
Related type:
3HS8, 4HS8

Miniature type used in agc amplifier, sync, and noise-limiting circuits of television receivers. One pentode unit is used as combined sync separator and sync clipper; second pentode unit is used as agc amplifier. Outline 6E,



9FG

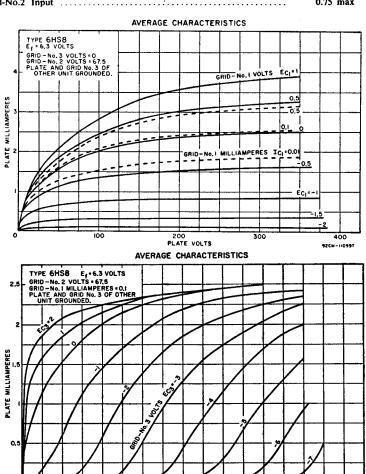
Outlines section. Tube requires miniature nine-contact socket and may be operated in any position. Type 3HS8 and 4HS8 are identical with type 6HS8 except for the heater ratings, as shown below.

|                                              | 3HS8    | 4HS8      | 6HS8      |         |
|----------------------------------------------|---------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                       | 3.15    | 4.2       | 6.3       | volts   |
| Heater Current                               | 0.6     | 0.45      | 0.3       | ampere  |
| Heater Warm-up Time (Average)                | 11      | 11        |           | seconds |
| Peak Heater-Cathode Voltage:                 |         |           |           |         |
| Heater negative with respect to cathode      | 200 max | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode      | 200 max | 200 = max | 200=max   | volts   |
| Direct Interelectrode Capacitances:          |         |           |           |         |
| Grid No.3 to Plate (Each Unit)               |         | <b></b>   | 2         | рF      |
| Grid No.1 to All Other Electrodes            |         |           | 6         | рF      |
| Grid No.3 (Each Unit) to All Other Electrode |         |           | 3.6       | pF      |
| Plate (Each Unit) to All Other Electrodes    |         |           | 3         | ρF      |
| Grid No.3 (Unit No.1) to Grid No.3 (Unit N   |         |           | 0.015 max | pF      |

• The dc component must not exceed 100 volts.

| MAXIMUM RATINGS (Design-Maximum Values): |         |       |
|------------------------------------------|---------|-------|
| Plate Voltages (Fach Unit)               | 300 max | volts |

| Grid-No.3 (Suppressor-Grid) Voltage (Each Unit):      |          |       |
|-------------------------------------------------------|----------|-------|
| Peak positive value                                   | 50 max   | volts |
| DC negative value                                     | 50 max   | volts |
| DC positive value                                     | 3 max    | volts |
| Grid-No.2 (Screen-Grid) Voltage                       | 150 max  | volts |
| Grid-No.1 (Control-Grid) Voltage, Negative-bias value | 50 max   | volts |
| Cathode Current                                       | 12 max   | mA    |
| Plate Dissipation (Each Unit)                         | 1.1 max  | watts |
| Grid-No.2 Input                                       | 0.75 max | watt  |



#### **CHARACTERISTICS:**

| With One Unit Operation              | ng●        |      |       |
|--------------------------------------|------------|------|-------|
| Plate Voltage                        | <b>100</b> | 100  | volts |
| Grid-No.3 Voltage                    | 0          | 0    | volts |
| Grid-No.2 Voltage                    | 67.5       | 67.5 | volts |
| Grid-No.1 Voltage                    | Ö          | 0    | volts |
| Transconductance, Grid-No.3-to-Plate | _          | 450  | μmhos |
| Transconductance, Grid-No.1-to-Plate | 1100       | -    | umhos |
| Plate Current                        | _          | 2    | mA    |

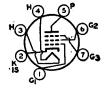
200 PLATE VOLTS

| Grid-No.3 Voltage (Approx.) for plate current of 100 μA      | _          | -3.5    | voits  |
|--------------------------------------------------------------|------------|---------|--------|
| Grid-No.1 Voltage (Approx.) for plate current of 100 $\mu$ A |            | -2.3    | volts  |
| With Both Units Operation                                    | ng         |         |        |
| Plate Voltage (Each Unit)                                    | 100        | 100     | volts  |
| Grid-No.3 Voltage (Each Unit)                                | -10        | 0       | volts  |
| Grid-No.2 Voltage                                            | 67.5       | 67.5    | volts  |
| Grid-No.1 Voltage                                            | <b>D</b> - |         | volts  |
| Plate Current (Each Unit)                                    | _          | 2       | mA     |
| Grid-No.2 Current                                            | 7          | 4.4     | mA     |
| Cathode Current                                              | 7.1        | 8.5     | mA     |
| MAXIMUM CIRCUIT VALUES:                                      |            |         |        |
| Grid-No.3-Circuit Resistance (Each Unit)                     |            | 0.5 max | megohm |
| Grid-No.1-Circuit Resistance                                 |            | 0.5 max | megohm |
| • With plate and grid No.3 of other unit connected to ground | 1.         |         |        |

## SHARP-CUTOFF PENTODE

6HZ6

Miniature type used as sound-detector tube in FM and television receivers employing series-connected heater strings. Tube has two independent control grids. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.



7EN

| Heater Voltage (ac/dc)                                     | 6.3     | voits   |
|------------------------------------------------------------|---------|---------|
| Heater Current                                             | 0.45    | ampere  |
| Heater Warm-up Time (Average)                              | 11      | seconds |
| Peak Heater-Cathode Voltage:                               |         |         |
| Heater negative with respect to cathode                    | 200 max | volts   |
| Heater positive with respect to cathode                    | 200 max | volts   |
| Direct Interelectrode Capacitances (Approx.):              |         |         |
| Grid No.1 to Plate                                         | 0.023   | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3,        |         |         |
| and Internal Shield                                        | 8.2     | pF      |
| Grid No.1 to Grid No.3                                     | 0.09    | рF      |
| Grid No.3 to Plate                                         | 1.6     | ρF      |
| Grid No.3 to Cathode, Heater, Grid No.1, Grid No.2, Plate, |         | •       |
| and Internal Shield                                        | 7.2     | pF      |
| • The dc component must not exceed 100 volts.              |         |         |

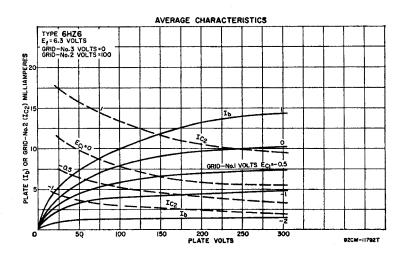
#### Class A<sub>1</sub> Amplifier

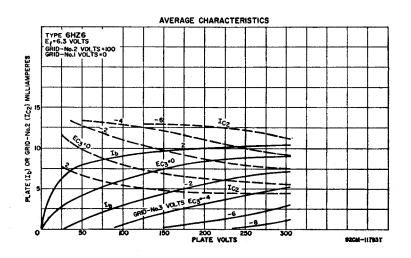
| CHARACTERISTICS:                                                   |           |        |
|--------------------------------------------------------------------|-----------|--------|
| Plate Supply Voltage                                               | 150       | volts  |
| Grid-No.3 Supply Voltage                                           | 0         | volts  |
| Grid-No.2 Supply Voltage                                           | 100       | volts  |
| Grid-No.1 Supply Voltage                                           | 0         | volts  |
| Cathode-Bias Resistor                                              | 180       | ohms   |
| Plate Resistance (Approx.)                                         | 0.11      | megohm |
| Transconductance, Grid No.1 to Plate                               | 3400      | μmhos  |
| Transconductance, Grid No.3 to Plate                               | 600       | μmhos  |
| Plate Current                                                      | 3.2       | mA.    |
| Grid-No.2 Current                                                  | 3.2       | mA     |
| Grid-No.3 Supply Voltage (Approx.) for plate current of 20 $\mu$ A | <b>—7</b> | volts  |
| Grid-No.1 Supply Voltage (Approx.) for plate current of 20 $\mu$ A | -4.5      | volts  |
| FM Sound Detector                                                  |           |        |

| MAXIMUM RATINGS (Design-Maximum Values): |      |       |         |
|------------------------------------------|------|-------|---------|
| Plate Voltage                            | 300  | max   | volts   |
| Grid-No.3 (Control-Grid) Voltage:        |      |       |         |
| Negative value (dc and peak ac)          | -100 | max   | volts   |
| Positive value (dc and peak ac)          | 25   | max   | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage   | 300  | max   | volts   |
| Grid-No.2 Voltage                        | See  | curve | page 80 |
| -                                        |      |       |         |

<sup>□</sup> Adjusted to give grid-No.1 current of 0.1 milliampere.

| Grid-No.1 (Control-Grid) Voltage:                |          |           |
|--------------------------------------------------|----------|-----------|
| Negative-bias value                              | -50 max  | volts     |
| Positive-bias value                              | 0 max    | volts     |
| Plate Dissipation                                | 1.7 max  | watts     |
| Grid-No.3 Input                                  | 0.1 max  | watt      |
| Grid-No.2 Input:                                 |          |           |
| For grid-No.2 voltages up to 150 volts           | 1 max    | watt      |
| For grid-No.2 voltages between 150 and 300 volts | See curv | e page 80 |
| MAXIMUM CIRCUIT VALUES:                          |          |           |
| Grid-No.3-Circuit Resistance                     | 0.68 max | megohm    |
| Grid-No.1-Circuit Resistance:                    |          |           |
| For fixed-bias operation                         | 0.22 max | megohm    |
| For cathode-bias operation                       | 0.47 max | megohm    |





### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

6HZ8

Miniature type used in television receivers. The triode unit is used as a voltage amplifier or sync separator, and the pentode unit as a video amplifier. Outline 8E, Outlines section. Tube requires duodecar nine-contact



9DX

socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.125; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

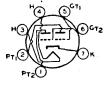
### Class A<sub>1</sub> Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              | Triode Unit    | Pentode Un  | it        |
|-------------------------------------------------------|----------------|-------------|-----------|
| Plate Voltage                                         | 300 max        | 300 max     | volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                | -              | 330 max     | volts     |
| Grid-No.2 Voltage                                     | _              | See curv    | e page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive bias value | 0 max          | 0 max       | volts     |
| Plate Dissipation                                     | 1 max          | 8 max       | watts     |
| Grid-No.2 Input:                                      |                |             |           |
| For grid-No.2 voltages up to 165 volts                | _              | 2 max       | watts     |
| For grid-No.2 voltages between 165 and 330 volts      |                | See curv    | e page 80 |
|                                                       |                |             | - F6      |
| CHARACTERISTICS:                                      |                |             |           |
| Plate Voltage                                         | 200            | 60 250      | volts     |
| Grid-No.2 Supply Voltage                              |                | 170 170     | volts     |
| Grid-No.1 Voltage                                     | -2             | 0 -         | volts     |
| Cathode-Bias Resistor                                 | _              | _ 100       | ohms      |
| Amplification Factor                                  | 70             |             | · · ·     |
| Plate Resistance (Approx.)                            |                | - 0.14      | megohm    |
| Transconductance                                      | 4000           | 12600       | μmhos     |
| Plate Current                                         | 3.5            | 90= 29      | mA        |
| Grid-No.2 Current                                     | _              | 22.5 6      | mA        |
| Grid-No.1 Voltage (Approx.) for plate current         |                | 22.5        | ****      |
| of 10 $\mu$ A                                         | 5              | 11.5        | volts     |
| οι το με                                              | 3              |             | 1014      |
| MAXIMUM CIRCUIT VALUES:                               |                |             |           |
| Grid-No.1-Circuit Resistance:                         |                |             |           |
| For fixed-bias operation                              | 0.5 max        | 0.25 max    | megohm    |
| For cathode-bias operation                            | 1 max          | 1 max       |           |
|                                                       |                |             |           |
| • This value can be measured by a method involving    | a recurrent wa | veiorm such | that the  |

## maximum ratings of the tube will not be exceeded.

### MEDIUM-MU TWIN TRIODE

6J6A Related type: 5J6 Miniature type used as combined rf power amplifier and oscillator or as twin af amplifier. With push-pull arrangement of the grids and the plates in parallel this type can also be used as a mixer at frequencies as high as



7BF

600 megacycles per second. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Type 5J6 is identical with type 6J6A except for the heater ratings, as shown below.

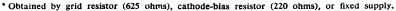
|                                         | 5J6     | 6J6A    |         |
|-----------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                  | 4.7     | 6.3     | volts   |
| Heater Current                          | 0.6     | 0.45    | ampere  |
| Heater Warm-up Time (Average)           | 11      | 11      | seconds |
| Peak Heater-Cathode Voltage:            |         |         |         |
| Heater negative with respect to cathode | 100 max | 100 max | volts   |
| Heater positive with respect to cathode | 100 max | 100 max | volts   |

With

Without

| Direct Interelectrode Capacitances (Each Unit, Approx.): Grid to Plate Grid to Cathode and Heater Plate to Cathode and Heater (Unit No.1) Plate to Cathode and Heater (Unit No.2) | Without<br>External<br>Shield<br>1.6<br>2.2<br>0.4<br>0.4 | With<br>External<br>Shield<br>1.6<br>2.6<br>1.6 | pF<br>pF<br>pF<br>pF                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------|--------------------------------------|
| Class A <sub>1</sub> Amplifier (Each                                                                                                                                              | n Unit)                                                   |                                                 |                                      |
| MAXIMUM RATINGS (Design-Center Values): Plate Voltage Grid Voltage, Positive-bias value Plate Dissipation                                                                         |                                                           | 300 max<br>0 max<br>1.5 max                     | volts<br>volts<br>watts              |
| CHARACTERISTICS: Plate Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) Transconductance Plate Current                                               |                                                           | 100<br>50†<br>38<br>7100<br>5300<br>8.5         | volts<br>ohms<br>ohms<br>µmhos<br>mA |
| MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance: For fixed-bias operation For cathode-bias operation                                                                              |                                                           | Not reco                                        | mmended<br>megohm                    |
| † Value is for both units operating at the specified condit                                                                                                                       | ions.                                                     |                                                 |                                      |
| RF Power Amplifier and Oscillator—<br>Key-down conditions per tube with                                                                                                           |                                                           |                                                 |                                      |
| MAXIMUM RATINGS (Design-Center Values, Each Ur<br>Plate Voltage                                                                                                                   |                                                           | 300 max                                         | volts                                |
| Grid Voltage: Negative-bias value Positive-bias value                                                                                                                             |                                                           | -40 max<br>0 max                                | volts<br>volts                       |

| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 300 max | volts |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------|
| Grid Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |         |       |
| Negative-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -40 max | volts |
| Positive-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0 max   | volts |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 15 max  | mA    |
| Grid Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 8 max   | mA    |
| Plate Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 4.5 max | watts |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1.5 max | watts |
| TYPICAL PUSH-PULL OPERATION (Both Units):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |       |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 150     | volts |
| Grid Voltage°                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -10     | volts |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 30      | mA    |
| Grid Current (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 16      | mA    |
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| A COLOR TO THE COL |         |       |





### PENTODE— BEAM POWER TUBE

Duodecar type used in FM and television receivers. The pentode unit is
used as a gated-beam discriminator
and the beam power unit is used in
audio power-output stages in FM and
television limiter and discriminator

OJIU Related type: 13J10

applications. Outline 8B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 13J10 is identical with type 6J10 except for heater ratings, as shown below.

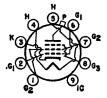
|                               | 6J 10 | 13310 |         |
|-------------------------------|-------|-------|---------|
| Heater Voltage (ac/dc)        | 6.3   | 13.2  | volts   |
| Heater Current                | 0.95  | 0.45  | ampere  |
| Heater Warm-up Time (Average) |       | 11    | seconds |

| Peak Heater-Cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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Tube r duodecar twelve-contact sock may be mounted in any position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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Outline requires G <sub>2</sub> et and on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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| Grid-No.2 (Accelerate Peak Positive Grid-No.2 Average Cathode Cu  6J11  Heater Voltage (ac/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-an service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position (dc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| Grid-No.2 (Accelerate Peak Positive Grid-No.2 Average Cathode Cu  6J11  Heater Voltage (ac/Heater Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position (dc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| Fid-No.2 (Accelerate Peak Positive Grid-No.2)  Average Cathode Cu  6J11  Heater Voltage (ac/Heater Current Peak Heater-Cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the contact sock may be mounted in any position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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Outline requires G <sub>2</sub> et and on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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max<br>13 max<br>13 max<br>14 G2PI<br>6 7 8<br>4 12BW<br>6.3<br>0.8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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 Gip <sub>i</sub> volts ampere                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| Fid-No.2 (Accelerate Peak Positive Grid-No.2)  Average Cathode Cu  6J11  Heater Voltage (ac/Heater Current Peak Heater-Cathode Heater negative                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-an service in television receivers. 8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact sock may be mounted in any position of the contact 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| Peak Positive Grid-No.2 (Accelerate Peak Positive Grid-No.2 Cathode Cu  6J11  Heater Voltage (ac/Heater Current Peak Heater-Cathode Heater negative Heater positive                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers. 8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the contact sock with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| Fid-No.2 (Accelerate Peak Positive Grid-No.2 (Accelerate Peak Positive Grid-No.2)  6J11  Heater Voltage (ac/Heater Current Peak Heater-Cathode Heater negative Heater positive Direct Interelectrode Unit No. 1:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-an service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the service with respect to cathode with respect to cathode with respect to cathode capacitances:**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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and on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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max<br>13 max<br>13 max<br>K <sub>P2</sub> G <sub>2PI</sub><br>6 7 8<br>4 12BW<br>6.3<br>0.8<br>200 max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| Fid-No.2 (Accelerate Peak Positive Grid-No.1)  Average Cathode Cu  6J11  Heater Voltage (ac/Heater Current Peak Heater Cathode Heater negative Heater positive Direct Interelectrode Unit No. 1:  Grid No.1 to Ca                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the  | G <sub>II</sub> G <sub>3p2</sub> IS  IS  Coutline  equires  et and  on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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| Fid-No.2 (Accelerate Peak Positive Grid-No.1)  Heater Voltage (ac/Heater Current Peak Heater-Cathode Heater negative Heater positive Direct Interelectrode Unit No. 1:  Grid No.1 to Ca of Unit No.2,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the service with respect to cathode with | G <sub>II</sub> Gap <sub>2</sub> IS  mplifier P <sub>P2</sub> Outline requires 62 et and on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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| Fid-No.2 (Accelerate Peak Positive Grid-No.2 (Accelerate Peak Positive Grid-No.2)  Heater Voltage (ac/Heater Current Peak Heater Cathode Heater negative Heater positive Direct Interelectrode Unit No. 1:  Grid No.1 to Caof Unit No.2, Plate to Cathod                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-an service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the  | G <sub>II</sub> G3P2 IS  mplifier PP2  Outline requires G2 et and on.  G, Grid No.3 id No. 3 of                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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max<br>13 max<br>14 G2PI<br>6 7 8<br>12 BW<br>6.3<br>0.8<br>200 max<br>200*max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| Fid-No.2 (Accelerate Peak Positive Grid-No.2)  Average Cathode Cu  6J11  Heater Voltage (ac/Heater Current Peak Heater Current Heater negative Heater positive Direct Interelectrode Unit No.1:  Grid No.1 to Ca of Unit No.2, Plate to Cathod Unit No.2, and Unit No.2, and Cathod | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the service with respect to cathode with | G <sub>II</sub> G3P2 IS  mplifier PP2  Outline requires G2 et and on.  G, Grid No.3 id No. 3 of                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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max<br>13 max<br>KP2 G2PI<br>6 7 8<br>4<br>12BW<br>6.3<br>0.8<br>200 max<br>200*max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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| Heater Voltage (ac/<br>Heater Voltage (ac/<br>Heater Current Peak Heater Current Peak Heater-Cathode Heater negative Heater positive Direct Interelectrode Unit No. 1:  Grid No.1 to Ca of Unit No.2, Plate to Cathod Unit No.2, an Unit No. 2:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers. 8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the s | G <sub>II</sub> G <sub>3p2</sub> IS  IS  mplifier P <sub>P2</sub> ( Outline requires 62 et and on.  G, Grid No.3 rid No. 3 of                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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G2PI<br>6 7 8<br>12 BW<br>6.3<br>0.8<br>200 max<br>200*max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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| Heater Voltage (ac/Heater Current Peak Heater Current Peak Heater Cathode Heater negative Heater positive Direct Interelectrode Unit No. 1:  Grid No.1 to Ca of Unit No.2, Plate to Cathode Unit No. 2:  Grid No.1 to Ca of Unit No. 2:  Grid No.1 to Ca of Unit No. 2:  Grid No.1 to Ca of Unit No. 1:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-an service in television receivers. 8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the s | of Gape 15 of Section 15 of Se | 110 max<br>60 max<br>13 max<br>13 max<br>14 G2PI<br>6 7 8<br>12 BW<br>6.3<br>0.8<br>200 max<br>200*max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | volts volts mA  KPI  PPI  (B)  GipI  volts ampere  volts volts volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Heater Voltage (ac/Heater Current Peak Heater Current Peak Heater Cathode Heater negative Heater positive Direct Interelectrode Unit No. 1:  Grid No. 1 to Ca of Unit No.2, an Unit No. 2:  Grid No.1 to Ca of Unit No.1, Plate to Cathod                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the service with respect to cathode with | on of the state of | 110 max<br>60 max<br>13 max<br>13 max<br>14 G2PI<br>6 7 8<br>4 12BW<br>6.3<br>0.8<br>200 max<br>200*max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | volts volts mA  KPI  (PPI  (Gapi, IS  (Gapi, |
| Heater Voltage (ac/Heater Current Peak Heater Current Peak Heater Course Heater positive Heater Intercetoed Unit No. 1:  Grid No.1 to Caof Unit No.2, an Unit No.2. Grid No.1 to Caof Unit No.1, plate to Cathod Unit No.1, plate to Cathod Unit No.1, and Unit No.1, | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-an service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the  | G <sub>II</sub> G <sub>3P2</sub> IS mplifier P <sub>P2</sub> (Outline requires et and on.  G, Grid No.3 Gid No. 3 of Scrid No.3 of                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 110 max<br>60 max<br>13 max<br>13 max<br>14 max<br>15 max<br>16 7 max<br>17 max<br>18 max<br>19 max<br>11 max<br>11 max<br>11 max<br>11 max<br>11 max<br>12 max<br>11 max | volts volts mA  KPI  PPI  (B) G3PI, IS  Wolts ampere volts volts volts pF  pF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Heater Voltage (ac/Heater Current Peak Heater Current Peak Heater Cathode Heater negative Heater positive Direct Interelectrode Unit No.1; Grid No.1 to Ca of Unit No.2, and Unit No.2; Grid No.1 to Ca of Unit No.1; Plate to Cathode Unit No.1; Plate to Cathode Unit No.1, and Grid No.1 to Page 18 of Unit No.1, and Grid No.1 to Page 18 of Unit No.1, and Grid No.1 to Page 18 of Unit No.1 to P | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-an service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the  | on of the second | 110 max<br>60 max<br>13 max<br>13 max<br>KP2 G2PI<br>6 7 8<br>4 12BW<br>6.3<br>0.8<br>200 max<br>200*max<br>11<br>2.8<br>11<br>3.2<br>0.04 max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | volts volts mA   PPI  PPI  PPI  POSAPI,IS  OSAPI  Volts ampere  volts volts  pF  pF  pF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Heater Voltage (ac/<br>Heater Voltage (ac/<br>Heater Current Peak Heater Current Peak Heater-Cathode Heater negative Heater positive Direct Interelectrode Unit No. 1:  Grid No. 1 to Ca of Unit No.2, Plate to Cathod Unit No.2;  Grid No.1 to Ca of Unit No.1, plate to Cathod Unit No.1, ar Grid No.1 to P Cathode of Unit No.1, Plate to Cathod Unit No.1, ar Grid No.1 to P Cathode of Unit No.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the  | on of the second | 110 max<br>60 max<br>13 max<br>13 max<br>13 max<br>14 max<br>15 max<br>16 7 max<br>17 max<br>18 max<br>18 max<br>19 max<br>11 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>12 max<br>12 max<br>13 max<br>14 max<br>15 max<br>16 max<br>17 max<br>18 max | volts volts mA  KPI  (PPI  (Gapi, IS  (Gapi, IS  (Gapi, IS  (Gapi)  (G |
| Heater Voltage (ac/Heater Current Peak Heater Current Peak Heater Courrent Peak Heater positive Heater Intercetored Unit No. 1:  Grid No.1 to Ca of Unit No.2, an Unit No.2;  Grid No.1 to Ca of Unit No.1, plate to Cathod Unit No.1, ar Grid No.1 to Ca of Unit No.1, ar Grid No.1 to Ca of Unit No.1, ar Grid No.1 to P Cathode of Unit Grid No.1 of Unit Mo.1, of Unit Grid No.1 of Unit Mo.1, of Unit Grid No.1 of Unit Mo.1 of Unit Grid No.1 of Unit Mo.1 of Unit Mo | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-an service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the  | G <sub>II</sub> G <sub>3P2</sub> IS mplifier P <sub>P2</sub> (Outline requires et and on.  3, Grid No.3 id No. 3 of Grid No.3 of                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 110 max<br>60 max<br>13 max<br>13 max<br>14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | volts volts mA  KPI  (PPI  (B) 63PI, IS  (B) 64PI  (C) FPI  (C) FP |
| Heater Voltage (ac/Heater Current Peak Heater Current Peak Heater Cathode Heater negative Heater positive Direct Interelectrode Unit No.1; Grid No.1 to Ca of Unit No.2, and Unit No.2, and Unit No.2, and Unit No.1; Plate to Cathode Unit No.1, plate to Cathode Unit No.1 to Ca of Unit No.1, ar Grid No.1 to Positive No.1 to Positiv | SHARP-CUTOFF TWIN PENTODE  Duodecar type used for if-ar service in television receivers.  8A, Outlines section. Tube r duodecar twelve-contact sock may be mounted in any position of the section of the  | on of the second | 110 max<br>60 max<br>13 max<br>13 max<br>13 max<br>14 max<br>15 max<br>16 7 max<br>17 max<br>18 max<br>18 max<br>19 max<br>11 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>12 max<br>11 max<br>12 max<br>12 max<br>13 max<br>14 max<br>15 max<br>16 max<br>17 max<br>18 max | volts volts mA   PPI  (PPI  (P |

- \* The dc component must not exceed 100 volts.
- \*\* With external shield connected to cathode.

### Class A. Amplifier (Each Unit)

| BEARING THE MANUFACE (Design Maximum Volume):                                                                                                                                                       |                                              |                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------|
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                            | 330 ma                                       | x volts                                      |
| Plate Voltage                                                                                                                                                                                       | 330 ma                                       |                                              |
| Grid-No.2 (Screen-Grid) Supply Voltage                                                                                                                                                              | 200                                          | rve page 80                                  |
| Grid-No.2 Voltage                                                                                                                                                                                   |                                              |                                              |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                               | 0 ma                                         |                                              |
| Plate Dissipation                                                                                                                                                                                   | 3.1 ma:                                      | x watts                                      |
| Grid-No.2 Input:                                                                                                                                                                                    |                                              |                                              |
| For Grid No.2 Voltages up to 165 volts                                                                                                                                                              | 0.65 ma:                                     | k watt                                       |
| For Grid No.2 Voltages between 165 and 300 volts                                                                                                                                                    | See cu                                       | rve page 80                                  |
|                                                                                                                                                                                                     |                                              |                                              |
| CHARACTERISTICS:                                                                                                                                                                                    |                                              |                                              |
| Plate Supply Voltage                                                                                                                                                                                | 125                                          | volts                                        |
|                                                                                                                                                                                                     |                                              |                                              |
| Grid No.3 (Suppressor Grid)                                                                                                                                                                         | ected to cathod                              | e at socket                                  |
| Grid No.3 (Suppressor Grid) Conn.                                                                                                                                                                   | ected to cathod<br>125                       | e at socket<br>volts                         |
| Grid-No.2 Voltage                                                                                                                                                                                   | ected to cathod<br>125<br>56                 | e at socket<br>volts<br>ohms                 |
| Grid-No.2 Voltage Cathode-Bias Resistor                                                                                                                                                             | 125                                          | volts                                        |
| Grid-No.2 Voltage                                                                                                                                                                                   | 125<br>56                                    | volts<br>ohms                                |
| Grid-No.2 Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance                                                                                                                 | 125<br>56<br>0.2                             | volts<br>ohms<br>megohm                      |
| Grid-No.2 Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance Plate Current                                                                                                   | 125<br>56<br>0.2<br>13000                    | volts<br>ohms<br>megohm<br>µmhos<br>mA       |
| Grid-No.2 Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current                                                                                 | 125<br>56<br>0.2<br>13000<br>11<br>3.8       | volts<br>ohms<br>megohm<br>µmhos<br>mA<br>mA |
| Grid-No.2 Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance Plate Current                                                                                                   | 125<br>56<br>0.2<br>13000                    | volts<br>ohms<br>megohm<br>µmhos<br>mA       |
| Grid-No.2 Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 20 µA                          | 125<br>56<br>0.2<br>13000<br>11<br>3.8       | volts<br>ohms<br>megohm<br>µmhos<br>mA<br>mA |
| Grid-No.2 Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 20 μA  MAXIMUM CIRCUIT VALUES: | 125<br>56<br>0.2<br>13000<br>11<br>3.8       | volts<br>ohms<br>megohm<br>µmhos<br>mA<br>mA |
| Grid-No.2 Voltage Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 20 µA                          | 125<br>56<br>0.2<br>13000<br>11<br>3.8<br>—3 | volts<br>ohms<br>megohm<br>µmhos<br>mA<br>mA |



## **BEAM POWER TUBE**

Novar types used as high-efficiency horizontal-deflection-amplifier tubes in television receivers. Outlines 18A and 32, respectively, **Outlines** section. Tubes require novar nine-contact socket and may be mounted in any

6JB6 6JB6A

Related types: 12JB6, 12JB6A, 17JB6, 17JB6A

position. Types 12JB6 and 12JB6A and types 17JB6 and 17JB6A are identical with types 6JB6 and 6JB6A except for the heater ratings, as shown below.

|                                               | 6JB6      | 12JB6   | 17JB6   |         |
|-----------------------------------------------|-----------|---------|---------|---------|
|                                               | 6JB6A     | 12JB6A  | 17JB6A  |         |
| Heater Voltage (ac/dc)                        | 6.3       | 12.6    | 16.8    | volts   |
| Heater Current                                | 1.2       | 0.6     | 0.45    | ampere  |
| Heater Warm-up Time (Average)                 |           | 11      | 11      | seconds |
| Peak Heater-Cathode Voltage:                  |           |         |         |         |
| Heater negative with respect to cathode       | 200 max   | 200 max | 200 max | volts   |
| Heater positive with respect to cathode       | 200 • max | 200 max | 200 max | voits   |
| Direct Interelectrode Capacitances (Approx.): |           |         |         |         |
| Grid No.1 to Plate                            |           |         | 0.2     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2,      | and Grid  | No.3    | 15      | pF      |
| Plate to Cathode, Heater, Grid No.2, and      | Grid No.3 |         | 6       | ρF      |
|                                               |           |         |         | -       |

• The dc component must not exceed 100 volts.

| CHARACTERISTICS:                  | Triode        | Per         | ntode   |    |               |
|-----------------------------------|---------------|-------------|---------|----|---------------|
|                                   | Connectio     | n^ Coni     | nection |    |               |
| Plate Voltage                     | 150           | 60          | 150     |    | volts         |
| Grid No.3 (Suppressor Grid)       | C             | onnected to | cathode | at | socket        |
| Grid No.2 (Screen-Grid) Voltage   | _             | 150         | 150     |    | volts         |
| Grid No.1 (Control-Grid) Voltage  | 22.5          | 0           | -22.5   |    | volts         |
| Mu-Factor, Grid No.2 to Grid No.1 | 4.4           | _           | _       |    |               |
| Plate Resistance (Approx.)        | . —           | . <u> </u>  | 15000   |    | ohm <b>s</b>  |
| Transconductance                  |               | _           | 7100    |    | μmho <b>s</b> |
| Plate Current                     | · <del></del> | 390□        | 70      |    | mA            |

|                                             | Triode<br>Connection* |     | tode<br>ection |       |
|---------------------------------------------|-----------------------|-----|----------------|-------|
| Grid-No.2 Current                           | _                     | 320 | 2.1            | mA    |
| Grid-No.1 Voltage for plate current of 1 mA |                       | _   | -42            | volts |
| ▲ Grid No.2 connected to plate.             |                       |     |                |       |

□ This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

| For operation in a 525-line, 30-frame system |           |       |
|----------------------------------------------|-----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):     |           |       |
| DC Plate Supply Voltage                      | 770 max   | volts |
| Peak Positive-Pulse Plate Voltage#           | 6500 max  | volts |
| Peak Negative-Pulse Plate Voltage            | -1500 max | volts |
| DC Grid-No.3 Voltage†                        | 70 max    | volts |
| DC Grid-No.2 Voltage                         | 220 max   | volts |
| DC Grid-No.1 Voltage                         | -55 max   | voits |
| Peak Negative-Pulse Grid-No.1 Voltage        | -330 max  | volts |
| Peak Cathode Current                         | 550 max   | mA    |
| Average Cathode Current                      | 175 max   | mA    |
| Plate Dissipation•                           | 17.5 max  | watts |
| Grid-No.2 Input                              | 3.5 max   | watts |
| Bulb Temperature (At hottest point)          | 240 max   | °C    |

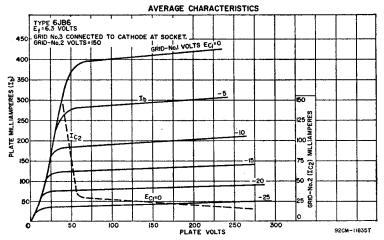
#### MAXIMUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance:

# The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

† For horizontal-deflection service, a positive voltage may be applied to grid No.3 to minimize "snivets" intereference in both vhf and uhf television receivers. A typical value for this purpose is 30 volts.

• An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### SHARP-CUTOFF PENTODE

6JC6
Related types:
3JC6, 4JC6

Miniature type with frame grid used in if-amplifier stages of television receivers utilizing intermediate frequencies in the order of 40 megacycles. Tube features high transconductance at low B-supply voltages. Outline 6B,



6JC6

Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Types 3JC6 and 4JC6 are identical with type 6JC6 except for the heater ratings, as shown below.

3JC6

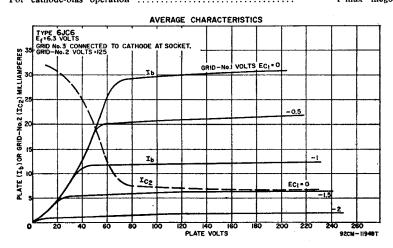
4JC6

| Heater Voltage (ac/dc)                           | 3.5       | 4.5     | 6.3       | volts   |
|--------------------------------------------------|-----------|---------|-----------|---------|
| Heater Current                                   | 0.6       | 0.45    | 0.3       | ampere  |
| Heater Warm-up Time (Average)                    | 11        | 11      |           | seconds |
| Peak Heater-Cathode Voltage:                     |           |         |           |         |
| Heater negative with respect to cathode          | 200 max   | 200 max | 200 max   | volts   |
| Heater positive with respect to cathode          | 200 max   | 200 max | 200-max   | volts   |
| Direct Interelectrode Capacitances:              |           |         |           |         |
| Grid No.1 to Plate                               |           |         | 0.019 max | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2,         |           |         |           |         |
| Internal Shield                                  |           |         | 8.2       | рF      |
| Plate to Cathode, Heater, Grid No.2, Grid        | No.3, and | 1       |           |         |
| Internal Shield                                  |           |         | 3         | рF      |
| Class A, A                                       | mplifier  |         |           |         |
| MAXIMUM RATINGS (Design-Maximum Valu             | es):      |         |           |         |
| Plate Voltage                                    |           |         | 330 max   | volts   |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive vi |           |         | 0 max     | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage           |           |         | 330 max   | volts   |
| Grid-No.2 Voltage                                |           |         | See curve | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias  |           |         | 0 max     | volts   |
| Grid-No.2 Input:                                 |           |         | * ******  |         |
| For grid-No.2 voltages up to 165 volts           |           |         | 0.6 max   | watt    |
| For grid-No.2 voltages between 165 and 33        |           |         | See curve | page 80 |
| Plate Dissipation                                |           |         | 2.5 max   | watts   |
| •                                                |           |         |           |         |
| CHARACTERISTICS:                                 |           |         |           |         |

| Plate Supply Voltage                                         | 125        | volts         |
|--------------------------------------------------------------|------------|---------------|
| Grid No.3                                                    | to cathode | at socket     |
| Grid-No.2 Supply Voltage                                     | 125        | volts         |
| Cathode-Bias Resistor                                        | 56         | ohms          |
| Plate Resistance (Approx.)                                   | 0.18       | megohm        |
| Transconductance                                             | 15000      | μ <b>mhos</b> |
| Plate Current                                                | 13         | mA            |
| Grid-No.2 Current                                            | 3.2        | mA            |
| Grid-No.1 Voltage (Approx.) for plate current of 100 $\mu$ A | -3         | voits         |

#### MAXIMUM CIRCUIT VALUES:

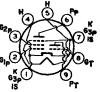
| Grid-No.1-Circuit Resistance: |          |        |
|-------------------------------|----------|--------|
| For fixed-bias operation      | 0.25 max | megohm |
| For authode hine operation    | 1 mar    | meanhm |



### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

6JC8

Miniature type used as combined vhf oscillator and mixer tube in television receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature ninecontact socket and may be mounted



9PA

in any position. Heater volts (ac/dc), 6.3; amperes, 0.45; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

| Class A, Amplifier                                                                                                                                                                                                                                |                                                 |                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 137.5 volts | Triode Unit<br>275 max<br>—<br>0 max<br>1.7 max | 275 max volts 275 max volts 275 max volts See curve page 80 0 max volts 2.3 max watts 0.45 max watt |
| For grid-No.2 voltages between 137.5 and 275 volts                                                                                                                                                                                                |                                                 | See curve page 80                                                                                   |
| CHARACTERISTICS: Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Amplification Factor Plate Resistance (Approx.) Transconductance Plate Cuyrent Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 20 µA                        | 125<br>1<br>40<br>6000<br>6500<br>12<br>7       | 100 125 volts 70 125 volts 0 —1 volt — — 300000 ohms 5700 5500 μmhos — 9 mA — 2.2 mA — 6.5 volts    |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation                                                                                                                                         | Ξ                                               | 0.1 max megohm<br>0.5 max megohm                                                                    |

### SHARP-CUTOFF PENTODE

6JD6
Related types:
3JD6, 4JD6

Miniature type used as if-amplifier tube in television receivers utilizing an intermediate frequency in the order of 40 megacycles. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be



9PM

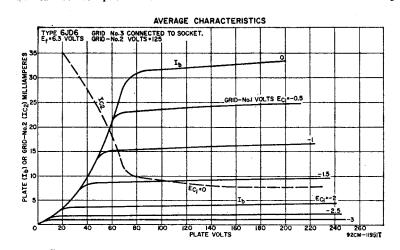
mounted in any position. Types 3JD6 and 4JD6 are identical with type 6JD6 except for the heater ratings, as shown below.

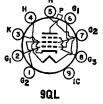
|                                             | 3JD6      | 4JD6    | 6JD6      |               |
|---------------------------------------------|-----------|---------|-----------|---------------|
| Heater Voltage (ac/dc)                      | 3.5       | 4.5     | 6.3       | volts         |
| Heater Current                              | 0.6       | 0.45    | 0.3       | ampere        |
| Heater Warm-up Time (Average)               | 11        | 11      | -         | seconds       |
| Peak Heater-Cathode Voltage:                |           |         |           |               |
| Heater negative with respect to cathode     | 200 max   | 200 max | 200 max   | volt <b>s</b> |
| Heater positive with respect to cathode     | 200•max   | 200=max | 200 max   | volt <b>s</b> |
| Direct Interelectrode Capacitances:         |           |         |           |               |
| Grid No.1 to Plate                          |           |         | 0.019 max | pF            |
| Grid No.1 to Cathode, Heater, Grid No.2,    |           |         |           |               |
| and Internal Shield                         |           |         | 8.2       | рF            |
| Plate to Cathode, Heater, Grid No.2, Grid N | lo.3, and |         |           |               |
| Internal Shield                             |           |         | 3         | рF            |
|                                             |           |         |           |               |

<sup>•</sup> The dc component must not exceed 100 volts.

| Class A | , Amplifiei |
|---------|-------------|
|---------|-------------|

| MAXIMUM RATINGS (Design-Maximum Values):                      |          |                  |
|---------------------------------------------------------------|----------|------------------|
| Plate Voltage                                                 | 330 max  | volts            |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value           | 0 max    | volts            |
| Grid-No.2 (Screen-Grid) Supply Voltage                        | 330 max  | volts            |
| Grid-No.2 Voltage                                             | See curv | e page 80        |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value         | 0 max    | volts            |
| Grid-No.2 Input:                                              |          |                  |
| For grid-No.2 voltages up to 165 volts                        | 0.6 max  | watts            |
| For grid-No.2 voltages between 165 and 330 volts              | See curv | e page 80        |
| Plate Dissipation                                             | 2.5 max  | watts            |
|                                                               |          |                  |
| CHARACTERISTICS:                                              |          |                  |
| Plate Supply Voltage                                          | 125      | volts            |
| Grid-No.3 Voltage                                             | 0        | volts            |
| Grid-No.2 Supply Voltage                                      | 125      | volts            |
| Grid-No.1 Supply Voltage                                      | 0        | volts            |
| Cathode-Bias Resistor                                         | 56       | ohms             |
| Plate Resistance (Approx.)                                    | 160000   | ohms             |
| Transconductance                                              | 14000    | $\mu$ mhos       |
| Plate Current                                                 | 15       | mA               |
| Grid-No.2 Current                                             | 4        | mA               |
| Grid-No.1 Voltage (Approx.) for transconductance of 600 µmhos | -4.5     | volts            |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:         | 0.24     |                  |
| For fixed-bias operation                                      | 0.25 max | megonm<br>megohm |
| roi camoue-oras operation                                     | 1 max    | писвоин          |





### **BEAM POWER TUBE**

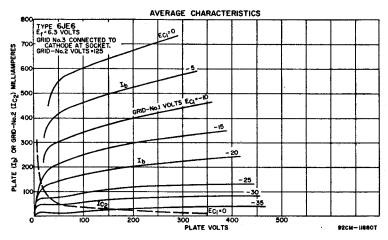
Novar type used as horizontal-deflection-amplifier tube in color television receivers. Outline 32A, Outlines section. Tube requires novar nine-contact socket and may be mounted in any position.

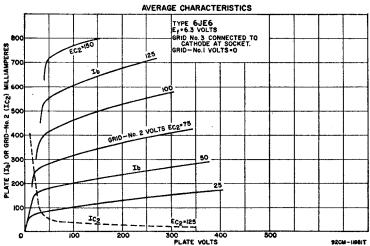
# 6JE6A

| Heater Voltage (ac/dc) Heater Current                                                                          | 6.3<br>2.5         | volts<br>amperes |
|----------------------------------------------------------------------------------------------------------------|--------------------|------------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode | 200 max<br>200*max | volts<br>volts   |

| Direct Interelectrode Capacitances (Approx.):          |      |    |
|--------------------------------------------------------|------|----|
| Grid No.1 to Plate                                     | 0.56 | υF |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 22   | pF |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 11   | ρF |

<sup>\*</sup> The dc component must not exceed 100 volts.





| CHARACTERISTICS:                 | Triode<br>Connection* |       | ntode<br>nection |            |
|----------------------------------|-----------------------|-------|------------------|------------|
| Plate Voltage                    | 125                   |       | 175              | volts      |
| Grid No.3 (Suppressor Grid)      | Connecto              | ed to | cathode          | at socket  |
| Grid-No.2 (Screen-Grid) Voltage  | _                     |       | 125              | volts      |
| Grid-No.1 (Control-Grid) Voltage | -25                   | 0     | -25              | volts      |
| Amplification Factor             | 3                     | _     | _                |            |
| Plate Resistance (Approx.)       | _                     | _     | _                | ohms       |
| Transconductance                 | _                     | _     |                  | $\mu$ mhos |

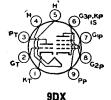
|                                                       | Triode      | Pentode      |       |
|-------------------------------------------------------|-------------|--------------|-------|
|                                                       | Connection* | Connection   |       |
| Plate Current                                         |             | 600† 130     | mA    |
| Grid-No.2 Current                                     |             | 36† 2.8      | mA    |
| Grid-No.1 Voltage (Approx.) for plate current of 1 mA | _           | <b>→ −54</b> | volts |

† This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

| For operation in a 525-line, 30-frame system                     |           |         |
|------------------------------------------------------------------|-----------|---------|
| MAXIMUM RATINGS (Design-Maximum Values):                         |           |         |
| DC Plate Supply Voltage                                          | 990 max   | volts   |
| Peak Positive-Pulse Plate Voltage                                | 7500 max  | volts   |
| Peak Negative-Pulse Plate Voltage                                | -1100 max | volts   |
| DC Grid-No.3 Voltage•                                            | 75 max    | volts   |
| DC Grid-No.2 Voltage                                             | 220 max   | volts   |
| Peak Negative-Pulse Grid-No.1 Voltage                            | -330 max  | volts   |
| Peak Cathode Current                                             | 1200 max  | mA      |
| Average Cathode Current                                          | 350 max   | . mA    |
| Grid-No.2 Input                                                  | 3.2 max   | watts   |
| Plate Dissipation                                                | 30 max    | watts   |
| Bulb Temperature (At hottest point)                              | 250 max   | °C      |
| MAXIMUM CIRCUIT VALUES:                                          |           |         |
| Grid-No.1-Circuit Resistance:                                    |           |         |
| For grid-resistor-bias operation                                 | 0.47 max  | megohm  |
| For plate-pulsed operation (horizontal-deflection circuits only) | 10 max    | megohms |

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- In this service, a positive voltage may be applied to grid No.3 to minimize "snivets" interference; a typical value for this voltage is 30 volts.
- □ An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### HIGH-MU TRIODE-SHARP-CUTOFF PENTODE

Miniature type used in television receivers. The triode unit is used as a voltage amplifier or sync separator, and the pentode unit as a video amplifier. Outline 6E, Outlines section. Tube requires miniature nine-contact

6.1E8 Related type: 11JE8

socket and may be mounted in any position. Type 11JE8 is identical with type 6JE8 except for heater ratings, as shown below.

|                                               | 6JE8    | 11JE8     |         |
|-----------------------------------------------|---------|-----------|---------|
| Heater Voltage (ac/dc)                        | 6.3     | 10.9      | volts   |
| Heater Current                                | 0.78    | 0.45      | ampere  |
| Heater Warm-up Time (Average)                 | _       | 11        | seconds |
| Peak Heater-Cathode Voltage:                  |         |           |         |
| Heater negative with respect to cathode       | 200 max | 200 max   | volts   |
| Heater positive with respect to cathode       | 200°max | 200 • max | volts   |
| • The dc component must not exceed 100 volts. |         |           |         |
| Class A. Amnlifier                            |         |           |         |

#### viass A, Ampimei

| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Pentode Unit      |
|--------------------------------------------------------|-------------|-------------------|
| Plate Voltage                                          | 300 max     | 330 max volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                 |             | 330 max volts     |
| Grid-No.2 Voltage                                      | _           | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage Positive-bias value . | 0 max       | 0 max volts       |
| Plate Dissipation                                      | 1 max       | 5 max watts       |
| Grid-No.2 Input:                                       |             |                   |
| For plate voltages up to 165 volts                     |             | 1.5*max watts     |
| For plate voltages between 165 and 330 volts           | _           | See curve page 80 |

<sup>&</sup>lt;sup>▲</sup> Grid No.2 connected to plate.

| CHARACTERISTICS:                                            | Triode Unit | Pento | de Uni | t          |
|-------------------------------------------------------------|-------------|-------|--------|------------|
| Plate Voltage                                               | 200         | 60    | 250    | volts      |
| Grid-No.2 Voltage                                           |             | 170   | 170    | volts      |
| Grid-No.1 Voltage                                           | 2           | 0     |        | volts      |
| Cathode-Bias Resistor                                       | _           | -     | 82     | ohms       |
| Amplification Factor                                        | 70          |       | -      |            |
| Plate Resistance (Approx.)                                  | -           |       | 0.14   | megohm     |
| Transconductance                                            | 4200        | _     | 12000  | $\mu$ mhos |
| Plate Current                                               | 4.5         | 48=   | 22     | mA         |
| Grid-No.2 Current                                           | _           | 12=   | 4      | mA         |
| Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A | 5           | _     | -10    | volts      |
| MAXIMUM CIRCUIT VALUES:                                     |             |       |        |            |
| Grid-No.1-Circuit Resistance:                               |             |       |        |            |
| For fixed-bias operation                                    | 0.5 max     | 0.2   | 5 max  | megohm     |
| For cathode bias operation                                  | 1 max       |       |        | megohm     |

Grid-No.2 input may reach 2 watts for plate-dissipation values of 4 watts or less.

### **BEAM POWER TUBE**

6JG6A Related types: 17JG6A, 22JG6A Novar type used as horizontal-deflection amplifier tube in low-B, blackand-white television receivers. Outline 31B, Outlines section. Tube requires novar nine-contact socket and may be mounted in any position. Types



17JG6A and 22JG6A are identical with type 6JG6A except for heater ratings, as shown below.

| Heater Voltage (ac/dc)                   | 6JG6A<br>6.3 | 17JG6A<br>16.8 | 22JG6A<br>22 | volts      |
|------------------------------------------|--------------|----------------|--------------|------------|
| Heater Current                           |              | 0.6            | 0.45         | amperes    |
| Heater Warm-up Time (Average)            |              | 11             | 11           | seconds    |
| Peak Heater-Cathode Voltage:             |              |                |              |            |
| Heater negative with respect to cathode  |              | <i>.</i>       | 200 max      | volts 🏲    |
| Heater positive with respect to cathode  |              |                | 200#max      | volts      |
| Direct Interelectrode Capacitances:      |              |                |              |            |
| Grid No.1 to Plate                       |              |                | 0.7          | рF         |
| Grid No.1 to Cathode, Heater, Grid No.2, | and Gri      | d No.3         | 22           | рF         |
| Plate to Cathode, Heater, Grid No.2, and | Grid No.:    | 3              | 9            | p <b>F</b> |

<sup>#</sup> The dc component must not exceed 100 volts.

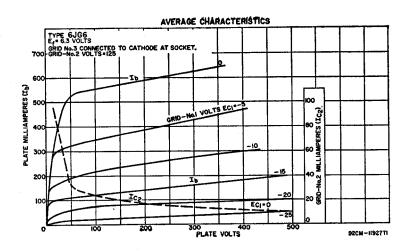
#### Class A, Amplifier

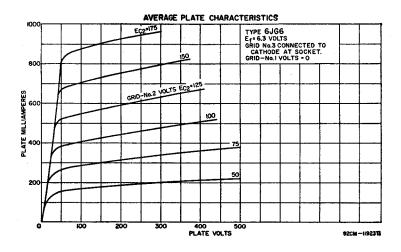
| CHARACTERISTICS:                 | Triode=<br>Connection |         | itode<br>iection |                |
|----------------------------------|-----------------------|---------|------------------|----------------|
| Plate Voltage                    | 125                   | 50      | 130              | volts          |
| Grid No.3 (Suppressor Grid)      |                       | Connect | ed to cati       | hode at socket |
| Grid-No.2 (Screen-Grid) Voltage  |                       | 125     | 125              | volts          |
| Grid-No.1 (Control-Grid) Voltage | 20                    | 0       | -20              | volts          |
| Amplification Factor             | 4.1                   | _       |                  |                |
| Plate Resistance (Approx.)       |                       | _       | 12000            | ohms           |
| Transconductance                 | -                     | _       | 10000            | $\mu$ mhos     |
| Plate Current                    |                       | 525•    | 80               | mA             |
| Grid-No.2 Current                | _                     | 32●     | 2.5              | mA             |
| Grid-No.1 Voltage (Approx.).     |                       |         |                  |                |
| for plate current of 1 mA        | _                     | · —     | -40              | volts          |

<sup>&</sup>quot;With grid No.2 connected to plate at socket.

This value may be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

<sup>•</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.





### Horizontal-Deflection Amplifier

#### For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values):  |              |     |               |
|-------------------------------------------|--------------|-----|---------------|
| DC Plate Supply Voltage                   | 770 1        | max | volt <b>s</b> |
| Peak Positive-Pulse Plate Voltage         | 6500 1       | max | volts         |
| Peak Negative-Pulse Plate Voltage         | -1500 1      | max | volts         |
| DC Grid-No.3 Voltage*                     | 75 1         | max | volts         |
| DC Grid-No.2 Voltage                      | 220 1        | max | volts         |
| DC Grid-No.1 Voltage, Negative-bias value | <b>—55</b> 1 | max | volts         |
| Peak Negative-Pulse Grid-No.1 Voltage     | -330 ı       |     | volt <b>s</b> |
| Peak Cathode Current                      | 950 1        | max | mA            |
| Average Cathode Current                   | 275 1        | max | mA            |
| Plate Dissipation†                        |              | max | watts         |
| Grid-No.2 Input                           | 3.5          |     | watts         |
| Bulb Temperature (At hottest point)       | 240 r        | max | °C            |

0.25 max megohm 1 max megohm

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1 Circuit Resistance:

Grid-No.1-Circuit Resistance:

For fixed-bias operation ......

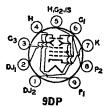
For cathode-bias operation ......

For grid-No.1-resistor-bias operation 2.2 max megohms

The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle.

- ☐ The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- In a horizontal-deflection-amplifier service, a positive voltage (typical value, 30 volts) may be applied to grid No.3 to reduce "snivets" interference, which may occur in both vhf and uhf television receivers.
- † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

#### SEMIREMOTE-CUTOFF PENTODE 6)G2 Miniature type used in the gain-controlled picture if-amplifier stages of 6.1H6 television receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. For curves 7CM of average plate characteristics, refer to type 6BZ6. Heater Voltage (ac/dc) ..... 6.3 volte Heater Current 0.3 ampere Peak Heater-Cathode Voltage: Heater negative with respect to cathode ...... 200 max volte Heater positive with respect to cathode ...... 200=max volts With Without External External Direct Interelectrode Capacitances: Shield Shield<sup>D</sup> Grid No.1 to Plate ...... 0.025 max 0.015 max рF Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield 7 pF Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield ..... 2 3 pF The dc component must not exceed 100 volts. UWith external shield connected to cathode. Class A, Amplifier MAXIMUM RATINGS (Design-Maximum Values): 300 max volts Grid-No.3 (Suppressor-Grid) Voltage, Positive value ..... 0 max volts Grid-No.2 (Screen-Grid) Supply Voltage ..... 300 max volts Grid-No.2 Voltage See curve page 80 Grid-No.1 (Control-Grid) Voltage, Positive-bias value ..... 0 max volts Grid-No.2 Input: For grid-No.2 voltages up to 150 volts ... 0.55 max watt For grid-No.2 voltages between 150 and 300 volts ..... See curve page 80 CHARACTERISTICS: Plate Supply Voltage ..... 125 volts Grid No.3 cathode at socket Grid-No.2 Supply Voltage ..... 125 volts Cathode-Bias Resistor ...... 56 ohms Plate Resistance (Approx.) 0.26 megohm 8000 umhos Transconductance Range for grid-No.1 voltage of -4.5 volts and cathode-bias resistor of 56 ohms ...... 400-900 umhos Grid-No.1 Voltage (Approx.) for transconductance of 50 µmhos and no cathode-bias resistor ........ -19 volts Plate Current ....... 14 mA Grid-No.2 Current ..... 3.6 mA MAXIMUM CIRCUIT VALUES:



MAXIMUM RATINGS (Design-Maximum Values):

### **BEAM-DEFLECTION TUBE**

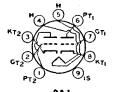
Miniature type used in color-demodulator and burst-gate circuits in color television receivers. This type has two plates and two deflecting electrodes; the control grid varies beam deflection. Outline 6E, Outlines section.

**6JH8** 

Tube requires miniature nine-contact socket and may be mounted in any position. Pin 5 should be connected to cathode at socket. The 6JH8 should be so located in the equipment that it is not subjected to stray magnetic fields. Heater volts (ac/dc), 6.3; amperes, 0.3.

#### Color TV Demodulator

| Plate Voltage (Each Plate) Peak Deflecting-Electrode Voltage (Each Electrode):                         | 330 max  | volts  |
|--------------------------------------------------------------------------------------------------------|----------|--------|
| Negative value                                                                                         | -165 max | volts  |
| Positive value                                                                                         | -105 max |        |
| Grid-No.3 (Accelerating-Grid) Voltage                                                                  | 330 max  |        |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                  |          |        |
|                                                                                                        | 0 max    |        |
| Cathode Current                                                                                        | 33 max   |        |
| Plate Dissipation (Each Plate)                                                                         | 3 max    |        |
| Grid-No.3 Input                                                                                        | 1 max    | watt   |
| MAXIMUM CIRCUIT VALUES:                                                                                |          |        |
| Grid-No.1 Circuit Resistance:                                                                          |          |        |
| For fixed-bias operation                                                                               | 0.1 max  | megohm |
| For cathode-bias operation                                                                             |          | megohm |
| •                                                                                                      | 0120     |        |
| Class A, Amplifier                                                                                     |          |        |
| With both plates connected together and with both deflecting electrodes connected to cathode at socket |          |        |
| CHARACTERISTICS:                                                                                       |          |        |
| Plate-No.1 Supply Voltage                                                                              | 250      | volts  |
| Plate-No.2 Supply Voltage                                                                              | 250      | volts  |
| Grid-No.3 Voltage                                                                                      | 250      | volts  |
| Cathode-Bias Resistor                                                                                  | 220      |        |
| Transconductance                                                                                       |          | ohms   |
| Total Dista Current                                                                                    | 4400     | μmhos  |
| Total Plate Current                                                                                    | 14       | mĄ     |
| Grid-No.3 Current                                                                                      | 1.5      | mA     |
| Grid-No.1 Voltage (Approx.) for total plate current of 10 $\mu$ A                                      | -13      | voits  |



#### **DUAL TRIODE**

Miniature type used as combined rfamplifier and mixer-oscillator tube in FM tuners. Unit No.1 is a mediummu triode unit used as an oscillatormixer, and unit No.2 is a high-mu triode unit used as an rf amplifier.

6JK8

Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage:               | 6.3<br>0.4         | volts<br>ampere |
|----------------------------------------------------------------------------------|--------------------|-----------------|
| Heater negative with respect to cathode  Heater positive with respect to cathode | 100 max<br>100 max | volts<br>volts  |

1 max

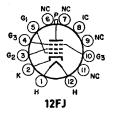
| Direct Interelectrode Capacitances: Grid to Plate Grid to Cathode, Heater, and Internal Shield Plate to Cathode, Heater, and Internal Shield Heater to Cathode Grid of Unit No.1 to Grid of Unit No.2 Plate of Unit No.1 to Plate of Unit No.2 |                                                                 | Unit No.2<br>0.6<br>5<br>4<br>2.8<br>0.003 max<br>0.009 max       | pF<br>pF<br>pF<br>pF<br>pF            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------|
| Class A, Amplifier                                                                                                                                                                                                                             | •                                                               |                                                                   |                                       |
| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Negative Grid Voltage DC Cathode Current Plate Dissipation                                                                                                                              | Unit No.1<br>Oscillator<br>165 max<br>50 max<br>22 max<br>1 max | Unit No.2<br>RF Amplifier<br>200 max<br>50 max<br>22 max<br>2 max | volts<br>volts<br>mA<br>watts         |
| CHARACTERISTICS: Plate Voltage Grid Voltage Amplification Factor Plate Resistance (Approx.) Transconductance Plate Current                                                                                                                     | 100<br>-1<br>55<br>8000<br>6800<br>5.3                          | 135<br>-1.2<br>70<br>5400<br>13000                                | volts<br>volts<br>ohms<br>µmhos<br>mA |
| Grid Voltage (Approx.):  For plate current of 20 µA  For transconductance of 150 µmhos  For transconductance of 1500 µmhos                                                                                                                     | -4.4<br>                                                        | -5.5<br>-2.8                                                      | volts<br>volts<br>volts               |

## BEAM POWER TUBE

6JM6 Related type: 173M6

MAXIMUM CIRCUIT VALUES: Grid-Circuit Resistance:

Duodecar type used as horizontalamplifier tube in television receivers. G<sub>2</sub>(3) Outline 16A, **Outlines** section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Type 17JM6 is identical with type



1 max megohm

6JM6 except for the heater ratings, as shown below.

For cathode-bias operation .....

|                                               | 6JM6    | 17JM6   |         |
|-----------------------------------------------|---------|---------|---------|
| Heater Voltage (ac/dc)                        | 6.3     | 16.8    | volts   |
| Heater Current                                | 1.2     | 0.45    | ampere  |
| Heater Warm-up Time (Average)                 | -       | 11      | seconds |
| Peak Heater-Cathode Voltage:                  |         |         |         |
| Heater negative with respect to cathode       | 200 max | 200 max | volts   |
| Heater positive with respect to cathode       | 200†max | 200†max | volts   |
| † The dc component must not exceed 100 volts. |         |         |         |

#### Class A<sub>1</sub> Amplifier

| CHARACTERISTICS:                              |      |        |                 |              |
|-----------------------------------------------|------|--------|-----------------|--------------|
| Plate Voltage                                 | 5000 | 60     | 250             | volts        |
| Grid-No.3 Suppressor-Grid)                    |      | Connec | cted to cathode | at socket    |
| Grid-No.2 (Screen-Grid) Voltage               | 150  | 150    | 150             | volts        |
| Grid-No.1 (Control-Grid) Voltage              | _    | 0      | <b>—22.5</b>    | volts        |
| Plate Resistance (Approx.)                    |      |        | 18000           | ohm <b>s</b> |
| Transconductance                              |      |        | 7300            | μmhos        |
| Plate Current                                 | -    | 345*   | 65              | mA           |
| Grid-No.2 Current                             | _    | 27*    | 1.8             | mA           |
| Grid-No.1 Voltage (Approx.) for plate current |      |        |                 |              |
| of 1 µA                                       | -100 | _      | -42             | volts        |
| Triode Amplification Factor**                 |      | _      | 4.4             |              |

<sup>•</sup> This value can be measured by a method utilizing a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

<sup>\*\*</sup> Triode connection (grid No.2 tied to plate); plate and grid-No.2 volts = 150, and grid-No.1 volts = -22.5.

#### Class A<sub>1</sub> Amplifier

| MAXIMUM CIRCUIT VALUES:      |       |        |
|------------------------------|-------|--------|
| Grid-No.1-Circuit Resistance | 1 max | megohm |

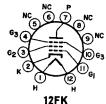
#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| · · · · · · · · · · · · · · · · · · ·     |           |       |
|-------------------------------------------|-----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):  |           |       |
| DC Plate Supply Voltage                   | 770 max   | volts |
| Peak Positive-Pulse Plate Voltage#        | 6500 max  | volts |
| Peak Negative-Pulse Plate Voltage         | -1500 max | volts |
| DC Grid-No. 3 Voltage                     | 70 max    | volts |
| DC Grid-No.2 Voltage                      | 220 max   | volts |
| DC Grid-No.1 Voltage, Negative-bias value | —55 max   | volts |
| Peak Negative-Pulse Grid-No.1 Voltage     | —330 max  | volts |
| Average Cathode Current                   | 175 max   | mA    |
| Peak Cathode Current                      | 550 max   | mA    |
| Plate Dissipation##                       | 17.5 max  | watts |
| Grid-No.2 Input                           | 3.5 max   | watts |
| Bulb Temperature (At hottest point)       | 220 max   | °C    |

#The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

## An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



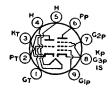
#### **BEAM POWER TUBE**

Duodecar type used as horizontalamplifier tube in television receivers. Outline 15A, **Outlines** section. Tube requires duodecar twelve-contact socket and may be mounted in any position. This type is electrically identical with

6JN6 Related types: 12JN6, 17JN6

type 6JM6 except that it has a slightly lower grid-No.1 to plate capacitance. Types 12JN6 and 17JN6 are identical with type 6JN6 except for heater ratings, as shown below.

| Heater Current | (ac/dc) Time (Average) | 1.2 | 12.6<br>0.6<br>11 | 173 N6<br>16.8<br>0.45<br>11 | volts<br>ampere<br>seconds |
|----------------|------------------------|-----|-------------------|------------------------------|----------------------------|
|                |                        |     |                   |                              |                            |



### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used as FM converter and rf-amplifier tube in radio receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any

6JN8 Related types: 12JN8, 19JN8

position. Types 12JN8 and 19JN8 are identical with type 6JN8 except for heater ratings, as shown below.

|                                         | 6JN8    | 12JN8     | 19JN8   |         |
|-----------------------------------------|---------|-----------|---------|---------|
| Heater Voltage (ac/dc)                  | 6.3     | 12.6      | 18.9    | volts   |
| Heater Current                          | 0.45    | 0.225     | 0.15    | ampere  |
| Heater Warm-up Time (Average)           | 11      | _         | _       | seconds |
| Peak Heater-Cathode Voltage:            |         |           |         |         |
| Heater negative with respect to cathode | 200 max | x 200 max | 200 max | volts   |
| Heater positive with respect to cathode | 200 ma  | x 200=max | 200 max | volts   |
|                                         |         |           |         |         |

| Direct Interelectrode Capacitances:*                                                                                                   |      |    |
|----------------------------------------------------------------------------------------------------------------------------------------|------|----|
| Pentode Unit: Grid No.1 to Plate                                                                                                       | 0.01 | pF |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield                                                                | 5.5  | pF |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield                                                                    | 3.4  | pF |
| Triode Unit: Grid to Plate                                                                                                             | 1.7  | pF |
| Grid to Cathode, Heater, Pentode Cathode, Grid No.3, and Internal Shield                                                               | 3.2  | pF |
| Plate to Cathode, Heater, Pentode Cathode, Grid No.3, and Internal Shield                                                              | 2.2  | рF |
| <ul> <li>The dc component must not exceed 100 volts.</li> <li>With external shield connected to cathode of unit under test.</li> </ul> |      |    |
| Class & Amulifian                                                                                                                      |      |    |

| Class A, Amplifier                                     |             |           |            |
|--------------------------------------------------------|-------------|-----------|------------|
| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Pentode U | nit        |
| Plate Voltage                                          | 300 max     | 300 max   |            |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | _           | 300 max   | volts      |
| Grid-No.2 Voltage                                      | _           | See cur   | ve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value  | 0 max       | 0 max     |            |
| Plate Dissipation                                      | 2.5 max     | 2.5 ma    | k watts    |
| Grid-No.2 Input:                                       |             |           |            |
| For grid-No.2 voltages up to 150 volts                 |             | 0.55 max  | watt       |
| For grid-No.2 voltages between 150 and 300 volts       |             | See cur   | ve page 80 |
| CHARACTERISTICS:                                       |             |           |            |
| Plate Voltage                                          | 125         | 125       | volts      |
| Grid-No.2 Voltage                                      | _           | 125       | volts      |
| Grid-No.1 Voltage                                      | -1          | -1        | volt       |
| Amplification Factor                                   | 46          | _         |            |
| Plate Resistance (Approx.)                             | 5400        | 200000    | ohms       |
| Transconductance                                       | 8500        | 7500      | μmhos      |
| Plate Current                                          | 13.5        | 12        | mA         |
| Grid-No.2 Current                                      |             | 4         | mA         |
| Grid-No.1 Voltage (Approx.) for plate current of 10 µA | -8          | -8        | volts      |
| MAXIMUM CIRCUIT VALUES:                                |             |           |            |
| Grid-No.1-Circuit Resistance:                          |             |           |            |
| For fixed-bias operation                               | 2.2 max     | 2.2 mar   | megohms    |
| For cathode-bias operation                             | 2.2 max     | 2.2 max   | megohms    |

#### **BEAM POWER TUBE**

**6JS6** 

Duodecar type used as horizontaldeflection amplifier in television receivers. Outline 16B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position.

| GI GEO NC     |  |  |
|---------------|--|--|
| 63(4) B)IC    |  |  |
| 023 0003      |  |  |
| K2 11 G2      |  |  |
| " (1)—(12) °2 |  |  |
| 12FY          |  |  |

| Heater Voltage (ac/dc)                                 | 6.3     | volts   |
|--------------------------------------------------------|---------|---------|
| Heater Current                                         | 2.25    | amperes |
| Peak Heater-Cathode Voltage:                           |         |         |
| Heater negative with respect to cathode                | 200 max | volts   |
| Heater positive with respect to cathode                | 200≡max | volts   |
| Direct Interelectrode Capacitances (Approx.):          |         |         |
| Grid No.1 to Plate                                     | 0.7     | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 24      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 10      | pF      |
| ■ The dc component must not exceed 100 volts.          |         |         |

#### Class A. Amplifier

| 5000 | 70    | 175            | volts                                          |
|------|-------|----------------|------------------------------------------------|
|      | Conne | cted to cathod | e at socket                                    |
| 125  | 125   | 125            | volts                                          |
| _    | 0     | 25             | volts                                          |
| _    | _     | 5600           | ohms                                           |
|      |       | 11300          | μmhos                                          |
|      | 125   | 125 125<br>- 0 | Connected to cathod<br>  125   125   125   125 |

| Plate Current                                                                        |   | 570† | 125      | mA     |
|--------------------------------------------------------------------------------------|---|------|----------|--------|
| Grid-No.2 Current                                                                    | _ | 34†  | 4.5      | mA     |
| Grid-No.1 Voltage (Approx.) for plate current of 1 mA  Triode Amplification Factor†† |   | _    | -54<br>3 | volts  |
| MAXIMUM CIRCUIT VALUE: Grid-No.1 Circuit Resistance                                  |   |      | 1 max    | megohm |

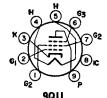
† These values can be measured by a method involving a recurrent waveform such that the plate dissipation and grid-No.2 input will not exceed their maximum ratings. †† Triode connection (grid No.2 tied to plate).

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |          |       |
|------------------------------------------|----------|-------|
| DC Plate Supply Voltage                  | 990 max  | volts |
| Peak Positive-Pulse Plate Voltage*       | 7500 max | volts |
| Peak Negative-Pulse Plate Voltage        | 1100 max | volts |
| DC Grid-No.3 Voltage                     | 70 max   | volts |
| DC Grid-No.2 Voltage                     | 190 max  | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | -250 max | volts |
| Average Cathode Current                  | 315 max  | mA    |
| Peak Cathode Current                     | 1100 max | mA    |
| Plate Dissipation**                      | 28 max   | watts |
| Grid-No.2 Input                          | 5.5 max  | watts |
| Bulb Temperature (At hottest point)      | 225 max  | °C    |

\* The duration of the pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds. \*\* An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### **BEAM POWER TUBE**

Novar types used as horizontal deflection amplifiers in high-efficiency deflection circuits of black-and-white television receivers employing wideangle or high-voltage picture tubes. Tubes require novar nine-contact 6JT6 6JT6A

Related types: 12JT6, 12JT6A, 17JT6, 17JT6A

socket and may be mounted in any position. Outlines 17C and 31A, respectively, Outlines section. Types 12JT6 and 12JT6A and types 17JT6 and 17JT6A are identical with types 6JT6 and 6JT6A except for heater ratings, as shown below.

|                                            | 0110      | 12316  | 17316     |         |
|--------------------------------------------|-----------|--------|-----------|---------|
|                                            | 6JT6A     | 12JT6A | 17JT6A    |         |
| Heater Voltage (ac/dc)                     | 6.3       | 12.6   | 16.8      | volts   |
| Heater Current                             | 1.2       | 0.6    | 0.45      | amperes |
| Heater Warm-up Time (Average)              |           | 11     | 11        | seconds |
| Peak Heater-Cathode Voltage:               |           |        |           |         |
| Heater negative with respect to cathode    |           |        | 200 max   | volts   |
| Heater positive with respect to cathode    |           |        | 200 • max | volts   |
| Direct Interelectrode Capacitances:        |           |        |           |         |
| Grid No.1 to Plate                         |           |        | 0.26      | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, a | nd Grid   | No.3   | 15        | pF      |
| Plate to Cathode, Heater, Grid No.2, and C | Frid No.3 | 3      | 6.5       | pF      |
| ,                                          |           |        |           | _       |

• The dc component must not exceed 100 volts.

### Class A, Amplifier

| CHARACTERISTICS:                |      |                  |           |
|---------------------------------|------|------------------|-----------|
| Plate Voltage                   | 60   | 250              | volts     |
| Grid No.3 (Suppressor Grid)     | Conn | ected to cathode | at socket |
| Grid-No.2 (Screen-Grid) Voltage | 150  | 150              | volts     |
| Grid-No.1 (Screen-Grid) Voltage | 0    | -22.5            | volts     |
| Triode Amplification Factor     |      | 4.4*             |           |
| Plate Resistance (Approx.)      | -    | 15000            | ohms      |

| Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 1 mA | 390 <b>-</b><br>32 <b>-</b> | 7100<br>70<br>2.1<br>—42 | μmhos<br>mA<br>mA<br>volts |
|--------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------|----------------------------|
|--------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------|----------------------------|

- Grid No.2 connected to plate; plate and grid-No.2 volts, 150; grid-No.1 volts, -22.5.
- This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): DC Plate Supply Voltage | ite |
|------------------------------------------------------------------|-----|
| Peak Positive-Pulse Plate Voltage#                               |     |
| Peak Negative-Pulse Plate Voltage                                |     |
| DC Grid-No.3 Voltage <sup>4</sup>                                |     |
| DC Grid-No.2 Voltage                                             |     |
| DC Grid-No.1 Voltage, Negative-bias value55 max vo               | lts |
| Peak Negative-Pulse Grid-No.1 Voltage                            | lts |
| Peak Cathode Current 550 max m                                   | ١À  |
|                                                                  | ıA  |
| Plate Dissipation† 17.5 max war                                  | tts |
| Grid-No.2 Input                                                  | tts |
| Bulb Temperature (At hottest point)                              | °C  |

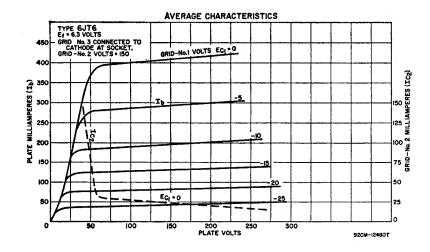
#### MAXIMUM CIRCUIT VALUE:

Grid-No.1-Circuit Resistance:

For grid-resistor-bias operation .....

1 max megohm

- # The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- A positive voltage may be applied to grid No.3 to reduce interference from "snivets" which may occur in television receivers. A typical value for this voltage is 30 volts.
- † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.





### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type with frame-grid pentode unit used in television receivers. The triode unit is used as a voltageamplifier or sync-separator tube, and the pentode unit is used as a videoamplifier tube. Outline 10A, Outlines

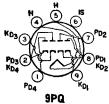
**6JT8** 

section, except base is small-button miniature 9-pin. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.725; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage | Triode<br>Unit<br>330 max | 330<br>330 | tode<br>nit<br>max<br>max | volts<br>volts |
|-----------------------------------------------------------------------------------------------|---------------------------|------------|---------------------------|----------------|
| Grid-No.2 Voltage                                                                             |                           |            |                           | e page 80      |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation                       | 0 max<br>1 max            | -          | max<br>max                | volts<br>watts |
| For grid-No.2 voltages up to 165 volts                                                        | -                         | 1.1        | max                       | watts          |
| For grid-No.2 voltages between 165 and 330 volts                                              | _                         | See        | curve                     | e page 80      |
| CHARACTERISTICS:                                                                              | 0.50                      | 25         | 200                       |                |
| Plate Supply Voltage                                                                          | 250                       | 35<br>100  | 200<br>100                | voits          |
| Grid-No.2 Supply Voltage                                                                      | <u></u> 2                 | 100        | 100                       | voits          |
| Cathode-Bias Resistor                                                                         |                           | ~          | 82                        | ohms           |
| Amplification Factor                                                                          | 100                       | _          | _                         | OIIII          |
| Plate Resistance (Approx.)                                                                    | 37000                     | 5          | 0000                      | ohms           |
| Transconductance                                                                              | 2700                      |            | 0000                      | umhos          |
| Plate Current                                                                                 | 1.5                       | 50•        | 17                        | · mA           |
| Grid-No.2 Current                                                                             |                           | 17•        | 3.5                       | mA             |
| Grid-No.1 Voltage (Approx.) for plate current of 100 μA                                       | -                         |            | <b>-5</b>                 | volts          |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A                                   | <b>-5.3</b>               | -          | _                         | volts          |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:                                         |                           |            |                           |                |
| For fixed-bias operation                                                                      | 0.5 max                   | 0.25       | max                       | megohm         |
| For cathode-bias operation                                                                    | 1 max                     |            |                           | megohm         |

• This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.



### QUADRUPLE DIODE

Miniature types used in phase-detector and noise-immune, color-killer circuits of color television receivers; also used in bridge-matrixing circuits in FM stereo multiplex equipment. Outlines 6E and 6B, respectively, Out-

6JU8 A8UL6

lines section. Units 1 and 2 are shielded from units 3 and 4 to minimize coupling between the series-connected pairs of diodes. Tube requires miniature nine-contact socket and may be mounted in any position.

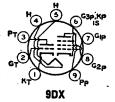
| Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage:              | 6.3<br>0.6         | volts<br>ampere |
|---------------------------------------------------------------------------------|--------------------|-----------------|
| Heater pegative with respect to cathode Heater positive with respect to cathode | 300 max<br>300 max | volts<br>volts  |

| Direct Interelectrode Capacitances (Approx.):             |         |       |
|-----------------------------------------------------------|---------|-------|
| Plate of Unit No.1 and Cathode of Unit No.2 to Cathode of |         |       |
| Unit No.1                                                 | 1.8     | ρF    |
| Plate of Unit No.1 and Cathode of Unit No.2 to Plate of   | -10     |       |
| Unit No.2                                                 | 2.2     | pF    |
| Plate of Unit No.2 to Heater and Internal Shield          | 0.62    | ρF    |
| Plate of Unit No.3 and Cathode of Unit No.4 to Cathode of | 0.02    | γ.    |
| Unit No.3                                                 | 1.9     | ρF    |
| Plate of Unit No.3 and Cathode of Unit No.4 to Plate of   |         | -     |
| Unit No.4                                                 | 2.2     | pF    |
| Plate of Unit No.4 to Heater and Internal Shield          | 0.94    | ρF    |
| Cathode of Unit No.1 to Heater and Internal Shield        | 1.8     | pF    |
| Cathode of Unit No.3 to Heater and Internal Shield        | 1.9     | рF    |
| MAXIMUM RATINGS (Design-Maximum Values, Each Unit):       |         |       |
| Peak Inverse Plate Voltage                                | 300 max | volts |
| Peak Plate Current                                        | 54 max  | volts |
| DC Output Current                                         | 9 max   | mA    |
| CHARACTERISTICS, Instantaneous Value (Each Unit):         |         |       |
| Plate Current for plate voltage of 10 volts               | 60      | mA    |
|                                                           |         |       |

### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

6JV8
Related type:

Miniature type used in a wide variety of applications in television receivers, particularly those having low-voltage "B" supplies and employing seriesconnected heater strings. The triode unit is used in sound-if, keyed-agc,



sync-separator, sync-amplifier, and noise-suppression circuits. The pentode unit is especially useful as a video amplifier tube. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Type 8JV8 is identical with type 6JV8 except for the heater ratings, as shown below.

| 8JV8 is identical with type 6JV8 except for the     | heater ratings,               | as shown  | below.     |
|-----------------------------------------------------|-------------------------------|-----------|------------|
|                                                     | 6JV8                          | 8JV8      |            |
| Heater Voltage (ac/dc)                              | 6.3                           | 8.5       | volts      |
| Heater Current                                      | 0.6                           | 0.45      | ampere     |
| Heater Warm-up Time (Average)                       | - 11                          | 11        | seconds    |
| Peak Heater-Cathode Voltage:                        |                               |           |            |
| Heater negative with respect to cathode             | 200 max                       | 200 max   | volts      |
| Heater positive with respect to cathode             | 200 • max                     | 200 • max | volts      |
| Direct Interelectrode Capacitances (Approx.):       |                               |           |            |
| Triode Unit:                                        |                               |           |            |
| Grid to Plate                                       |                               | 2.2       | pF         |
| Grid to Cathode and Heater                          |                               | 3         | pF         |
| Plate to Cathode and Heater                         |                               | 2         | pF         |
| Pentode Unit:                                       |                               |           |            |
| Grid No.1 to Plate                                  |                               | 0.08 max  | рF         |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.   |                               |           |            |
| Internal Shield                                     |                               | 8         | pF         |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and |                               |           |            |
| Internal Shield                                     |                               | 3.2       | р <b>F</b> |
| Pentode Grid No.1 to Triode Plate                   |                               | 0.012 max | рF         |
| Pentode Plate to Triode Plate                       | · · · · · · · · · · · · · · · | 0.24 max  | pF         |
| • The dc component must not exceed 100 volts.       |                               |           |            |
| Class A, Amplifie                                   | r                             |           |            |
| - · ·                                               | Triode                        | Pentode   |            |
| MAXIMUM RATINGS (Design-Maximum Values):            | Unit                          | Unit      |            |
| Plate Voltage                                       | 330 max                       | 330 max   | volts      |
| Grid-No.2 (Screen-Grid) Voltage                     | -                             | 330 max   | volts      |
| Grid-No.1 (Control-Grid) Voltage:                   |                               |           |            |
| Positive-bias value                                 | 0 max                         | 0 max     | volts      |
| 37 3.1                                              | <b>7</b> 0                    | •         |            |

50 max

1.1 max

50 max

4 max

1.7 max

volts

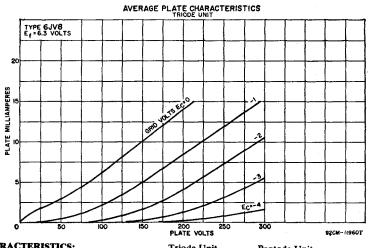
watts

watts

Negative-bias value .....

Plate Dissipation .....

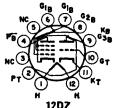
Grid-No.2 Input ......



| CHARACTERISTICS:                                       | Triode Unit | r   | entode L    | Jnit     |          |
|--------------------------------------------------------|-------------|-----|-------------|----------|----------|
| Plate Voltage                                          | 200         | 60  | 125         | 200      | volts    |
| Grid-No.2 Voltage                                      |             | 200 | 125         | 200      | volts    |
| Grid-No.1 Voltage                                      | -2          | - 0 | -1          | -2.9     | volts    |
| Amplification Factor                                   | 70          | _   | _           |          |          |
| Plate Resistance (Approx.)                             | 0.0175      | _   | 0.1         | 0.15     | megohm   |
| Transconductance                                       | 4000        |     | 11500       | 10700    | μmhos    |
| Plate Current                                          | 4           | 51• | 22          | 22       | mA       |
| Grid-No.2 Current                                      |             | 14• | 4           | 4        | mA       |
| Grid-No.1 Voltage (Approx.) for plate current of 20 µA | <b></b> 5   |     | <b>-5.5</b> | <b>9</b> | volts    |
| MAXIMUM CIRCUIT VALUES:                                |             |     |             |          |          |
| Grid-No.1-Current Resistance: For fixed-bias operation |             | 0.5 | max         | 0.25 ma  | x megohm |

For cathode-bias operation ..... 1 max megohm • This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

1 max



### MEDIUM-MU TRIODE-**BEAM POWER TUBE**

Duodecar type used in combined ver-67 tical-deflection-oscillator and verticaldeflection-amplifier applications in television receivers. Outline 8B, Outlines section. Tube requires duodecar twelve-contact socket and may be

6JZ8

mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.2; peak heatercathode volts, 200 (the dc component must not exceed 100 volts when heater is positive with respect to cathode).

| Class A <sub>1</sub>             | Amplifier   |      |          |       |
|----------------------------------|-------------|------|----------|-------|
| CHARACTERISTICS:                 | Triode Unit | Pent | ode Unit |       |
| Plate Voltage                    | 150         | 45   | 120      | volts |
| Grid-No.2 (Screen-Grid) Voltage  |             | 110  | 110      | volts |
| Grid-No.1 (Control-Grid) Voltage | <b>—5</b>   | 0    | 8        | volts |
| Amplification Factor             | 20          |      |          | 1016  |
| Plate Resistance (Approx.)       | 8500        |      | 11700    | ohms  |
| Transconductance                 | 2350        |      | 7100     | umhos |
| Plate Current                    | 5.5         | 122= | 46       | mA    |

|                                                        | Triode Unit | Pentoc         | le Unit |       |
|--------------------------------------------------------|-------------|----------------|---------|-------|
| Grid-No.2 Current                                      | _           | 16.5           | 3.5     | mA    |
| Grid-No.1 Voltage (Approx.) for plate current of 10 μA |             |                |         | 14-   |
| Grid-No.1 Voltage (Approx.) for plate current          |             | . <del>-</del> | -       | volts |
| of 100 μA                                              | -           |                | 25      | volts |

This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Vertical Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

|                                          | Triode<br>Unit | Beam Powe<br>Unit | r      |
|------------------------------------------|----------------|-------------------|--------|
| MAXIMUM RATINGS (Design-Maximum Values): | Oscillator     | Amplifier         |        |
| DC Plate Voltage                         | 250 max        | 250 max           | volts  |
| Peak Positive-Pulse Plate Voltage#       | _              | 2000 max          | volts  |
| DC Grid-No.2 Voltage                     |                | 200 max           | volts  |
| Peak Negative-Pulse Grid-No.1 Voltage    | -400 max       | -150 max          | volts  |
| Peak Cathode Current                     | 70 max         | 245 max           | mA     |
| Average Cathode Current                  | 20 max         | 70 max            | mA     |
| Plate Dissipation                        | 1 max          | 7 max             | watts  |
| Grid-No.2 Input                          |                | 1.8 max           | watts  |
| MAXIMUM CIRCUIT VALUES:                  |                |                   |        |
| Grid-No.1-Circuit Resistance:            |                |                   |        |
| For fixed-bias operation                 | 1 max          | 1 max             | megohm |
| For cathode-bias operation               | 2.2 max        | 2.2 max           |        |

#The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

### **POWER PENTODE**

# 6K6GT

Glass octal type used in output stage of radio receivers and, triode-connected, as a vertical deflection amplifier in television receivers. It is capable of delivering moderate power output with relatively small input



7S

voltage. Tube may be used singly or in push-pull. This type may be supplied with pin No.1 omitted. Tube requires octal socket and may be mounted in any position. Outline 13D, Outlines section. It is especially important that this tube, like other power-handling tubes, be adequately ventilated.

| like other power-handling tubes, be adequately ventilated. |         |        |
|------------------------------------------------------------|---------|--------|
| Heater Voltage (ac/dc)                                     | 6.3     | volts  |
| Heater Current                                             | 0.4     | ampere |
| Peak Heater-Cathode Voltage:                               |         |        |
| Heater negative with respect to cathode                    | 200 max | volts  |
| Heater positive with respect to cathode                    | 200*max | volts  |
| Direct Interelectrode Capacitances (Approx.):              | *       |        |
| Grid No.1 to Plate                                         | 0.5     | pF     |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3     | 5.5     | рF     |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3         | 6.0     | рF     |
| * The dc component must not exceed 100 volts.              |         |        |
| Class A, Amplifier                                         |         |        |
| MAXIMUM RATINGS (Design-Center Values):                    |         |        |
| Plate Voltage                                              | 315 max | volts  |
| Grid-No.2 (Screen-Grid) Voltage                            | 285 max | volts  |

| Class A, A                              | mplifier |     |         |       |
|-----------------------------------------|----------|-----|---------|-------|
| MAXIMUM RATINGS (Design-Center Values): |          |     |         |       |
| Plate Voltage                           |          |     | 315 max | volts |
| Grid-No.2 (Screen-Grid) Voltage         |          |     | 285 max | volts |
| Plate Dissipation                       |          |     | 8.5 max | watts |
| Grid-No.2 Input                         |          |     | 2.8 max | watts |
| TYPICAL OPERATION:                      |          |     |         |       |
| Plate Voltage                           | 100      | 250 | 315     | volts |
| Grid-No.2 Voltage                       | 100      | 250 | 250     | volts |
| Grid-No.1 (Control-Grid) Voltage        | 7        | -18 | 21      | volts |
| Peak AF Grid-No.1 Voltage               | 7        | 18  | 21      | volts |
| Zero-Signal Plate Current               | •        | 32  | 25.5    | mA    |

mA

mA

mA

volts

mA

mA

watts

28

Maximum-Signal Plate Current

Zero-Signal Grid-No.2 Current

Maximum Signal Grid No.2 Current

| Maximum-Signal Grid-No.2 Current 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10                  | 9            | · mA     |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------|----------|--|
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 90000               | 110000       | ohms     |  |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2300                | 2100         | μmhos    |  |
| Load Resistance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 7600                | 9000         | ohms     |  |
| Total Harmonic Distortion 11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 11                  | 15           | per cent |  |
| Maximum-Signal Power Output 0.35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3.4                 | 4.5          | watts    |  |
| aramining and are a series of the series of |                     |              |          |  |
| TYPICAL PUSH-PULL OPERATION (Values are                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |              |          |  |
| for two tubes):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Fixed Bias          | Cathode Bias |          |  |
| Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 285                 | 285          | volts    |  |
| Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 285                 | 285          | volts    |  |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | -25.5               |              | volts    |  |
| Cathode-Bias Resistor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 400          | ohms     |  |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 51                  | 51           | volts    |  |
| Zero-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 55                  | 55           | mA       |  |
| Maximum-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 72                  | 61           | mA       |  |
| Zero-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 9                   | 9            | mA       |  |
| Maximum-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 17                  | 13           | mA       |  |
| Effective Load Resistance (Plate-to-plate)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 12000               | 12000        | ohms     |  |
| Total Harmonic Distortion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6                   | 4            | per cent |  |
| Maximum-Signal Power Output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 10.5                | 9.8          | watts    |  |
| ***************************************                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |              |          |  |
| CHARACTERISTICS (Triode Connection)*:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |              |          |  |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     | 250          | volts    |  |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     | -18          | volts    |  |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     | 37.5         | mA       |  |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     | 2700         | μmhos    |  |
| Amplification Factor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | 6.8          |          |  |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | 2500         | ohms     |  |
| Grid-No.1 Voltage (Approx.) for plate current of 0.5 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | 48           | volts    |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |              |          |  |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |              |          |  |
| Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     | 0.1          |          |  |
| For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |              | megohm   |  |
| For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | • • • • • • • • • • | 0.5 max      | megohm   |  |
| • Grid-No.2 connected to plate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |              |          |  |
| Vertical Deflection Amplifier (Tri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ode Connec          | tion)*       |          |  |
| •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |              |          |  |
| For operation in a 525-line, 30-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | traine system       |              |          |  |
| MAXIMUM RATINGS:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |              |          |  |
| DC Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     | 315 max      | volts    |  |
| Peak Positive-Pulse Plate Voltaget (Absolute maximum)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     | 1200° max    | volts    |  |
| B 1 17 / B 1 A 1117 / TT 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | 250          | *rolta   |  |

9.5

1.6

MAXIMUM CIRCUIT VALUE: Grid-No.1-Circuit Resistance:

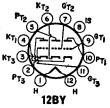
Peak Cathode Current .....

Peak Negative-Pulse Grid-No.1 Voltage .....

Average Cathode Current

Plate Dissipation

For cathode-bias operation ......



#### THREE-UNIT TRIODE

Duodecar type containing one mediummu and two high-mu triode units used as combined agc, sync, and noise-inverter tube in television receivers employing series-connected heater strings. Outline 8A, Outlines section.

6K11/ 6Q11

250 max 75 max

25 max

7 max

2.2 max megohms

<sup>•</sup> Grid No.2 connected to plate.

<sup>†</sup> The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

<sup>\*</sup> Under no circumstances should this absolute value be exceeded.

Heater volts (ac/dc), 6.3; amperes, 0.6; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):               | Unit<br>No.1 | Units Nos. |       |
|--------------------------------------------------------|--------------|------------|-------|
| Plate Voltage                                          |              | 2 and 3    | _     |
| Plate Voltage                                          | 330 max      | 330 max    | volts |
|                                                        |              |            |       |
| Negative-bias value                                    | 50 max       | -50 max    | volts |
| Positive-bias value                                    | 0 max        | 0 max      | volts |
| Cathode Current                                        | 20 max       | _          | mA    |
| Plate Dissipation                                      | 2.75 max     | 0.3 max    | watts |
| CHARACTERISTICS:                                       | 2.73 IIIAX   | U.5 Illax  | watts |
| Plate Voltage                                          | 250          | 250        | volts |
| Grid Voltage                                           | -8.5         | -2         | volts |
| Amplification Factor                                   | _0.5<br>17   | _          | VOILS |
| Plote Desistance (America)                             |              | 100        |       |
| Plate Resistance (Approx.)                             | 7700         | 62500      | ohms  |
| Transconductance                                       | 2200         | 1600       | μmhos |
| Plate Current                                          | 10.5         | 1.2        | mA    |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A | -24          | _          | volts |

### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

6KA8
Related type:
8KA8

Miniature type used in color and  $\kappa$ , is 3 black-and-white television receivers employing series-connected heater  $\epsilon_T$  2 strings. The triode unit is used in sync-separator circuits; the pentode unit has two independent control

grids and is used in gated-agc-amplifier and noise-inverter circuits. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For curves of average plate characteristics for triode unit, refer to type 6AW8A. Type 8KA8 is identical with type 6KA8 except for the heater ratings, as shown below.

|                                                       | 6KA8      | 8KA8    |         |
|-------------------------------------------------------|-----------|---------|---------|
| Heater Voltage (ac/dc)                                | 6.3       | 8.4     | volts   |
| Heater Current                                        | 0.6       | 0.45    | ampere  |
| Heater Warm-up Time (Average)                         | 11        | 11      | seconds |
| Peak Heater-Cathode Voltage:                          |           |         |         |
| Heater negative with respect to cathode               | 200 max   | 200 max | volts   |
| Heater positive with respect to cathode               | 200*max   | 200 max | volts   |
| Direct Interelectrode Capacitances:                   |           |         |         |
| Triode Unit:                                          |           |         |         |
| Grid to Plate                                         |           | 2.2     | mA      |
| Grid to Cathode, Heater, and Internal Shield          |           | 2.8     | pF      |
| Plate to Cathode, Heater, and Internal Shield         |           | 2.2     | pF      |
| Pentode Unit:                                         |           |         | •       |
| Grid-No.1 to Plate                                    |           | 0.1 max | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.     |           |         | •       |
| and Internal Shield                                   |           | 9.5     | pF      |
| Grid No.1 to Grid No.3                                |           | 0.5     | ρF      |
| Grid No.3 to Plate                                    |           | 2.2     | pF      |
| Grid No.3 to All Other Electrodes, Heater, and Intern | al Shield | 7       | pF      |
| • The dc component must not exceed 100 volts.         |           |         |         |

#### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): | Triode Unit |       |
|------------------------------------------|-------------|-------|
| Plate Voltage                            | 300 max     | volts |
| Grid Voltage:                            |             |       |
| Positive-bias value                      | 0 max       | volts |
| Negative-bias value                      | -50 max     | volts |
| Plate Dissipation                        | 1.1 max     | watts |

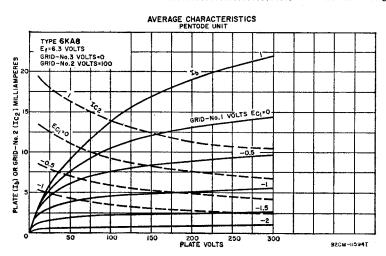
| Plate Supply Voltage         200         150         volts           Grid-No.3 Supply Voltage         —         0         volts           Grid-No.1 Supply Voltage         —2         0         volts           Grid-No.1 Supply Voltage         —2         0         volts           Cathode-Bias Resistor         —         180         ohms           Amplification Factor         70         —           Plate Resistance (Approx.)         17500         100000         ohms           Transconductance, Grid No.1 to Plate         4000         4400         μmhos           Transconductance, Grid No.3 to Plate         —         600         μmhos           Plate Current         4         4         mA           Grid-No.2 Current         —         2.8         mA           Grid-No.1 Supply Voltage (Approx.):         For plate current of 10 μA         —         —         volts           For plate current of 20 μA         —         —         —         volts           Grid No.3 Supply Voltage (Approx.) for plate current         —         —         —         7         volts |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Grid-No.1 Supply Voltage         -2         0         volts           Cathode-Bias Resistor         -         180         ohms           Amplification Factor         70         -           Plate Resistance (Approx.)         17500         100000         ohms           Transconductance, Grid No.1 to Plate         4000         4400         μmhos           Plate Current         -         600         μmhos           Piate Current         4         4         mA           Grid-No.2 Current         -         2.8         mA           Grid-No.1 Supply Voltage (Approx.):         -         -         volts           For plate current of 10 μA         -5         -         volts           Grid No.3 Supply Voltage (Approx.) for plate current         -         -         4         volts                                                                                                                                                                                                                                                                                              |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Plate Resistance (Approx.) 17500 100000 ohms Transconductance, Grid No.1 to Plate 4000 4400 $\mu$ mhos Transconductance, Grid No.3 to Plate — 600 $\mu$ mhos Plate Current 4 4 4 mM Grid-No.2 Current — 2.8 mA Grid-No.1 Supply Voltage (Approx.):  For plate current of 10 $\mu$ A — 5 — volts For plate current of 20 $\mu$ A — — 4 volts Grid No.3 Supply Voltage (Approx.) for plate current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Transconductance, Grid No.1 to Plate 4000 $\mu$ mhos Transconductance, Grid No.3 to Plate $-$ 600 $\mu$ mhos Plate Current 4 4 $\mu$ 4 $\mu$ MA Grid-No.2 Current $-$ 2.8 $\mu$ MGrid-No.1 Supply Voltage (Approx.):  For plate current of 10 $\mu$ A $\mu$ Crid-No.3 Supply Voltage (Approx.) $ -$ 4 volts Grid-No.3 Supply Voltage (Approx.) for plate current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Transconductance, Grid No.3 to Plate — 600 $\mu$ mhos Plate Current 4 4 $\mu$ mA Grid-No.2 Current — 2.8 mA Grid-No.1 Supply Voltage (Approx.):  For plate current of 10 $\mu$ A — 5 — volts For plate current of 20 $\mu$ A — — 4 volts Grid No.3 Supply Voltage (Approx.) for plate current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Plate Current 4 4 mA Grid-No.2 Current - 2.8 mA Grid-No.1 Supply Voltage (Approx.):  For plate current of 10 $\mu$ A - 5 - volts For plate current of 20 $\mu$ A - 4 volts Grid No.3 Supply Voltage (Approx.) for plate current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Grid-No.1 Supply Voltage (Approx.):  For plate current of 10 $\mu$ A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| For plate current of 10 $\mu$ A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| For plate current of 20 $\mu$ A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Grid No.3 Supply Voltage (Approx.) for plate current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| MAXIMUM CIRCUIT VALUES: Triode Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Grid-Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Gated AGC Amplifier and Noise Inverter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| ·                                                                         |                  |         |
|---------------------------------------------------------------------------|------------------|---------|
| MAXIMUM RATINGS (Design-Maximum Values):                                  | Pentode Unit     |         |
| DC Plate Voltage                                                          | 300 max          | volts   |
| Peak Positive-Pulse Plate Voltage                                         | 600 max          | volts   |
| Grid-No.3 (Control-Grid) Voltage:                                         |                  |         |
| Positive-bias value                                                       | 0 max            | volts   |
| Negative-bias value                                                       | -100 max         | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                                    | 300 max          | volts   |
| Grid-No.2 Voltage                                                         | See curve        | page 80 |
| Grid-No.1 (Control-Grid) Voltage:                                         |                  |         |
| Positive-bias value                                                       | 0 max            | volts   |
| Negative-bias value                                                       | -50 max          | volts   |
| Plate Dissipation                                                         | 2 max            | watts   |
| Grid-No.2 Input:                                                          |                  |         |
| For grid-No.2 voltages up to 150 volts                                    | 1.1 max          | watts   |
| For grid-No.2 voltages between 150 and 300 volts                          |                  |         |
| The duration of the voltage pulse must not exceed 15 per cent of c        |                  |         |
| cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scan | ning cycle is 10 | micro-  |
| seconds.                                                                  | 0,510 13 10      |         |

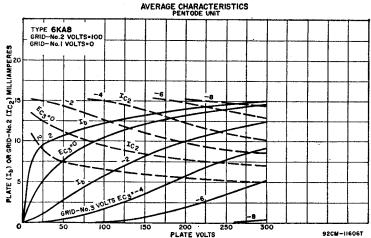
#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.3-Circuit Resistance

0.68 max megohm



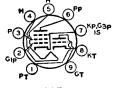




### MEDIUM-MU TRIODE SHARP-CUTOFF PENTODE

6KD8 Related type: 5KD8

Miniature type used as combined vhf oscillator and mixer tube in television receivers. Outline 6B, Outlines section. Tube requires miniature ninecontact socket and may be mounted in any position. Type 5KD8 is identi-



9AE

volts

cal with type 6KD8 except for the heater ratings, as shown below. 5KD8 6KD8 6.3 volts Heater Voltage (ac/dc) ...... 5.6 Heater Current 0.45 0.4 ampere Heater Warm-up Time seconds 11

s

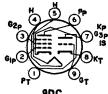
| Peak Heater-Cathode Voltage:                           |             |            | 2000224    |
|--------------------------------------------------------|-------------|------------|------------|
| Heater negative with respect to cathode                | 200 max     | 200 max    | volts      |
| Heater positive with respect to cathode                | 200*max     | 200°max    | volts      |
| * The dc component must not exceed 100 volts.          |             |            |            |
| Class A, Amplifier                                     |             |            |            |
| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Pentode Un | iit        |
| Plate Voltage                                          | 330 max     | 330 max    | volts      |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | _           | 330 max    | volts      |
| Grid-No.2 Voltage                                      |             | See curv   | ve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value. | 0 max       | 0 max      | volts      |
| Plate Dissipation                                      | 2.5 max     | 3 max      | watts      |
| Grid-No.2 Input:                                       |             |            |            |
| For grid-No.2 voltages up to 165 volts                 | _           | 0.55 max   |            |
| For grid-No.2 voltages between 165 and 330 volts       | · —         | See cur    | ve page 80 |
| CHARACTERISTICS:                                       |             |            |            |
| Plate Voltage                                          | 125         | 125        | volts      |
| Grid-No.2 Voltage                                      | _           | 110        | volts      |
| Grid-No.1 Voltage                                      | -1          | <b>i</b>   | volt       |
| Amplification Factor                                   | 40          |            |            |
| Plate Resistance (Approx.)                             | _           | 0.2        | megohm     |
| Transconductance                                       | 7500        | 5000       | $\mu$ mhos |
| Plate Current                                          | 13.5        | 9.5        | mĄ         |
| Grid-No.2 Current                                      |             | 3.5        | mA         |

Grid-No.1 Voltage (Approx.) for plate current of 20 µA

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

For fixed-bias operation ... 0.5 max megohm
For cathode-bias operation ... 1 max megohm



### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

O G Miniature type with frame-grid pentode unit used as combined oscillatormixer tube in television receivers using an intermediate frequency in the order of 40 megacycles. Outline 6B, Outlines section. Tube requires min-

6KE8
Related type:
5KE8

iature nine-contact socket and may be mounted in any position. Type 5KE8 is identical with type 6KE8 except for the heater ratings, as shown below.

| There Walter Could N                                | 5KE8    | 6KE8      | . 14.   |
|-----------------------------------------------------|---------|-----------|---------|
| Heater Voltage (ac/dc)                              | 5.6     | 6.3       | volts   |
| Heater Current                                      | 0.45    | 0.4       | ampere  |
| Heater Warm-up Time (Average)                       | 11      | _         | seconds |
| Peak Heater-Cathode Voltage:                        |         |           |         |
| Heater negative with respect to cathode             | 200 max | 200 max   | voits   |
| Heater positive with respect to cathode             | 200 max | 200 max   | volts   |
| Direct Interelectrode Capacitances:                 |         |           |         |
| Triode Unit:                                        |         |           |         |
| Grid to Plate                                       |         | 1.3       | pF      |
| Grid to Cathode, Heater, Pentode Cathode, Pentode   | Grid    | 1.5       | ν.      |
| No.3, and Internal Shield                           |         | 2.4       | pF      |
| Plate to Cathode, Heater, Pentode Cathode, Pentode  |         |           |         |
| and Internal Shield                                 |         | 2         | pF      |
| Pentode Unit:                                       |         | -         | P-      |
| Grid No.1 to Plate                                  |         | 0.015 max | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3  |         | 0,015 111 | P-      |
| and Internal Shield                                 |         | 5         | ρF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and |         | ,         | Pr.     |
|                                                     |         | 2.4       | ~F7     |
|                                                     |         | 3.4       | pF      |
| Heater to Triode Cathode and Pentode Cathode        |         | 5.5=      | pF      |
|                                                     |         |           |         |

<sup>•</sup> The dc component must not exceed 100 volts.

#### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              | Triode Unit | Pentode   | Unit         |
|-------------------------------------------------------|-------------|-----------|--------------|
| Plate Voltage                                         | 280 max     | 280 m     | ax volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                | _           | 280 m     | ax volts     |
| Grid-No.2 Voltage                                     |             | See o     | urve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max       | 0 m       |              |
| Cathode Current                                       | 20 max      | 20 m      | ax mA        |
| Plate Dissipation                                     | 2 max       | 2 m       | ax watts     |
| Grid-No.2 Input:                                      |             |           |              |
| For grid-No.2 voltages up to 140 volts                | _           | 0.5 m     | ax watt      |
| For grid-No.2 voltages between 140 and 280 volts      | -           | See o     | urve page 80 |
| CHARACTERISTICS:                                      | Triode Unit | Pentode U | nit          |
| Plate Supply Voltage                                  | 125         | 125       | volts        |
| Grid-No.2 Supply Voltage                              |             | 125       | volts        |
| Grid-No.1 Supply Voltage                              | 0           | 0         | volts        |
| Cathode-Bias Resistor                                 | 68          | 33        | ohms         |
| Amplification Factor                                  | 40          |           |              |
| Plate Resistance (Approx.)                            | 5000        | 125000    | ohms         |
| Transconductance                                      | 8000        | 12000     | µmhos.       |
| Plate Current                                         | 13          | 10        | mA           |
| Grid-No.2 Current                                     | -           | 2.8       | mA           |
| Grid-No.1 Voltage (Approx.):                          |             |           |              |
| For plate current of 100 $\mu$ A                      | 5           |           | volta        |
| For plate current of 50 µA                            | _           | -3        | volts        |
|                                                       |             |           |              |

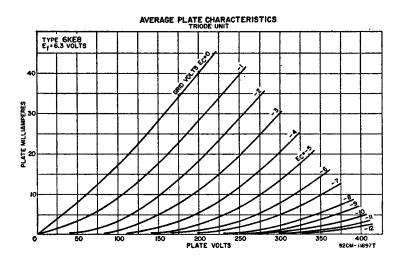
<sup>□</sup> With external shield connected to cathode of unit under test, except as noted.

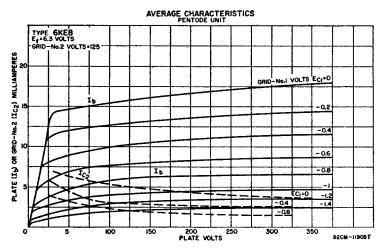
<sup>•</sup> With external shield connected to ground.

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

For fixed-bias operation 0.5 max 0.25 max megohm
For cathode-bias operation 1 max 0.5 max megohm





## **BEAM POWER TUBE**

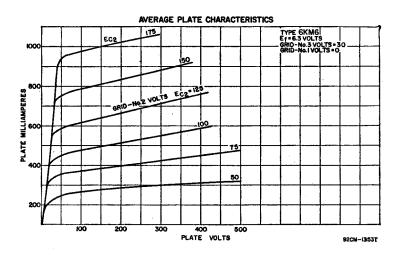
**6KM6** 

Novar type used as horizontal-deflection amplifier in color television receivers. Outline 18A, Outlines section. Tube requires novar nine-contact socket and may be mounted in any position.



| Heater Voltage (ac/dc)                                 | 6.3     | volts   |
|--------------------------------------------------------|---------|---------|
| Heater Current                                         | 1.6     | amperes |
| Peak Heater-Cathode Voltage:                           |         | _       |
| Heater positive with respect to cathode                | 200 max | voits   |
| Heater negative with respect to cathode                | 200*max | volts   |
| Direct Interelectrode Capacitances:                    |         |         |
| Grid No.1 to Plate                                     | 1.2     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 22      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 9       | pF      |

<sup>\*</sup> The dc component must not exceed 100 volts.



## Class A. Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): | Triode<br>Connection |      | Pentode<br>Connection |       |           |
|------------------------------------------|----------------------|------|-----------------------|-------|-----------|
| CHARACTERISTICS:                         |                      |      |                       |       |           |
| Plate Voltage                            | 140                  |      | 60                    | 140   | volts     |
| Peak Positive-Pulse Plate Voltage**      |                      | 6500 | _                     |       | volts     |
| Grid-No.3 (Suppressor-Grid) Voltage      | . 0                  | 30   | 30                    | 30    | volts     |
| Grid-No.2 (Screen-Grid) Voltage          | 140                  | 140  | 140                   | 140   | volts     |
| Grid-No.1 (Control-Grid) Voltage         | -24.5                |      | 0                     | -24.5 | volts     |
| Amplification Factor†                    |                      |      | _                     |       | , , , , , |
| Plate Resistance (Approx.)               |                      | _    | _                     | 6000  | ohms      |
| Transconductance                         | . —                  | _    |                       | 9500  | umhos     |
| Plate Current                            |                      |      | 560††                 | 80    | mA        |
| Grid-No.2 Current                        |                      |      | 31††                  | 2.4   | mA        |
| Grid-No.1 Voltage for plate current      |                      |      |                       |       |           |
| of 1 mA                                  | <del>-</del>         | -110 | _                     | -42   | volts     |

### Horizontal-Deflection Amplifier

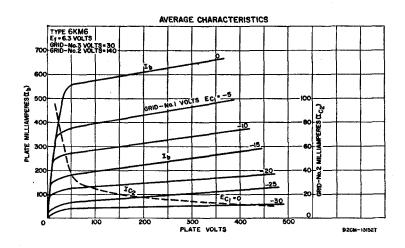
For operation in 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |           |       |
|------------------------------------------|-----------|-------|
| DC Plate Supply Voltage                  | 770 max   | volts |
| Peak Positive-Pulse Plate Voltage**      | 6500 max  | voits |
| Peak Negative-Pulse Plate Voltage        | -1500 max | voits |
| DC Grid-No.3 Voltage•                    | 75 max    | volts |
| DC Grid-No.2 Voltage                     | 220 max   | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | 330 max   | volts |
| Peak Cathode Current                     | 950 max   | mA    |
| Average Cathode Current                  | 275 max   | mA    |
| Grid-No.2 Input                          | 3.5 max   | watts |
| Plate Dissipation.                       | 20 max    | watts |
| Bulb Temperature (At hottest point)      | 240 max   | °C    |

#### MAXIMUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance:

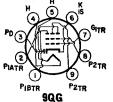
- \*\* The duration of the cycle must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of the horizontal scanning cycle is 10 microseconds.
- † With grid No.3 and grid No.2 connected, respectively, to cathode and plate at socket.
- †† This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.
- In this service, a positive value may be applied to grid No.3 to minimize snivets" interference; a typical value for this voltage is 30 volts.
- •• An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### DIODE— THREE-PLATE TETRODE

# **6KM8**

Miniature type used in frequency-divider and complex-wave generator circuits of electronic musical instruments. In such circuits the tetrode unit can provide three independent output-signal voltages; the diode unit



can be used as a key in a vibrato circuit. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc)                  | 6.3      | volts  |
|-----------------------------------------|----------|--------|
| Heater Current                          | 0.3      | ampere |
| Peak Heater-Cathode Voltage:            |          |        |
| Heater negative with respect to cathode | 200 max  | volts  |
| Heater positive with respect to cathode | 200=max  | volts  |
| Direct Interelectrode Capacitances:     |          |        |
| Tetrode Unit:                           |          |        |
| Grid No.1 to Plate No.1A                | 0.02 max | рF     |
| Grid No.1 to Plate No.1B                | 0.02 max | рF     |
| Grid No.1 to Plate No.2                 | 0.06 max | pF     |
|                                         |          |        |

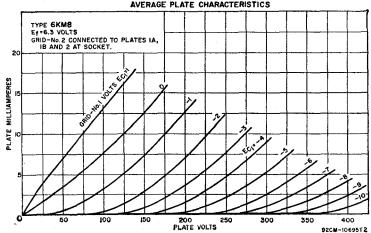
| Grid No.1 to Cathode, Heater, Grid No.2, and Internal Shield Plate No.1A to Cathode, Heater, Grid No.2, and Internal Shield Plate No.1B to Cathode, Heater, Grid No.2, and Internal Shield Plate No.2 to Cathode, Heater, Grid No.2, and Internal Shield Plate No.2 to Cathode, Heater, Grid No.2, and Internal Shield Tetrode Grid No.1 to Diode Plate Tetrode Plate No.1A to Diode Plate Tetrode Plate No.1B to Diode Plate | 5.5<br>1.2<br>1.3<br>1.8<br>0.024 max<br>0.18<br>0.024 | pF<br>pF<br>pF<br>pF<br>pF |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|----------------------------|
| Tetrode Plate No.1B to Diode Plate  Tetrode Plate No.2 to Diode Plate                                                                                                                                                                                                                                                                                                                                                         | 0.024                                                  | pF                         |

• The dc component must not exceed 100 volts.

# Totrodo Unit as Class A. Amnlifier

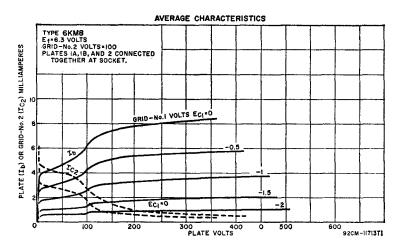
| retrode unit as ci                                  | 855 M    | Ampiniei      |             |         |
|-----------------------------------------------------|----------|---------------|-------------|---------|
| Plates No. 1A, 1B, and                              | 2 conne  | cted together |             |         |
| CHARACTERISTICS:                                    |          |               |             | _       |
| Plate Voltage                                       |          |               | 100         | volts   |
| Grid-No.2 Voltage                                   |          |               | 100         | volts   |
| Grid-No.1 Supply Voltage                            |          |               | 0           | volts   |
| Grid-No.1 Resistor (Bypassed)                       |          |               | 2.2         | megohms |
| Plate Resistance (Approx.)                          |          |               | 30000       | ohms    |
| Transconductance                                    |          |               | 3400        | μmhos   |
| Plate Current                                       |          |               | 4.2         | mA      |
| Grid-No.2 Current                                   |          |               | 1.7         | mA      |
| Grid-No.1 Voltage (Approx.) for plate current of    |          |               | -4          | volts   |
| Triode Connection—Plates No.1A, 1: CHARACTERISTICS: | B, and 2 | connected to  | o grid No.2 |         |
| Piate Voltage                                       |          |               | 100         | volts   |
| Grid-No.1 Supply Voltage                            |          |               | .00         | volts   |
|                                                     |          |               | 2.2         | megohms |
| Grid-No.1 Resistor (Bypassed)                       |          |               | 4500        | μmhos   |
| Transconductance                                    |          |               | 45          | μIIIIOS |
| Amplification Factor                                |          |               | 5.5         | mA      |
| Plate Current                                       |          |               | 2.3         | ши      |
| Separate plate operation; plate                     | es not u | nder test gro | unded       |         |
| Plate                                               | 1A       | 1B            | 2           |         |
| Plate Voltage                                       | 100      | 100           | 100         | volts   |
| Grid-No.2 Voltage                                   | 100      | 100           | 100         | volts   |
| C 14 M. 4 Complex Malana                            | Δ.       | Α             | Λ           | volte   |

#### volts 2.2 2.2 megohms 1800 2000 2000 μmhos. Transconductance ..... Plate Resistance (Approx.) 0.1 0.12 megohm 0.1 Plate Current Grid-No.2 Current 2.3 2.3 2.1 mA 3.8 3.8 3.3 mA AVERAGE PLATE CHARACTERISTICS



## Tetrode Unit as Frequency Divider and Complex-Wave Generator

| MAXIMUM RATINGS (Design-Maximum Values):         |           |         |
|--------------------------------------------------|-----------|---------|
| Plate Voltage (Each plate)                       | 330 max   | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage           | 330 max   | volts   |
| Grid-No.2 Voltage                                | See curve | page 80 |
| Grid-No.1 (Control-Grid) Voltage:                | 0 max     | volts   |
| Positive-bias value                              |           |         |
| Negative-bias value                              | —50 max   | volts   |
| Grid-No.2 Input:                                 |           |         |
| For grid-No.2 voltages up to 165 volts           | 0.65 max  | watt    |
| For grid-No.2 voltages between 165 and 330 volts | See curve | page 80 |
| Plate Dissipation (Each plate)                   | 1 max     | watt    |
| MAXIMUM CIRCUIT VALUES:                          |           |         |
| Grid-No.1-Circuit Resistance:                    |           |         |
| For grid-No.1-resistor-bias operation            | 2.2 max m | negohms |
| Diode Unit                                       |           |         |
| MAXIMUM RATINGS (Design-Maximum Values):         |           |         |
| Plate Current                                    | 1 max     | mA      |
| CHARACTERISTICS, Instantaneous Values:           |           |         |
| Tube Voltage Drop for plate current of 2 mA      | 10        | volts   |



## MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

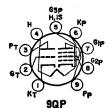
6KR8
Related type:
10KR8

Miniature type used in a wide variety of applications in television receivers. The triode unit is used as a general-purpose amplifier; the pentode unit is used as a video amplifier. Outline 6E, Outlines section. Tube requires minia-

ture nine-contact socket and may be mounted in any position. Type 10KR8 is identical with type 6KR8 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc)                                                                                         | 6.3<br>0.75 | 10.5<br>0.45<br>11 | volts<br>ampere<br>seconds |
|----------------------------------------------------------------------------------------------------------------|-------------|--------------------|----------------------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode | 200 max     | 200 max            | volts                      |
|                                                                                                                | 200*max     | 200*max            | volts                      |

| Direct Interelectrode Capacitances:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |              |                |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------|----------------|---------------|
| Triode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |              |                | 251           |
| Grid to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |              | 2.6            | рF            |
| Grid to Triode Cathode, Pentode Cathode, I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |              | 4.2            | ρF            |
| No.3, and Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |              | 4.2            | рr            |
| Plate to Triode Cathode, Pentode Cathode, No.3, and Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | neater, Pt       | entode Grid  | 3              | ρF            |
| Pentode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |              | 3              | ρ.            |
| Grid No.1 to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |              | 0.075          | pF            |
| Grid No.1 to Cathode, Heater, Grid No.2,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Grid No          | .3. and      | 0.070          | •-            |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                  |              | 13             | pF            |
| Plate to Cathode, Heater, Grid No.2, Grid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | d No.3, a        | nd           |                |               |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                  |              | 4.4            | рF            |
| • The de component must not exceed 100 volts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |              |                |               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                  |              |                |               |
| Class A <sub>1</sub> /                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Amplifier</b> | •            |                |               |
| MAXIMUM RATINGS (Design-Maximum Val                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ues):            | Triode Unit  | Pentode Un     | it            |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  | _            | 330 max        | volts         |
| Grid-No.2 (Screen-Grid) Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                  | 330 max      | 330 max        | volts         |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  | <del>-</del> |                | ve page 80    |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias v                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  | 0 max        | 0 max          | volts         |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  | 2 max        | 5 max          | watts         |
| Grid-No.2 Input:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |              | 1.1 max        | watts         |
| For voltages up to 165 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |              |                | ve page 80    |
| For voltages between 103 and 330 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                  |              | See cui        | ve page 60    |
| CHARACTERISTICS:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |              |                |               |
| Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 125              | 35           | 200            | volts         |
| Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <del>-</del> -   | 100          | 100            | volts         |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | _                | 0            |                | volts         |
| Cathode-Bias Resistor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 68               | _            | 82             | ohms          |
| Amplification Factor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 46               | <del></del>  |                | -1            |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4400<br>10400    | _            | 60000<br>20000 | ohms<br>µmhos |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 15               | 54           | 19.5           | μιμιος<br>mA  |
| Plate Current Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                | 13.5         | 3              | mA            |
| Grid-No.1 Voltage (Approx.) for plate current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  | 13.5         | •              | ,,,,,         |
| of 10 µA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | -8               | _            | _              | volts         |
| Grid-No.1 Voltage (Approx.) for plate current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | •                |              |                |               |
| of 100 μA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | -                |              | 6.3            | volts         |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |              |                |               |
| Grid-No.1 Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |              |                |               |
| For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  | 0.5 max      | 0.5 max        | megohm        |
| For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  | 1.0 max      |                | megohm        |
| A DE COMMUNICATION OF THE PROPERTY OF THE PROP |                  |              |                |               |



### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in a variety of applications in television receivers. The pentode unit is used as an if-amplifier tube, and the triode unit as a sync-separator or voltage-amplifier tube. Outline 6B, **Outlines** section.

**6KT8** 

Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.6; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode)

#### Class A. Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              | Triode Unit | Pentode Unit      |
|-------------------------------------------------------|-------------|-------------------|
| Plate Voltage                                         | 330 max     | 330 max volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                | _           | 330 max volts     |
| Grid-No.2 Voltage                                     |             | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max       | 0 max volts       |
| Plate Dissipation                                     | 1 max       | 2.5 max watts     |

| Grid-No.2 Input: For grid-No.2 voltages up to 165 volts For grid-No.2 voltages between 165 and 330 volts | <u>-</u> | 0.55 max<br>See cur | watt<br>ve page 80 |
|----------------------------------------------------------------------------------------------------------|----------|---------------------|--------------------|
| CHARACTERISTICS:                                                                                         |          |                     |                    |
| Plate Voltage                                                                                            | 250      | 125                 | volts              |
| Grid-No.2 Voltage                                                                                        | _        | 125                 | volts              |
| Grid-No.1 Voltage                                                                                        | -2       | -1                  | volts              |
| Amplification Factor                                                                                     | 100      |                     |                    |
| Plate Resistance (Approx.)                                                                               | 31500    | 150000              | ohms               |
| Transconductance                                                                                         | 3200     | 10000               | $\mu$ mhos         |
| Plate Current                                                                                            | 1.8      | 12                  | mA                 |
| Grid-No.2 Current                                                                                        | _        | 4.5                 | mA                 |
| Grid-No.1 Voltage (Approx.) for plate current of 20 µA                                                   | -3.5     | 7                   | volts              |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:                                                    |          |                     |                    |
| For fixed-bias operation                                                                                 | 0.5 max  | 0.5 ma              | x megohm           |
| For cathode-bias operation                                                                               | 1 max    | 1 ma                | x megohm           |

### TWIN DIODE— SHARP-CUTOFF PENTODE

6KU8
Related type:

Neonoval type with frame-grid pentode. Diode units are used as horizontal phase detectors and the pentode unit is used as a video amplifier. Outline 10A, Outlines section. Tube requires neonoval nine-contact socket

PD<sub>1</sub>(3) PP Pp Solid a D2 PP

and may be mounted in any position. Type 10KU8 is identical with type 6KU8

6KU8 10KU8 10.2 volts Heater Voltage (ac/dc) ..... 6.3 Heater Current . 0.725 0.45 ampere Heater Warm-up Time (Average) ...... 11 seconds Peak Heater-Cathode Voltage: 200 max 200 max Heater negative with respect to cathode ...... volts 200\*max Heater positive with respect to cathode ...... 200\*max volts Direct Interelectrode Capacitances: Diode Units: Plate of Diode Unit No.1 to All Other Electrodes ..... 1.1 pF рF Plate of Diode Unit No.2 to All Other Electrodes ..... 1.1 Diode Cathode to Plate of Diode Unit No.1 ..... 5.5 рF Diode Cathode to Plate of Diode Unit No.2 ..... рF 5.5 Pentode Unit: Grid No.1 to Plate 0.1 max Grid No.1 to Pentode Cathode, Diode Cathode, Heater, Grid No.2, Grid No.3, and Internal Shields 12 pF Plate to Pentode Cathode, Diode Cathode, Heater, Grid No.2, Grid No.3, and Internal Shields рF Pentode Grid No.1 to Plate of Diode Unit No.1 ..... 0.003 max ρF Pentode Grid No.1 to Plate of Diode Unit No.2 ..... 0.003 max pF Pentode Plate to Plate of Diode Unit No.1 ..... 0.008 max ρF 0.008 max Pentode Plate to Plate of Diode Unit No.2 .....

except for heater ratings, as shown below.

#### Pentode Unit as Class A. Amplifier

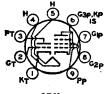
| MAXIMUM RATINGS (Design-Maximum Values):              |           |         |
|-------------------------------------------------------|-----------|---------|
| Plate Voltage                                         | 330 max   | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                | 330 max   | volts   |
| Grid-No.2 Voltage                                     | See curve | page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max     | volts   |
| Plate Dissipation                                     | 4 max     | watts   |
| Grid-No.2 Input:                                      |           |         |
| For voltages up to 165 volts                          | 1.1 max   | watts   |
| For voltages between 165 and 330 volts                | See curve | page 80 |

<sup>•</sup> The dc component must not exceed 100 volts.

| CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode-Bias Resistor Transconductance Plate Resistance (Approx.) Plate Current Grid-No.2 Current Grid-No.1 Voltage for plate current of 100 uA | 50<br>100<br>0<br><br><br>55*<br>18* | 200<br>100<br>0<br>82<br>20000<br>50000<br>17<br>3.5<br>5 | volts volts volts ohms  µmhos ohms  mA  mA |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------------------------------|--------------------------------------------|
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation  * This value can be measured by a method involving a maximum ratings of the tube will not be exceeded.                |                                      | 0.25 max<br>1 max                                         | megohm<br>megohm                           |

#### Diode Units (Each Unit)

| CHARACTERISTICS, In     | istantaneous  | Value:  |    |       |
|-------------------------|---------------|---------|----|-------|
| Tube Voltage Drop for I | plate current | of 2 mA | 10 | volts |



### HIGH-MU TRIODE-SHARP-CUTOFF PENTODE

Gp Miniature type with frame-grid pentode unit used in black-and-white television receivers. The triode unit is used in general-purpose voltage-amplifier, sync-separator, and sound-if-

6KV8 Related type: 11KV8

9DX

amplifier applications. The pentode

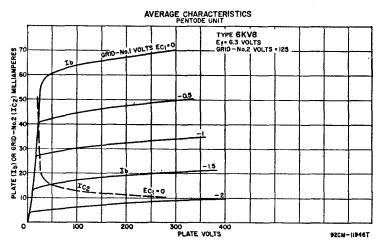
unit is used as a video output tube. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For curves of average plate characteristics for triode unit, refer to type 6AW8A. Type 11KV8 is identical with type 6KV8 except for the heater ratings, as shown below.

|                                                      | OK V 8    | 111.00    |         |
|------------------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                               | 6.3       | 10.9      | volts   |
| Heater Current                                       | 0.775     | 0.45      | ampere  |
| Heater Warm-up Time (Average)                        | -         | 11        | seconds |
| Peak Heater-Cathode Voltage:                         |           |           |         |
| Heater negative with respect to cathode              | 200 max   | 200 max   | volts   |
| Heater positive with respect to cathode              | 200 = max | 200=max   | volts   |
| Direct Interelectrode Capacitances (Approx.):        |           |           |         |
| Triode Unit:                                         |           |           |         |
| Grid to Plate                                        |           | 3.7       | pF      |
| Grid to Cathode, Heater, Pentode Cathode, Pentode G  | rid No.3, |           |         |
| and Internal Shield                                  |           | 2.5       | pF      |
| Plate to Cathode, Heater, Pentode Cathode, Pentode G | rid No.3, |           |         |
| and Internal Shield                                  |           | 2.4       | рF      |
| Triode Grid to Pentode Plate                         |           | 0.015 max |         |
| Pentode Unit:                                        |           |           |         |
| Grid No.1 to Plate                                   |           | 0.12 max  | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3   |           |           |         |
| Internal Shield                                      |           | 13        | pF      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, an   |           |           |         |
| Internal Shield                                      |           | 4.8       | pF      |
| Pentode Plate to Triode Plate                        |           | 0.17 max  | pF      |
| • The dc component must not exceed 100 volts.        |           |           |         |

#### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              | Triode Unit | Pentode Unit      |
|-------------------------------------------------------|-------------|-------------------|
| Plate Voltage                                         | 300 max     | 300 max volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                |             | 300 max volts     |
| Grid-No.2 Voltage                                     | -           | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max       | 0 max volts       |
| Plate Dissipation                                     | 1 max       | 5 max watts       |

|                                                                                                                                                                                                                                                                        | Triode Unit                                      | Pento                                                             | de Unit                                                           |                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------|
| Grid-No.2 Input:  For grid-No.2 voltages up to 150 volts  For grid-No.2 voltages between 150 and 300 volts                                                                                                                                                             | =                                                |                                                                   | 1 max<br>See curve                                                | watt<br>page 80                                                       |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Supply Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 100 µA | 200<br>2<br>7<br>70<br>17500<br>4000<br>4<br>4.5 | 125<br>125<br>0<br>82<br><br>55000<br>21000<br>16.5<br>3.1<br>4.2 | 200<br>125<br>0<br>68<br>-<br>75000<br>23000<br>20<br>3.5<br>-4.2 | volts<br>volts<br>volts<br>ohms<br>ohms<br>µmhos<br>mA<br>mA<br>volts |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation                                                                                                                                                              | 0.5 ma<br>1 ma                                   |                                                                   | 0.1 max<br>0.25 max                                               |                                                                       |



### HIGH-MU TRIODE— BEAM POWER TUBE

6KY8A 6KY8A Related types: 15KY8, 15KY8A Novar types used in combined vertical-deflection-oscillator and vertical-deflection-amplifier applications in black-and-white television receivers having low-voltage "B" supplies. Outlines 11C and 30A, respectively, Out-



9QT

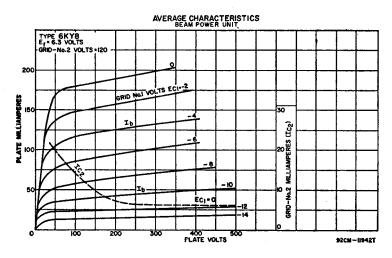
lines section. Tubes require novar nine-contact socket and may be mounted in any position. Types 15KY8 and 15KY8A are identical with types 6KY8 and 6KY8A, except for heater ratings, as shown below.

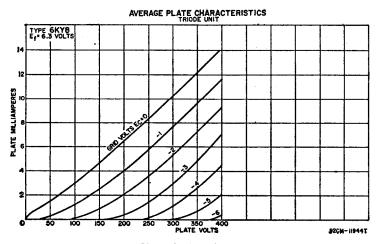
|                                                                                                                | 6KY8A              | 15KY8A             |                |
|----------------------------------------------------------------------------------------------------------------|--------------------|--------------------|----------------|
| Heater Voltage (ac/dc)                                                                                         | 6.3                | 15                 | volts          |
| Heater Current                                                                                                 | 1.1                | 0.45               | amperes        |
| Heater Warm-up Time (Average)                                                                                  |                    | 11                 | seconds        |
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode | 200 max<br>200•max | 200 max<br>200•max | volts<br>volts |

| Direct | Interelectrode | Capacitances | (Approx.): |
|--------|----------------|--------------|------------|
|        |                |              |            |

| Triode Unit:                                           |       |    |
|--------------------------------------------------------|-------|----|
| Grid to Plate                                          | 0.44  | pF |
| Grid to Cathode and Heater                             | 15    | pF |
| Plate to Cathode and Heater                            | 7     | ρF |
| Pentode Unit:                                          |       | •  |
| Grid No.1 to Plate                                     | 0.048 | pF |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 2.6   | pF |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 0.28  | pF |

<sup>•</sup> The dc component must not exceed 100 volts.





### Class A<sub>1</sub> Amplifier

| CHARACTERISTICS:                 | Triode Unit | Bean | 1 Power | Unit |       |
|----------------------------------|-------------|------|---------|------|-------|
| Plate Voltage                    | 250         | 50   | 135     | 120  | volts |
| Grid-No.2 (Screen-Grid) Voltage  | -           | 120  | 120     | •    | volts |
| Grid-No.1 (Control-Grid) Voltage | -3          | 0    | -10     | -10  | volts |
| Amplification Factor             | 64          | _    |         | 7    |       |

| Plate Resistance (Approx.)                    | 40000 |      | 18000 | _ | ohms       |
|-----------------------------------------------|-------|------|-------|---|------------|
| Transconductance                              | 1600  |      | 8400  | _ | $\mu$ mhos |
| Plate Current                                 | 1.4   | 170• | 39    | _ | m <b>A</b> |
| Grid-No.2 Current                             |       | 20•  | 3     | _ | mA         |
| Grid-No.1 Voltage (Approx.) for plate current |       |      |       |   |            |
| of 1 mA                                       |       | _    | -24   |   | volts      |

\* Triode connection, grid No.2 connected to plate at socket.

#### Vertical-Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

| Triode<br>Unit | Beam Power<br>Unit                       |                                                   |
|----------------|------------------------------------------|---------------------------------------------------|
| Oscillator     | Amplifier                                |                                                   |
| 330 max        | 300 max                                  | volts                                             |
|                |                                          |                                                   |
| -              | 2200†max                                 | volts                                             |
| _              | 150 max                                  | volts                                             |
| -400 max       | -250 max                                 | volts                                             |
| 77 max         | 200 max                                  | mA                                                |
| 22 max         | 60 max                                   | mA                                                |
| 1.5 max        | 12 max                                   | watts                                             |
| _              | 1.9 max                                  | watts                                             |
|                | Oscillator 330 max 400 max 77 max 22 max | Unit Oscillator Amplifier 330 max 300 max 300 max |

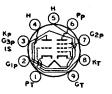
#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

6KZ8
Related type:
9KZ8

Miniature type used as combined oscillator and mixer in vhf television
receivers employing series-connected
heater strings. Outline 6B, Outlines
section. Tube requires miniature ninecontact socket and may be mounted



9FZ

in any position. Type 9KZ8 is identical with type 6KZ8 except for the heater ratings, as shown below.

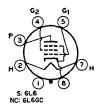
|                                                     | 6KZ8    | 9KZ8     |         |
|-----------------------------------------------------|---------|----------|---------|
| Heater Voltage (ac/dc)                              | 6.3     | 9.45     | volts   |
| Heater Current                                      | 0.45    | 0.3      | ampere  |
| Heater Warm-up Time (Average)                       | 11      | 11       | seconds |
| Peak Heater-Cathode Voltage:                        |         |          |         |
| Heater negative with respect to cathode             | 200 max | 200 max  | volts   |
| Heater positive with respect to cathode             | 200*max | 200*max  | volts   |
| Direct Interelectrode Capacitances: **              |         |          |         |
| Triode Unit:                                        |         |          | _       |
| Grid to Plate                                       |         | 1.6      | pF      |
| Grid to Triode Cathode, Pentode Cathode, Heater, P. |         |          | _       |
| No.3, and Heater                                    |         | 3.2      | pF      |
| Plate to Triode Cathode, Pentode Cathode, Heater, P |         |          |         |
| No.3, and Heater                                    |         | 1.8      | pF      |
| Pentode Unit:                                       |         | 0.01 max | рF      |
| Grid No.1 to Plate                                  |         | U.UI max | pr.     |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, |         | 5.5      | pF      |
| Shield                                              |         | 3.3      | pı      |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, a   |         | 3.4      | pF      |
| Shield Heater to Cathode (Each Unit)                |         | 3.2#     | pF      |
| Heater to Cathode (Each Out)                        |         |          | γ-      |
|                                                     |         |          |         |

<sup>•</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

- \* The dc component must not exceed 100 volts.
- \*\* With external shield connected to cathode.
- # With external shield connected to ground.

#### Class A<sub>1</sub> Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Pentode Unit      |
|--------------------------------------------------------|-------------|-------------------|
| Plate Voltage                                          | 330 max     | 330 max volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                 |             | 330 max volts     |
| Grid-No.2 Voltage                                      | _           | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value  | 0 max       | 0 max volts       |
| Plate Dissipation                                      | 2.5 max     | 2.5 max watts     |
| Grid-No.2 Input:                                       |             |                   |
| For grid-No.2 voltages up to 165 volts                 |             | 0.55 max watt     |
| For grid-No.2 voltages between 165 and 330 volts       |             | See curve page 80 |
| CHARACTERISTICS:                                       |             |                   |
| Plate Voltage                                          | 125         | 125 volts         |
| Grid-No.2 Voltage                                      |             | 125 volts         |
| Grid-No.1 Voltage                                      | -1          | -1 volt           |
| Amplification Factor                                   | 46          |                   |
| Plate Resistance (Approx.)                             | 5400        | 200000 ohms       |
| Transconductance                                       | 8500        | 7500 µmhos        |
| Plate Current                                          | 13.5        | 12 mA             |
| Grid-No.2 Current                                      |             | 4 mA              |
| Grid-No.1 Voltage (Approx.) for plate current of 10 µA | 8           | -8 volts          |
| MAXIMUM CIRCUIT VALUES:                                |             |                   |
| Grid-No.1-Circuit Resistance:                          |             |                   |
|                                                        | 0.05        | 0.05              |
| For fixed-bias operation                               | 0.25 max    | 0.25 max megohm   |
| For cathode-bias operation                             | 0.5 max     | 0.5 max megohm    |



### **BEAM POWER TUBE**

Metal type 6L6 and glass octal type 6L6GC are used in the output stage of audio amplifying equipment, especially units designed to have ample reserve of power-delivering ability. These types provide high power output, sen-

6L6 6L6GC

7AC

sitivity, and high efficiency. Power output at all levels has low third- and higherorder harmonics. Type 6L6, Outline 4, type 6L6GC, Outline 19D; Outlines section. Tubes require an octal socket and may be mounted in any position. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. Type 6L6GC can be used in place of type 6L6 and may be supplied with pin 1 omitted.

| Heater Voltage (ac/dc) Heater Current         |         | 6.3<br>0.9 | volts<br>ampere |
|-----------------------------------------------|---------|------------|-----------------|
| Peak Heater-Cathode Voltage:                  |         |            |                 |
| Heater negative with respect to cathode       | 180 max | 200 max    | volts           |
| Heater positive with respect to cathode       | 180 max | 200 max    | volts           |
| Direct Interelectrode Capacitances (Approx.): | 6L6*    | 6L6GC      |                 |
| Grid No.1 to Plate                            | 0.4     | 0.6        | рF              |
| Grid No.1 to Cathode, Heater, Grid No.2, and  |         |            | •               |
| Grid No.3                                     | 10      | 10         | pF              |
| Plate to Cathode, Heater, Grid No.2, and      |         |            | -               |
| Grid No.3                                     | 12      | 6.5        | pF              |
| * With nin 1 connected to nin 8               |         |            |                 |

#### Class A, Amplifier

|                                 | OLO           | OLOGC         |       |
|---------------------------------|---------------|---------------|-------|
|                                 | Design-Center | Design-Maximu | ım    |
| MAXIMUM RATINGS:                | Values        | Values        |       |
| Plate Voltage                   | 360 max       | 500 max       | volts |
| Grid-No.2 (Screen-Grid) Voltage | 270 max       | 450*max       | volts |
| Plate Dissipation               | 19 max        | 30 max        | watts |
| Grid-No.2 Input                 | 2.5 max       | 5 max         | watts |

| TYPICAL OPERATION:               |       |       |       |          |
|----------------------------------|-------|-------|-------|----------|
| Plate Voltage                    | 250   | 300   | 350   | volts    |
| Grid-No.2 Voltage                | 250   | 200   | 250   | volts    |
| Grid-No.1 (Control-Grid) Voltage | -14   | -12.5 | 18    | volts    |
| Peak AF Grid-No.1 Voltage        | 14    | 12.5  | 18    | volts    |
| Zero-Signal Plate Current        | 72    | 48    | 54    | mA       |
| Maximum-Signal Plate Current     | 79    | 55    | 66    | mA       |
| Zero-Signal Grid-No.2 Current    | 5     | 2.5   | 2.5   | mA       |
| Maximum-Signal Grid-No.2 Current | 7.3   | 4.7   | 7     | mA       |
| Plate Resistance (Approx.)       | 22500 | 35000 | 33000 | ohms     |
| Transconductance                 | 6000  | 5300  | 5200  | μmhos    |
| Load Resistance                  | 2500  | 4500  | 4200  | ohms     |
| Total Harmonic Distortion        | 10    | 11    | 15    | per cent |
| Maximum-Signal Power Output      | 6.5   | 6.5   | 10.8  | watts    |

In push-pull circuits where grid No.2 of each tube is connected to a tap on the plate winding of the output transformer, this maximum rating is 500 volts.

### Class A, Amplifier (Triode Connection)†

|                                 | 6L6           | 6L6GC     |          |
|---------------------------------|---------------|-----------|----------|
|                                 | Design-       | Design-   |          |
| MAXIMUM RATINGS:                | Center Values | Maximum V | /alues   |
| Plate Voltage                   | 275 max       | 450 ma    | x volts  |
| Plate Dissipation (Total)       | 19 max        | 30 ma     | x watts  |
| TYPICAL OPERATION:              |               |           |          |
| Plate Voltage                   |               | 250       | volts    |
| Grid-No.1 Voltage               |               | 20        | volts    |
| Peak AF Grid-No.1 Voltage       |               | 20        | volts    |
| Zero-Signal Plate Current       |               | 40        | mA       |
| Maximum-Signal Plate Current    |               | 44        | mA       |
| Plate Resistance (Approx.)      |               | 1700      | ohms     |
| Amplification Factor            |               | 8         |          |
| Transconductance                |               | 4700      | μmhos    |
| Load Resistance                 |               | 5000      | ohms     |
| Total Harmonic Distortion       |               | 5         | per cent |
| Maximum-Signal Power Output     |               | 1.4       | watts    |
| † Grid No.2 connected to plate. |               |           |          |

#### Push-Pull Class A, Amplifier

#### **MAXIMUM RATINGS:**

(Same as for Class A<sub>1</sub> Amplifier)

| TYPICAL OPERATION (Values are for two tubes): |      |      |          |
|-----------------------------------------------|------|------|----------|
| Plate Voltage                                 | 250  | 270  | volts    |
| Grid-No.2 Voltage                             | 250  | 270  | volts    |
| Grid-No.1 Voltage                             | —16  | 17.5 | volts    |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage        | 32   | 35   | voits    |
| Zero-Signal Plate Current                     | 120  | 134  | mA       |
| Maximum-Signal Plate Current                  | 140  | 155  | mA       |
| Zero-Signal Grid-No.2 Current                 | 10   | 11   | mA       |
| Maximum-Signal Grid-No.2 Current              | 16   | 17   | mA       |
| Effective Load Resistance (Plate-to-plate)    | 5000 | 5000 | ohms     |
| Total Harmonic Distortion                     | 2    | 2    | per cent |
| Maximum-Signal Power Output                   | 14.5 | 17.5 | watts    |

### Push-Pull Class AB, Amplifier

~ ~~

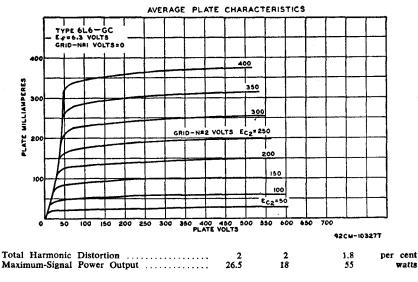
#### **MAXIMUM RATINGS:**

(Same as for Class A1 Amplifier)

| TYP | ICAL | OPE | RAI | ION |
|-----|------|-----|-----|-----|
|     | /T   |     | •   |     |

| (Values are for two tubes):                |       | 6L6  | 6L6GC |       |
|--------------------------------------------|-------|------|-------|-------|
| Plate Voltage                              | 360   | 360  | 450   | volts |
| Grid-No.2 Voltage                          | 270   | 270  | 400   | volts |
| Grid-No.1 Voltage                          | -22.5 | 22.5 | 37    | volts |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage     | 45    | 45   | 70    | volts |
| Zero-Signal Plate Current                  | 88    | 88   | 116   | mA    |
| Maximum-Signal Plate Current               | 132   | 140  | 210   | mA    |
| Zero-Signal Grid-No.2 Current              | 5     | 5    | 5.6   | mA    |
| Maximum-Signal Grid-No.2 Current           | 15    | 11   | 22    | mA    |
| Effective Load Resistance (Plate-to-plate) | 6600  | 3800 | 5600  | ohms  |

6LB8



#### Push-Pull Class AB, Amplifier

#### **MAXIMUM RATINGS:**

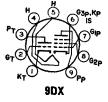
(Same as for Class A<sub>1</sub> Amplifier)

| (,                                            |      |       |          |
|-----------------------------------------------|------|-------|----------|
| TYPICAL OPERATION (Values are for two tubes): |      |       |          |
| Plate Voltage                                 | 360  | 360   | voits    |
| Grid-No.2 Voltage                             | 225  | 270   | volts    |
| Grid-No.1 Voltage                             | -18  | -22.5 | volts    |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage        | 52   | 72    | volts    |
| Zero-Signal Plate Current                     | 78   | . 88  | mA       |
| Maximum-Signal Plate Current                  | 142  | 205   | mA       |
| Zero-Signal Grid-No.2 Current                 | 3.5  | 5     | mA       |
| Maximum-Signal Grid-No.2 Current              | 11   | 16    | mA       |
| Effective Load Resistance (Plate-to-plate)    | 6000 | 3800  | ohms     |
| Total Harmonic Distortion                     | 2    | 2     | per cent |
| Maximum-Signal Power Output                   | 31   | 47    | watts    |
| MAVIMIM CIDCUIT WALTED.                       |      |       |          |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

For fixed-bias operation 0.1 max megohm
For cathode-bias operation 0.5 max megohm



### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Neonoval type with frame-grid pentode used in television receivers. Triode unit is used as a voltage amplifier; the pentode unit is used as a video amplifier. Outline 10A, Outlines section. Tube requires neonoval nine-

contact socket and may be mounted in any position.

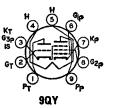
| Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage:              | 6.3<br>0.725       | volts<br>ampere |
|---------------------------------------------------------------------------------|--------------------|-----------------|
| Heater negative with respect to cathode Heater positive with respect to cathode | 200 max<br>200•max | volts<br>volts  |

| Direct Interelectrode Capacitances:                                |              |                |             |            |
|--------------------------------------------------------------------|--------------|----------------|-------------|------------|
| Triode Unit: Grid to Plate Grid to Triode Cathode, Pentode Cathode |              | Pantoda        | 2.8         | pF         |
| Grid No.3, and Internal Shield                                     |              |                | 1.9         | pF         |
| Grid No.3, and Internal Shield Pentode Unit:                       |              |                | 1.8         | pF         |
| Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2,        | Grid N       | o.3. and       | 0.1 max     | pF         |
| Internal Shield                                                    | d No.3.      | and            | 12          | pF         |
| Internal Shield                                                    | <del>.</del> |                | 3           | pF         |
| Triode Grid to Pentode Plate                                       |              |                | 0.02 max    | pF         |
| Pentode Grid No.1 to Triode Plate                                  |              |                | 0.004 max   | ρF         |
| Pentode Plate to Triode Plate                                      |              |                | 0.13 max    | pΨ         |
| • The dc component must not exceed 100 volts.                      |              |                | orro man    | P.         |
| Class A, J                                                         | Amplifie     | r              |             |            |
| MAXIMUM RATINGS (Design-Maximum Val                                | 1100).       | Triode Unit    | Pentode Un  | 14         |
| Plate Voltage                                                      |              | 330 max        | 330 max     |            |
| Grid No 2 (Screen Grid) Sunnly Voltage                             |              | 330 Illan      |             | volts      |
| Grid-No.2 (Screen-Grid) Supply Voltage                             | • • • • • •  | _              | 330 max     | volts      |
| Grid-No.2 Voltage                                                  |              | _              |             | ve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias                    | value        | 0 max          | 0 max       | volts      |
| Plate Dissipation Grid-No.2 Input:                                 |              | 2 max          | 4 max       | watts      |
| For grid-No.2 voltages up to 165 volts                             |              | _              | 1.1 max     | watts      |
| For grid-No.2 voltages between 165 and 330                         | volts .      | _              | See cur     | ve page 80 |
| CHARACTERISTICS:                                                   |              |                |             |            |
| Plate Supply Voltage                                               | 125          | 50             | 200         |            |
| Grid-No.2 Supply Voltage                                           | 123          |                |             | volts      |
| Grid-No.1 Voltage                                                  | _            | 100            | 100         | volts      |
|                                                                    | •            | 0              | 0           | volts      |
| Cathode-Bias Resistor                                              | 68           |                | 82          | ohms       |
| Amplification Factor                                               | 30           |                | <del></del> |            |
| Plate Resistance (Approx.)                                         | 6000         |                | 50000       | ohms       |
| Transconductance                                                   | 5000         | <b>-</b>       | 20000       | $\mu$ mhos |
| Plate Current                                                      | 13           | 55*            | 17          | mA         |
| Grid-No.2 Current                                                  | _            | 18*            | 3.5         | mA         |
| Grid-No.1 Voltage (Approx.) for plate current                      |              |                |             |            |
| of 20 μA                                                           | 10           |                |             | volts      |
| Grid-No.1 Voltage (Approx.) for plate current                      |              |                |             |            |
| of 100 μA                                                          | -            | _              | <b>-5</b>   | volts      |
| MAXIMUM CIRCUIT VALUES:                                            |              |                |             |            |
| Grid-No.1 Circuit Resistance:                                      |              |                |             |            |
| For fixed-bias operation                                           |              | 0.5 max        | 0.25 max    | megohm     |
| For cathode-bias operation                                         |              | 1 max          | 1 max       | megohm     |
| * This value can be measured by a method in                        |              |                |             | -          |
| maximum ratings of the tube will not be exceed                     | ed.          | a recurrent wa | vetorm such | mat the    |

### HIGH-MU TRIODE— SHARP-CUTOFF PENTODE

6LC8
Related type:
8LC8

Miniature type used in color and black-and-white television receivers. Pentode unit is used in noise-immune gated-agc-amplifier circuits, and the triode unit in sync-separator circuits. Outline 6E, Outlines section. Tube



requires miniature nine-contact socket and may be mounted in any position. Type 8LC8 is identical with type 6LC8 except for heater ratings, as shown below. For curves of average plate characteristics, refer to type 6KA8.

|                               | 6LC8 | 8LC8 |         |
|-------------------------------|------|------|---------|
| Heater Voltage (ac/dc)        | 6.3  | 8.4  | volts   |
| Heater Current                | 0.6  | 0.45 | ampere  |
| Heater Warm-up Time (Average) | 11   | 11   | seconds |

| ileater negative with respect to eathere it.                                 | 200 max<br>200•max | 200 max<br>200•max | volts      |
|------------------------------------------------------------------------------|--------------------|--------------------|------------|
| Heater positive with respect to cathode  Direct Interelectrode Capacitances: | 200-max            | 200 - IIIax        | VOILE      |
|                                                                              |                    |                    |            |
| Triode Unit:                                                                 |                    |                    | _          |
| Grid to Plate                                                                |                    | 2.2                | pF         |
| Grid to Cathode, Heater, Pentode Grid No.3, and Interna                      | l Shield           | 2.8                | pF         |
| Plate to Cathode, Heater, Pentode Grid No.3, and Interna                     | l Shield           | 2.2                | рF         |
| Pentode Unit:                                                                |                    |                    | _          |
| Grid No.1 to Plate                                                           |                    | 0.10 max           | pF         |
| Grid No.1 to Cathode, Heater, Grid No.3, Triode Catho                        | de, and            |                    |            |
| Internal Shield                                                              |                    | 10                 | pF         |
| Grid No.3. Triode Cathode, and Internal Shield to Plate                      |                    | 3.4                | p <b>F</b> |
| Grid No.1 to Grid No.3, Triode Cathode, and Internal Shie                    |                    | 0.36               | pF         |
| Grid No.3, Triode Cathode, and Internal Shield to Plate, C                   |                    |                    |            |
| Heater, Grid No.1, and Grid No.2                                             |                    | 12.5               | рF         |
| The dc component must not exceed 100 volts.                                  |                    |                    |            |

| Class A, Amplifie                                        | Г      |               |     |            |
|----------------------------------------------------------|--------|---------------|-----|------------|
| MAXIMUM RATINGS (Design-Maximum Values):                 |        | Triode Unit   |     |            |
| Plate Voltage                                            |        | 300           | max | volts      |
| Grid Voltage:                                            |        |               |     |            |
| Positive-bias value                                      |        | 0             | max | volts      |
| Negative-bias value                                      |        | 50            | max | volts      |
| Plate Dissipation                                        |        | 1.1           | max | watts      |
|                                                          | Triode | Pento         | je  |            |
| CHARACTERISTICS:                                         | Unit   | Unit          |     |            |
| Plate Supply Voltage                                     | 200    | 150           |     | volts      |
| Grid-No.2 Supply Voltage                                 | -      | 100           |     | volts      |
| Grid-No.1 Voltage                                        | -2     | _             |     | volts      |
| Cathode-Bias Resistor                                    | -      | 180           |     | ohms       |
| Amplification Factor                                     | 70     | —             |     |            |
| Plate Resistance (Approx.)                               | 17500  | <b>100000</b> |     | ohms       |
| Transconductance, Grid No.1 to Plate                     | 4000   | 4400          |     | $\mu$ mhos |
| Transconductance, Grid No.3 to Plate                     | _      | <b>6</b> 00   |     | μmhos      |
| Plate Current                                            | 4      | 4             |     | mA.        |
| Grid-No.2 Current                                        | -      | 2.8           |     | mA         |
| Grid-No.1 Voltage (Approx.):                             |        |               |     |            |
| For plate current of 10 $\mu$ A                          | 5      | _             |     | volts      |
| For plate current of 20 $\mu$ A                          |        | 4             |     | volts      |
| Grid-No.3 Voltage (Approx.) for plate current of 20 μA   | -      | <b>←</b> 7    | •   | volts      |
| MAXIMUM CIRCUIT VALUES:                                  |        |               |     |            |
| Grid-Circuit Resistance:                                 |        | Triode Unit   |     |            |
| For fixed-bias operation                                 |        | 0.25          | max | megohm     |
| For cathode-bias operation                               |        | 1             | max | megohm     |
| * With no external connection to triode plate and triode | grid.  |               |     |            |

### **Gated AGC Amplifier and Noise Inverter**

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage | Pentode Unit<br>300 max | volts   |
|-----------------------------------------------------------|-------------------------|---------|
| Peak Positive-Pulse Plate Voltage                         | 600 max                 | volts   |
| Grid-No.3 (Control-Grid) Voltage:                         |                         |         |
| Positive-bias value                                       | 0 max                   | volts   |
| Negative-bias value                                       | 100 max                 | volts   |
| Grid-No.2 (Screen-Grid) Supply Voltage                    | 300 max                 | volts   |
| Grid-No.2 Voltage                                         | See curve page 80       |         |
| Grid-No.1 (Control-Grid) Voltage:                         |                         |         |
| Positive-bias value                                       | 0 max                   | volts   |
| Negative-bias value                                       | -50 max                 | volts   |
| Plate Dissipation                                         | 2 max                   | watts   |
| Grid-No.2 Input:                                          |                         |         |
| For grid-No.2 voltages up to 150 volts                    | 1.1 max                 | watts   |
| For grid-No.2 voltages between 150 and 300 volts          | See curve p             | page 80 |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

For fixed-bias operation ... 0.5 max megohm For cathode-bias operation ..... 1 max megohm

The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

#### TWIN PENTODE

# 6LE8

Miniature type used as combined color demodulator and matrix amplifier in color television receivers utiliz- 63p ing high-level demodulation systems. Outline 6G, Outlines section Tube requires miniature nine-contact socket and may be mounted in any position.



| Heater Voltage (ac/dc)                         | 6.3     | volts      |
|------------------------------------------------|---------|------------|
| Heater Current                                 | 0.76    | ampere     |
| Peak Heater-Cathode Voltage:                   |         |            |
| Heater negative with respect to cathode        | 300 max | volts      |
| Heater positive with respect to cathode        | 200*max | volts      |
| Direct Interelectrode Capacitance (Approx.):   |         |            |
| Plate (Each Unit) to All Other Electrodes      | 3.7     | p <b>F</b> |
| Grid No.1 to All Other Electrodes              | 15.5    | pF         |
| Grid No.3 (Each Unit) to All Other Electrodes  | 6       | pF         |
| Grid No.3 to Plate (Each Unit)                 | 2.7     | рF         |
| Grid No.3 (Unit No.1) to Grid No.3 (Unit No.2) | 0.1     | p₽         |
|                                                |         |            |

<sup>\*</sup> The dc component must not exceed 100 volts.

### Class A<sub>1</sub> Amplifier

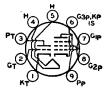
| MAXIMUM RATINGS (Design-Maximum Values):              |         |       |
|-------------------------------------------------------|---------|-------|
| Plate Voltage (Each Unit)                             | 300 max | volts |
| Grid-No.2 (Screen-Grid) Voltage                       | 150 max | volts |
| Plate Dissipation (Each Unit)                         | 2 max   | watts |
| Grid-No.2 Input                                       | 2 max   | watts |
| CHARACTERISTICS (Each Unit):                          |         |       |
| Plate Voltage                                         | 100     | volts |
| Grid-No.3 (Suppressor-Grid) Voltage                   | 0       | voits |
| Grid-No.2 Voltage                                     | 100     | volts |
| Grid-No.1 (Control-Grid) Voltage, Negative-bias value | -2.5    | volts |
| Transconductance (Approx.):                           |         |       |
| Grid-No.1 to Plate                                    | 5800    | μmhos |
| Grid-No.3 to Plate                                    | 350     | μmhos |
| Plate Resistance (Approx.)                            | 50000   | ohms  |
| Plate Current                                         | 7.6     | mA    |
| Grid-No.2 Current                                     | 14.5    | mA    |
| Grid-No.1 Voltage for plate current of 20 µA          | 7.2     | volts |
| Grid-No.1 Voltage for plate current of 100 µA         | -6.3    | volts |
| Grid-No.3 Voltage for plate current of 20 µA          | -17.5** | volts |
| Grid-No.3 Voltage for place current of 100 µA         | -16.5** | volts |

<sup>\*\*</sup> For this test, a grid-No.1 voltage of -3 volts is used to keep the grid-No.2 input within tube ratings.

### HIGH-MU TRIODE-SHARP-CUTOFF PENTODE

6LF8

Miniature type used in video-amplifier stages of color-television receivers and in other applications where operation of a triode in the positive-grid region c is desirable. Outline 6E, Outlines section. Tube requires miniature nine-



9DX

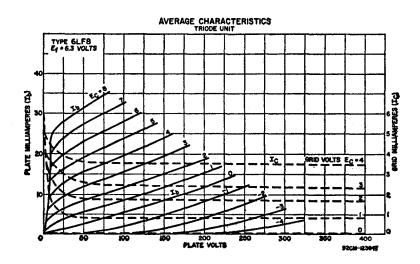
contact socket and may be mounted in any position.

| Heater Voltage (ac/dc)                                         | 6.3       | volts      |
|----------------------------------------------------------------|-----------|------------|
| Heater Current                                                 | 0.6       | ampere     |
| Heater Warm-up Time (Average)                                  | 11        | seconds    |
| Peak Heater-Cathode Voltage:                                   |           | 2000       |
| Heater negative with respect to cathode                        | 200 max   | volts      |
| Heater positive with respect to cathode                        | 200 max   | volts      |
| Direct Interelectrode Capacitances:                            | 200 11.00 | 70113      |
| Triode Unit:                                                   |           |            |
| Grid to Plate                                                  | 2.2       | pF         |
| Grid to Cathode, Heater, Pentode Cathode, Pentode Grid No.3,   | 2.2       | pr         |
| and Internal Shield                                            | 3.2       | -10        |
|                                                                | 3.2       | pF         |
| Plate to Cathode, Heater, Pentode Cathode, Pentode Grid. No.3, | 4.0       | 173        |
| and Internal Shield                                            | 1.8       | pF         |
| Pentode Unit:                                                  |           |            |
| Grid No.1 to Plate                                             | 0.06 max  | рF         |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and        |           |            |
| Internal Shield                                                | 10        | pF         |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and            |           | -          |
| Internal Shield                                                | 3.6       | pF         |
| Pentode Grid No.1 to Triode Plate                              | 0.008 max | pF         |
| Pentode Plate to Triode Plate                                  | 0.15 max  | pF         |
| The de component must not exceed 100 volta                     |           | <b>P</b> ~ |

<sup>•</sup>The dc component must not exceed 100 volts.

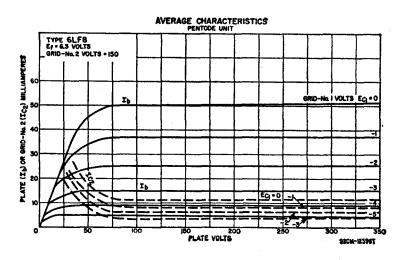
### Class A Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage | Triode Unit | Pentode Unit<br>330 max | volts   |
|--------------------------------------------------------|-------------|-------------------------|---------|
| Grid-No.2 (Screen-Grid) Supply Voltage                 | 330 max     | 330 max                 | volts   |
| Grid-No.2 Voltage                                      | _           | See curve               |         |
| Grid-No.1 (Control-Grid) Voltage:                      |             |                         | P46-00  |
| Positive-bias value                                    | 4 max       | 0 max                   | volts   |
| Negative-bias value                                    | -55 max     | —55 max                 | volts   |
| Plate Dissipation                                      | 1.1 max     | 3.75, max               | watts   |
| Grid-No.2 Input:                                       |             |                         |         |
| For grid-No.2 voltages up to 165 volts                 | _           | 1.1 max                 | watts   |
| For grid-No.2 voltages between 165 and 330 volts       | _           | See curve               | page 80 |
| Grid-No.1 Current                                      | 8 max       | 0 max                   | mA      |
| CHARACTERISTICS:                                       |             |                         |         |
| Plate Voltage                                          | 200 40      | 75 100                  | volts   |
| Grid-No.2 Voltage                                      |             | 150 150                 | volts   |
| Grid-No.1 Voltage                                      | -2 3        | 0 —2.5                  | volts   |



| Amplification Factor                                        | 70    | 40    |      | _      |        |
|-------------------------------------------------------------|-------|-------|------|--------|--------|
| Plate Resistance (Approx.)                                  | 17500 | 10000 | _    | 200000 | ohms   |
| Transconductance                                            | 4000  | 4000  | _    | 11000  | μmhos  |
| Plate Current                                               | 4     | 11    | 50=  | 20     | mA     |
| Grid-No.2 Current                                           |       |       | 12=  | 5      | mA     |
| Grid-No.1 Current                                           | 0     | 2.7   | 0    | 0      | mA     |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A | 5     | _     |      | 8      | volts  |
| MAXIMUM CIRCUIT VALUES:                                     |       |       |      |        |        |
| Grid-No.1-Circuit Resistance:                               |       |       |      |        |        |
| For fixed-bias operation                                    | 0.5   | max   | 0.2  | 5 max  | megohm |
| For cathode-bias operation                                  | 1     | max   | ٠.ــ |        | megohm |

<sup>•</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.



### MEDIUM-MU TRIODE— SEMIREMOTE-CUTOFF PENTODE

## **6LM8**

Miniature type used in a wide variety of circuit applications in color and black-and-white television receivers.

The pentode unit is used in burst-amplifier circuits, and the triode unit as a general-purpose amplifier tube.



Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

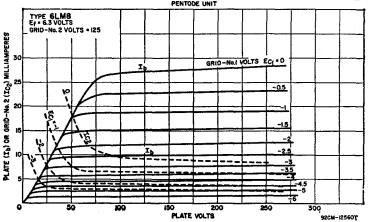
| Heater Voltage (ac/dc)                                        | 6.3       | volts  |
|---------------------------------------------------------------|-----------|--------|
| Heater Current                                                | 0.45      | ampere |
| Peak Heater-Cathode Voltage:                                  |           |        |
| Heater negative with respect to cathode                       | 200 max   | volts  |
| Heater positive with respect to cathode                       | 200 • max | voits  |
| Direct Interelectrode Capacitances:                           |           |        |
| Triode Unit:                                                  |           |        |
| Grid to Plate                                                 | 1.8       | рF     |
| Grid to Cathode, Heater, Pentode Cathode, Pentode Grid No.3,  |           |        |
| and Internal Shield                                           | 3.2       | рF     |
| Plate to Cathode, Heater, Pentode Cathode, Pentode Grid No.3, |           | _      |
| and Internal Shield                                           | 1.9       | pF     |
|                                                               |           | _      |

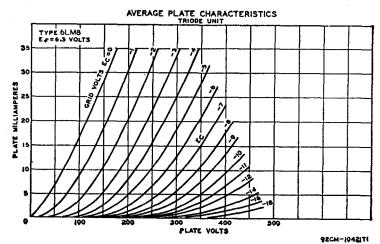
| Pentode Unit: Grid No.1 to Plate                                             | 0.015 max | pF |
|------------------------------------------------------------------------------|-----------|----|
| Internal Shield Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal | 5.5       | pF |
| Shield                                                                       | 3.8       | pF |
| Heater to Cathode (Each Unit)                                                | 3.2       | рF |
| • The dc component must not exceed 100 volts.                                |           |    |

#### Class A. Amplifier

| Olass A <sub>1</sub> Ampilion                         |             |                   |
|-------------------------------------------------------|-------------|-------------------|
| MAXIMUM RATINGS (Design-Maximum Values):              | Triode Unit | Pentode Unit      |
| Plate Voltage                                         | 330 max     | 350 max volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                | _           | 330 max volts     |
| Grid-No.2 Voltage                                     |             | See curve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max       | 0 max volts       |
| Plate Dissipation                                     | 2.5 max     | 2.5 max volts     |
| Grid-No.2 Input:                                      |             |                   |
| For grid-No.2 voltages up to 165 volts                |             | 0.55 max watts    |
| For grid-No.2 voltages between 165 and 330 volts      | 400         | See curve page 80 |

#### AVERAGE CHARACTERISTICS PENTODE UNIT



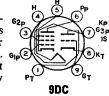


| CHARACTERISTICS:                                            |         |         |          |
|-------------------------------------------------------------|---------|---------|----------|
| Plate Voltage                                               | 125     | 125     | volts    |
| Grid-No.2 Voltage                                           | _       | 125     | volts    |
| Grid-No.1 Voltage                                           | -1      | -2      | volts    |
| Amplification Factor                                        | 46      | _       |          |
| Plate Resistance (Approx.)                                  | 5400    | 150000  | ohms     |
| Transconductance                                            | 8500    | 6000    | μmhos    |
| Plate Current                                               | 13.5    | 12      | mA.      |
| Grid-No.2 Current                                           | _       | 4       | mA       |
| Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A | 8       | -14     | volts    |
| MAXIMUM CIRCUIT VALUES:                                     |         |         |          |
| Grid-No.1-Circuit Resistance:                               |         |         |          |
| For fixed-bias operation                                    | 0.5 max | 0.25 ma | x megohm |
| For cathode-bias operation                                  | 1 max   | 0.5 ma  | x megohm |
|                                                             |         |         |          |

### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

## 6LN8

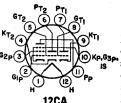
Miniature type used in frequency-changer service in television receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.



| Heater Current                          | 6.0<br>0.45 | volts<br>ampere |
|-----------------------------------------|-------------|-----------------|
| Peak Heater-Cathode Voltage:            | 0           |                 |
| Heater negative with respect to cathode | 100 max     | volts           |
| Heater positive with respect to cathode | 100 max     | volts           |

### Class A. Amplifier

| Oldas VI Vinhilloi                            |             |            |              |
|-----------------------------------------------|-------------|------------|--------------|
| MAXIMUM RATINGS (Design-Center Values):       | Triode Unit | Pentode Un | it           |
| Plate Supply Voltage                          | 550 max     | 550 max    | volts        |
| Plate Voltage                                 | 250 max     | 250 max    | volts        |
| Grid-No.2 (Screen-Grid) Supply Voltage        | _           | 550 max    | volts        |
| Grid-No.2 Voltage:                            |             |            |              |
| With cathode current of 14 mA                 | _           | 175 max    | volts        |
| With cathode current less than 10 mA          | 14 max      | 14 max     | mA           |
| Cathode Current                               |             | 200 max    | volts        |
| Grid-No.2 Input:                              |             | 0.5 max    | watt         |
| With plate dissipation greater than 1.2 watts |             |            |              |
| With plate dissipation less than 1.2 watts    | _           | 0.75 max   | watt         |
| Plate Dissipation                             | 1.5 max     | 1.7 max    | watts        |
| CHARACTERISTICS:                              |             |            |              |
| Plate Voltage                                 | 100         | 170        | volts        |
| Grid-No.2 Voltage                             |             | 170        | volts        |
| Grid-No.1 Voltage                             | -2          | -2         | volts        |
| Amplification Factor                          | 20          | _          | , 0.00       |
| Mu-Factor, Grid No.2 to Grid No.1             | _           | 47         |              |
| Plate Resistance (Approx.)                    | _           | 0.4        | megohm       |
| Transconductance                              | 5000        | 6200       | μmhos        |
| Plate Current                                 | 14          | 10         | mA           |
| Grid-No.2 Current                             |             | 2.8        | mA           |
| Input Resistance at frequency of 50 Mc/s      | _           | 0.01       | megohm       |
| Equivalent Noise Resistance                   | _           | 1500       | ohms         |
| MAXIMUM CIRCUIT VALUES:                       |             |            |              |
| Grid-No.1-Circuit Resistance:                 |             |            |              |
| For fixed-bias operation                      | 0.5 max     | 0.5 max    | megohm       |
| For cathode-bias operation                    | 0.5 max     | 1 max      | megohm       |
| ror camoue-oras operation                     | VIJ IIIAA   | 2 11140    | Transporting |



### HIGH-MU TWIN TRIODE— SHARP-CUTOFF PENTODE

Duodecar type used in television receivers. The triode units are used in sync-separator and agc-amplifier circuits; the pentode unit is used in ifamplifier circuits. Outline 8B, Outlines section. Tube requires duodecar

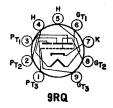
6M11

| twelve-contact socket and may be mounted in any position.       |         |        |
|-----------------------------------------------------------------|---------|--------|
| Heater Voltage (ac/dc)                                          | 6.3     | volts  |
| Heater Current                                                  | 0.77    | ampere |
| Peak-Heater-Cathode Voltage:                                    |         |        |
| Heater negative with respect to cathode                         | 200 max | volts  |
| Heater positive with respect to cathode                         | 200*max | volts  |
| Direct Interelectrode Capacitances:**                           |         |        |
| Triode Units:                                                   |         |        |
| Grid to Plate                                                   | 1.8     | рF     |
| Grid to Triode Cathode, Pentode Cathode, Heater, Pentode        |         |        |
| Grid No.3, and Iuternal Shield                                  | 3.4     | pF     |
| Plate to Triode Cathode, Pentode Cathode, Heater, Pentode       |         |        |
| Grid No.3, and Iuternal Shield                                  | 0.8     | рF     |
| Pentode:                                                        |         |        |
| Grid No.1 to Plate                                              | 0.03    | pF     |
| Grid No.1 to Cathode, Grid No.2, Grid No.3, and Internal Shield | 12      | рF     |
| Plate to Cathode, Grid No.2, Grid No.3, and Internal Shield     | 2.8     | рF     |

<sup>\*</sup> The dc component must not exceed 100 volts.

#### Class A<sub>1</sub> Amplifier

|                                                        | Each        | Pentode  |               |
|--------------------------------------------------------|-------------|----------|---------------|
| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Unit     |               |
| Plate Voltage                                          | 330 max     | 330 max  | volts         |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | _           | 330 max  | voits         |
| Grid-No.2 Voltage                                      |             | See curv | e page 80     |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value. | 0 max       | 0 max    | volts         |
| Plate Dissipation                                      | 2.25 max    | 3.1 max  | watts         |
| Grid-No.2 Input:                                       |             |          |               |
| For voltages up to 165 volts                           | _           | 0.65 max | watts         |
| For voltages between 165 and 330 volts                 |             | See curv | e page 80     |
| CHARACTERISTICS:                                       |             |          |               |
| Plate Supply Voltage                                   | 125         | 125      | volts         |
| Grid-No.2 Supply Voltage                               | -           | 125      | volts         |
| Cathode-Bias Resistor                                  | 125         | 56       | ohms          |
|                                                        | 58          | 30       | Olilis        |
| Amplification Factor                                   | 7250        | 200000   | ohms          |
| Plate Resistance (Approx.)                             | 8000        | 13000    | μmhos         |
| Transconductance                                       | 8           | 11       | μιιιιος<br>mA |
| Plate Current                                          | 0           | 3.4      | mA            |
| Grid-No.2 Current                                      | _           | 3.4      | шл            |
|                                                        |             | -3.5     | volts         |
| of 20 μA                                               |             | -3.5     | VOILS         |
|                                                        | -4.5        | _        | volts         |
| of 50 μA                                               | -4.5        | · . —    | Vons          |
| MAXIMUM CIRCUIT VALUES:                                |             |          |               |
| Grid-No.1-Circuit Resistance:                          |             |          |               |
| For cathode-bias operation                             | 0.68 max    | 1 max    | megohm        |
|                                                        |             |          |               |



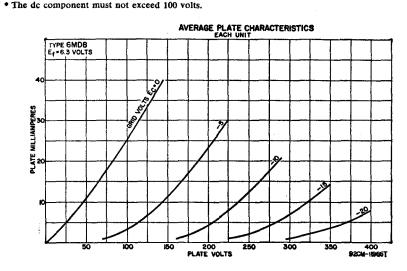
### MEDIUM-MU TRIPLE TRIODE

Novar type used in matrixing circuits of color television receivers. Outline 11E, Outlines section. Tube requires novar nine-contact socket and may be mounted in any position.

6MD8

<sup>\*\*</sup> With external shield connected to pentode cathode, grid No.3, and internal shield.

| Heater Voltage (ac/dc)                                                          |              |                               | 6.3<br>0.9         | volts<br>amper <b>e</b> |
|---------------------------------------------------------------------------------|--------------|-------------------------------|--------------------|-------------------------|
| Heater negative with respect to cathode Heater positive with respect to cathode |              |                               | 200 max<br>200*max | volts<br>volts          |
| Direct Interelectrode Capacitances (Approx.):                                   | No.1<br>Unit | No.2<br>Unit                  | No.3<br>Unit       |                         |
| Grid to Plate                                                                   | 3            | 3                             | 3                  | pF                      |
| Grid to Cathode and Heater                                                      | 3.6          | 3.6                           | 3.4                | pF                      |
| Plate to Cathode and Heater                                                     | 0.48         | 0.48                          | 0.36               | pF                      |
| Class A <sub>1</sub> Amplifi MAXIMUM RATINGS (Design-Maximum Vah                |              | n Unit)                       |                    |                         |
| Plate Voltage                                                                   |              |                               | 330 max            | volts                   |
| Grid Voltage, Positive-bias value                                               |              |                               | 0 max              | volts                   |
| Plate Dissipation                                                               |              |                               | 3 max              | watts                   |
| CHARACTERISTICS:                                                                |              |                               |                    |                         |
| Plate Voltage                                                                   |              |                               | 250                | volts                   |
| Grid Voltage                                                                    |              |                               | -10.5              | volts                   |
| Amplification Factor                                                            |              |                               | 17                 |                         |
| Plate Resistance (Approx.)                                                      |              |                               | 5500               | ohms                    |
| Transconductance                                                                |              |                               | 3100               | μmhos                   |
| Plate Current                                                                   |              |                               | 11.5               | mA                      |
| Plate Current for grid voltage of -14 volts                                     |              |                               | 4                  | mA                      |
| Grid Voltage (Approx.) for plate current of 50 $\mu$                            | A            | • • • • • • • • • • •         | 23                 | volts                   |
| MAXIMUM CIRCUIT VALUES:                                                         |              |                               |                    |                         |
| Grid-Circuit Resistance:                                                        |              |                               |                    |                         |
| For fixed-bias operation                                                        |              | · · · · · · · · · · · · · · · | 1 max              | megohm                  |
|                                                                                 |              |                               |                    |                         |



### MEDIUM-MU TRIODE

**6S4A** 

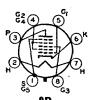
Miniature type having high perveance used as vertical deflection amplifier in television receivers. This type has a controlled heater warm-up time for use in television receivers employing series-connected heater strings. Out-



line 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| may be mounted in any position.                        |           |         |
|--------------------------------------------------------|-----------|---------|
| Heater Voltage (ac/dc)                                 | 6.3       | volts   |
| Heater Current                                         | 0.6       | ampere  |
| Heater Warm-up Time (Average)                          | 11        | seconds |
| Peak Heater-Cathode Voltage:                           |           |         |
| Heater negative with respect to cathode                | 200 max   | volts   |
| Heater positive with respect to cathode                | 200 = max | volts   |
| Direct Interelectrode Capacitances (Approx.):          |           |         |
| Grid to Plate                                          | 2.4       | рF      |
| Grid to Cathode and Heater                             | 4.2       | pF      |
| Plate to Cathode and Heater                            | 0.6       | pF      |
| • The dc component must not exceed 100 volts.          |           |         |
| Class A, Amplifier                                     |           |         |
| CHARACTERISTICS:                                       |           |         |
| Plate Voltage                                          | 250       | volts   |
| Grid Voltage                                           | 8         | volts   |
| Amplification Factor                                   | 16.5      |         |
| Plate Resistance (Approx.)                             | 3700      | ohms    |
| Transconductance                                       | 4500      | μmhos   |
| Plate Current                                          | 24        | mA      |
| Plate Current for grid voltage of -15 volts            | 4         | mA      |
| Grid Voltage (Approx.) for plate current of 50 $\mu$ A | 22        | volts   |
| Vertical Deflection Amplifier                          |           |         |
| For operation in a 525-line, 30-frame system           |           |         |
| MAXIMUM RATINGS (Design-Maximum Values):               |           |         |
| DC Plate Voltage                                       | 550 max   | volts   |
| Peak Positive-Pulse Plate Voltage†                     | 2200 max  | volts   |
| Peak Negative-Pulse Grid Voltage                       | -250 max  | volts   |
| Peak Cathode Current                                   | 105 max   | mA      |
| Average Cathode Current                                | 30 max    | mA      |
| Plate Dissipation                                      | 8.5 max   | watts   |
| MAXIMUM CIRCUIT VALUE:                                 |           |         |
| Grid-Circuit Resistance:                               |           |         |
| For cathode-bias operation                             | 2.2 max   | megohms |
|                                                        |           |         |

† The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.



### PENTAGRID CONVERTER

Metal type used as converter in superheterodyne circuits. It is similar in performance to type 6BE6. For general discussion of pentagrid types, see Frequency Conversion in Electron Tube Applications section. This tube

6SA7
Related type:
12SA7

has excellent frequency stability. Tube requires octal socket and may be mounted in any position. Outline 2A, Outlines section. Type 12SA7 is identical with type 6SA7 except for the heater ratings, as shown below.

|                                                | 6SA7   | 12SA7     |        |
|------------------------------------------------|--------|-----------|--------|
| Heater Voltage (ac/dc)                         | 6.3    | 12.6      | volts  |
| Heater Current                                 | 0.3    | 0.15      | ampere |
| Peak Heater-Cathode Voltage:                   |        |           | -      |
| Heater negative with respect to cathode        | 90 max | 90 max    | volts  |
| Heater positive with respect to cathode        | 90 max | 90 max    | volts  |
| Direct Interelectrode Capacitances:            |        |           |        |
| Grid No.3 to All Other Electrodes (RF Input)   |        | 9,5*      | pF     |
| Plate to All Other Electrodes (Mixer Output)   |        | 9.5*      | pF     |
| Grid No.1 to All Other Electrodes (Osc. Input) |        | 7*        | pF     |
| Grid No.3 to Plate                             |        | 0.25 max* | pF     |
| Grid No.3 to Grid No.1                         |        | 0.15 max* | pF     |

| Grid No.1 to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            | 0.06        | max*  | pF         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|-------|------------|
| except Cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            | 4.4         |       | рF         |
| Grid No.1 to Cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            | 2.6         |       | pF         |
| Cathode to Shell, Grid No.5, and All Other Electrode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |             |       |            |
| except Grid No.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            | 5           |       | pF         |
| * With shell connected to cathode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |             |       | •          |
| With Shell connected to canode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |            |             |       |            |
| Converter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |             |       |            |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |             |       |            |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            | 300         | max   | volts      |
| Grids-No.2-and-No.4 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |             | max   | volts      |
| Grids-No.2-and-No.4 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |             | max   | volts      |
| Grid-No.3 (Control-Grid) Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |             |       |            |
| Negative bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            | 50          | max   | volts      |
| Positive bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            | 0           | max   | volts      |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            | 1.0         | max   | watt       |
| Grids-No.2-and-No.4 Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            | 1.0         | max   | watt       |
| Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |            | 14          | max   | mA         |
| TYPICAL OPERATION: Separate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Excitation | t           |       |            |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 100        | 250         |       | voits      |
| Grid No.5 and shell                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Cont       | ected to ca | thode | at socket  |
| Grids-No.2-and-No.4 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 100        | 100         |       | volts      |
| Grid-No.3 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>—</b> 2 | 2           |       | volts      |
| Grid-No.1 (Oscillator-Grid) Resistor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 20000      | 20000       |       | ohms       |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.5        | 1.0         |       | megohm     |
| Conversion Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 425        | 450         |       | $\mu$ mhos |
| Grid-No.3 Voltage (Approx.) for transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |             |       |            |
| of 10 μmhos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 25         | 25          |       | volts      |
| Grid-No.3 Voltage (Approx.) for conversion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | _          |             |       |            |
| transconductance of 100 \( \mu \text{mhos} \\ \dots \d | 9          | 9           |       | volts      |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3.3        | 3.5         |       | mA.        |
| Grids-No.2-and-No.4 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 8.5        | 8.5         |       | mA         |
| Grid-No.1 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.5        | 0.5         |       | mA<br>mA   |
| Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 12.3       | 12.5        |       |            |
| STORES PRO A COLUMN TO A COLUM | . Nr. 2 d  | No 4 come   |       | to minte   |

NOTE: The transconductance between grid No.1 and grids No.2 and No.4 connected to plate (not oscillating) is 4500  $\mu$ mhos under the following conditions: grids No.1, No.3 at 0 volts; grids No.2 and No.4 and plate at 100 volts; grid No.5 and shell are connected to cathode at socket.

† The characteristics shown with separate excitation correspond very closely to those obtained in a self-excited oscillator circuit operating with zero bias.

### SHARP-CUTOFF PENTODE

6SJ7
Related type: 12SJ7

Metal type used as rf amplifier and biased detector. As a detector, this type is capable of delivering large audio-frequency output voltage with relatively small input voltage. Outline 2A, Outlines section. Tube requires



8N

octal socket and may be mounted in any position. Type 12SJ7 is identical with type 6SJ7 except for the heater ratings, as shown below.

|                                                       | 021/   | 1431/     |        |
|-------------------------------------------------------|--------|-----------|--------|
| Heater Voltage (ac/dc)                                | 6.3    | 12.6      | volts  |
| Heater Current                                        | 0.3    | 0.15      | ampere |
| Peak Heater-Cathode Voltage:                          |        |           |        |
| Heater negative with respect to cathode               | 90 max | 90 max    | volts  |
| Heater positive with respect to cathode               | 90 max | 90 max    | volts  |
| Direct Interelectrode Capacitances:                   |        |           |        |
| Pentode Connection:                                   |        |           |        |
| Grid No.1 to Plate                                    |        | 0.005 max | pF     |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No. | 0.3    | 6.0       | pF     |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3.   |        | 7.0       | pF     |
|                                                       |        |           |        |

| Triode Connection:              |     |    |
|---------------------------------|-----|----|
| Grid No.1 to Plate              | 2.8 | рF |
| Grid No.1 to Cathode and Heater | 3.4 | рF |
| Plate to Cathode and Heater     | 11  | pF |

<sup>\*</sup> With shell connected to cathode.

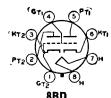
### Class A, Amplifier

|                                     |                    | Triode      | Pentode    |         |
|-------------------------------------|--------------------|-------------|------------|---------|
| MAXIMUM RATINGS (Design-Cent        | er Values):        | Connection* | Connection |         |
| Plate Voltage                       |                    | 250 max     | 300 max    | volts   |
| Grid-No.2 (Screen-Grid) Voltage     |                    |             | See curve  | page 80 |
| Grid-No.2 Supply Voltage            |                    |             | 300 max    | volts   |
| Grid-No.1 (Control-Grid) Voltage, P | ositive-bias value | 0 max       | 0 max      | volts   |
| Plate Dissipation                   |                    | 2.5 max     | 2.5 max    | watts   |
| Grid-No.2 Input:                    |                    |             |            |         |
| For grid-No.2 voltages up to 150    | volts              | -           | 0.7 max    | watt    |
| For grid-No.2 voltages between 1    | 50 and 300 volts   | _           | See curve  | page 80 |
|                                     | Triode             | Pe          | ntode      |         |
| TYPICAL OPERATION:                  | Connection*        | Con         | nection    |         |
| D1-4- 37-14                         | 100 050            | 100         | 250        |         |

| TYPICAL OPERATION:                    |      | nection* | Con          | nection |            |
|---------------------------------------|------|----------|--------------|---------|------------|
| Plate Voltage                         | 180  | 250      | 100          | 250     | volts      |
| Grid No.3                             |      | _        | Connected to | cathode | at socket  |
| Grid-No.2 Voltage                     | _    |          | 100          | 100     | volts      |
| Grid-No.1 Voltage                     | 6    | 8.5      | -3           | 3       | volts      |
| Amplification Factor                  | 19   | 19       | _            |         |            |
| Plate Resistance (Approx.)            | 8250 | 7600     | 700000       | †       | ohms       |
| Transconductance                      | 2300 | 2500     | 1575         | 1650    | $\mu$ mhos |
| Grid-No.1 Voltage (Approx.) for plate |      |          |              |         |            |
| current of 10 $\mu A$                 | _    | _        | 8            | 8       | volts      |
| Plate Current                         | 6.0  | 9.2      | 2.9          | 3.0     | volts      |
| Grid-No.2 Current                     | _    | _        | 0.9          | 0.8     | mA         |
|                                       |      |          |              |         |            |

<sup>\*</sup> Grids No.2 and No.3 connected to plate.

<sup>†</sup> Greater than 1 megohm.



### HIGH-MU TWIN TRIODE

Glass octal type used as phase inverter in radio equipment. Each unit amplifier circuits. Outline 13D, Outsocket and may be mounted in any lines section. Tube requires octal may also be used in resistance-coupled

6SL7GT

Related type 12SL/GT

position. Except for the common heater, each triode unit is independent of the other. For typical operation as phase inverter or resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Type 12SL7GT is identical with type 6SL7GT except for the heater ratings, as shown below.

|                                               | OSLIOI    | 1232101   |        |
|-----------------------------------------------|-----------|-----------|--------|
| Heater Voltage (ac/dc)                        | 6.3       | 12.6      | volts  |
| Heater Current                                | 0.3       | 0.15      | ampere |
| Peak Heater-Cathode Voltage:                  |           |           |        |
| Heater negative with respect to cathode       | 90 max    | 90 max    | volts  |
| Heater positive with respect to cathode       | 90 max    | 90 max    | volts  |
| Direct Interelectrode Capacitances (Approx.): | Unit No.1 | Unit No.2 |        |
| Grid to Plate                                 | 2.8       | 2.8       | pF     |
| Grid to Cathode and Heater                    | 3.0       | 3.4       | pF     |
| Plate to Cathode and Heater                   | 3.8       | 3.2       | pF     |
|                                               |           |           |        |

<sup>\*</sup> With external shield connected to cathode.

### Class A, Amplifier

| MAXIMUM KATINGS (Design-Center values): |         |       |
|-----------------------------------------|---------|-------|
| Plate Voltage                           | 300 max | volts |
| Grid Voltage, Positive-bias value       | 0 max   | volts |
| Plate Dissipation                       | 1 max   | watt  |

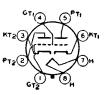
<sup>•</sup> With grids No.2 and No.3 connected to plate.

| CHARACTERISTICS:           |       |       |
|----------------------------|-------|-------|
| Plate Voltage              | 250   | volts |
| Grid Voltage               | -2    | volts |
| Amplification Factor       | 70    |       |
| Plate Resistance (Approx.) | 44000 | ohms  |
| Transconductance           | 1600  | μmhos |
| Plate Current              | 2.3   | mA    |

#### MEDIUM-MU TWIN TRIODE

## 6SN7GTB

Related types: 12SN7GTA Glass octal type used as combined vertical oscillator and vertical deflection amplifier, and as horizontal deflection oscillator, in television receivers. Each unit may also be used in multivibrator or resistance-coupled



8BD

amplifier circuits in radio equipment. This type has a controlled heater warm-up time to permit use in series-connected heater strings. Outline 13D, Outlines section. Tube requires octal socket and may be mounted in any position. Except for the common heater, each triode unit is independent of the other. For typical operation as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Type 12SN7GTA is identical with type 6SN7GTB except for the heater ratings, as shown below.

6SN7CTR

|                                                          | 6SN7GTB   | 12SN7GTA |         |
|----------------------------------------------------------|-----------|----------|---------|
| Heater Voltage (ac/dc)                                   | 6.3       | 12.6     | volts   |
| Heater Current                                           | 0.6       | 0.3      | ampere  |
| Heater Warm-up Time (Average)                            | 11        | _        | seconds |
| Heater negative with respect to cathode                  | 200 max   | 200 max  | volts   |
| Heater positive with respect to cathode                  | 200°max   | 200°max  | volts   |
| Direct Interelectrode Capacitances (Approx.):            | Unit No1  | Unit No2 |         |
| Grid to Plate                                            | 4.0       | 3.8      | pF      |
| Grid to Cathode and Heater                               | 2.2       | 2.6      | ρF      |
| Plate to Cathode and Heater                              | 0.7       | 0.7      | ρF      |
| <sup>o</sup> The dc component must not exceed 100 volts. |           |          | • -     |
| Class A, Amplifier (Each                                 | n Unit)   |          |         |
| MAXIMUM RATINGS (Design-Center Values):                  | •         |          |         |
| Plate Voltage                                            |           | 450 max  | volts   |
| Cathode Current                                          |           | 20 max   | mA      |
| Plate Dissipation:                                       |           |          |         |
| For either plate                                         |           | 5 max    | watts   |
| For both plates with both units operating                |           | 7.5 max  | watts   |
| CHARACTERISTICS:                                         |           |          |         |
| Plate Voltage                                            | 90        | 250      | volts   |
| Grid Voltage                                             | Ō         | 8        | volts   |
| Amplification Factor                                     | 20        | 20       |         |
| Plate Resistance (Approx.)                               | 6700      | 7700     | ohms    |
| Transconductance                                         | 3000      | 2600     | #mhos   |
| Plate Current                                            | 10        | 9        | mA      |
| Plate Current for grid voltage of -12.5 volts            | _         | 1.3      | mA      |
| Grid Voltage (Approx.) for plate current of 10 µA        | <b>—7</b> | 18       | volts   |
| MAXIMUM CIRCUIT VALUE:                                   |           |          |         |
| Grid-Circuit Resistance:                                 |           |          |         |
| For fixed-bias operation                                 |           | 1.0 max  | megohm  |
|                                                          | •••       |          |         |
| Oscillator (Each Ur                                      | אונו      |          |         |

## Oscillator (Each Unit) For operation in a 525-line, 30-frame system

|                                         | Deflection | Deflection |       |
|-----------------------------------------|------------|------------|-------|
| MAXIMUM RATINGS (Design-Center Values): | Oscillator | Oscillator |       |
| DC Plate Voltage                        | 450 max    | 450 max    | volts |
| Peak Negative-Pulse Grid Voltage        | -400 max   | 600 max    | volts |
| Peak Cathode Current                    | 70 max     | 300 max    | mA    |
| Average Cathode Current                 | 20 max     | 20 max     | mA    |

| Plate Dissipation: For either plate            | 5 max   | 5 max watts    |
|------------------------------------------------|---------|----------------|
| For both plates with both units operating      | 7.5 max | 7.5 max watts  |
| MAXIMUM CIRCUIT VALUE: Grid-Circuit Resistance | 2.2 max | 2.2 max megohm |

#### Vertical Deflection Amplifier (Each Unit)

| For operation in a 525-line, 30-frame system                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------|
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |       |
| DC Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 450 max  | volts |
| Peak Positive-Pulse Plate Voltage# (Absolute maximum)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1500 max | volts |
| Peak Negative-Pulse Grid Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 250 max  | volts |
| Peak Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 70 max   | mA    |
| Average Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 20 max   | mA    |
| Plate Dissipation:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |       |
| For either plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 5 max    | watts |
| For both plates with both units operating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 7.5 max  | watts |
| # The decade of the college of the c |          |       |

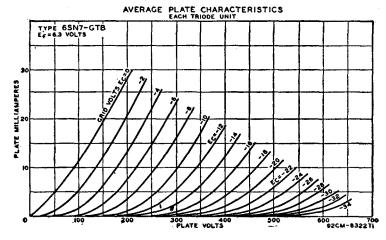
# The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds. Under no circumstances should this absolute value be exceeded.

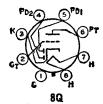
#### MAXIMUM CIRCUIT VALUE:

Grid-Circuit Resistance:

For cathode-bias operation .....

2.2 max megohms





#### TWIN DIODE— HIGH-MU TRIODE

Metal type used as combined detector, amplifier, and avc tube in radio receivers. Outline 2A, Outlines section. Tube requires octal socket and may be mounted in any position. Diodebiasing of the triode unit is not suit-

Related type:

12507

able because of the probability of triode plate-current cutoff even with relatively small signal voltages applied to the diode circuit. Type 12SQ7 is identical with type 6SQ7 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc)                                                          | 6.3    | 12.6   | volts  |
|---------------------------------------------------------------------------------|--------|--------|--------|
|                                                                                 | 0.3    | 0.15   | ampere |
| Heater negative with respect to cathode Heater positive with respect to cathode | 90 max | 90 max | volts  |
|                                                                                 | 90 max | 90 max | volts  |

| Direct Interelectrode Capacitances:  Triode Unit: Grid to Plate Grid to Cathode and Heater Plate to Cathode and Heater Either Diode Plate to Cathode and Heater Triode Grid to Plate of Diode No.1 Triode Grid to Plate of Diode No.2  *With shell connected to cathode. | 1.6<br>3.2<br>3<br>3.3 max<br>0.03 max<br>0.04 max | pF<br>pF<br>pF<br>pF<br>pF |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|----------------------------|
| Triode Unit as Class A, Amplifier                                                                                                                                                                                                                                        |                                                    |                            |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                  |                                                    |                            |
| Plate Voltage                                                                                                                                                                                                                                                            | 300 max                                            | volts                      |
| Grid Voltage, Positive-bias value                                                                                                                                                                                                                                        | 0 max                                              | volts                      |
| Plate Dissipation                                                                                                                                                                                                                                                        | 0.5 max                                            | watt                       |
| CHARACTERISTICS:                                                                                                                                                                                                                                                         |                                                    |                            |
| Plate Voltage 100                                                                                                                                                                                                                                                        | 250                                                | volts                      |
| Grid Voltage                                                                                                                                                                                                                                                             | -2                                                 | volts                      |
| Amplification Factor 100                                                                                                                                                                                                                                                 | 100                                                |                            |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                               | 85000                                              | ohms                       |
| Transconductance 925                                                                                                                                                                                                                                                     | 1175                                               | μmhos                      |
| Plate Current 0.5                                                                                                                                                                                                                                                        | 1.1                                                | mA                         |
|                                                                                                                                                                                                                                                                          |                                                    |                            |

#### **Diode Units**

MAXIMUM RATING (Design-Center Value):

Two diode plates are placed around a cathode, the sleeve of which is common to the triode unit. Each diode plate has its own base pin. For diode operation curves, refer to type 6AV6.

# TRIPLE DIODE-HIGH-MU TRIODE

6T8A
Related type:

Miniature type used as combined audio amplifier, AM detector, and FM detector in AM/FM radio receivers. Diode unit No.1 is used for AM detection, and diode units No.2 and No.3 are used for FM detection. This type



9E

STR A

has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For typical operation as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Type 5T8 is identical with type 6T8A except for the heater ratings, as shown below.

570

|                                                      | 210      | OIOA     |         |
|------------------------------------------------------|----------|----------|---------|
| Heater Voltage (ac/dc)                               | 4.7      | 6.3      | volts   |
| Heater Current                                       | 0.6      | 0.45     | ampere  |
| Heater Warm-up Time (Average)                        | 11       | 11       | seconds |
| Peak Heater-Cathode Voltage:                         |          |          |         |
| Heater negative with respect to cathode              | 200 max  | 100 max  | volts   |
| Heater positive with respect to cathode              | 200 max# | 100 max  | volts   |
|                                                      | Without  | With     |         |
| Direct Interelectrode Capacitances:                  | External | External |         |
| Triode Unit:                                         | Shield   | Shield*  |         |
| Grid to Plate                                        | 1.7      | 1.7      | pF      |
| Grid to Cathode, Internal Shield (pin 7), and Heater | 1.6      | 1.7      | pF      |
| Plate to Cathode, Internal Shield (pin 7), and       |          |          |         |
| Heater                                               | 1.2      | 2.4      | pF      |
| Diode Units:                                         |          |          |         |
| Diode-No.1 Plate to Cathode, Internal Shield         |          |          |         |
| (pin 7), and Heater                                  | 3.8      | 3.8      | pF      |
| Diode-No.2 Plate to Cathode, Internal Shield         |          |          |         |
| (pin 3), and Heater                                  | 3.8      | 3.8•     | pF      |
| Diode-No.3 Plate to Cathode, Internal Shield         |          |          | _       |
| (pin 7), and Heater                                  | 3.4      | 3.6      | рF      |
|                                                      |          |          |         |

| Diode Units MAXIMUM RATINGS (Design-Maximum Values):        |                         |                           |          |
|-------------------------------------------------------------|-------------------------|---------------------------|----------|
| Plate Current                                               | 0.8                     | 1.0                       | mA       |
| Transconductance                                            | 1300                    | 1200                      | μmhos    |
| Plate Resistance (Approx.)                                  | 54000                   | 58000                     | ohms     |
| Amplification Factor                                        | 70                      | 70                        | _        |
| Grid Voltage                                                | <b>—1</b>               | -3                        | volts    |
| Plate Voltage                                               | 100                     | 250                       | volts    |
| CHARACTERISTICS:                                            |                         |                           |          |
| Plate Dissipation                                           | • • • • • • • • • • • • | 1.1 max                   | watts    |
| Grid Voltage, Positive-bias value                           |                         | 0 max                     | volts    |
| Plate Voltage                                               |                         | 330 max                   | volts    |
| MAXIMUM RATINGS (Design-Maximum Values):                    |                         |                           |          |
| Triode Unit as Class A <sub>1</sub>                         | Amplifier               |                           |          |
| • With external shield connected to pins 4 and 5.           |                         |                           |          |
| • With external shield connected to pin 3.                  |                         |                           |          |
| • With external shield connected to pin 7 except as noted   | i.                      |                           |          |
| # The dc component must not exceed 100 volts.               |                         |                           |          |
| #77h- de communest mont mat amond 100 males                 |                         |                           |          |
| Other Electrodes, and Heater Triode Grid to any Diode Plate | 7.5<br>0.034 max        | 8.5 <b>•</b><br>0.034 max | pF<br>pF |
| Diode-No.2 Cathode, Internal Shield (pin 3) to All          |                         |                           |          |

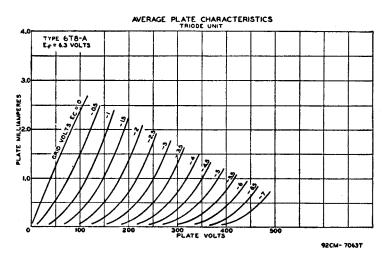
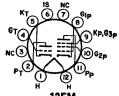


Plate Current (Each Unit) .....



## HIGH-MU TRIODE—POWER PENTODE

KP,63p Duodecar type used in audio-frequency circuits. The triode unit is used as a voltage amplifier; the pentode unit is used as a power amplifier.

Outline 8B, Outlines section. Tube requires duodecar twelve-contact socket

**6T9** 

5.5 max

mA

and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.93; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

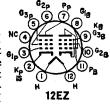
| Class | A. | Am | plifier |
|-------|----|----|---------|
|       |    |    |         |

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid-No.2 (Screen-Grid) Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input                                                                                                                                                                                  | Triode Unit 300 max  0 max 1.5 max | 12 r                                                                              | nax volts<br>max volts<br>nax volts                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------|
| CHARACTERISTICS (Triode Unit):                                                                                                                                                                                                                                                                                                                                  |                                    |                                                                                   |                                                                      |
| Plate Voltage Grid Voltage Amplification Factor Plate Resistance (Approx.) Transconductance Plate Current                                                                                                                                                                                                                                                       |                                    | 250<br>-2<br>95<br>45000<br>2100<br>1.5                                           | volts<br>volts<br>ohms<br>μmhos<br>mA                                |
|                                                                                                                                                                                                                                                                                                                                                                 |                                    |                                                                                   |                                                                      |
| TYPICAL OPERATION (Pentode Unit): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Plate Resistance (Approx.) Transconductance Load Resistance Total Harmonic Distortion (Approx.) Maximum-Signal Power Output |                                    | 250<br>250<br>-8<br>8<br>35<br>39<br>2.5<br>7<br>0.1<br>6500<br>5000<br>10<br>4.2 | volts volts volts volts mA mA mA mA megohm μhmos ohms per cent watts |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                         | Triode Unit                        | Pentode                                                                           | Unit                                                                 |
| Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation  * For cathode-bias operation of the triode unit, a maximur used provided the plate dissipation never exceeds 0.25 wat                                                                                                                                                        |                                    | 0.5 1                                                                             | max megohm<br>max megohm<br>ohms can be                              |

### BEAM POWER TUBE— SHARP-CUTOFF PENTODE

6T10

Duodecar type used as combined FM detector and audio-frequency output amplifier in television receivers. The beam power unit is used in af output stages, and the sharp-cutoff, dual-control pentode unit is used as an FM



detector. Outline 8B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.95; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode). For maximum ratings and characteristics, refer to type 6AL11.

### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

6U8A
Related types
5U8, 9U8A

Miniature type used as combined oscillator and mixer tube in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. This type has a controlled heater warm-up time for use in tele-



vision receivers employing series-controlled heater strings. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Types 5U8 and 9U8A are identical with type 6U8A except for the heater ratings, as shown below.

|                                              | 5U8         | 6U8A        | 9U8A        |         |
|----------------------------------------------|-------------|-------------|-------------|---------|
| Heater Voltage (ac/dc)                       | 4.7         | 6.3         | 9.45        | volts   |
| Heater Current                               | 0.6         | 0.45        | 0.3         | ampere  |
| Heater Warm-up Time (Average)                | 11          | 11          | 11          | seconds |
| Peak Heater-Cathode Voltage:                 |             |             |             |         |
| Heater negative with respect to cathode      | 200 max     | 200 max     | 200 max     | volts   |
| Heater positive with respect to cathode      | 200 • max   | 200 max     | 200 = max   | volts   |
|                                              |             | Without     | With        |         |
| Direct Interelectrode Capacitances:          |             | External    | External    |         |
| Triode Unit:                                 |             | Shield      | Shield*     |         |
| Grid to Plate                                |             | 1.8         | 1.8         | pF      |
| Grid to Cathode, Heater, Pentode Cathode, Pe |             | 1.0         | 1.0         | P       |
| Grid No.3, and Internal Shield               |             | 2.8         | 2.8         | pF      |
| Plate to Cathode, Heater, Pentode Cathode,   |             | 2.0         | 2.0         | P-      |
| Pentode Grid No.3, and Internal Shield       |             | 1.5         | 2           | pF      |
|                                              |             | 1.3         | 2           | PI.     |
| Pentode Unit:                                |             | 0.010 max   | 0.006 max   | рF      |
| Grid No.1 to Plate                           |             | U.UIU IIIAX | U.UUU IIIAX | Pa.     |
| Grid No.1 to Cathode, Heater, Grid No.2,     |             | 5.0         | 5.0         | рF      |
| No.3, and Internal Shield                    |             | 3.0         | 5.0         | рF      |
| Plate to Cathode, Heater, Grid No.2, Grid    | NU.5,       | 2.6         | 3.5         | pF      |
| and Internal Shield                          |             |             | 3.3         |         |
| Triode Cathode to Heater                     |             | 3           | 3*          | рF      |
| Pentode Cathode, Pentode Grid No.3, and In   |             | •           | 3●          | E       |
| Shield to Heater                             |             | 3           |             | pF      |
| Pentode Grid No.1 to Triode Plate            |             | 0.2 max     | 0.2 max     | pF      |
| Pentode Plate to Triode Plate                | · · · · · · | 0.1 max     | 0.02 max    | pF      |
| The do component must not exceed 100 volte   |             |             |             |         |

- The dc component must not exceed 100 volts.
- ▲ With external shield connected to pin 4 except as noted.
- With external shield connected to pin 6.

| Class A, Amplific                                      | er          |              |            |
|--------------------------------------------------------|-------------|--------------|------------|
| MAXIMUM RATINGS (Design-Maximum Values):               | Triode Unit | Pentode U    | nit        |
| Plate Voltage                                          | 330 max     | 330 max      | volts      |
| Grid-No.2 (Screen-Grid) Supply Voltage                 | *           | 330 max      | volts      |
| Grid-No.2 Voltage                                      | -           | See cur      | ve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value  | 0 max       | 0 max        | volts      |
| Plate Dissipation                                      | 2.5 max     | 3 max        | watts      |
| For grid-No.2 voltages up to 165 volts                 | _           | 0.55 max     | watt       |
| For grid-No.2 voltages between 165 and 330 volts       |             | See cur      | ve page 80 |
| CHARACTERISTICS:                                       | Triode Unit | Pentode Unit |            |
| Plate Voltage                                          | 125         | 125          | volts      |
| Grid-No.2 Voltage                                      |             | 110          | volts      |
| Grid-No.1 Voltage                                      | -1          | -1           | volts      |
| Amplification Factor                                   | 40          |              |            |
| Plate Resistance (Approx.)                             |             | 0.2          | megohm     |
| Transconductance                                       | 7500        | 5000         | μmhos      |
| Grid-No.1 Voltage (Approx.) for plate current of 20 μA | 9           | 8            | volts      |
| Plate Current                                          | 13.5        | 9.5          | mA.        |
| Grid-No 2 Current                                      |             | 3 5          | m A        |



### THREE-UNIT TRIODE

Duodecar type used in a variety of amplifier applications. Units No.1 and No.3 are medium-mu triode units, and unit No.2 is a high-mu triode unit. Outline 8A, Outlines section. Tube requires duodecar twelve-contact socket

6U10

and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.6; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (this value may reach 275 for units No.1 and No.3 when the heater is negative with respect to the cathode; the dc component must not exceed 100 volts).

### Class A, Amplifier

|                                          | Units Nos. | Unit    |         |
|------------------------------------------|------------|---------|---------|
| MAXIMUM RATINGS (Design-Maximum Values): | 1 and 3    | No.2    |         |
| Plate Voltage                            | 330 max    | 330 max | voits   |
| DC Grid Voltage:                         |            |         |         |
| Positive-bias value                      | 0 max      | 0 max   | volts   |
| Negative-bias value                      | -50 max    | -50 max | volts   |
| Average Cathode Current                  | 20 max     | _       | mA      |
| Plate Dissipation                        | 2 max      | 1 max   | watts   |
|                                          |            | ı mun   | " will  |
| CHARACTERISTICS:                         |            |         |         |
| Plate Voltage                            | 200        | 200     | volts   |
| Grid Voltage                             | 6          | 1.5     | volts   |
| Amplification Factor                     | 17.5       | 90      |         |
| Plate Resistance (Approx.)               | 7700       | 61000   | ohms    |
| Transconductance                         | 2300       | 1600    | umhos   |
| Plate Current                            | 9.6        | 1.2     | mA      |
| Grid Voltage (Approx.):                  |            |         |         |
| For plate current of 100 µA              | -15        | _       | volts   |
| For plate current of 35 $\mu$ A          |            | -3      | volts   |
|                                          |            | -       |         |
| MAXIMUM CIRCUIT VALUES:                  |            |         |         |
| Grid-Circuit Resistance:                 |            |         |         |
| For fixed-bias operation                 | 1 max      | 0.5 max | megohm  |
| For cathode-bias operation               | 2.2 max    |         | negohms |
| -                                        |            | ,       |         |

<sup>\*</sup> This value may reach 10 megohms provided the plate-supply voltage and load resistance are such that the plate dissipation can never exceed 0.5 watt.

### HALF-WAVE VACUUM RECTIFIER

6V3A

Miniature type used as a damper tube in horizontal deflection circuits of television receivers. Outline 7B, Outlines section. Tube requires miniature ninecontact socket and may be mounted in any position. It is especially important



9BD

that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 6.3; amperes, 1.75.

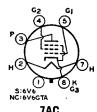
#### **Damper Service**

For operation in a 525-line, 30-frame system

#### MAXIMUM RATINGS (Design-Center Values):

| Peak Inverse Plate Voltage# (Absolute Maximum)              | 6000† max<br>800 max | volts    |
|-------------------------------------------------------------|----------------------|----------|
| Peak Plate Current DC Plate Current                         | 800 max<br>135 max   | mA<br>mA |
| Peak Heater-Cathode Voltage:                                | 133 Hink             | 1112 6   |
| Heater negative with respect to cathode# (Absolute Maximum) | 6750† • max          | volts    |
| Heater positive with respect to cathode                     | 300° max             | volts.   |

- # The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- † Under no circumstances should this absolute value be exceeded.
- The dc component must not exceed 750 volts.
- ° The dc component must not exceed 100 volts.



#### **BEAM POWER TUBE**

Metal type 6V6 and glass octal type 6V6GTA are used as output amplifiers in automobile, battery-operated, and other receivers in which reduced plate-current drain is desirable. Outlines 2B and 13D, respectively, **Outlines** sec-

## 6V6 6V6GTA

Related types: 5V6GT, 12V6GT

tion. Tubes require octal socket and may be mounted in any position. These tubes are equivalent in performance to type 6AQ5A. Refer to type 6AQ5A for average plate characteristic curves. Types 5V6GT and 12V6GT are identical with type 6V6GTA except for the heater ratings, as shown below.

|                                        | 5V6GT        | 6V6      | 6V6GTA    | 12V6GT  |         |
|----------------------------------------|--------------|----------|-----------|---------|---------|
| Heater Voltage (ac/dc)                 | 4.7          | 6.3      | 6.3       | 12.6    | volts   |
| Heater Current                         | 0.6          | 0.45     | 0.45      | 0.225   | ampere  |
| Heater Warm-up Time (Average)          | 11           | _        | 11        | _       | seconds |
| Peak Heater-Cathode Voltage:           |              |          |           |         |         |
| Heater negative with respect to        |              |          |           |         |         |
| cathode                                | 200 max      | 200 ma   | x 200 max | 200 max | volts   |
| Heater positive with respect to        |              |          |           |         |         |
| cathode                                | 200°max      | 200 • ma |           | 200=max | volts   |
| Direct Interelectrode Capacitances (Ap |              |          | 6V6°      | 6V6GTA  |         |
| Grid No.1 to Plate                     |              |          | 0.3       | 0.7     | рF      |
| Grid No.1 to Cathode, Heater, Gri      | id No.2, and |          |           |         |         |
| Grid No.3                              |              |          | 10        | 9.0     | pF      |
| Plate to Cathode, Heater, Grid No      | .2, and Grid | No.3     | 11        | 7.5     | pF      |
|                                        |              |          |           |         |         |

| Plate to Cathode, Heater, Grid No.2, and Gri                   | id No.3    | 11            | 7.5                        | pF             |
|----------------------------------------------------------------|------------|---------------|----------------------------|----------------|
| The dc component must not exceed 100 volts.                    |            |               |                            |                |
| * With shell connected to cathode.                             |            |               |                            |                |
| With shell connected to cathode.                               |            |               |                            |                |
|                                                                |            | _             |                            |                |
| Class A, I                                                     | Amplii     | fier          |                            |                |
| MAXIMUM RATINGS (Design-Maximum Value                          | s):        |               |                            |                |
| Plate Voltage                                                  | •          |               | 350 max                    | volts          |
| Grid-No.2 (Screen-Grid) Voltage                                |            |               | 315 max                    | volts          |
| Plate Dissipation                                              |            |               | 14 max                     | watts          |
| Grid-No.2 Input                                                |            |               | 2.2 max                    | watts          |
|                                                                |            |               | 2.2                        |                |
| TYPICAL OPERATION:                                             |            |               |                            |                |
|                                                                | 100        | 000           | 016                        | •.             |
| Plate Voltage                                                  | 180<br>180 | 250           | 315                        | volts<br>volts |
| Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage             | 8.5        | 250<br>—12.5  | 225<br>—13                 | volts          |
| Peak AF Grid-No.1 Voltage                                      | 8.5<br>8.5 | -12.5<br>12.5 | -13<br>13                  | volts          |
| Zero-Signal Plate Current                                      | 29         | 45            | 34                         | mA             |
| Maximum-Signal Plate Current                                   | 30         | 47            | 35                         | mA             |
| Zero-Signal Grid-No.2 Current                                  | 30         | 4.5           | 2.2                        | mA             |
| Maximum-Signal Grid-No.2 Current                               | 4          | 7.5           | 6                          | mA             |
| Plate Resistance (Approx.)                                     |            | 50000         | 80000                      | ohms           |
| Transconductance                                               | 3700       | 4100          | 3750                       | μmhos          |
| Load Resistance                                                | 5500       | 5000          | 8500                       | ohms           |
| Total Harmonic Distortion                                      | 8          | 8             | 12                         | per cent       |
| Maximum-Signal Power Output                                    | ž          | 4.5           | 5.5                        | watts          |
|                                                                | _          | •••           |                            |                |
| CHARACTERISTICS (Triode Connection):                           |            |               |                            |                |
|                                                                |            |               |                            | _              |
| Plate Voltage                                                  |            |               | 250                        | volts          |
| Grid-No.1 (Control-Grid) Voltage                               |            |               | -12.5                      | volts          |
| Amplification Factor                                           |            |               | 9.8                        |                |
| Plate Resistance (Approx.)                                     |            |               | 1960                       | ohms           |
| Transconductance                                               |            |               | 5000<br>49.5               | ⊬mhos<br>mA    |
| Plate Current Grid-No.1 Voltage (Approx.) for plate current of |            |               | <b>49.</b> 3<br><b></b> 36 | volts          |
| One-real voltage (Approx.) for plate current of                | ת כ.ט ני   | ILFA          | 30                         | VOMS           |
| A Child NY a Community of the sulface                          |            |               |                            |                |

<sup>&</sup>lt;sup>▲</sup> Grid No.2 connected to plate.

### Push-Pull Class A, Amplifier

MAXIMUM RATINGS (Same as for class A<sub>1</sub> amplifier)

| TYPICAL OPERATION (Values are for two tubes): |             |         |          |
|-----------------------------------------------|-------------|---------|----------|
| Plate Voltage                                 | 250         | 285     | volts    |
| Grid-No.2 Voltage                             | 250         | 285     | volts    |
| Grid-No.1 (Control-Grid) Voltage              | 15          | -19     | volts    |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage        | 30          | 38      | volts    |
| Zero-Signal Plate Current                     | 70          | 70      | mA       |
| Maximum-Signal Plate Current                  | 79          | 92      | mA       |
| Zero-Signal Grid-No.2 Current                 | 5           | 4       | mA       |
| Maximum-Signal Grid-No.2 Current              | 13          | 13.5    | mA       |
| Effective Load Resistance (Plate-to-Plate)    | 10000       | 8000    | ohms     |
| Total Harmonic Distortion                     | 5           | 3.5     | per cent |
| Maximum-Signal Power Output                   | 10          | 14      | watts    |
| MAXIMUM CIRCUIT VALUES:                       |             |         |          |
| Grid-No.1-Circuit Resistance:                 |             |         |          |
| For fixed-bias operation                      |             | 0.1 max | megohm   |
| For cathode-bias operation                    |             | 0.5 max | megohm   |
| Vertical Deflection Amplifier (Tric           | de Connect  | tion)*  |          |
| For operation in a 525-line, 30-f             | rame system |         |          |
| MAXIMUM RATINGS (Design-Maximum Values):      |             |         |          |

#### V Plata Valtaga

| DC Plate Voltage                                     | 350 max  | volts |
|------------------------------------------------------|----------|-------|
| Peak Positive-Pulse Plate Voltage#                   | 1200 max | volts |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage | 275 max  | volts |
| Peak Cathode Current                                 | 115 max  | mA    |
| Average Cathode Current                              | 40 max   | mA    |
| Plate Dissipation                                    | 10 max   | watts |
|                                                      |          |       |

## MAXIMUM CIRCUIT VALUE: Grid-No.1-Circuit Resistance:

For cathode-bias operation .....

\* Grid No.2 connected to plate.

# The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In

a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

### HALF-WAVE VACUUM RECTIFIER

## 6W4GT

Glass octal type used as damper tube in television receivers. Outline 13D, Outlines section. This type may be supplied with pin No.1 omitted. Tube requires octal socket and may be mounted in any position. Socket ter-



2.2 max megohms

4CG

minals 1, 2, 4, and 6 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Power-rectifier operation of this type is not recommended.

| Heater Voltage (ac)                           | 1.2 | amperes |
|-----------------------------------------------|-----|---------|
| Heater Current                                | 6.3 | volts   |
| Direct Interelectrode Capacitances (Approx.): |     |         |
| Plate to Cathode and Heater                   | 6   | pF      |
| Cathode to Plate and Heater                   | 13  | pF      |
| Heater to Cathode                             | 7   | pF      |
|                                               |     |         |

#### **Damper Service**

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Center Values):        |          |       |
|------------------------------------------------|----------|-------|
| Peak Inverse Plate Voltage (Absolute Maximum)* | 3850 max | volts |
| Peak Plate Current                             | 750 max  | mA,   |
| DC Plate Current                               | 125 mar  | mΔ    |

volts

volts

ohms

1600

#### Technical Data

| Plate Dissipation                                                                                    | 3.5 max             | watts          |
|------------------------------------------------------------------------------------------------------|---------------------|----------------|
| Heater negative with respect to cathode (Absolute Maximum)*  Heater positive with respect to cathode | 2300=max<br>300=max | volts<br>volts |
| CUADACTEDISTICS Instantaneous Value                                                                  |                     |                |

\* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

Tube Voltage Drop for plate current of 250 mA .....



Grid-No.1 Voltage

#### **BEAM POWER TUBE**

Glass octal type used in the audio output stage of radio and television receivers. Triode-connected, it is used as a vertical deflection amplifier in television receivers. Outline 13D, Outlines section. This type may be supplied

6W6GT Related type: 12W6GT

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with pin No.1 omitted. Tube requires octal socket and may be mounted in any position. Type 12W6GT is identical with type 6W6GT except for the heater ratings,

| as shown below.                                                                            |         |          |         |
|--------------------------------------------------------------------------------------------|---------|----------|---------|
|                                                                                            | 6W6GT   | 12W6GT   |         |
| Heater Voltage (ac/dc)                                                                     | 6.3     | 12.6     | volts   |
| Heater Current                                                                             | 1.2     | 0.6      | ampere  |
| Heater Warm-up Time (Average)                                                              | _       | 11       | seconds |
| Peak Heater-Cathode Voltage:                                                               |         |          |         |
| Heater negative with respect to cathode                                                    | 200 max | 300#max  | volts   |
| Heater positive with respect to cathode                                                    | 200 max | 200 max  | volts   |
| Direct Interelectrode Capacitances (Approx.):                                              |         |          | -       |
| Grid No.1 to Plate                                                                         |         | 0.8      | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.                                      | 3       | 15       | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid. No.3                                        |         | 9        | pF      |
| # The dc component must not exceed 200 volts.  The dc component must not exceed 100 volts. |         |          |         |
| Class A, Amplifier                                                                         |         |          |         |
| MAXIMUM RATINGS (Design-Maximum Values):                                                   |         |          |         |
| Plate Voltage                                                                              |         | 330 max  | volts   |
| Grid-No.2 (Screen-Grid) Voltage                                                            |         | 165 max  | voits   |
| Plate Dissipation                                                                          |         | 12 max   | watts   |
| Grid-No.2 Input                                                                            |         | 1.35 max | watts   |
| TYPICAL OPERATION:                                                                         |         |          |         |
| Plate Supply Voltage                                                                       | 110     | 200      | volts   |

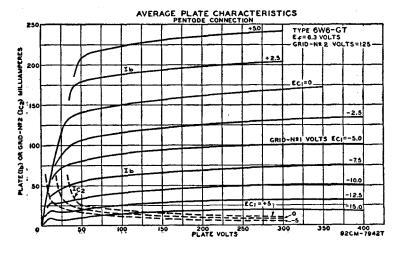
| Plate Dissipation                     |       | 12 max   | watts    |
|---------------------------------------|-------|----------|----------|
| Grid-No.2 Input                       |       | 1.35 max | watts    |
| TYPICAL OPERATION:                    |       |          |          |
| Plate Supply Voltage                  | 110   | 200      | volts    |
| Grid-No.2 Supply Voltage              | 110   | 125      | volts    |
| Grid-No.1 (Control-Grid) Voltage      | -7.5  |          | volts    |
| Cathode-Bias Resistor                 |       | 180      | ohms     |
| Peak AF Grid-No.1 Voltage             | 7.5   | 8.5      | volts    |
| Zero-Signal Plate Current             | 49    | 46       | mA       |
| Maximum-Signal Plate Current          | 50    | 47       | mA       |
| Zero-Signal Grid-No.2 Current         | 4     | 2.2      | mA       |
| Maximum-Signal Grid-No.2 Current      | 10    | 8.5      | mA       |
| Plate Resistance (Approx.)            | 13000 | 28000    | ohma     |
| Transconductance                      | 8000  | 8000     | µmhos    |
| Load Resistance                       | 2000  | 4000     | ohms     |
| Total Harmonic Distortion (Approx.)   | 10    | 10       | per cent |
| Maximum-Signal Power Output           | 2.1   | 3.8      | watts    |
| CHARACTERISTICS (Triode Connection)*: |       |          |          |
|                                       |       |          |          |
| Plate Voltage                         |       | 225      | voits    |

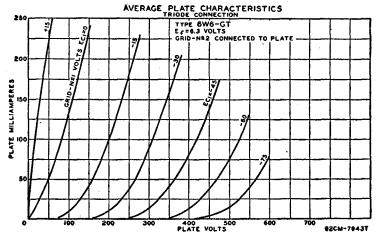
Amplification Factor ..... Plate Resistance (Approx.)

The dc component must not exceed 500 volts. ▲ The dc component must not exceed 100 volts.

| Transconductance Plate Current Grid No.1 Voltage (Approx.) for plate current of 0.5 mA | 3800<br>22<br>42 | μmhos<br>mA<br>volts |
|----------------------------------------------------------------------------------------|------------------|----------------------|
| MAXIMUM CIRCUIT VALUES:                                                                |                  |                      |
| Grid-No.1 Circuit Resistance: For fixed-bias operation For cathode-bias operation      |                  | x megohm<br>x megohm |

• Grid No. 2 connected to plate.





#### **Vertical Deflection Amplifier**

For operation in a 525-line, 30-frame system

|                                                           | Triode              | Pentode               |       |
|-----------------------------------------------------------|---------------------|-----------------------|-------|
| MAXIMUM RATINGS (Design-Maximum Values): DC Plate Voltage | Connection* 330 max | Connection<br>330 max | volts |
| Peak Positive-Pulse Plate Voltage†                        | 1200 max            | 1500 max              | volts |
| DC Grid No.2 (Screen-Grid) Voltage                        |                     | 165 max               | volts |

| Peak Negative-Pulse Grid-No.1 Voltage                    | -275 max | -275 max volts  |
|----------------------------------------------------------|----------|-----------------|
| Peak Cathode Current                                     | 195 max  | 195 max mA      |
| Average Cathode Current                                  | 65 max   | 65 max mA       |
| Plate Dissipation                                        | 8.5 max  | 8 max watts     |
| Grid-No.2 Input                                          | _        | 1.2 max watts   |
| MAXIMUM CIRCUIT VALUE:                                   |          |                 |
| Grid-No.1-Circuit Resistance: For cathode-bias operation | 2.2 max  | 2.2 max megohms |

<sup>\*</sup> Grid No.2 connected to plate.

† The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.



### **FULL-WAVE VACUUM RECTIFIER**

Miniature type used in power supply of automobile and ac-operated radio receivers. Equivalent in performance to larger type 6X5GT. Type 6X4 requires miniature seven-contact socket and may be mounted in any position.

6X4
Related type:
12X4

Outline 5D, Outlines section. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. For discussion of Rating Chart and Operation Characteristics, refer to Interpretation of Tube Data. Type 12X4 is identical with type 6X4 except for the heater ratings, as shown below.

| Heater Voltage (ac/dc)                                                                                         | 6X4<br>6.3▲        | 12X4<br>12.6       | volts          |
|----------------------------------------------------------------------------------------------------------------|--------------------|--------------------|----------------|
| Heater Current                                                                                                 | 0.6                | 0.3                | ampere         |
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode | 450 max<br>200•max | 450 max<br>200•max | volts<br>volts |

A When the heater is operated from a 3-cell (nominal-6-volt) storage-battery source, the permissible heater-voltage range is from 5 to 8 volts.

#### Full-Wave Rectifier

| MAXIMUM KATINGS (Design-maximum values):    |                  |
|---------------------------------------------|------------------|
| Peak Inverse Plate Voltage                  | 1250 max volts   |
| Steady-State Peak Plate Current (Per Plate) | 245 max mA       |
| AC Plate Supply Voltage (Per Plate, rms)    | See Rating Chart |
| DC Output Voltage (At filter input)†        | 350 max voits    |
| DC Output Current (Each plate)†             | 45 max mA        |

<sup>†</sup> This rating applies when the 6X4 is used in vibrator operation with a minimum duty cycle of 75 per cent.

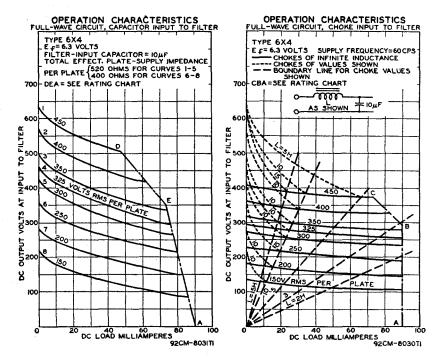
<sup>#</sup> If hot-switching is regularly required in operation, the use of choke-input circuits is recommended. Such circuits limit the hot-switching current to a value no higher than that of the peak plate current. When capacitor-input circuits are used, a maximum peak current value per plate of 1.1 amperes during the initial cycles of the hot-switching transient should not be exceeded.

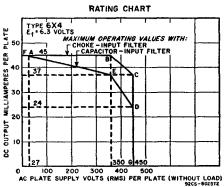
| Sine-Wave | Operation               | Vibrator Operation                          |                                       |
|-----------|-------------------------|---------------------------------------------|---------------------------------------|
| Capacitor | Choke                   | Capacitor                                   |                                       |
| 325       | 400                     |                                             | volts                                 |
| 10        | ·                       | 10                                          | $\mu$ <b>F</b>                        |
| 525       | _                       | <del></del>                                 | ohms                                  |
|           | 10                      |                                             | henries                               |
| . 70      | 70                      | 70                                          | mA                                    |
| 310       | 340                     | 240                                         | volts                                 |
|           | Capacitor 325 10 525 70 | Capacitor Choke 325 400 10 — 525 — 10 70 70 | 325 400 — 10 — 10 525 — — 70 70 70 70 |

<sup>·</sup> AC plate supply voltage is measured without load.

Hot-Switching Transient Plate Current .....

<sup>•</sup> The dc component must not exceed 100 volts.





### **FULL-WAVE VACUUM RECTIFIER**

## 6X5GT

Glass octal type used in power supply of automobile and ac-operated receivers. Outline 13D, Outlines section. This type may be supplied with pin No.1 omitted. Tube requires octal socket and may be operated in any position.



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For maximum ratings, and typical operation, refer to type 6X4.

#### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTOBE



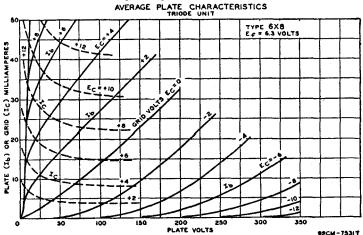
Miniature type used as combined oscillator and mixer tube in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. In such service, the 6X8 gives performance comparable to that

OAO Related types: 5X8, 19X8

obtainable with a 6AG5 mixer and an oscillator consisting of one unit of a type 6J6. When used in an AM/FM receiver, the triode unit is used as an oscillator for both sections. In the AM section, the pentode unit is used as a high-gain pentode mixer; in the FM section, the pentode unit is used either as a pentode mixer or as a triode-connected mixer depending on signal-to-noise considerations. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Types 5X8 and 19X8 are identical with type 6X8 except for the heater ratings, as shown below.

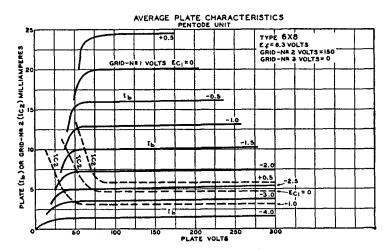
| orko oncope for the mouter fathings, as onco  |           |          |           |         |
|-----------------------------------------------|-----------|----------|-----------|---------|
| -                                             | 5X8       | 6X8      | 19X8      |         |
| Heater Voltage (ac/dc)                        | 4.7       | 6.3      | 18.4      | volts   |
| Heater Current                                | 0.6       | 0.45     | 0.15      | ampere  |
| Heater Warm-up Time (Average)                 | 11        | _        | _         | seconds |
| Peak Heater-Cathode Voltage:                  |           |          |           |         |
| Heater negative with respect to cathode       | 200 max   | 200 max  | 200 max   | volts   |
| Heater positive with respect to cathode       | 200 = max | 200 max  | 200 max   | volts   |
| •                                             |           | Without  | With      |         |
| Direct Interelectrode Capacitances:           |           | External | External  |         |
| Triode Unit:                                  |           | Shield   | Shield*   |         |
| Grid to Plate                                 |           | 1.5      | 1.5       | pF      |
| Grid to Cathode and Heater                    |           | 2        | 2.4       | pF      |
| Plate to Cathode and Heater                   |           | 0.5      | 1         | pF      |
| Pentode Unit:                                 |           |          |           |         |
| Grid No.1 to Plate                            |           | 0.09 max | 0.06 max  | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2       | , and     |          |           |         |
| Grid No.3                                     |           | 4,6      | 4.8       | рF      |
| Plate to Cathode, Heater, Grid No.2, and Grid | No.3      | 0.9      | 1.6       | pF      |
| Pentode Grid No.1 to Triode Plate             |           | 0.05 max | 0.04 max  | pF      |
| Pentode Plate to Triode Plate                 |           | 0.05 max | 0.008 max | рF      |
| Heater to Cathode                             |           | 6.5      | 6.5       | pF      |
|                                               |           |          |           |         |

- The dc component must not exceed 100 volts.
- ▲ With external shield connected to cathode except as noted.
- With external shield connected to pentode plate.



#### Class A, Amplifier

| oluco il illipino.                                     |                        |                       |             |
|--------------------------------------------------------|------------------------|-----------------------|-------------|
| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage | Triode Unit<br>275 max | Pentode Un<br>275 max | it<br>volts |
| Grid No.2 (Screen-Grid) Supply Voltage                 | _                      | 275 max               | volts       |
| Grid-No.2 Voltage                                      | _                      |                       | e page 80   |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value  | 0 max                  | 0 max                 | volts       |
| Plate Dissipation                                      | 1.7 max                | 2.3 max               | watts       |
| Grid-No.2 Input:                                       | 1.7 LOWA               | 2.5 1114              | watto       |
| For grid-No.2 voltages up to 137.5 volts               | _                      | 0.45 max              | watt        |
| For grid-No.2 voltages between 137.5 and 275 volts     | _                      | See curv              | e page 80   |
| CHARACTERISTICS:                                       | Triode Unit            | Pentode Uni           | t           |
| Plate Voltage                                          | 125                    | 125                   | volts       |
| Grid No.3                                              | Connect                | ed to cathode         | at socket   |
| Grid-No.2 Voltage                                      |                        | 125                   | volt        |
| Grid-No.1 Voltage                                      | -1                     | -1                    | volt        |
| Amplification Factor                                   | 40                     |                       |             |
| Plate Resistance (Approx.)                             | 12                     | 9                     | mA          |
| Transconductance                                       | _                      | 2.2                   | mA          |
| Plate Current                                          | 6000                   | 300000                | ohms        |
| Grid-No.2 Current                                      | 6500                   | 5500                  | umhos       |
| Grid-No.1 Voltage (Approx.) for plate current of 10 µA | <del>-</del> 7         | -6.5                  | volts       |



#### **BEAM POWER TUBE**

## 6Y6GA/ 6Y6G

Glass octal type used as output amplifier in radio receivers. Also used in rf-operated, high-voltage power supplies in television equipment. Outline 19B, Outlines section. Tube requires octal socket and may be mounted in any position.

| G2(4)(5)G1 |
|------------|
| P3/21      |
| Y L ]      |
|            |
|            |
| NC G3      |
| ***        |

7AC

| Heater Voltage (ac/dc)                        | 6.3     | volts   |
|-----------------------------------------------|---------|---------|
| Heater Current                                | 1.25    | amperes |
| Peak Heater-Cathode Voltage:                  |         |         |
| Heater negative with respect to cathode       | 180 max | volts   |
| Heater positive with respect to cathode       | 180 max | volts   |
| Direct Interelectrode Capacitances (Approx.): |         |         |
| Grid No.1 to Plate                            | 0.7     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2,      |         |         |
| and Grid No.3                                 | 12      | pF      |

0.4

10

2.8

6200

5000

14

megohm

μmhos

mΑ

mΑ

| Plate to Cathode, Heater, Grid No.2, and Grid No.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                    | 7.5                                                                                              | рF                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------|
| and Old 1100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                    |                                                                                                  |                                          |
| Class A, Amplifie                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | r                                                                                                                                                  |                                                                                                  |                                          |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                    | 200                                                                                              | volts                                    |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                    | 200 max<br>200 max                                                                               | volts                                    |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                    |                                                                                                  | e page 80                                |
| Grid-No.2 Input:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                    | 1.75 max                                                                                         | watts                                    |
| For grid-No.2 voltages up to 100 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                    |                                                                                                  | e page 80                                |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                    | 12.5 max                                                                                         | watts                                    |
| TYPICAL OPERATION:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                    |                                                                                                  |                                          |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 135                                                                                                                                                | 200                                                                                              | volts                                    |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 135                                                                                                                                                | 135                                                                                              | volts                                    |
| Grid-No.1 (Control-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | -13.5                                                                                                                                              | -14                                                                                              | volts<br>volts                           |
| Peak AF Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 13.5<br>58                                                                                                                                         | 14<br>61                                                                                         | mA                                       |
| Maximum-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 60                                                                                                                                                 | 66                                                                                               | mA                                       |
| Zero-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 3.5                                                                                                                                                | 2.2                                                                                              | mA                                       |
| Maximum-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 11.5<br>9300                                                                                                                                       | 9<br>18300                                                                                       | mA<br>ohms                               |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 7000                                                                                                                                               | 7100                                                                                             | μmhos                                    |
| Load Resistance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2000                                                                                                                                               | 2600                                                                                             | ohms                                     |
| Total Harmonic Distortion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 10<br>3.6                                                                                                                                          | 10<br>6                                                                                          | per cent<br>watts                        |
| Maximum-Signal Power Output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 3.0                                                                                                                                                | v                                                                                                | ***************************************  |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                    |                                                                                                  |                                          |
| Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                    | 0.1                                                                                              | maaahm                                   |
| For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                    |                                                                                                  | megohm<br>megohm                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                    |                                                                                                  |                                          |
| Pafer to type 8EO7/8CG7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                    | occ.                                                                                             | 7                                        |
| Refer to type 8FQ7/8CG7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                    | 8CG                                                                                              | 7                                        |
| ,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | DE                                                                                                                                                 | 8CG                                                                                              | 7                                        |
| H MEDIUM-MU TRIC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                    |                                                                                                  |                                          |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                    | 8CG                                                                                              |                                          |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | NTODE mbined os-                                                                                                                                   | 9 <b>A</b> 8                                                                                     |                                          |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE<br>Miniature types used as co<br>cillator and mixer tubes in                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | NTODE mbined os- n vhf tele-                                                                                                                       | 9 <b>A</b> 8                                                                                     |                                          |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE<br>SHARP-CUTOFF PE<br>Miniature types used as co-<br>cillator and mixer tubes in<br>vision receivers. Outline 61                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | mbined os-<br>n vhf tele-<br>B, Outlines                                                                                                           | 9A8                                                                                              | <b>3</b>                                 |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE<br>Miniature types used as co<br>cillator and mixer tubes in<br>vision receivers. Outline 61<br>section. Tubes require mini                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | mbined os-<br>n vhf tele-<br>B, Outlines<br>ature nine-                                                                                            | 9 <b>A</b> 8                                                                                     | <b>3</b>                                 |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE<br>Miniature types used as co<br>cillator and mixer tubes in<br>vision receivers. Outline of<br>section. Tubes require mini<br>contact socket and may be                                                                                                                                                                                                                                                                                                                                                                                                                                                          | mbined os-<br>n vhf tele-<br>B, Outlines<br>ature nine-<br>e mounted                                                                               | 9A8                                                                                              | <b>3</b>                                 |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE<br>Miniature types used as co<br>cillator and mixer tubes in<br>vision receivers. Outline 61<br>section. Tubes require mini<br>contact socket and may be<br>in any position. Heater vo                                                                                                                                                                                                                                                                                                                                                                                                                            | NTODE  mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc),                                                                       | 9A8<br>9A8<br>PCF8                                                                               | }<br>/<br>80                             |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE<br>Miniature types used as co-<br>cillator and mixer tubes in<br>vision receivers. Outline 60<br>section. Tubes require mini-<br>contact socket and may be<br>in any position. Heater vo<br>9; amperes, 0.3; peak heater-cathode volts, 200                                                                                                                                                                                                                                                                                                                                                                       | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negati                                                               | 9A8<br>9A8<br>PCF8                                                                               | 3<br>/<br>80<br>spect to                 |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as concillator and mixer tubes in vision receivers. Outline 61 section. Tubes require minicontact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 voltage.                                                                                                                                                                                                                                                                                                                                             | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negati                                                               | 9A8<br>9A8<br>PCF8                                                                               | 3<br>/<br>80<br>spect to                 |
| MEDIUM-MU TRIC<br>SHARP-CUTOFF PE<br>Miniature types used as co-<br>cillator and mixer tubes in<br>vision receivers. Outline 60<br>section. Tubes require mini-<br>contact socket and may be<br>in any position. Heater vo<br>9; amperes, 0.3; peak heater-cathode volts, 200                                                                                                                                                                                                                                                                                                                                                                       | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negati                                                               | 9A8<br>9A8<br>PCF8                                                                               | 3<br>/<br>80<br>spect to                 |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as concillator and mixer tubes in vision receivers. Outline 61 section. Tubes require minicontact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 voltage.                                                                                                                                                                                                                                                                                                                                             | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negativolts), 100 vol                                                | 9A8<br>9A8<br>PCF8                                                                               | 3<br>/<br>80<br>spect to                 |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as co-cillator and mixer tubes in vision receivers. Outline 61 section. Tubes require minicontact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A <sub>1</sub> Amplified MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                    | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negati volts), 100 vol                                               | 9A8<br>9A8<br>PCF8<br>ve with re<br>ts (heater                                                   | BO<br>spect to<br>positive               |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as co-cillator and mixer tubes in vision receivers. Outline 60 section. Tubes require minimodon contact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A <sub>1</sub> Amplified MAXIMUM RATINGS (Design-Center Values): Plate Supply Voltage                                                                                                                                                                                                                         | mbined os- n vhf tele- B, Outlines iature nine- ie mounted lts (ac/dc), (heater negati olts), 100 vol                                              | 9A8<br>9A8<br>PCF8<br>ve with re<br>ts (heater                                                   | Spect to positive                        |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as co-cillator and mixer tubes in vision receivers. Outline 60 section. Tubes require minicontact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A <sub>1</sub> Amplified MAXIMUM RATINGS (Design-Center Values):  Plate Supply Voltage                                                                                                                                                                                                                              | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negati volts), 100 vol                                               | 9A8<br>9A8<br>PCF8<br>ve with re<br>ts (heater                                                   | BO<br>spect to<br>positive               |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as concillator and mixer tubes in vision receivers. Outline 60 section. Tubes require minicontact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A <sub>1</sub> Amplified MAXIMUM RATINGS (Design-Center Values):  Plate Supply Voltage Plate Voltage Grid-No.2 (Screen-Grid) Voltage Cathode Current                                                                                                                                                                | mbined os- n vhf tele- B, Outlines iature nine- ee mounted lts (ac/dc), (heater negati volts), 100 vol  Triode Unit 550 max 250 max - 14 max       | 9A8 9A8 PCF8 ve with re ts (heater  Pentode Ur 550 max 250 max 175 max 14 max                    | spect to positive volts volts wolts mA   |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as co-cillator and mixer tubes in vision receivers. Outline 60 section. Tubes require minicontact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A, Amplifier  MAXIMUM RATINGS (Design-Center Values):  Plate Supply Voltage Plate Voltage Grid-No.2 (Screen-Grid) Voltage Cathode Current Plate Dissipation                                                                                                                                                         | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negati /olts), 100 vol  Triode Unit 550 max 250 max                  | 9A8 9A8 PCF8 ve with re ts (heater  Pentode Ur 550 max 250 max 175 max 14 max 1.7 max            | spect to positive volts volts mA watts   |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as concillator and mixer tubes in vision receivers. Outline 60 section. Tubes require minicontact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A, Amplified MAXIMUM RATINGS (Design-Center Values): Plate Supply Voltage Plate Voltage Grid-No.2 (Screen-Grid) Voltage Cathode Current Plate Dissipation Grid-No.2 Input                                                                                                                                           | mbined os- n vhf tele- B, Outlines iature nine- ee mounted lts (ac/dc), (heater negati volts), 100 vol  Triode Unit 550 max 250 max - 14 max       | 9A8 9A8 PCF8 ve with re ts (heater  Pentode Ur 550 max 250 max 175 max 14 max                    | spect to positive volts volts wolts mA   |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as co- cillator and mixer tubes in vision receivers. Outline 60 section. Tubes require minicontact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A, Amplifier  MAXIMUM RATINGS (Design-Center Values): Plate Supply Voltage Plate Voltage Grid-No.2 (Screen-Grid) Voltage Cathode Current Plate Dissipation Grid-No.2 Input  CHARACTERISTICS:                                                                                                                       | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negati volts), 100 vol  Triode Unit 550 max 250 max 1.5 max          | 9A8 9A8 PCF8 ve with re ts (heater  Pentode Ur 550 max 250 max 14 max 1.7 max 0.5 max            | spect to positive volts volts mA watts   |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as co- cillator and mixer tubes in vision receivers. Outline 60 section. Tubes require mini contact socket and may be in any position. Heater vo  9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A <sub>1</sub> Amplifier  MAXIMUM RATINGS (Design-Center Values): Plate Supply Voltage Plate Voltage Grid-No.2 (Screen-Grid) Voltage Cathode Current Plate Dissipation Grid-No.2 Input  CHARACTERISTICS: Plate Voltage                                                                                           | mbined os- n vhf tele- B, Outlines iature nine- ee mounted lts (ac/dc), (heater negati volts), 100 vol  Triode Unit 550 max 250 max - 14 max       | 9A8 PCF8 ve with rets (heater  Pentode Ur 550 max 250 max 175 max 14 max 1.7 max 1.7 max 1.7 max | spect to positive volts volts watts watt |
| MEDIUM-MU TRICE SHARP-CUTOFF PE  Miniature types used as co- cillator and mixer tubes in vision receivers. Outline for section. Tubes require minicontact socket and may be in any position. Heater vo  9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A <sub>1</sub> Amplified  MAXIMUM RATINGS (Design-Center Values): Plate Supply Voltage Plate Voltage Grid-No.2 (Screen-Grid) Voltage Cathode Current Plate Dissipation Grid-No.2 Input  CHARACTERISTICS: Plate Voltage Grid-No.1 Voltage Grid-No.1 Voltage Grid-No.1 Voltage Grid-No.1 Voltage Grid-No.1 Voltage | mbined os- n vhf tele- B, Outlines ature nine- e mounted lts (ac/dc), (heater negati volts), 100 vol  Triode Unit 550 max 250 max 1.5 max          | 9A8 9A8 PCF8 ve with re ts (heater  Pentode Ur 550 max 250 max 14 max 1.7 max 0.5 max            | spect to positive volts volts mA watts   |
| MEDIUM-MU TRIC SHARP-CUTOFF PE  Miniature types used as co-cillator and mixer tubes in vision receivers. Outline 61 section. Tubes require minic contact socket and may be in any position. Heater vo 9; amperes, 0.3; peak heater-cathode volts, 200 cathode, dc component must not exceed 120 with respect to cathode).  Class A <sub>1</sub> Amplified  MAXIMUM RATINGS (Design-Center Values): Plate Supply Voltage Plate Voltage Grid-No.2 (Screen-Grid) Voltage Cathode Current Plate Dissipation Grid-No.2 Input  CHARACTERISTICS: Plate Voltage Grid-No.2 Voltage Grid-No.2 Voltage                                                         | mbined os- n vhf tele- B, Outlines lature nine- ee mounted lts (ac/dc), (heater negati volts), 100 vol  Triode Unit 550 max 250 max 14 max 1.5 max | 9A8 PCF8  ve with re ts (heater  Pentode Ur 550 max 250 max 175 max 1.7 max 0.5 max 170 170      | spect to positive volts volts watts watt |

Plate Resistance (Approx.)

Transconductance

Plate Current

Grid-No.2 Current

#### **MAXIMUM CIRCUIT VALUES:**

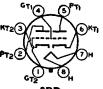
| Grid-No.1-Circuit Resistance: |         |                |
|-------------------------------|---------|----------------|
| For fixed-bias operation      | 0.5 max | 0.5 max megohm |
| For cathode-bias operation    | 0.5 max | 1 max megohm   |

Grid No.2 to Grid No.1.

#### **DUAL TRIODE**

10EG7

Glass octal type used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers employing series-connected heater strings. Outline 13B, Outlines section. Tube requires octal socket



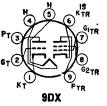
8BD

and may be operated in any position. Heater volts (ac/dc), 9.7; amperes, 0.6; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode). For maximum ratings and characteristics, refer to type 6EW7.

### HIGH-MU TRIODE— SHARP-CUTOFF TETRODE

**10JA8** 

Miniature type used in color and black-and-white television receivers employing series-connected heater strings. The triode unit is used as a sync separator, sync clipper, and phase inverter; the tetrode unit is used as a



video amplifier. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 10.5; amperes, 0.45; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

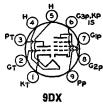
#### Class A, Amplifier

| MAXIMUM RATINGS (Design-M         | aximum '                                             | Values):    | Tri | ode Unit  | Tetrode U | Init       |
|-----------------------------------|------------------------------------------------------|-------------|-----|-----------|-----------|------------|
| Plate Voltage                     |                                                      |             | 30  | 00 max    | 330 ma    | x volts    |
| Grid-No.2 (Screen-Grid) Supply Vo | oltage                                               |             |     | _         | 330 ma    | x volts    |
| Grid-No.2 Voltage                 |                                                      |             |     | -         | See cur   | ve page 80 |
| Grid-No.1 (Control-Grid) Voltage, | id-No.1 (Control-Grid) Voltage, Positive-bias value. |             |     | 0 max     | 0 max     | x volts    |
| Plate Dissipation                 |                                                      |             |     | 1 max     | 5 max v   | x watts    |
| Grid-No.2 Input:                  |                                                      |             |     |           |           |            |
| For grid-No.2 voltages up to 1    | 65 volts .                                           |             |     | _         | 1.5 ma    | x watts    |
| For grid-No.2 voltages betwee     | n 165 and                                            | 1 330 volts | -   | -         | See cui   | ve page 80 |
| CHARACTERISTICS:                  | Trio                                                 | le Unit     | Т   | etrode Ui | nit       |            |
| Plate Voltage                     | 135                                                  | 200         | 30  | 135       | 200       | volts      |
| Grid-No.2 Voltage                 | _                                                    |             | 135 | 135       | 135       | volts      |
| Grid-No.1 Voltage                 | -2                                                   | -2          | 0   | -1.5      | 1.5       | volts      |
| Amplification Factor              | 60                                                   | 70          |     |           | _         |            |
| Plate Resistance                  | 23000                                                | 17000       |     | 6600      | 7000      | ohms       |
| Transconductance                  | 2600                                                 | 4000        | _   | 12600     | 14000     | $\mu$ mhos |
| Plate Current                     | 2                                                    | 4           | 32• | 17        | 18        | mA         |
| Grid-No.2 Current                 |                                                      |             | 14. | 4.2       | 4         | mA         |
| Grid-No.1 Voltage (Approx.) for   |                                                      |             |     |           |           |            |
| plate current of 10 #A            | 4.8                                                  | <b>—7</b>   |     | -5        | -5        | volts      |

| MAXIMUM      | CIRCUIT    | VALUES: |
|--------------|------------|---------|
| Grid-No.1-Ci | rcuit Resi | stance: |

| rid-No.1-Circuit Resistance: | Triode Unit | Tetrode Unit    |
|------------------------------|-------------|-----------------|
| For fixed-bias operation     | 0.5 max     | 0.25 max megohm |
| For cathode-bias operation   | 1 max       | 1 max megohm    |
|                              |             |                 |

• This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.



### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type used in a variety of applications in television receivers. The pentode unit is used as a video amplifier, and the triode unit as a sync separator. Outline 6E, Outlines section. Tube requires miniature nine-

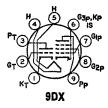
**10JY8** 

contact socket and may be mounted in any position. Heater volts (ac/dc), 10.5; amperes, 0.45; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when heater is positive with respect to cathode; this value may be 300 volts for the triode unit when heater is negative with respect to cathode, with a maximum peak value of 200 volts).

### Class A, Amplifier

| oldus ni niipini                                                                                                                                                                                                           |                                                       |                                      |                                                                   |                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------|
| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation                                    | Triode Unit 330 max  - 0 max 2 max                    | 33(<br>33)<br>S                      | ode Uni ) max ) max ee curve ) max max                            | volts<br>volts<br>e page 80<br>volts<br>watts                         |
| Grid-No.2 Input: For grid-No.2 voltages up to 165 volts                                                                                                                                                                    |                                                       | ٠,                                   | 1 max                                                             | watts                                                                 |
| For grid-No.2 voltages between 165 and 330 volts.                                                                                                                                                                          | _                                                     |                                      |                                                                   | e page 80                                                             |
| CHARACTERISTICS:                                                                                                                                                                                                           |                                                       |                                      | 00 0011                                                           | page oo                                                               |
| Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid Voltage (Approx.) for plate current of 10 µA | 125<br>—<br>68<br>46<br>4400<br>10400<br>15<br>—<br>8 | 50<br>150<br>0<br><br><br>60=<br>18= | 200<br>150<br>—<br>100<br>—<br>55000<br>11000<br>24<br>4.8<br>—10 | volts<br>volts<br>volts<br>ohms<br>ohms<br>μmhos<br>mA<br>mA<br>volts |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation This value can be measured by a method involving a                                                               |                                                       |                                      | 1 max                                                             | megohm<br>megohm<br>he maxi-                                          |

This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.



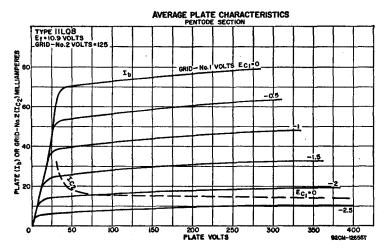
### MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Miniature type with frame-grid pentode used in black-and-white television receivers employing low-voltage power supplies and series-connected heater strings. The triode unit is used in general-purpose voltage-amplifier cir-

11LQ8

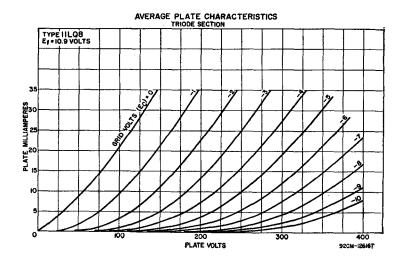
cuits. The pentode unit is used in video-output circuits. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                    | 10.9                                                                                                               | volts                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Heater Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                    | 0.45                                                                                                               | ampere                                                                                      |
| Heater Warm-up Time (Average)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    | 11                                                                                                                 | seconds                                                                                     |
| Peak Heater-Cathode Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |                                                                                                                    |                                                                                             |
| Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                    | 200 max                                                                                                            | volts                                                                                       |
| Heater positive with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                    | 200*max                                                                                                            | volts                                                                                       |
| Direct Interelectrode Capacitances (Approx.):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |                                                                                                                    | .01.0                                                                                       |
| Triode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |                                                                                                                    |                                                                                             |
| Grid to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    | 2.8                                                                                                                | рF                                                                                          |
| Grid to Triode Cathode, Pentode Cathode, He                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ater. Pentode                      |                                                                                                                    | P-                                                                                          |
| Grid No.3, and Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                    | 4.2                                                                                                                | pF                                                                                          |
| Plate to Triode Cathode, Pentode Cathode, He                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |                                                                                                                    | P                                                                                           |
| Grid No.3, and Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                    | 2.4                                                                                                                | рF                                                                                          |
| Pentode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |                                                                                                                    | F-                                                                                          |
| Grid No.1 to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                    | 0.12 max                                                                                                           | pF                                                                                          |
| Grid No.1 to Cathode, Heater, Grid No.2, Gr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | id No.3. and                       |                                                                                                                    | *-                                                                                          |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | •                                  | 14                                                                                                                 | pF                                                                                          |
| Plate to Cathode, Heater, Grid No.2, Grid N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | lo.3. and                          |                                                                                                                    | ν-                                                                                          |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                    | 4.8                                                                                                                | рF                                                                                          |
| Triode Grid to Pentode Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    | 0.015 max                                                                                                          | ρF                                                                                          |
| Pentode Plate to Triode Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    | 0.17 max                                                                                                           | pF                                                                                          |
| * The dc component must not exceed 100 volts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    | ***************************************                                                                            | Ρ-                                                                                          |
| The de component must not exceed 100 voits.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                    |                                                                                                                    |                                                                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                    |                                                                                                                    |                                                                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 110                                |                                                                                                                    |                                                                                             |
| Class A <sub>1</sub> Am <sub>1</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                    |                                                                                                                    |                                                                                             |
| MAXIMUM RATINGS (Design-Maximum Values)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : Triode Unit                      | Pentode Uni                                                                                                        | t                                                                                           |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : Triode Unit                      | Pentode Uni<br>300 max                                                                                             | t<br>volts                                                                                  |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                               | : Triode Unit                      |                                                                                                                    | -                                                                                           |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                             | Triode Unit 300 max                | 300 max<br>300 max                                                                                                 | volts                                                                                       |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                               | Triode Unit 300 max                | 300 max<br>300 max                                                                                                 | volts<br>volts                                                                              |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation                                                                                                                                                                                                                                                                                                                                                     | Triode Unit 300 max  0 max         | 300 max<br>300 max<br>See curv                                                                                     | volts<br>volts<br>e page 80                                                                 |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                                                                                                                                                                                                                                                       | Triode Unit 300 max  0 max         | 300 max<br>300 max<br>See curv<br>0 max                                                                            | volts<br>volts<br>e page 80<br>volts                                                        |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation                                                                                                                                                                                                                                                                                                                                                     | Triode Unit 300 max  - 0 max 2 max | 300 max<br>300 max<br>See curv<br>0 max                                                                            | volts<br>volts<br>e page 80<br>volts                                                        |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input:                                                                                                                                                                                                                                                                                                                                    | Triode Unit 300 max  - 0 max 2 max | 300 max<br>300 max<br>See curv<br>0 max<br>5 max                                                                   | volts<br>volts<br>e page 80<br>volts<br>watts                                               |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages                                                                                                                                                                                                                                         | Triode Unit 300 max  - 0 max 2 max | 300 max<br>300 max<br>See curv<br>0 max<br>5 max                                                                   | volts<br>volts<br>e page 80<br>volts<br>watts                                               |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts                                                                                                                                                                                                                                                                                             | Triode Unit 300 max  - 0 max 2 max | 300 max<br>300 max<br>See curv<br>0 max<br>5 max                                                                   | volts<br>volts<br>e page 80<br>volts<br>watts                                               |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages                                                                                                                                                                                                                                         | Triode Unit 300 max  - 0 max 2 max | 300 max<br>300 max<br>See curv<br>0 max<br>5 max                                                                   | volts<br>volts<br>e page 80<br>volts<br>watts                                               |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages CHARACTERISTICS: Plate Supply Voltage                                                                                                                                                                                                   | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv                                              | volts volts e page 80 volts watts  watt e page 80 volts                                     |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltage CHARACTERISTICS: Plate Supply Voltage 1 Grid-No.2 Supply Voltage                                                                                                                                                                                           | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv                                              | volts volts e page 80 volts watts  watt e page 80  volts volts                              |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Cathode-Bias Resistor                                                                                                                                                                      | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv                                              | volts volts e page 80 volts watts  watt e page 80 volts                                     |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Cathode-Bias Resistor Amplification Factor                                                                                                                               | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv                                              | volts volts e page 80 volts watts  watt e page 80  volts volts                              |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages CHARACTERISTICS: Plate Supply Voltage 1 Grid-No.2 Supply Voltage 1 Grid-No.2 Supply Voltage Cathode-Bias Resistor Amplification Factor                                                                                                  | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv<br>200<br>125<br>68                          | volts volts e page 80 volts watts  watt e page 80  volts volts ohms                         |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages CHARACTERISTICS: Plate Supply Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) 44 Transconductance 104                                                                                                                       | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv<br>200<br>125<br>68                          | volts volts volts e page 80 volts watts  watt e page 80  volts volts ohms                   |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages CHARACTERISTICS: Plate Supply Voltage 16 Grid-No.2 Supply Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) 104 Transconductance 104 Plate Current                                                                            | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv<br>200<br>125<br>68<br><br>75000<br>23000    | volts volts volts e page 80 volts watts  watt e page 80  volts volts volts ohms  µmhos      |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) 44 Transconductance 104                                                                                              | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv<br>200<br>125<br>68<br>-75000<br>23000<br>20 | volts volts volts volts watts  watt e page 80  volts volts volts volts volts ohms  µmhos mA |
| MAXIMUM RATINGS (Design-Maximum Values) Plate Voltage Grid-No.2 (Screen-Grid) Supply Voltage Grid-No.2 Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation Grid-No.2 Input: For grid-No.2 voltages up to 150 volts For grid-No.2 voltages between 150 and 300 voltages CHARACTERISTICS: Plate Supply Voltage Grid-No.2 Supply Voltage Cathode-Bias Resistor Amplification Factor Plate Resistance (Approx.) Transconductance 104 Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current | Triode Unit 300 max                | 300 max<br>300 max<br>See curv<br>0 max<br>5 max<br>1 max<br>See curv<br>200<br>125<br>68<br>-75000<br>23000<br>20 | volts volts volts volts watts  watt e page 80  volts volts volts volts volts ohms  µmhos mA |



#### **MAXIMUM CIRCUIT VALUES:**

| Grid-No.1-Circuit Resistance: |         |          |        |
|-------------------------------|---------|----------|--------|
| For fixed-bias operation      | 0.5 max | 0.1 max  | megohm |
| For cathode-bias operation    | 1 max   | 0.25 max | megohm |





### **BEAM POWER TUBE**

Miniature type used in the output stage of automobile radio receivers operating from a 12-volt storage battery. Outline 6E, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

12AB5

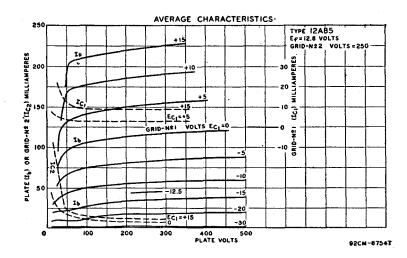
| 9EU                       | position.                                                            |       |                    |
|---------------------------|----------------------------------------------------------------------|-------|--------------------|
|                           | c/dc)* .) at 12.6 volts                                              |       |                    |
|                           | respect to cathode                                                   |       | max volts          |
| Direct Interelectrode Car | respect to cathode                                                   | 90    | max volts          |
| Grid No.1 to Cathod       | le, Heater, Grid No.2, and Grid No.3 eater, Grid No.2, and Grid No.3 | . 8   | max pF<br>pF<br>pF |
|                           | recommended that the heater be operated                              |       | voltage range      |
|                           | Class A, Amplifier                                                   |       |                    |
| MAXIMUM RATINGS           |                                                                      |       |                    |
|                           | <u></u>                                                              |       | max volts          |
|                           | Voltage                                                              |       | max volts          |
|                           |                                                                      |       | max watts          |
| Grid-No.2 Input           |                                                                      | . 2   | max watts          |
| Bulb Temperature (At ho   | ettest point)                                                        | 250   | max °C             |
| TYPICAL OPERATION         | WITH 12.6 VOLTS ON HEATER:                                           |       |                    |
| Plate Supply Voltage      |                                                                      | 250   | volts              |
| Grid-No.2 Supply Voltag   | e 200                                                                | 250   | volts              |
| Grid-No.1 (Control-Grid)  | Voltage –                                                            | -12.5 | volts              |
| Cathode-Bias Resistor     | 270                                                                  | _     | oħms               |

| Peak AF Grid-No.1 Voltage        | 10.5  | 12.5    | volts         |
|----------------------------------|-------|---------|---------------|
| Zero-Signal Plate Current        | 33.5  | 45      | mA            |
| Maximum-Signal Plate Current     | 36    | 47      | mA            |
| Zero-Signal Grid-No.2 Current    | 1.6   | 4.5     | mA            |
| Maximum-Signal Grid-No.2 Current | 3.2   | 7       | mÀ            |
| Plate Resistance (Approx.)       | 75000 | 50000   | ohms          |
| Transconductance                 | 4000  | 4100    | μmho <b>s</b> |
| Load Resistance                  | 6000  | 5000    | ohms          |
| Total Harmonic Distortion        | 8     | 8       | per cent      |
| Maximum-Signal Power Output      | 3.3   | 4.5     | watts         |
| MAXIMUM CIRCUIT VALUES:          |       |         |               |
| Grid-No.1-Circuit Resistance:    |       |         |               |
| For fixed-bias operation         |       | 0.1 max | megohm        |
| For cathode-bias operation       |       | 0.5 max | megohm        |

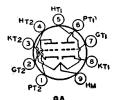
### Push-Pull Class AB, Amplifier

MAXIMUM RATINGS: (Same as for single-tube class A1 amplifier)

| TYPICAL OPERATION WITH 12.6 VOLTS ON HEATER (Values are | for two tubes): |       |
|---------------------------------------------------------|-----------------|-------|
| Plate Voltage                                           | 250             | volts |
| Grid-No.2 Voltage                                       | 250             | volts |
| Grid-No.1 Voltage                                       | 15              | volts |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage                  | 30              | volts |
| Zero-Signal Plate Current                               | 70              | mA    |
| Maximum-Signal Plate Current                            | 79              | mA    |
| Zero-Signal Grid-No.2 Current                           | 5               | mA    |
| Maximum-Signal Grid-No.2 Current                        | 13              | mA    |



| Effective Load Resistance (Plate-to-Plate) Total Harmonic Distortion Maximum-Signal Power Output | 10000<br>5<br>10 | ohms<br>per cent<br>watts |
|--------------------------------------------------------------------------------------------------|------------------|---------------------------|
| MAXIMUM CIRCUIT VALUES:                                                                          |                  |                           |
| Grid-No.1-Circuit Resistance: For fixed-bias operation                                           |                  | megohm                    |



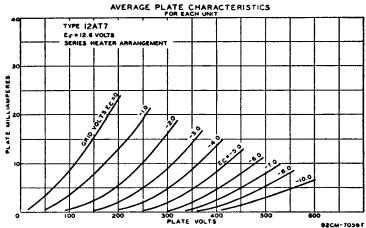
### HIGH-MU TWIN TRIODE

Miniature types used as push-pull cathode-drive amplifiers or frequency converters in the FM and television broadcast bands. Outline 6B, Outlines section. Tubes require miniature nine-contact socket and may be

## 12AT7/ 12AT7/ ECC81

mounted in any position. Each triode unit is independent of the other except for the common heater. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section.

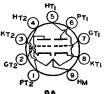
| Time A                                                 |                                         |          |               |
|--------------------------------------------------------|-----------------------------------------|----------|---------------|
| Heater Arrangement:                                    | Series                                  | Parallel |               |
| Heater Voltage (ac/dc)                                 | 12.6                                    | 6.3      | volt <b>s</b> |
| Heater Current                                         | 0.15                                    | 0.3      | ampere        |
| Peak Heater-Cathode Voltage:                           |                                         |          | -             |
| Heater negative with respect to cathode                |                                         | 90 max   | volta         |
| Heater positive with respect to cathode                |                                         | 90 max   | volts         |
| Direct Interelectrode Capacitances:                    |                                         |          |               |
| Grid-Drive Operation:                                  |                                         |          |               |
| Grid to Plate (Each unit)                              |                                         | 1.5      | ρF            |
| Grid to Cathode and Heater (Each unit)                 | • • • • • • • • • •                     | 2.2      | ρF            |
| Plate to Cathode and Heater:                           |                                         | . 2.2    | þr.           |
| Unit No.1                                              |                                         | 0.5      |               |
| Unit No.2                                              |                                         | 0.4      | pF            |
| Cathode-Drive Operation:                               |                                         | 0.4      | pF            |
|                                                        |                                         |          | _             |
| Cathode to Plate (Each Unit)                           |                                         | 0.2      | рF            |
| Cathode to Grid and Heater (Each unit)                 | · · · · · · · · · · · ·                 | 4.6      | p <u>F</u>    |
| Plate to Grid and Heater (Each unit)                   |                                         | 1.8      | рF            |
| Heater to Cathode (Each unit)                          |                                         | 2.4      | рF            |
| Class A, Amplifier (Each                               | unit)                                   |          |               |
| MAXIMUM RATINGS (Design-Center Values):                | •                                       |          |               |
| Plate Voltage                                          |                                         | 300 max  | volts         |
| Grid Voltage, Negative-bias value                      | • • • • • • • • • • • • • • • • • • • • | -50 max  | volts         |
| Plate Dissipation                                      | · · · · · · · · · · · · · · ·           | 2.5 max  |               |
| CHARACTERISTICS:                                       | • • • • • • • • • •                     | 2.5 max  | watts         |
|                                                        | 400                                     |          | -             |
| Plate Supply Voltage                                   | 100                                     | 250      | volts         |
| Cathode-Bias Resistor                                  | 270                                     | 200      | ohm <b>s</b>  |
| Amplification Factor                                   | 60                                      | 60       |               |
| Plate Resistance (Approx.)                             | 15000                                   | 10900    | ohm <b>s</b>  |
| Transconductance                                       | 4000                                    | 5500     | μmhos         |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A | <b>-5</b>                               | -12      | volts         |
| Plate Current                                          | 3.7                                     | 10       | mA            |
|                                                        |                                         |          |               |



## **12AU7A** 12AU7A/ ECC82 Related types:

### MEDIUM-MU TWIN TRIODE

Miniature types used as phase inverters KT2(3 or push-pull amplifiers in ac/dc radio equipment and in diversified applications such as multivibrators or oscillators in industrial control devices. Also used as combined vertical oscil-



12AT77A

Uarizontal

lators and vertical deflection amplifiers, and as horizontal deflection oscillators, in television receivers. These types are also useful in applications critical as to microphonics. Outline 6B, Outlines section. Tubes require miniature nine-contact socket and may be mounted in any position. Each triode unit is independent of the other except for the common heater. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. Types 7AU7 and 9AU7 are identical with types 12AU7A and 12AU7A/ECC82 except for the heater ratings, as shown below.

|                                                        |        |                   | 12AU/A     |         |
|--------------------------------------------------------|--------|-------------------|------------|---------|
|                                                        |        |                   | 12AU7A/    |         |
| Heater Voltage (ac/dc):                                | 7AU7   | 9AU7              | ECC82      |         |
| Series                                                 | 7      | 9.4               | 12.6       | volts   |
| Parallel                                               | 3.5    | 4.7               | 6.3        | volts   |
| Heater Current:                                        |        |                   |            |         |
| Series                                                 | 0.3    | 0.225             | 0.15       | ampere  |
| Parallel                                               | 0.6    | 0.45              | 0.3        | ampere  |
| Heater Warm-up Time (Parallel, Average)                | 11     | 11                | _          | seconds |
| Peak Heater-Cathode Voltage:                           |        |                   |            |         |
| Heater negative with respect to cathode                | 200 m  | ax - 200 max      | 200 max    | volts   |
| Heater positive with respect to cathode                | 200°m  | ax 200 max        | 200 max    | volts   |
| Direct Interelectrode Capacitances (Approx.):          |        | Unit No.1         | Unit No.2  |         |
| Grid to Plate                                          |        | 1. 5              | 1.5        | pF      |
| Grid to Cathode and Heater                             |        | 1.6               | 1.6        | pF      |
| Plate to Cathode and Heater                            |        | 0.5               | 0.35       | pF      |
| • The dc component must not exceed 100 volts.          |        |                   |            | -       |
| •                                                      |        |                   |            |         |
| Class A, Amplifier (Each Unit                          | Unless | Otherwise 5       | Specified) |         |
| MAXIMUM RATINGS (Design-Maximum Values                 |        |                   |            |         |
| Plate Voltage                                          |        |                   | 330 max    | volts   |
| Plate Dissipation:                                     |        |                   | JJO Max    | VOICE   |
| Each Plate                                             |        |                   | 2.75 max   | watts   |
| Both Plates (Both units operating)                     |        |                   | 5.5 max    | watts   |
| Cathode Current                                        |        |                   | 22 max     | mA      |
| CHARACTERISTICS:                                       |        | • • • • • • • • • | LL IIIAX   | uizs    |
|                                                        |        | 400               | 450        |         |
| Plate Voltage                                          |        | 100               | 250        | volts   |
| Grid Voltage                                           |        | 10.5              | -8.5       | volts   |
| Amplification Factor                                   |        | 19.5              | 17         |         |
| Plate Resistance (Approx.)                             |        | 6250              | 7700       | ohms    |
| Transconductance                                       |        | 3100              | 2200       | μmhos   |
| Plate Current                                          |        | 11.8              | 10.5       | mA      |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A |        |                   | -24        | volts   |
| MAXIMUM CIRCUIT VALUES:                                |        |                   |            |         |
| Grid-Circuit Resistance:                               |        |                   |            |         |
| For fixed-bias operation                               |        |                   | 0.25 max   |         |
| For cathode-bias operation                             |        |                   | 1.0 max    | megohm  |
| Oscillator (Each Unit Unit                             | ss Oth | erwise Spec       | ified)     |         |

### Oscillator (Each Unit Unless Otherwise Specified)

For operation in a 525-line, 30-frame system Vertical

| verucai-   | Horizontai-                                                                     |                                                                                               |
|------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Deflection | Deflection                                                                      |                                                                                               |
| Oscillator | Oscillator                                                                      |                                                                                               |
| 330 max    | 330 max                                                                         | voits                                                                                         |
| -440 max   | 660 max                                                                         | volts                                                                                         |
| 66 max     | 330 max                                                                         | mA                                                                                            |
| 22 max     | 22 max                                                                          | mA                                                                                            |
|            |                                                                                 |                                                                                               |
| 2.75 max   | 2.75 max                                                                        | watts                                                                                         |
| 5.5 max    | 5.5 max                                                                         | watts                                                                                         |
|            | Deflection<br>Oscillator<br>330 max<br>-440 max<br>66 max<br>22 max<br>2.75 max | Deflection Oscillator   330 max   330 max   -660 max   330 max   22 max   2.75 max   2.75 max |

#### MAXIMUM CIRCUIT VALUE:

Grid-Circuit Resistance ...... 2.2 max 2.2 max megohms

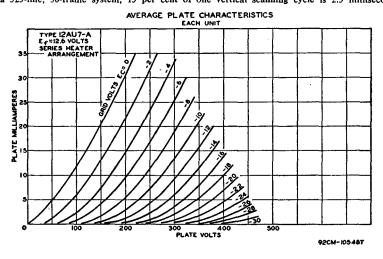
### Vertical-Deflection Amplifier (Each Unit Unless Otherwise Specified)

| vertical-benection Ampliner (Each Unit Unless Other | wise Sp | ecine | :a)   |
|-----------------------------------------------------|---------|-------|-------|
| For operation in a 525-line, 30-frame system        |         |       |       |
| MAXIMUM RATINGS (Design-Maximum Values):            |         |       |       |
| DC Plate Voltage                                    | 330     | max   | voits |
| Peak Positive-Pulse Plate Voltage#                  | 1200    | max   | volts |
| Peak Negative-Pulse Grid Voltage                    | 275     | max   | volts |
| Peak Cathode Current                                | 66      | max   | mA    |
| Average Cathode Current                             | 22      | max   | mA    |
| Plate Dissipation:                                  |         |       |       |
| Each Plate                                          | 2.75    | max   | watts |
| Both Plates (Both units operating)                  | 5.5     | max   | watts |
|                                                     |         |       |       |

#### MAXIMUM CIRCUIT VALUES:

Grid-Circuit Resistance:

For cathode-bias operation ..... 2.2 max megohms # The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.



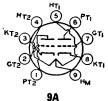


### SHARP-CUTOFF PENTODE

Miniature type used as an rf or if amplifier up to 400 megacycles in compact ac/dc FM receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket. Heater volts (ac/dc), 12.6; amperes, 0.15. Ex-

**12AW6** 

cept for heater ratings and terminal connections, this type is identical with miniature type 6AG5.



### HIGH-MU TWIN TRIODE

76T1 Miniature types used as phase inverters or twin resistance-coupled amor plifiers in radio equipment. These types have controlled hum and noise characteristics and are used in high-fidelity audio-amplifier applications. Outline

**12AX7A** 12AX7A/ ECC83

6B, Outlines section. Tubes require miniature nine-contact socket and may be mounted in any position. Each triode unit is independent of the other except for common heater. For characteristics and curves, refer to type 6AV6. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section.

| Heater Arrangement:                                             | Series    | Parallel  |        |
|-----------------------------------------------------------------|-----------|-----------|--------|
| Heater Voltage (ac/dc)                                          | 12.6      | 6.3       | volts  |
| Heater Current                                                  | 0.15      | 0.3       | ampere |
| Peak Heater-Cathode Voltage:                                    |           |           | -      |
| Heater negative with respect to cathode                         |           | 200 max   | volts  |
| Heater positive with respect to cathode                         |           | 200 = max | volts  |
| Direct Interelectrode Capacitances (Approx.):                   | Unit No.1 | Unit No.2 |        |
| Grid to Plate (Each unit)                                       | 1.7       | 1.7       | pF     |
| Grid to Cathode and Heater (Each unit)                          | 1.6       | 1.6       | pF     |
| Plate to Cathode and Heater                                     | 0.46      | 0.34      | рF     |
| <ul> <li>The dc component must not exceed 100 volts.</li> </ul> |           |           |        |

### Class A. Amplifier (Each Unit)

| MAXIMUM RATINGS (Design-Maximum Values): |         |       |
|------------------------------------------|---------|-------|
| Plate Voltage                            | 330 max | volts |
| Plate Dissipation                        | 1.2 max | watts |
| Grid Voltage:                            |         |       |
| Negative-bias value                      | —55 max | volts |
| Positive-bias value                      | 0 max   | volts |
|                                          |         |       |

EQUIVALENT NOISE AND HUM VOLTAGE (Reference to Grid, Each Unit):

Average Value

1.8 μV rm

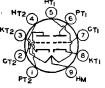
Measured in "true rms" units under the following conditions: Heater voltage (parallel co

• Measured in "true rms" units under the following conditions: Heater voltage (parallel connection), 6.3 volts ac; center tap of heater transformer grounded; plate supply voltage, 250 volts dc; plate load resistor, 100000 ohms; cathode resistor, 2700 ohms physased by 100-µF capacitor; grid resistor, 0 ohms; and amplifier covering frequency range between 25 and 10000 c/s.

### MEDIUM-MU TWIN TRIODE

12AY7

Miniature type used in the first stages KT2(3) of high-gain audio-frequency amplifiers where reduction of microphonics, leakage noise, and hum are primary considerations. Outline 6B, Outlines section. Tube requires miniature nine-



9A

contact socket and may be mounted in any position. Each triode unit is independent of the other except for the common heater. Use of the 12.6-volt connection with an ac heater supply is not recommended for applications involving low hum. For typical operation as a resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section.

| Heater Arrangement: Heater Voltage (ac/dc) Heater Current | Series<br>12.6<br>0.15 | Parallel<br>6.3<br>0.3 | volts<br>ampere |
|-----------------------------------------------------------|------------------------|------------------------|-----------------|
| Peak Heater-Cathode Voltage:                              |                        |                        |                 |
| Heater negative with respect to cathode                   |                        | 90 max                 | volts           |
| Heater positive with respect to cathode                   |                        | 90 max                 | volts           |
| Amplification Factor (Each unit)*                         |                        | 44                     |                 |
| Plate Resistance (Each unit, approx.)*                    |                        | 25000                  | ohms            |
| Transconductance*                                         |                        | 1750                   | $\mu$ mhos      |

<sup>\*</sup> For plate volts, 250; grid volts, -4; plate mA, 3.

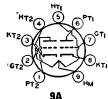
#### Class A, Amplifier (Each Unit)

| MAXIMUM RATINGS |                                       | -    |  |
|-----------------|---------------------------------------|------|--|
| Plate Voltage   | • • • • • • • • • • • • • • • • • • • | <br> |  |

300 max

volts

| Grid Voltage:       |         |       |
|---------------------|---------|-------|
| Negative bias value | -50 max | volts |
| Positive bias value | 0 max   | volts |
| Plate Dissipation   | 1.5 max | watts |
| Cathode Current     | 10 max  | mA    |



### HIGH-MU TWIN TRIODE

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For char-

**12AZ7A** 

acteristics, class A1 amplifier, refer to miniature type 12AT7.

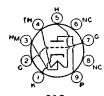
| Heater Voltage (ac/dc): Series               |          | 12.6     | volts   |
|----------------------------------------------|----------|----------|---------|
| Parallel                                     |          | 6.3      | volts   |
| Heater Current:                              |          |          |         |
| Series                                       |          | 0.225    | ampere  |
| Parallel                                     |          | 0.45     | атреге  |
| Heater Warm-up Time (Average)                | ·        | 11       | seconds |
| Peak Heater-Cathode Voltage:                 |          |          |         |
| Heater negative with respect to cathode      |          | 200 max  | volts   |
| Heater positive with respect to cathode      |          | 200°max  | volts   |
|                                              | Without  | With     |         |
|                                              | External | External |         |
| Direct Interelectrode Capacitance (Approx.): | Shield   | Shield*  |         |
| Grid to Plate (Each unit)                    | 2        | 1.9      | pF      |
| Grid to Cathode and Heater (Each unit)       | 2.6      | 2.8      | pF      |
| Plate to Cathode and Heater:                 |          |          | -       |
| Unit No.1                                    | 0.44     | 1.4      | pF      |
|                                              |          | 1.6      | ρF      |

## Class A. Amplifier (Fach Unit)

| MAXIMUM RATINGS (Design-Maximum Values): |                    |                |
|------------------------------------------|--------------------|----------------|
| Plate Voltage                            | 330 max<br>—55 max | volts<br>volts |
| Plate Dissipation                        | 2.5 max            | Walts          |
| MAXIMUM CIRCUIT VALUES (Each Unit):      |                    |                |

#### MAXIMUM CIRCUIT VALUES (Each Unit)

| Grid-Circuit Resistance:   |          |        |
|----------------------------|----------|--------|
| For fixed-bias operation   | 0.25 max | megohm |
| For cathode-bias operation | 1 max    | megohm |



### LOW-MU TRIODE

Miniature type having high perveance used as vertical deflection amplifier in television receivers. This type has a controlled heater warm-up time for use in series-connected heater strings. Outline 6E, Outlines section.

12B4A

9AG

Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 12.6 (series), 6.3 (parallel); amperes, 0.3 (series), 0.6 (parallel); warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

| Class | A, | Amp | lifier |
|-------|----|-----|--------|
|-------|----|-----|--------|

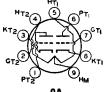
| MAXIMUM RATINGS (Design-Center Values):                 |                 |         |
|---------------------------------------------------------|-----------------|---------|
| Plate Voltage                                           | 550 max         | volts   |
| Grid Voltage, Negative-bias value                       | -50 max         | volts   |
| Plate Dissipation                                       | 5.5 max         | watts   |
| CHARACTERISTICS:                                        |                 |         |
| Plate Voltage                                           | 150             | volts   |
| Grid Voltage                                            | 17.5            | volts   |
| Amplification Factor                                    | 6.5             |         |
| Plate Resistance (Approx.)                              | 1030            | ohms    |
| Transconductance                                        | 6300            | μmhos   |
| Plate Current                                           | 34              | mA      |
| Grid Voltage (Approx.) for plate current of 200 $\mu$ A | -32             | volts   |
| Plate Current for grid voltage of -23 volts             | 9.6             | mA      |
| MAXIMUM CIRCUIT VALUES:                                 |                 |         |
| Grid-Circuit Resistance:                                |                 |         |
| For fixed-bias operation                                | 0.47 max        | megohm  |
| For cathode-bias operation                              | 2.2 max megohms |         |
|                                                         |                 | -       |
| Vertical Deflection Amplifier                           |                 |         |
| For operation in a 525-line, 30-frame system            |                 |         |
| MAXIMUM RATINGS (Design-Center Values):                 |                 |         |
| DC Plate Voltage                                        | 550 max*        | volts   |
| Peak Positive-Pulse Plate Voltage# (Absolute Maximum)   | 1000†max        | voits   |
| Peak Negative-Pulse Grid Voltage                        | -250 max        | volts   |
| Peak Cathode Current                                    | 105 max         | mA      |
| Average Cathode Current                                 | 30 max          | mA      |
| Plate Dissipation                                       | 5.5 max         | watts   |
| MAXIMUM CIRCUIT VALUE:                                  |                 |         |
| Grid-Circuit Resistance:                                |                 |         |
| For cathode-bias operation                              | 2.2 max r       | negohms |

# The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds. † Under no circumstances should this absolute value be exceeded.

### MEDIUM-MU TWIN TRIODE

## **12BH7A**

Miniature type used as combined vertical tical deflection amplifier and vertical oscillator, and as horizontal deflection oscillator, in television receivers. This type has a controlled heater warm-up time for use in series-connected heater



9A

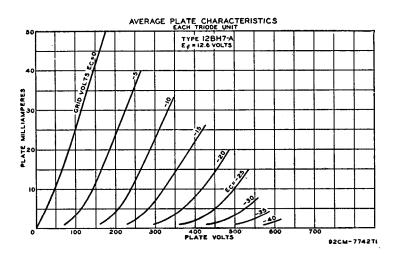
strings. Tube is also used in other applications including phase-inverter circuits and multivibrator circuits. Outline 6E, **Outlines** section. This tube requires miniature nine-contact socket and may be mounted in any position. Each triode unit is independent of the other except for the common heater.

| Heater Arrangement:                           | Series    | Paraliel  |         |
|-----------------------------------------------|-----------|-----------|---------|
| Heater Voltage (ac/dc)                        | 12.6      | 6.3       | volts   |
| Heater Current                                | 0.3       | 0.6       | ampere  |
| Heater Warm-up Time (Average)                 | _         | 11        | seconds |
| Peak Heater-Cathode Voltage:                  |           |           |         |
| Heater negative with respect to cathode       |           | 200 max   | volts   |
| Heater positive with respect to cathode       |           | 200 • max | volts   |
| Direct Interelectrode Capacitances (Approx.): | Unit No.1 | Unit No.2 |         |
| Grid to Plate                                 | 2.6       | 2.6       | pF      |
| Grid to Cathode and Heater                    | 3.2       | 3.2       | pF      |
| Plate to Cathode and Heater                   | 0.5       | 0.4       | pF      |
| Plate of Unit No.1 to Plate of Unit No.2      | 0.        | 8         | pF      |

<sup>•</sup> The dc component must not exceed 100 volts.

| Class | A, | Amplif | fier | (Each | Uni | t) |
|-------|----|--------|------|-------|-----|----|
|-------|----|--------|------|-------|-----|----|

| MAXIMUM RATINGS (Design-Center Values): Plate Voltage Grid Voltage: Negative-bias value Positive-bias value Cathode Current Plate Dissipation: Each Plate Both plates (Both units operating) | 300 max -50 max 0 max 20 max 7 max | volts volts volts mA watts watts |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------|
| CHARACTERISTICS:                                                                                                                                                                             |                                    | _                                |
| Plate Voltage                                                                                                                                                                                | 250                                | volts                            |
| Grid Voltage                                                                                                                                                                                 | -10.5                              | volts                            |
| Amplification Factor                                                                                                                                                                         | 16.5                               |                                  |
| Plate Resistance (Approx.)                                                                                                                                                                   | 5300                               | ohms                             |
| Transconductance                                                                                                                                                                             | 3100                               | μmho <b>s</b>                    |
| Grid Voltage (Approx.) for plate current of 50 $\mu$ A                                                                                                                                       | -23                                | volts                            |
| Plate Current                                                                                                                                                                                | 11.5                               | mA                               |
| Plate Current for grid voltage of -14 volts                                                                                                                                                  | 4                                  | mA                               |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                      |                                    |                                  |
| Grid-Circuit Resistance:                                                                                                                                                                     | 0.25                               |                                  |
| For fixed-bias operation                                                                                                                                                                     | 0.25 max                           | megohm<br>megohm                 |
| For cathode-bias operation                                                                                                                                                                   | 1.0 max                            | megonin                          |



#### Oscillator (Each Unit)

For operation in a 525-line, 30-frame system

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Vertical<br>Deflection | Horizontal<br>Deflection |         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------|---------|
| DEATHERING TO A MINISTER OF THE STATE OF THE | Oscillator             | Oscillator               |         |
| MAXIMUM RATINGS (Design-Center Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Oscillator             |                          |         |
| DC Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 450 max                | 450 max                  | volts   |
| Peak Negative-Pulse Grid Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 400 max                | 600 max                  | volts   |
| Peak Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 70 max                 | 300 max                  | mA      |
| Average Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 20 max                 | 20 max                   | mA      |
| Plate Dissipation:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                        |                          |         |
| Each Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3.5 max                | 3,5 max                  | watts   |
| Both Plates (Both units operating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 7 max                  | ,7 max                   | watts   |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |                          |         |
| Grid-Circuit Resistance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2.2 max                | 2.2 max n                | negohms |

### Vertical Deflection Amplifier (Each Unit)

For operation in a 525-line, 30-frame system

|                                                       | 50 max | volts |
|-------------------------------------------------------|--------|-------|
| Peak Positive-Pulse Plate Voltage# (Absolute maximum) | 00*max | volts |
|                                                       | 50 max | volts |
|                                                       | 70 max | mA    |
| Average Cathode Current                               | 20 max | mA    |
| Plate Dissipation:                                    |        |       |
| Each Plate                                            | .5 max | watts |
|                                                       | 7 max  | watts |

#### MAXIMUM CIRCUIT VALUE:

Grid-Circuit Resistance:

For cathode-bias operation .....

2.2 max megohms

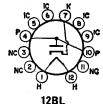
# The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

\* Under no circumstances should this absolute value be exceeded.

### HALF-WAVE VACUUM RECTIFIER

# 12BT3

Duodecar type used as damper tube in horizontal-deflection circuits of television receivers. Outline 8C, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 12.6; amperes, 0.45.



#### **Damper Service**

For operation in a 525-line, 30-frame system

Tube Voltage Drop for plate current of 250 mA max .....

| Peak Inverse Plate Voltage#             | 3300 max | volts |
|-----------------------------------------|----------|-------|
| Peak Plate Current                      | 1000 max | mA    |
| DC Plate Current                        | 165 max  | mA    |
| Plate Dissipation                       | 5.3 max  | watts |
| Peak Heater-Cathode Voltage:            |          |       |
| Heater negative with respect to cathode | 3300 max | volts |
| Heater positive with respect to cathode | 300=max  | volts |
| CHADACTEDISTICS Instantaneous Value     |          |       |

#### ACTERISTICS, Instantaneous Value:

# The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning

- cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- The dc component must not exceed 600 volts.
- The dc component must not exceed 100 volts.

### SHARP-CUTOFF PENTODE

# **12BY7A**

Miniature type used as video amplifier in television receivers. This type has a controlled heater warm-up time for use in series-connected heater strings. Outline 6E, Outlines section. Tubes require miniature nine-contact socket and may be mounted in any position.

| <sup>H</sup> |
|--------------|
| 63<br>15(3)  |
|              |
| CIE CE       |
| M. C.        |
| 9RF          |

| Heater V | Arrangement:<br>/oltage (ac/dc)<br>Current | Series<br>12.6<br>0.3 | Parallel<br>6.3<br>0.6 | volts<br>ampere |
|----------|--------------------------------------------|-----------------------|------------------------|-----------------|
|          | Varm-up Time (Average)                     | U.3<br>—              | 0.6<br>11              | seconds         |

0.25 max megohn 1 max megohn

| Peak Heater-Cathode Voltage: Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 200 max     | volts    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| Heater positive with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 200° max    | volts    |
| Direct Interelectrode Capacitances: Grid No.1 to Plate Grid No.1 to Plate Grid No.2 Crid No.2 Cr | 0.063       | pF       |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield  Plate to Cathode, Heater, Grid No.2, and Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 10.2<br>3.5 | pF<br>pF |
| * The dc component must not exceed 100 volts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |          |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |          |
| Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 330 max     | volts    |
| Grid-No.3 (Suppressor-Grid) Voltage, Positive value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0 max       | volts    |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 190 max     | volts    |
| Grid-No.1 (Control-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |          |
| Negative-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | —55 max     | volts    |
| Positive-hias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0 max       | volts    |

#### AVERAGE PLATE CHARACTERISTICS TYPE 12BY7-A E¢=12.6 VOLTS SERIES HEATER ARRANGEMENT. GRID N=3 AND INTERNAL SHIELD CONNECTED TO CATHODE AY SOCKET, GRID-N=2 VOLTS=180 120 EC1=+2.0 PLATE MILLIAMPERES +1.0 +0.5 GRID-Nº I VOLTS ECI=0 -0.5 -1.0 -2.0 40 -3.0 Ec1=-4.0 -5.0 200 00 400 PLATE VOLTS 600 500 700 92CM-9234TL

| Grid-No.2 Input                                             | 1.2 max          | watts     |
|-------------------------------------------------------------|------------------|-----------|
| Plate Dissipation                                           | 6.5 max          | watts     |
| CHARACTERISTICS:                                            |                  |           |
| Plate Supply Voltage                                        | 250              | volts     |
| Grid No.3 Conn                                              | ected to cathode | at socket |
| Grid-No.2 Supply Voltage                                    | 180              | volts     |
| Cathode-Bias Resistor                                       | 100              | ohms      |
| Plate Resistance (Approx.)                                  | 93000            | ohms      |
| Transconductance                                            | 11000            | µmho:     |
| Plate Current                                               | 26               | mA        |
| Grid-No.2 Current                                           | 5.75             | mA        |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu$ A | -11.6            | volts     |
| MAXIMUM CIRCUIT VALUES:                                     |                  |           |
| Grid-No 1-Circuit Resistance:                               |                  |           |

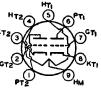
For fixed-bias operation ......

For cathode-bias operation .....

### HIGH-MU TWIN TRIODE

12BZ7

Miniature type used in sync-separator KT2(3 and sync-amplifier circuits of television receivers. This tube is also used GT (2) in clipping circuits and in generalpurpose audio amplifier applications. Outline 6E, Outlines section. Tube re-



quires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 12.6 (series), 6.3 (parallel); amperes, 0.3 (series), 0.6 (parallel); peak heater-cathode volts, 180.

### Class A, Amplifier (Each Unit)

| MAXIMUM RATINGS (Design-Center Values): |         |         |
|-----------------------------------------|---------|---------|
| Plate Voltage                           | 300 max | volts   |
| Grid Voltage:                           |         |         |
| Negative-bias value                     | -50 max | volts   |
| Positive-bias value                     | 0 max   | volts   |
| Plate Dissipation                       | 1.5 max | watts   |
| CHARACTERISTICS:                        |         |         |
| Plate Voltage                           | 250     | volts   |
| Grid Voltage                            | —2      | volts   |
| Amplification Factor                    | 100     |         |
| Plate Resistance (Approx.)              | 31800   | ohms    |
| Transconductance                        | 3200    | μmhos   |
| Plate Current                           | 2.5     | mA      |
| MAXIMUM CIRCUIT VALUE:                  |         |         |
| Grid-Circuit Resistance:                |         |         |
| For contact-potential-bias operation    | 5 max r | megohms |

12C5

Refer to type 12CU5/12C5.

12CU6

Refer to type 12BQ6GTB/12CU6.

HALF-WAVE VACUUM RECTIFIER

12D4

Glass octal type used as damper diode in horizontal-deflection circuits of television receivers employing seriesconnected heater strings. Outline 13D, Outlines section. Tube requires octal socket and may be mounted in any

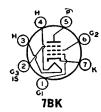


position. Socket terminals 1, 2, 4, and 6 should not be used as tie points. This type may be supplied with pin 1 omitted. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds.

### **Damper Service**

| For operation in a 525-line, 30-trame system |                   |       |
|----------------------------------------------|-------------------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):     |                   |       |
| Peak Inverse Plate Voltage#                  | 4400 max          | volts |
| Peak Plate Current                           | 900 max           | mA    |
| DC Plate Current                             | 155 max           | mA    |
| Plate Dissipation                            | 5.5 max           | watts |
| Peak Heater-Cathode Voltage:                 |                   | _     |
| Heater negative with respect to cathode#     | 4400 <b>≜</b> max | volts |
| Heater positive with respect to cathode      | 300 = max         | volts |

- #The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds. The dc component must not exceed 900 volts.
- The dc component must not exceed 100 volts.



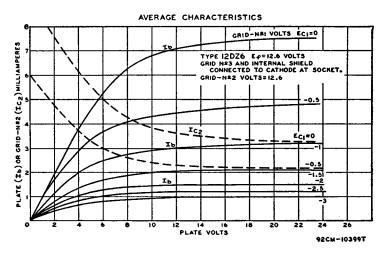
### **REMOTE-CUTOFF PENTODE**

Miniature type used as rf and if amplifier in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

12DZ6

| Heater-Voltage Range (ac/dc)                                            | to 15.9  | volts  |
|-------------------------------------------------------------------------|----------|--------|
| Heater Current (Approx.) at 12.6 volts                                  | 0.19     | ampere |
| Peak Heater-Cathode Voltage:                                            |          | ••     |
| Heater negative with respect to cathode                                 | 16 max   | volts  |
| Heater positive with respect to cathode                                 | 16 max   | volts  |
| Direct Interelectrode Capacitances:                                     |          |        |
| Grid No.1 to Plate                                                      | 0.05 max | pF     |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield | 9.5      | pF     |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and<br>Internal Shield  | 4        | pF     |

• For longest life, it is recommended that the heater be operated within the voltage range of 11 to 14 volts.



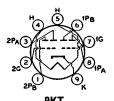
#### MAXIMUM RATINGS (Design-Maximum Values): volts 16 max Plate Voltage 16 max volts Grid-No.2 (Screen-Grid) Voltage ... volts 0 max Grid-No.1 (Control-Grid) Voltage, Positive-bias value CHARACTERISTICS WITH 12.6 VOLTS ON HEATER: volts 12.6 Plate Voltage ...... Connected to cathode at socket Grid No.3 12.6 volts Grid-No.2 Voltage 0 volts Grid-No.1 Supply Voltage ..... megohm 10 Grid-No.1 Resistor (Bypassed) .....

| Grid-No.3 Resistor (Bypassed) Plate Resistance (Approx.) Transconductance Grids No.1 and No.3 Supply Voltage (Approx.) for transconductance, | 10<br>25000<br>3800 | megohms<br>ohms<br>μmhos |
|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|
| grid No.1 to plate, of 10 µmhos                                                                                                              | -10<br>4.5          | volts<br>mA              |
| Grid-No.2 Current                                                                                                                            | 2.2                 | mA                       |
| MAXIMUM CIRCUIT VALUES:                                                                                                                      |                     |                          |
| Grid-No.3-Circuit Resistance Crid-No.3-Circuit Resistance                                                                                    |                     | ax megohms<br>ax megohms |

### HIGH-MU TWIN DOUBLE-PLATE TRIODE

12FQ8

Miniature type used in frequencydivider and complex-wave-generator circuits of electronic musical instruments. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any



position. Heater volts (ac/dc), 12.6; amperes, 0.15; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A. Amplifier (Each Unit)

| CHARACTERISTICS:           |       |       |
|----------------------------|-------|-------|
| Plate Voltage              | 250   | volts |
| Grid Voltage               | -1.5  | volts |
| Amplification Factor       | 95    |       |
| Plate Resistance (Approx.) | 76000 | ohms  |
| Transconductance           | 1250  | μmhos |
| Plate Current              | 1.5   | mA    |

• Using either plate A or plate B, with plate not in use connected to ground.

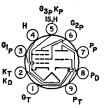
### Frequency-Divider and Complex-Wave Generator (Each Unit)

MAXIMUM RATINGS (Design-Maximum Values): 330 max Plate A Voltage ..... volts Plate B Voltage ..... 330 max volts Grid Voltage, Positive-bias value ..... volts 0 max Plate A Dissipation ..... 0.5 max watt 0.5 max Plate B Dissipation .... watt

### DIODE—MEDIUM-MU TRIODE— REMOTE-CUTOFF PENTODE

12FR8

Miniature type used as if amplifier, audio amplifier, and second detector in receivers operating directly from 12-volt battery. Outline 6K, Outlines section. Tube requires miniature ninecontact socket and may be operated



9KU

in any position. Heater voltage (ac/dc), 12.6; amperes, 0.32; peak heater-cathode voltage, 16.

| Unit | Unit                         | Unit                   | 14                                             |
|------|------------------------------|------------------------|------------------------------------------------|
| _    | 16 max                       |                        | volts<br>volts                                 |
|      | -                            |                        | voits                                          |
|      | _                            | 10 max                 | mA                                             |
| 3    |                              |                        | IIIA                                           |
| 10   | 12.6                         | 12.6                   | volts                                          |
|      | Diode<br>Unit<br>—<br>—<br>5 | Unit Unit - 16 max 5 - | Unit Unit Unit - 16 max 16 max 16 max 5 16 max |

| Grid-No.2 Voltage                                  | _ | _           | 12.6   | volts   |
|----------------------------------------------------|---|-------------|--------|---------|
| across a 2.2-megohm resistor                       |   | 0.6*        | -0.8   | volt    |
| Transconductance                                   | _ | 1200        | 2700   | umhos   |
| Plate Resistance (Approx.)                         |   | _           | 0.4    | megohm  |
| Amplification Factor                               | _ | 10          | _      |         |
| Plate Current                                      | 2 | 1           | 1.9    | mA      |
| Grid No.2 Current                                  |   | _           | 0.7    | mA      |
| Grid-No.1 Voltage for transconductance of          |   |             |        |         |
| 30 μmhos                                           |   |             | -2.8   | volts   |
| Grid-No.1 Voltage for plate current of 10 $\mu$ A. |   | <b>—3.5</b> | _      | volts   |
| MAXIMUM CIRCUIT VALUES:                            |   |             |        |         |
| Grid-No.1-Circuit Resistance                       | _ | 10 max      | 10 max | megohms |
|                                                    |   |             |        |         |

<sup>\*</sup> Developed across a 2.2-megohm grid-No.1 resistor.



### **POWER PENTODE**

Miniature type used in output stages of audio amplifiers employing series-connected heater strings. Outline 5D, Outlines section. Type 60FX5 is identical with type 12FX5 except for the heater ratings, as shown below.

12FX5
Related type: 60FX5

| 7 <b>CV</b>            | the heater ratings, as show           | vn below.                       |         |            |
|------------------------|---------------------------------------|---------------------------------|---------|------------|
|                        |                                       | 12FX5                           | 60FX5   |            |
| Heater Voltage (ac/de  | e)                                    | 12.6                            | 60      | volts      |
|                        |                                       | 0.45                            | 0.1     | ampere     |
|                        | e (Average)                           | 11                              | _       | seconds    |
| Peak Heater-Cathode    |                                       |                                 |         |            |
| Heater negative w      | ith respect to cathode                | 200 max                         | 200 max | volts      |
|                        | ith respect to cathode                | 200*max                         | 200*max | volts      |
| Direct Interelectrode  | Capacitances (Approx.):               |                                 |         |            |
| Grid No.1 to Plat      | te                                    |                                 | 0.65    | ₽F         |
|                        | hode, Heater, Grid No.2, and Grid     |                                 | 17      | pF         |
| Plate to Cathode,      | Heater, Grid No.2, and Grid No.3      |                                 | 9       | pF         |
| * The dc component r   | nust not exceed 100 volts.            |                                 |         |            |
|                        | Class A Amplifion                     | •                               |         |            |
|                        | Class A, Amplifier                    |                                 |         |            |
| MAXIMUM RATING         | S (Design-Maximum Values):            |                                 |         |            |
| Plate Voltage          |                                       |                                 | 150 max | voits      |
| Grid-No.2 (Screen-Grid | d) Voltage                            |                                 | 130 max | volts      |
| Plate Dissipation      | · · · · · · · · · · · · · · · · · · · |                                 | 5.5 max | watts      |
|                        |                                       |                                 | 2 max   | watts      |
| Bulb Temperature (At   | hottest point)                        |                                 | 225 max | °C         |
| TYPICAL OPERATION      | N:                                    |                                 |         |            |
| Plate Supply Voltage   |                                       |                                 | 110     | volts      |
|                        | Itage                                 |                                 | 115     | volts      |
| Cathode-Bias Resistor  |                                       |                                 | 62      | ohms       |
| Peak AF Grid-No.1 V    | Voltage                               |                                 | 3       | volte      |
|                        | rent                                  |                                 | 36      | mA         |
|                        | Current                               |                                 | 35      | mA         |
| Zero-Signal Grid No.:  | 2 Current                             |                                 | 10      | mA         |
|                        | No.2 Current                          |                                 | 12      | mA         |
|                        |                                       |                                 | 17500   | ohms       |
|                        |                                       |                                 | 13500   | $\mu$ mhos |
|                        |                                       |                                 | 3000    | ohms       |
|                        | ortion                                |                                 |         | per cent   |
| Maximum-Signal Power   | er Output                             | · · · · · · · · · · · · · · · · | 1.3     | watts      |
| MAXIMUM CIRCUIT        | Γ VALUES:                             |                                 |         |            |
| Grid-No.1-Circuit Resi | stance:                               |                                 |         |            |
|                        | eration                               |                                 | 0.1 max | megohm     |
| For cathode-bias       | operation                             |                                 | 0.5 max | megohm     |
|                        |                                       |                                 |         |            |

### MEDIUM-MU TRIODE— PENTAGRID CONVERTER

# **12FX8A**

Miniature type used as combined rf amplifier and frequency converter in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 6D, Outlines section. Tube requires minia-



ture nine-contact socket and may be operated in any position. Heater-voltage range (dc), 10 to 15.9; amperes at 12.6 volts, 0.27; peak heater-cathode volts, 16.

#### **Heptode Unit as Converter**

| MAXIMUM RATINGS (Design-Center Values):                          |            |             |
|------------------------------------------------------------------|------------|-------------|
| Plate Voltage                                                    | 16 max     | volts       |
| Negative-bias value                                              | -16 max    | volts       |
| Positive-bias value                                              | 0 max      | volts       |
| Grids-No.2 and No.4 (Screen-Grid) Voltage                        | 16 max     | volts       |
| TYPICAL OPERATION AND CHARACTERISTICS WITH 12.6 VOLTS ON HEATER: |            |             |
| Plate Voltage                                                    | 12.6       | volts       |
| Grid-No.3 Voltage•                                               | -0.5       | volt        |
| Grids-No.2 and No.4 Voltage                                      | 12.6       | volts       |
| RMS Grid-No.1 (Oscillator-Grid) Voltage                          | 1.6        | volts       |
| Grid-No.1 Resistor                                               | 33000      | ohms        |
| Plate Resistance (Approx.)                                       | 0.5        | megohm      |
| Conversion Transconductance                                      | 300        | $\mu$ mhos  |
| Grid-No.3 Voltage (Approx.):                                     | _          |             |
| For conversion transconductance of 10 μmhos                      | -3         | volts       |
| For conversion transconductance of 1 μmho                        | <b>—8</b>  | volts       |
|                                                                  | 290        | $\mu A$     |
| Grids-No.2 and No.4 Current                                      | 1.25       | mA          |
| OSCILLATOR CHARACTERISTICS (Not Oscillating):*                   |            |             |
| Plate and Grids-No.2 and No.4 Voltage                            | 12.6       | volts       |
| Grids-No.3 Voltage                                               | 0          | volts       |
| Grid-No.1 Voltage                                                | 0          | volts       |
| Amplification Factor (between grid No.1 and grids No.2 and       | 9          |             |
| No.4 connected to plate)                                         | y          |             |
| Transconductance (between grid No.1 and grids No.2 and           | 3600       |             |
| No.4 connected to plate)                                         | 4.4        | μmhos       |
| Cathode Current                                                  | 4.4<br>4.5 | mA<br>volts |
| · · · · · · · · · · · · · · · · · · ·                            | -4.5       | VOILS       |
| MAXIMUM CIRCUIT VALUES:                                          |            |             |
| Grid-No.3-Circuit Resistance                                     | 10 тах     | megohms     |
| - With solf evolution                                            |            |             |

<sup>•</sup> With self-excitation.

Developed across a 2.2-megohm grid-No.3 resistor.

### Triode Unit as Class A, Amplifier

| MAXIMUM RATINGS (Design-Center Values):                |        |        |
|--------------------------------------------------------|--------|--------|
| Plate Voltage                                          | 16 max | volts  |
| CHARACTERISTICS WITH 12.6 VOLTS ON HEATER:             |        |        |
| Plate Voltage                                          | 12.6   | volts  |
| Grid Voltage                                           | -0.8   | volt   |
| Amplification Factor                                   | 10     |        |
| Plate Resistance (Approx.)                             | 7150   | ohms   |
| Transconductance                                       | 1400   | μmhos. |
| Plate Current                                          | 1.3    | mA     |
| Grid Voltage (Approx.) for plate current of 10 $\mu$ A | -3.2   | volts  |

Developed across a 2.2-megohm grid resistor.

<sup>\*</sup> With grids No.2 and No.4 connected to plate and with 12.6 volts on heater.



### SHARP-CUTOFF PENTODE

Miniature type with frame grid used as video amplifier tube in television receivers employing series-connected heater strings. Outline 6E, Outlines section. Tube requires miniature ninecontact socket and may be mounted

# 12GN7 12GN7A

in any position. Type 12GN7A is identical with type 12GN7 except for a higher plate dissipation. Heater volts, 6.3 (parallel), 12.6 (series); amperes, 0.6 (parallel), 0.3 (series); warm-up time (average), 11 seconds, peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

#### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              |     |          |            |
|-------------------------------------------------------|-----|----------|------------|
| Plate Voltage                                         |     | 400 max  | volts      |
| Grid-No.2 (Screen-Grid) Supply Voltage                |     | 330 max  | volts      |
| Grid-No.2 Voltage                                     |     | See cur  | ve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value |     | 0 max    | volts      |
| Plate Dissipation (12GN7)                             |     | 7.5 max  | watts      |
| Plate Dissipation (12GN7A)                            |     | 11.5 max | watts      |
| Grid-No.2 Input:                                      |     |          |            |
| For grid-No.2 voltages up to 165 volts                |     | 1.5 max  | watts      |
| For grid-No.2 voltages between 165 and 330 volts      |     | See cur  | ve page 80 |
| •                                                     |     |          |            |
| CHARACTERISTICS:                                      |     |          |            |
| Plate Supply Voltage                                  | 50  | 250      | volts      |
| Grid-No.2 Supply Voltage                              | 125 | 150      | volts      |
| Grid-No.1 Voltage                                     | 0   | 0        | volts      |
| Cathode-Bias Resistor                                 | _   | 56       | ohms       |
| Plate Resistance (Approx.)                            | _   | 0.05     | megohm     |
| Transconductance                                      |     | 36000    | μmhos      |
| Plate Current                                         | 70• | 28       | mA.        |
| Grid-No.2 Current                                     | 24• | 6.5      | mA         |
| Grid-No.1 Voltage (Approx.) for plate current of      |     |          |            |
| 100 μΑ                                                | _   | -5.7     | volts      |
| •                                                     |     |          |            |
| MAXIMUM CIRCUIT VALUES:                               |     |          |            |
| Grid-No.1-Circuit Resistance                          |     | 0.25 max | megohm     |

Refer to type 12GW6/12DQ6B.

maximum ratings of the tube will not be exceeded.

12GW6



#### SHARP-CUTOFF PENTODE

This value can be measured by a method involving a recurrent waveform such that the

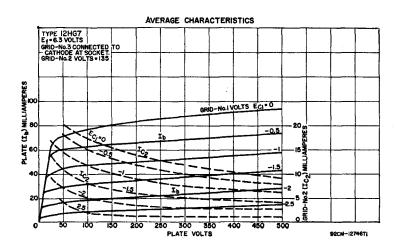
Duodecar type with frame grid used as video amplifier in color television receivers. Outline 10C, Outlines section. Tube requires nine-contact duodecar socket and may be mounted in any position.

12**HG7** 

| Heater Arrangement: Heater Voltage (ac/dc) Heater Current                                                      | Series<br>12.6<br>0.26 | Parallel 6.3 0.52  | volts<br>ampere |
|----------------------------------------------------------------------------------------------------------------|------------------------|--------------------|-----------------|
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode |                        | 200 max<br>200*max | volts<br>volts  |

<sup>\*</sup> The dc component must not exceed 100 volts.

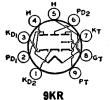
| Direct Interelectrode Capacitances: Grid No.1 to Plate Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.15 max                                                                       | pF                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 14 max                                                                         | рF                                                                                                        |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 27                                                                             | -                                                                                                         |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 4.4 max                                                                        | pF                                                                                                        |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                |                                                                                                           |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 400 max                                                                        | volts                                                                                                     |
| Grid-No.2 (Screen-Grid) Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 330 max                                                                        | volts                                                                                                     |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                | e page 80                                                                                                 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0 max                                                                          | volts                                                                                                     |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 10 max                                                                         | watts                                                                                                     |
| Grid-No.2 Input:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                |                                                                                                           |
| For Grid-No.2 voltages up to 165 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1 max                                                                          | watt                                                                                                      |
| For Grid-No.2 voltages between 165 and 330 volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | See curv                                                                       | e page 80                                                                                                 |
| The state of the s |                                                                                |                                                                                                           |
| Class A <sub>1</sub> Amplifier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                |                                                                                                           |
| Class A <sub>1</sub> Amplifier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                |                                                                                                           |
| CHARACTERISTICS: Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 300                                                                            | volts                                                                                                     |
| CHARACTERISTICS: Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | cted to cathode                                                                | at socket                                                                                                 |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.2 Supply Voltage Connec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | cted to cathode<br>135                                                         | at socket<br>volts                                                                                        |
| CHARACTERISTICS: Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | cted to cathode<br>135<br>e end of cathod                                      | at socket<br>volts<br>le resistor                                                                         |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Connection Grid-No.1 Voltage Crid-No.1 Voltage Cathode Resistor  Characteristics Connected to negative                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | cted to cathode<br>135<br>e end of cathod<br>47                                | at socket<br>volts<br>le resistor<br>ohms                                                                 |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode Resistor Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | cted to cathode<br>135<br>e end of cathod<br>47<br>60000                       | at socket<br>volts<br>le resistor<br>ohms<br>ohms                                                         |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode Resistor Plate Resistance (Approx.) Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | cted to cathode<br>135<br>e end of cathod<br>47<br>60000<br>32000              | at socket<br>volts<br>le resistor<br>ohms<br>ohms<br>µmhos                                                |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.1 Voltage Grid-No.1 Voltage Cathode Resistor Plate Resistance (Approx.) Transconductance Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | cted to cathode<br>135<br>e end of cathod<br>47<br>60000<br>32000<br>31        | at socket volts le resistor ohms ohms  µmhos mA                                                           |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | cted to cathode<br>135<br>e end of cathod<br>47<br>60000<br>32000<br>31<br>4.8 | at socket volts le resistor ohms ohms  µmhos mA mA                                                        |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.1 Voltage Grid-No.1 Voltage Cathode Resistor Plate Resistance (Approx.) Transconductance Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | cted to cathode<br>135<br>e end of cathod<br>47<br>60000<br>32000<br>31        | at socket volts le resistor ohms ohms  µmhos mA                                                           |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 100 µA  MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | cted to cathode<br>135<br>e end of cathod<br>47<br>60000<br>32000<br>31<br>4.8 | at socket volts le resistor ohms ohms  µmhos mA mA                                                        |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 100 µA  MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | cted to cathode 135 e end of cathod 47 60000 32000 31 4.8 -4.5                 | at socket<br>volts<br>de resistor<br>ohms<br>ohms<br>\( \mu \text{mhos} \)<br>\( \mu \text{M} \text{N} \) |
| CHARACTERISTICS: Plate Supply Voltage Grid-No.3 (Suppressor-Grid) Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 100 µA  MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | cted to cathode<br>135<br>e end of cathod<br>47<br>60000<br>32000<br>31<br>4.8 | at socket volts le resistor ohms ohms  µmhos mA mA                                                        |



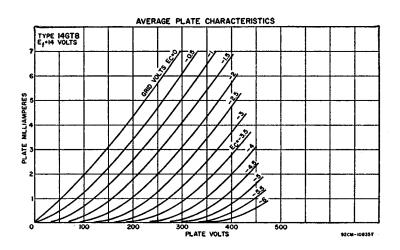
### TWIN DIODE— HIGH-MU TRIODE

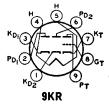
14GT8

Miniature type used as combined detector and af voltage amplifier in radio receivers. Outline 6B, Outlines section. Tube requires miniature ninecontact socket and may be operated in any position.



| Heater Voltage (ac/dc)  Heater Current  Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode  Amplification Factor | 14<br>0.15<br>200 max<br>200 max<br>72 | volts<br>ampere<br>volts<br>volts |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----------------------------------|
| Plate Resistance (Approx.)° Transconductance°                                                                                                                                | 72000<br>1000                          | ohms<br>µmhos                     |
| <ul> <li>The dc component must not exceed 100 volts.</li> <li>For triode unit; plate volts, 250; grid volts, -3; plate mA, 0.7.</li> </ul>                                   |                                        | •                                 |
| Triode Unit as Class A, Amplifier                                                                                                                                            |                                        |                                   |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                     |                                        |                                   |
| Plate Voltage Grid Voltage, Positive-bias value                                                                                                                              | 330 max<br>0 max                       | volts<br>volts                    |
| Plate Dissipation                                                                                                                                                            | 1.1 max                                | watts                             |
| Diode Units (Each Unit)                                                                                                                                                      |                                        |                                   |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                     |                                        |                                   |
| Plate Current                                                                                                                                                                | 5 max                                  | mA                                |
| CHARACTERISTICS, Instantaneous Value:                                                                                                                                        |                                        |                                   |
| Tube Voltage Drop for plate current of 18 mA                                                                                                                                 | 5                                      | volts                             |





# TWIN DIODE---HIGH-MU TRIODE

Miniature type used as combined FM detector and af voltage amplifier. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 14; amperes,

**14JG8** 

0.15; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Triode Unit as Class A1 Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): |         |       |
|------------------------------------------|---------|-------|
| Plate Voltage                            | 330 max | volts |
| Grid-No.1 (Control-Grid) Voltages:       |         |       |
| Positive-bias Value                      | 0 max   | volts |
| Negative-bias Value                      | 50 max  | volts |
| Plate Dissipation                        | 1.1 max | watts |
| CHARACTERISTICS:                         |         |       |
| Plate Voltage                            | 250     | volts |
| Grid Voltage                             | -2      | volts |
| Amplification Factor                     | 90      |       |
| Plate Resistance (Approx.)               | 41000   | ohms  |
| Transconductance                         | 2200    | μmhos |
| Plate Current                            | 2       | mA    |
| Diode Units                              |         |       |
| MAXIMUM RATINGS (Design-Maximum Values): |         |       |

# 16AQ3

XY88

Plate Current (Each Unit) ......

### DIODE

Miniature types used as booster diodes in line-time-base circuits of transformerless television receivers. Outline, 7D, Outlines section. Tubes require miniature nine-contact socket and may



5 max

mΑ

be mounted in any position. Heater volts (ac/dc), 16.4; amperes, 0.6; peak heatercathode volts, 6600 (the pulse duration must not exceed 22 per cent of a cycle, or a maximum of 18 microseconds).

| MAXIMUM RATINGS (Design-Center Values): |                             |       |
|-----------------------------------------|-----------------------------|-------|
| Supply Voltage at zero current          | 550 max                     | volts |
| Supply Voltage                          | 250 max                     | volts |
| Peak Plate Current                      |                             | mΑ    |
| Average Plate Current                   | <ul> <li>220 max</li> </ul> | mA    |
| Plate Dissipation                       | 5 max                       | watts |
| Peak Negative-Pulse Plate Voltage       | —6000∙max                   | volts |

- Under no conditions should an absolute maximum value of 7500 volts be exceeded.
- The pulse duration must not exceed 22 per cent of a cycle, or a maximum of 18 microseconds.

### HIGH-MU TWIN TRIODE

# 17EW8

Miniature type used in rf-amplifier and oscillator-mixer circuits in FM and AM radio receivers. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts,



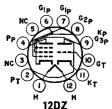
17.5; amperes, 0.15; peak heater-cathode volts, 90.

#### Class A. Amplifier (Each Unit)

| MAXIMUM RATINGS (Design-Maximum Value) Plate Voltage Plate Dissipation Grid-Voltage, Negative-bias Value Cathode Current |            |                   | 250 max<br>2.5 max<br>-100 max<br>15 max | volts<br>watts<br>volts<br>mA |
|--------------------------------------------------------------------------------------------------------------------------|------------|-------------------|------------------------------------------|-------------------------------|
| CHARACTERISTICS: Plate Voltage Amplification Factor Transconductance Grid Voltage                                        | 50<br>4600 | 170<br>50<br>6200 | 200<br>48<br>5800<br>—2.1                | volts<br>μmhos<br>volts       |
| Plate Current                                                                                                            | 4.5        | 10                | 10                                       | mA                            |

#### **MAXIMUM CIRCUIT VALUES:**

\* Should not be used if grid current is not permissible.



### MEDIUM-MU TRIODE— POWER PENTODE

Duodecar type used as combined vertical-deflection-oscillator and verticaldeflection-amplifier tube in television receivers employing series-connected heater strings Outline 8B, Outlines section. Tube requires duodecar twelve-

17JZ8

contact socket and may be mounted in any postion. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A, Amplifier

| CHARACTERISTICS:                                        | Triode<br>Unit | Pentode<br>Unit |       |
|---------------------------------------------------------|----------------|-----------------|-------|
| Plate Voltage                                           | 150            | 45 120          | volts |
| Grid-No.2 (Screen-Grid) Voltage                         | _              | 110 110         | volts |
| Grid-No.1 (Control-Grid) Voltage                        | 5              | 0 —8            | volts |
| Amplification Factor                                    | 21.5           |                 |       |
| Plate Resistance (Approx.)                              | 11300          | <b>— 11700</b>  | ohms  |
| Transconductance                                        | 1900           | <b>—</b> 7100   | μmhos |
| Plate Current                                           | 3.3            | 122• 46         | mA    |
| Grid-No.2 Current                                       |                | 17• 4           | mA    |
| Grid-No.1 Voltage (Approx.) for plate current of 100 µA | _              | 25              | volts |
| Grid-No.1 Voltage (Approx.) for plate current of 10 μA  | 10             |                 | volts |

<sup>•</sup> This value may be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Vertical-Deflection Oscillator and Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): | Triode<br>Unit<br>Oscillator | Pentode<br>Unit<br>Amplifier |         |
|------------------------------------------|------------------------------|------------------------------|---------|
| DC Plate Voltage                         | 250 max                      | 250 max                      | volts   |
| Peak Positive-Pulse Plate Voltage#       | _                            | 2000 max                     | volts   |
| Grid-No.2 Voltage                        | _                            | 200 max                      | volts   |
| Peak Negative-Pulse Grid-No.1 Voltage    | -400 max                     | -150 max                     | volts   |
| Peak Cathode Current                     | 70 max                       | 245 max                      | mA      |
| Average Cathode Current                  | 20 max                       | 70 max                       | mA      |
| Plate Dissipation†                       | 1 max                        | 7 max                        | watts   |
| Grid-No.2 Input                          |                              | 1.8 max                      | watts   |
| MAXIMUM CIRCUIT VALUES:                  |                              |                              |         |
| Grid-No.1-Circuit Resistance:            |                              |                              |         |
| For fixed-bias operation                 | 1 max                        | 1 max                        | megohm  |
| For cathode-bias operation               | 2.2 max                      | 2.2 max 1                    | negohms |

<sup>#</sup>The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds. † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

### REMOTE-CUTOFF PENTODE

# **18FW6A**

Miniature type used as rf- and ifamplifier tube in ac/dc radio receivers. Outline 5C, **Outlines** section. Tube requires miniature seven-contact socket and may be mounted in any position.

7CC

Heater volts (ac/dc), 18; amperes, 0.1;

warm-up time (average), 20 seconds; peak heater-cathode volts, 100.

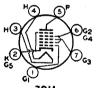
#### Class A. Amplifier

| Class N <sub>1</sub> Amplition                               |                 |            |
|--------------------------------------------------------------|-----------------|------------|
| MAXIMUM RATINGS (Design-Maximum Values):                     |                 |            |
| Plate Voltage                                                | 150 max         | volta      |
| Grid-No.2 (Screen-Grid) Supply Voltage                       | 150 max         | volts      |
| Grid-No.2 Voltage                                            | See cur         | ve page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value        | 0 max           | volts      |
| Grid-No.2 Input:                                             |                 |            |
| For grid-No.2 voltages up to 75 volts                        | 0.6 max         | watt       |
| For grid-No.2 voltages between 75 and 150 volts              | See cur         | ve page 80 |
| Plate Dissipation                                            | 2.5 max         | watts      |
| CHARACTERISTICS:                                             |                 |            |
| Plate Supply Voltage                                         | 100             | volts      |
| Grid No.3 Conne                                              | cted to cathode | at socket  |
| Grid-No.2 Supply Voltage                                     | 100             | volts      |
| Cathode-Bias Resistor                                        | 68              | ohms       |
| Plate Resistance (Approx.)                                   | 0.25            | megohm     |
| Transconductance                                             | 4400            | $\mu$ mhos |
| Plate Current                                                | 11              | mA         |
| Grid-No.2 Current                                            | 4.4             | mA         |
| Grid-No.1 Voltage (Approx.) for transconductance of 25 μmhos | -20             | volts      |

### PENTAGRID CONVERTER

# **18FX6A**

Miniature type used for converter applications in ac/dc radio receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 18; amperes, 0.1;



7CH

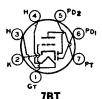
warm-up time (average), 20 seconds; peak heater-cathode volts, 100.

#### Converter

| MAXIMUM RATINGS (Design-Maximum Values):                       |       |     |        |
|----------------------------------------------------------------|-------|-----|--------|
| Plate Voltage                                                  | 150   | max | volts  |
| Grids-No.2-and-No.4 (Screen-Grid) Supply Voltage               | 150   | max | volts  |
| Grids-No.2-and-No.4 Voltage                                    | 110   | max | volts  |
| Grids-No.2-and-No.4 Input                                      | 1.2   | max | watte  |
| Plate Dissipation                                              | 1     | max | watt   |
| TYPICAL OPERATION (Separate Excitation):*                      |       |     |        |
| Plate Voltage                                                  | 100   |     | volts  |
| Grids-No.2-and-No.4 (Screen-Grid) Voltage                      | 100   |     | volts  |
| Grid-No.3 (Control-Grid) Voltage                               | -1.5  |     | volts  |
| Grid-No.1 (Oscillator-Grid) Resistor                           | 20000 |     | ohms   |
| Plate Resistance (Approx.)                                     | 0.4   |     | megohm |
| Conversion Transconductance                                    | 480   |     | μmhos  |
| Grid-No.3 Voltage (Approx.) for conversion transconductance of |       |     | •      |
| 10 μmhos                                                       | -21   |     | volts  |
| Plate Current                                                  | 2.3   |     | mA     |
| Grids-No.2-and-No.4 Current                                    | 6.2   |     | mA     |
| Grid-No.1 Current                                              | 0.5   |     | mA     |
| Total Cathode Current                                          | 9     |     | mA     |

NOTE: The transconductance between grid No.1 and grids No.2 and No.4 connected to plate (not oscillating) is approximately 7000  $\mu$ mhos under the following conditions: grids No.1 and No.3 at 0 volts; grids No.2 and No.4 and plate at 100 volts. Under the same conditions, the plate current is 24  $\mu$ A, and the amplification factor is 22.

\* The characteristics shown with separate excitation correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.



### TWIN DIODE— HIGH-MU TRIODE

Miniature type used for combined detector, amplifier, and ave tube in compact ac/dc radio receivers. Out line 5C, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

**18FY6A** 

Heater volts (ac/dc), 18; amperes, 0.1; warm-up time (average), 20 seconds; peak heater-cathode volts, 100.

#### Triode Unit as Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid Voltage, Positive-bias value Plate Dissipation | 150 max<br>0 max<br>0.5 max | volts<br>volts<br>watt |
|------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------|
| CHARACTERISTICS: Plate Voltage Grid Voltage Amplification Factor                                           | 100<br>—1<br>100            | volt <b>s</b><br>volt  |
| Plate Resistance (Approx.) Transconductance Plate Current                                                  | 77000<br>1300<br>0.6        | ohms<br>µmhos<br>mA    |

#### Diode Units (Each Unit)

MAXIMUM RATINGS (Design-Maximum Values):



### SHARP-CUTOFF PENTODE

Miniature type used in the if, rf, and converter stages of ac/dc AM radio receivers. Outline 5C, Outlines section. Tube requires miniature seven-contact socket and may be operated in any position.

## **18GD6A**

|                       | F                                                       |               |         |
|-----------------------|---------------------------------------------------------|---------------|---------|
| Heater Voltage (ac/e  | dc)                                                     | 18            | volts   |
|                       | · · · · · · · · · · · · · · · · · · ·                   | 0.1           | атреге  |
| Warm-up Time (Ave     | rage)                                                   | 20            | seconds |
| Peak Heater-Cathode   | Voltage:                                                |               |         |
| Heater negative       | with respect to cathode                                 | 100 max       | volts   |
|                       | with respect to cathode                                 | 100 max       | volts   |
| Direct Interelectrode | Capacitances:                                           |               |         |
| Grid-No.1 to Pl       | ate                                                     | 0.0035        | pF      |
| Grid No.1 to Ca       | thode, Heater, Grid No.2, Grid No.3, and                |               |         |
| Internal Shiel        | d                                                       | 6.0           | pF      |
|                       | e, Heater, Grid No.2, Grid No.3 and Internal            |               |         |
| Shield                |                                                         | 5.0           | рF      |
| • Values are same wi  | thout external shield, or with external shield connecte | d to cathode. |         |

### Class A, Amplifier

| CHARACTERISTICS:                |               |           |
|---------------------------------|---------------|-----------|
| Plate Supply Voltage            | 100           | volts     |
| Grid No.3 (Suppressor Grid)     | ed to cathode | at socket |
| Grid-No.2 (Screen-Grid) Voltage | 100           | volts     |

| Cathode-Bias Resistor Plate Resistance (Approx.) Transconductance Plate Current Grid-No.2 Current Grid-No.1 Voltage (Approx.) for plate current of 10 $\mu$ A | 150<br>0.5<br>4300<br>5<br>2<br>4.7 | ohms megohm  µmhos  mA  mA  volts |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------|
| RF Amplifier and Converter                                                                                                                                    |                                     |                                   |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                      |                                     |                                   |
| Plate Voltage                                                                                                                                                 | 150 max                             | volts                             |
| Grid-No.2 Supply Voltage                                                                                                                                      | 150 max                             | volts                             |
| Grid-No.2 Voltage                                                                                                                                             | See curv                            | e page 80                         |
| Plate Dissipation                                                                                                                                             | 2.5 max                             | watts                             |
| Grid-No.2 Input:                                                                                                                                              |                                     |                                   |
| For grid-No.2 voltages up to 75 volts                                                                                                                         | ' 0.6 max                           | watt                              |
| For grid-No.2 voltages between 75 and 150 volts                                                                                                               | See curv                            | e page 80                         |

### HALF-WAVE VACUUM RECTIFIER

# 19AU4

Glass octal type used as damper diode in horizontal-deflection circuits of black-and-white television receivers employing series-connected heater strings. Outline 13G, Outlines section. Tube requires octal socket and may



4CG

be mounted in any position. This type may be supplied with pin 1 omitted. Socket terminals 1, 2, 4, and 6 should not be used as tie points. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 18.9; amperes, 0.6; warm-up time (average), 11 seconds.

#### **Damper Service**

For operation in a 525-line, 30-frame system

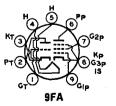
| MAXIMUM RATINGS (Design-Center Values): |           |       |
|-----------------------------------------|-----------|-------|
| Peak Inverse Plate Voltage#             | 4500°max  | volts |
| Peak Plate Current                      | 1050 max  | mA    |
| DC Plate Current                        | 175 max   | mA    |
| Plate Dissipation                       | 6 max     | watts |
| Peak Heater-Cathode Voltage:            |           |       |
| Heater negative with respect to cathode | 4500°†max | volts |
| Heater positive with respect to cathode | 300≜max   | volts |

- # The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal cycle is 10 microseconds.
- Onder no circumstances should this absolute value be exceeded.
- † The dc component must not exceed 900 volts.
- A The dc component must not exceed 100 volts.

### HIGH-MU TRIODE SHARP-CUTOFF PENTODE

# 19HV8

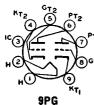
Miniature type used as if-amplifier and af voltage-amplifier tube in radio receivers employing series-connected heater strings. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted



in any position. Heater volts (ac/dc), 18.9; amperes, 0.15; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):                    | Triode<br>Unit | Pentode<br>Unit |           |
|-------------------------------------------------------------|----------------|-----------------|-----------|
|                                                             |                |                 |           |
| Plate Voltage                                               | 330 max        | 330 max         | volts     |
| Grid-No.2 (Screen-Grid) Supply Voltage                      |                | 330 max         | volts     |
| Grid-No.2 Voltage                                           | _              |                 | e page 80 |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value       | 0 max          | 0 max           | volts     |
| Plate Dissipation                                           | 0.55 max       | 3 max           | watts     |
| Grid-No.2 Input:                                            |                | 0.55            |           |
| For grid-No.2 voltages up to 165 volts                      | -              | 0.55 max        | watt      |
| For grid-No.2 voltages between 165 and 330 volts            | _              | See curv        | e page 80 |
| CHARACTERISTICS:                                            |                |                 |           |
| Plate Voltage                                               | 100            | 125             | volt9     |
| Grid-No.2 Voltage                                           | _              | 125             | volts     |
| Grid-No.1 Voltage                                           | -1             | -1              | volt      |
| Amplification Factor                                        | 70             | _               |           |
| Plate Resistance (Approx.)                                  | 54000          | 200000          | ohms      |
| Transconductance                                            | 1300           | 6500            | μmhos     |
| Plate Current                                               | 0.8            | 12              | mA        |
| Grid-No.2 Current                                           | _              | 4               | mA        |
| Grid-No.1 Voltage (Approx.) for plate current of 50 μA      | -1.5           | _               | volts     |
| Grid-No.1 Voltage (Approx.) for plate current of 20 $\mu A$ | -              | -9              | volts     |
| MAXIMUM CIRCUIT VALUES:                                     |                |                 |           |
| Grid-No.1-Circuit Resistance:                               |                |                 |           |
| For fixed-bias operation                                    | 0.5 max        | 0.25 max        | megohm    |
| For cathode-bias operation                                  | 1 max          |                 | megohm    |



### HIGH-MU TWIN TRIODE

Miniature type used in high-gain, resistance-coupled, low-level audio amplifiers operating at low-signal levels, such as preamplifiers for stereo phonographs. Outline 6B, Outlines section. For typical operation as resistance-

**20EZ7** 

coupled amplifier, refer to Resistance-Coupled Amplifier section. Tube requires miniature nine-contact socket and may be operated in any position.

| Heater Volts (ac/dc)                                                                                           |           | 20                 | volts          |
|----------------------------------------------------------------------------------------------------------------|-----------|--------------------|----------------|
| Heater Current                                                                                                 |           | 0.1                | ampere         |
| Heater Warm-up Time (Average)                                                                                  |           | 20                 | seconds        |
| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode |           | 200 max<br>200*max | volts<br>volts |
| Direct Interelectrode Capacitances;°                                                                           | Unit No.1 | Unit No.2          |                |
| Grid to Plate                                                                                                  | 1.5       | 1.5                | pF             |
| Grid to Cathode and Heater                                                                                     | 1.6       | 1.6                | pF             |
| Plate to Cathode and Heater                                                                                    | 0.2       | 0.3                | рF             |

- The dc component must not exceed 100 volts.
- ° Without external shield.

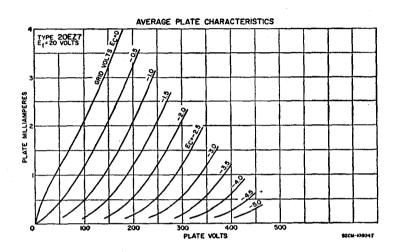
### Class A, Amplifier (Each Unit)

| MAXIMUM RATINGS (Design-Maximum Values): |         |       |
|------------------------------------------|---------|-------|
| Plate Voltage                            | 330 max | volts |
| Grid Voltage:                            |         |       |
| Negative-bias value                      | 55 max  | volts |
| Positive-bias value                      | 0 max   | volts |
| Plate Dissipation                        | 1.2 max | watts |

0.5

| CHARACTERISTICS:                        |       |       |       |
|-----------------------------------------|-------|-------|-------|
| Plate Voltage                           | 100   | 250   | volts |
| Grid Voltage                            | -1    | 2     | volts |
| Amplification Factor                    | 100   | 100   |       |
| Plate Resistance (Approx.)              | 80000 | 62500 | ohms  |
| Transconductance                        | 1250  | 1600  | μmhos |
| 210100011111111111111111111111111111111 | ~ ~   | 4.4   |       |

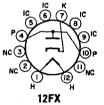
Plate Current



### HALF-WAVE VACUUM RECTIFIER

# **22BW3**

Duodecar type used as damper tube in horizontal-deflection circuits of television receivers. Outline 8D, Outlines section. Tube requires duodecar socket and may be mounted in any position. Heater volts (ac/dc), 22.4;



mΑ

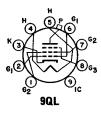
amperes, 0.45; average warm-up time, 11 seconds.

#### **Damper Service**

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values):      |          |       |
|-----------------------------------------------|----------|-------|
| Peak Inverse Plate Voltage*                   | 5000 max | volts |
| Peak Plate Current                            | 1100 max | mA    |
| Average Plate Current                         | 175 max  | mA    |
| Palte Dissipation                             | 6.5 max  | watts |
| Peak Heater-Cathode Voltage:                  |          |       |
| Heater negative with respect to cathode       | 5000*max | voits |
| Heater positive with respect to cathode       | 300†max  | volts |
| CHARACTERISTICS, Instantaneous Value:         |          |       |
| Tube Voltage Dron for plate current of 350 mA | 32       | volts |

- \* The dc component must not exceed 900 volts.
- † The dc component must not exceed 100 volts.
- \*The duration of the voltage pulse must not exceed 15 per cent of one scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.



### **BEAM POWER TUBE**

Novar type used as horizontal-deflection amplifier tube in low-B, black-and-white television receivers. Outline 18A, Outlines section. Tube requires novar nine-contact socket and may be mounted in any position.

22JF6
Related types
22JF6

| Heater Voltage (ac/dc)                                 | 22      | volts   |
|--------------------------------------------------------|---------|---------|
| Heater Current                                         | 0.45    | ampere  |
| Heater Warm-up Time (Average)                          | 11      | seconds |
| Peak Heater-Cathode Voltage:                           |         |         |
| Heater negative with respect to cathode                | 200 max | volts   |
| Heater positive with respect to cathode                | 200*max | volts   |
| Direct Interelectrode Capacitances:                    |         |         |
| Grid No.1 to Plate                                     | 1.2     | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 22      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 9       | pF      |
| • The dc component must not exceed 100 volts.          |         |         |

#### Class A<sub>1</sub> Amplifier

### CHARACTERISTICS:

| 6500 | _                                                                                 |                                             | volts                                                                                                |
|------|-----------------------------------------------------------------------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------|
| _    | 50                                                                                | 130                                         | volts                                                                                                |
|      | Connected to c                                                                    | athode at sock                              | et                                                                                                   |
| 125  | 125                                                                               | 125                                         | volts                                                                                                |
| _    | 0                                                                                 | 20                                          | voits                                                                                                |
| _    |                                                                                   | 12000                                       | ohms                                                                                                 |
| _    | _                                                                                 | 10000                                       | μmhos                                                                                                |
| _    | 525†                                                                              | 80                                          | mA                                                                                                   |
| _    | 32†                                                                               | 2.5                                         | mA                                                                                                   |
|      |                                                                                   |                                             |                                                                                                      |
| -125 | _                                                                                 | -40                                         | volts                                                                                                |
|      |                                                                                   | 4.1                                         |                                                                                                      |
|      | 6500<br>-<br>125<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>- | - 50 Connected to c  125 125 - 0 525† - 32† | - 50 130 Connected to cathode at sock 125 125 125 - 0 -20 - 12000 - 10000 - 525† 80 - 32† 2.5 -12540 |

<sup>\*\*</sup>The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): |          |       |
|------------------------------------------|----------|-------|
| DC Plate Supply Voltage                  | 770 max  | volts |
| Peak Positive-Pulse Plate Voltage**      | 6500 max | volts |
| Peak Negative-Pulse Plate Voltage        | 1500 max | volts |
| DC Grid-No.3 Voltage                     | 100 max  | volts |
| DC Grid-No.2 Voltage                     | 220 max  | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | 330 max  | volts |
| Peak Cathode Current                     | 950 max  | mA    |
| Average Cathode Current                  | 275 max  | m A   |
| Grid-No.2 Input                          | 3.5 max  | watts |
| Plate Dissipation ••                     | 17 max   | watts |
| Bulb Temperature (at hottest point)      | 240 max  | °C    |

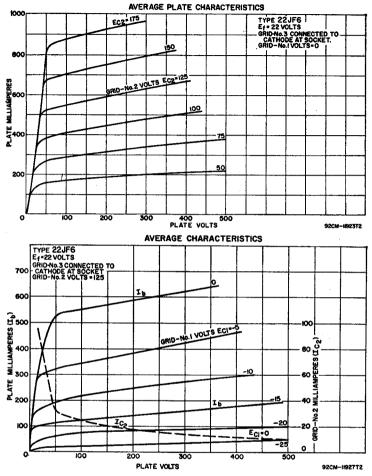
#### **MAXIMUM CIRCUIT VALUES:**

<sup>†</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

<sup>††</sup> Triode connection (grid No.2 tied to plate).

<sup>•</sup> In a horizontal-deflection-amplifier service, a positive voltage (typical value, 50 volts) may be applied to grid No.3 to reduce "snivets" interference, which may occur in both vhf and uhf television receivers.

<sup>••</sup> An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



### **BEAM POWER TUBE**

# **22JU6**

Novar type used as horizontal deflection amplifier in low-B+ black-and-white television receivers employing series-connected heater strings. Outline 18A, Outlines section. Tube requires novar nine-contact socket and may be mounted in any position.

| H<br>(4 | (6)      |
|---------|----------|
| K3      | 77°62    |
| 61      | (3) G3   |
| 62      | 9)<br>IC |

9QL

.,

| Heater Voltage (ac/dc)                                 | 22        | volts   |
|--------------------------------------------------------|-----------|---------|
| Heater Current                                         | 0.45      | ampere  |
| Heater Warm-up Time (Average)                          | 11        | seconds |
| Peak Heater-Cathode Voltage:                           |           |         |
| Heater negative with respect to cathode                | 200 max   | volts   |
| Heater positive with respect to cathode                | 200 • max | volts   |
| Direct Interelectrode Capacitances:                    |           |         |
| Grid No.1 to Plate                                     | 1.2       | ρF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 22        | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 9         | pF      |

• The dc component must not exceed 100 volts.

#### Class A, Amplifier

| CHARACTERISTICS:                                      | Triode<br>Connection* |     | Pentode<br>Connection |       |
|-------------------------------------------------------|-----------------------|-----|-----------------------|-------|
| Plate Voltage                                         | 125                   | 50  | 130                   | volts |
| Grid No.3 (Suppressor Grid)                           |                       | to  | cathode at socket     |       |
| Grid-No.2 (Screen-Grid) Voltage                       |                       | 125 | 125                   | volts |
| Grid-No.1 (Control-Grid) Voltage                      | 20                    | 0   | -20                   | volts |
| Amplification Factor                                  | 5                     | _   |                       |       |
| Plate Resistance (Approx.)                            |                       |     | 18000                 | ohms  |
| Transconductance                                      | -                     | _   | 7000                  | μmhos |
| Plate Current                                         | -                     | 470 | • 45                  | mA    |
| Grid-No.2 Current                                     |                       | 28  | <b>1.5</b>            | mA    |
| Grid-No.1 Voltage (Approx.) for plate current of 1 mA |                       | _   | -32                   | volts |

- Grid No.2 connected to plate.
- This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

#### MAXIMUM RATINGS (Design-Maximum Values):

| 770 max   | volts                                                                                                        |
|-----------|--------------------------------------------------------------------------------------------------------------|
| 6500 max  | volts                                                                                                        |
| -1500 max | volts                                                                                                        |
| 75 max    | volts                                                                                                        |
| 220 max   | volts                                                                                                        |
| —55 max   | volts                                                                                                        |
| -330 max  | volts                                                                                                        |
| 850 max   | mA                                                                                                           |
| 245 max   | mA                                                                                                           |
| 17 max    | watts                                                                                                        |
| 3.5 max   | watts                                                                                                        |
| 240 max   | °C                                                                                                           |
|           | 6500 max<br>-1500 max<br>75 max<br>220 max<br>-55 max<br>-330 max<br>850 max<br>245 max<br>17 max<br>3.5 max |

#### **MAXIMUM CIRCUIT VALUE:**

Grid-No.1-Circuit Resistance:
For grid-No.1-resistor-bias operation

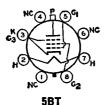
# The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle.

- # The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- ^ In this service, a positive voltage may be applied to grid No.3 to minimize "snivets" interference; a typical value for this voltage is 30 volts.
- † An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

Refer to type 25BO6GTB/25CU6.

**25CU6** 

2.2 max megohms



### **BEAM POWER TUBE**

Glass octal type used as horizontaldeflection amplifier in television receivers employing series-connected heater strings. Outline 21B, Outlines section. Tube requires octal socket. Vertical tube mounting is preferred

**25DN6** 

but horizontal operation is permissible if pins 1 and 3 are in vertical plane.

| Heater Voltage (ac/dc) Heater Current Heater Warm-up Time (Average) | 25<br>0.6<br>11 | volts<br>ampere<br>seconds |
|---------------------------------------------------------------------|-----------------|----------------------------|
| Peak Heater-Cathode Voltage:                                        |                 |                            |
| Heater negative with respect to cathode                             | 200 max         | volts                      |
| Heater positive with respect to cathode                             | 200=max         | volts                      |
| Plate Resistance (Approx.)†                                         | 4000            | ohms                       |
| Transconductance†                                                   | 9000            | $\mu$ mhos                 |
| Mu-Factor,† Grid No.2 to Grid No.1                                  | 4.35            |                            |
| Ma-Lactor's Otto 140.5 to Otto 140.1                                | 4.50            |                            |

• The dc component must not exceed 100 volts.

† For plate and grid-No.2 volts, 125; grid-No.1 volts, -18; plate mA, 70; grid-No.2 mA, 6.3.

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

MAXIMUM RATINGS (Design-Center Values):

| DC Plate Voltage                                      | 700 max   | SHOA          |
|-------------------------------------------------------|-----------|---------------|
| Peak Positive-Pulse Plate Voltage# (Absolute Maximum) | 6600□max  | volts         |
| Peak Negative-Pulse Plate Voltage                     | -1500 max | volts         |
| DC Grid-No.2 (Screen-Grid) Voltage                    | 175 max   | volts         |
| Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage  | —200 max  | volt <b>s</b> |
| Peak Cathode Current                                  | 700 max   | mA            |
| Average Cathode Current                               | 200 max   | mA            |
| Grid-No.2 Input                                       | 3 max     | watts         |
| Plate Dissipation†                                    | 15 max    | watts         |
| Bulb Temperature (At hottest point)                   | 225 max   | °C            |
|                                                       |           |               |

#### MAXIMUM CIRCUIT VALUE:

Grid-No.1-Circuit Resistance .....

0.47 max megohm

- # The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds. 

  Under no circumstances should this absolute value be exceeded.
- † An adequate bias resistor or other means is required to protect the tube in the absence of excitation,

### BEAM POWER TUBE

# 25F5A

Miniature type used in audio-output stage of ac/dc radio receivers employing series-connected heater strings. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position.

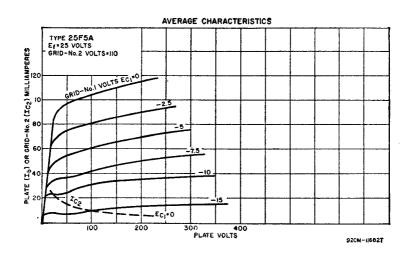


| and may be mounted in any position.                    | 7CV     |         |
|--------------------------------------------------------|---------|---------|
| Heater Voltage (ac/dc)                                 | 25      | volts   |
| Heater Current                                         | 0.15    | ampere  |
| Heater Warm-up Time (Average)                          | 17      | seconds |
| Peak Heater-Cathode Voltage:                           |         |         |
| Heater negative with respect to cathode                | 200 max | volts   |
| Heater positive with respect to cathode                | 200=max | volts   |
| Direct Interelectrode Capacitances (Approx.):          |         |         |
| Grid No.1 to Plate                                     | 0.44    | рF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 12      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 8       | pF      |
| ■ The dc component must not exceed 100 volts.          |         |         |
| Class A Amnlifier                                      |         |         |

#### Class A<sub>1</sub> Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):              |         |       |
|-------------------------------------------------------|---------|-------|
| Plate Voltage                                         | 150 max | volts |
| Grid-No.2 (Screen-Grid) Voltage                       | 130 max | volts |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value | 0 max   | volts |
| Plate Dissipation                                     | 5.5 max | watts |
| Grid-No.2 Input                                       | 1,1 max | watts |
| Bulb Temperature (at hottest point)                   | 220 max | °C    |

| TYPICAL OPERATION AND CHARACTERISTICS:                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                   |                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------|
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                          | 110                                                               | volts                                                |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                      | 110                                                               | volts                                                |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>7.5</b>                                                        | volts                                                |
| Peak AF Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>—7.5</b>                                                       | volts                                                |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                             | 13000                                                             | ohms                                                 |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6400                                                              | μmhos                                                |
| Zero-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                              | 43                                                                | mA                                                   |
| Maximum-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                           | 45                                                                | mA.                                                  |
| Zero-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                          | 3.8                                                               | mA                                                   |
| Maximum-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                       | 7.3                                                               | mA                                                   |
| Effective Load Resistance                                                                                                                                                                                                                                                                                                                                                                                                                              | 2500                                                              | ohms                                                 |
| Total Harmonic Distortion                                                                                                                                                                                                                                                                                                                                                                                                                              | 7<br>1.5                                                          | per cent                                             |
| Maximum-Signal Power Output                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.5                                                               | watts                                                |
| MAXIMUM CIRCUIT VALUES:                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                   |                                                      |
| Grid-No.1-Circuit Resistance:                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                   |                                                      |
| For fixed-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                               | 0.1 max                                                           | megohm                                               |
| For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.5 max                                                           |                                                      |
| •                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                   |                                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                   |                                                      |
| D                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                   |                                                      |
| Push-Pull Class AB, Amplifier                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                   |                                                      |
| Push-Pull Class AB, Amplifier MAXIMUM RATINGS: (Same as for class AB, amplifier)                                                                                                                                                                                                                                                                                                                                                                       |                                                                   |                                                      |
| MAXIMUM RATINGS: (Same as for class AB1 amplifier)                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                   |                                                      |
| MAXIMUM RATINGS: (Same as for class AB <sub>1</sub> amplifier)  TYPICAL OPERATION (Values are for two tubes):                                                                                                                                                                                                                                                                                                                                          | 110                                                               | <b>v</b> olts                                        |
| MAXIMUM RATINGS: (Same as for class AB <sub>1</sub> amplifier)  TYPICAL OPERATION (Values are for two tubes):  Plate Voltage                                                                                                                                                                                                                                                                                                                           | 110<br>110                                                        | volts                                                |
| MAXIMUM RATINGS: (Same as for class AB <sub>1</sub> amplifier)  TYPICAL OPERATION (Values are for two tubes): Plate Voltage  Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                         |                                                                   |                                                      |
| MAXIMUM RATINGS: (Same as for class AB <sub>1</sub> amplifier)  TYPICAL OPERATION (Values are for two tubes):  Plate Voltage                                                                                                                                                                                                                                                                                                                           | 110                                                               | volts                                                |
| MAXIMUM RATINGS: (Same as for class AB <sub>1</sub> amplifier)  TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage                                                                                                                                                                                                                                                                                        | 110<br>—8                                                         | volts<br>volts                                       |
| MAXIMUM RATINGS: (Same as for class AB; amplifier)  TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current                                                                                                                                                                                                      | 110<br>8<br>14.4                                                  | volts<br>volts<br>volts                              |
| MAXIMUM RATINGS: (Same as for class AB <sub>1</sub> amplifier)  TYPICAL OPERATION (Values are for two tubes):  Plate Voltage  Grid-No.2 Voltage  Grid-No.1 Voltage  Peak AF Grid-No.1-to-Grid-No.1 Voltage  Zero-Signal Plate Current                                                                                                                                                                                                                  | 110<br>8<br>14.4<br>82                                            | volts<br>volts<br>volts<br>mA                        |
| MAXIMUM RATINGS: (Same as for class AB <sub>1</sub> amplifier)  TYPICAL OPERATION (Values are for two tubes):  Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current                                                                                                                          | 110<br>8<br>14.4<br>82<br>88                                      | volts volts volts mA mA                              |
| MAXIMUM RATINGS: (Same as for class AB; amplifier)  TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Effective Load Resistance (Plate-to-plate)                                                                                            | 110<br>8<br>14.4<br>82<br>88<br>7.2                               | volts volts volts mA mA                              |
| MAXIMUM RATINGS: (Same as for class AB <sub>1</sub> amplifier)  TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Effective Load Resistance (Plate-to-plate) Total Harmonic Distortion                     | 110<br>8<br>14.4<br>82<br>88<br>7.2<br>12.5<br>4500<br>2.6        | volts volts volts mA mA mA                           |
| MAXIMUM RATINGS: (Same as for class AB; amplifier)  TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Effective Load Resistance (Plate-to-plate)                                                                                            | 110<br>8<br>14.4<br>82<br>88<br>7.2<br>12.5<br>4500               | volts volts volts mA mA mA ohms                      |
| MAXIMUM RATINGS: (Same as for class AB1 amplifier)  TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Effective Load Resistance (Plate-to-plate) Total Harmonic Distortion Maximum-Signal Power Output                                      | 110<br>8<br>14.4<br>82<br>88<br>7.2<br>12.5<br>4500<br>2.6        | volts volts volts mA mA mA ohms per cent             |
| MAXIMUM RATINGS: (Same as for class AB1 amplifier) TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Effective Load Resistance (Plate-to-plate) Total Harmonic Distortion Maximum-Signal Power Output MAXIMUM CIRCUIT VALUES:               | 110<br>8<br>14.4<br>82<br>88<br>7.2<br>12.5<br>4500<br>2.6        | volts volts volts mA mA mA ohms per cent             |
| MAXIMUM RATINGS: (Same as for class AB1 amplifier)  TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Effective Load Resistance (Plate-to-plate) Total Harmonic Distortion Maximum-Signal Power Output  MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: | 110<br>8<br>14.4<br>82<br>88<br>7.2<br>12.5<br>4500<br>2.6<br>2.9 | volts volts volts volts mA mA mA ohms per cent watts |
| MAXIMUM RATINGS: (Same as for class AB1 amplifier) TYPICAL OPERATION (Values are for two tubes): Plate Voltage Grid-No.2 Voltage Grid-No.1 Voltage Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Plate Current Maximum-Signal Plate Current Zero-Signal Grid-No.2 Current Maximum-Signal Grid-No.2 Current Effective Load Resistance (Plate-to-plate) Total Harmonic Distortion Maximum-Signal Power Output MAXIMUM CIRCUIT VALUES:               | 110<br>8<br>14.4<br>82<br>88<br>7.2<br>12.5<br>4500<br>2.6<br>2.9 | volts volts volts mA mA mA ohms per cent             |



### **POWER PENTODE**

# **32ET5A**

Miniature type used in audio output stage of compact ac/dc radio receivers. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 32; amperes, 0.1;



7CV

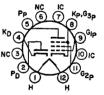
warm-up time (average), 20 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

| Class A, Amplifier                       |         |          |
|------------------------------------------|---------|----------|
| MAXIMUM RATINGS (Design-Maximum Values): |         |          |
| Plate Voltage                            | 150 max | volts    |
| Grid-No.2 (Screen-Grid) Voltage          | 130 max | volts    |
| Grid-No.2 Input                          | 1.2 max | watts    |
| Plate Dissipation                        | 5.4 max | watts    |
| TYPICAL OPERATION AND CHARACTERISTICS:   |         |          |
| Plate Voltage                            | 110     | volts    |
| Grid-No.2 Voltage                        | 110     | volts    |
| Grid-No.1 (Control-Grid) Voltage         | -7.5    | volts    |
| Peak AF Grid-No.1 Voltage                | 7.5     | volts    |
| Zero-Signal Plate Current                | 30      | mA       |
| Zero-Signal Grid-No.2 Current            | 2.8     | mA       |
| Plate Resistance (Approx.)               | 21500   | ohms     |
| Transconductance                         | 5500    | μmhos    |
| Load Resistance                          | 2800    | ohms     |
| Total Harmonic Distortion                | 10      | per cent |
| Maximum-Signal Power Output              | 1.2     | watts    |
| MAXIMUM CIRCUIT VALUES:                  |         |          |
| Grid-No.1-Circuit Resistance:            |         |          |
| For fixed-bias operation                 | 0.1 max | megohm   |
| For cathode-bias operation               | 0.5 max |          |

### DIODE-BEAM POWER TUBE

# 33GT7

Duodecar type used in a wide variety of applications in television receivers. The diode unit is used for damper service and the beam power unit for horizontal-deflection amplifier service. Outline 15A, Outlines section. Tube



12FC

requires duodecar twelve-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc)                                 | 33.6    | volts   |
|--------------------------------------------------------|---------|---------|
| Heater Current                                         | 0.45    | ampere  |
| Heater Warm-up Time (Average)                          | 11      | seconds |
| Peak Heater-Cathode Voltage:                           |         |         |
| Heater negative with respect to cathode                | 200 max | volts   |
| Heater positive with respect to cathode                | 200*max | volts   |
| Direct Interelectrode Capacitances (Approx.):          |         |         |
| Diode Unit:                                            |         |         |
| Plate to Cathode and Heater                            | 5.5     | pF      |
| Cathode to Plate and Heater                            | 8.5     | pF      |
| Heater to Cathode                                      | 3.2     | pF      |
| Beam Power Unit:                                       |         | _       |
| Grid No.1 to Plate                                     | 0.2     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 17      | ρF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 7       | pF      |

<sup>\*</sup> The dc component must not exceed 100 volts.

### Beam Power Unit as Class A. Amplifier

| CHARACTERISTICS:                              |      |     |       |       |
|-----------------------------------------------|------|-----|-------|-------|
| Plate Voltage                                 | 3500 | 60  | 130   | volts |
| Grid-No.2 (Screen-Grid) Voltage               | 130  | 130 | 130   | volts |
| Grid-No.1 (Control-Grid) Voltage              | _    | 0   | -22.5 | volts |
| Plate Resistance (Approx.)                    | _    |     | 10000 | ohms  |
| Transconductance                              | _    | -   | 6500  | μmhos |
| Grid-No.1 Voltage (Approx.) for plate current |      |     |       |       |
| of 1 mA                                       | 60   |     | -40   | volts |
| Plate Current                                 | _    | 320 | 48    | mA    |
| Grid-No.2 Current                             |      | 22  | 2.9   | mA    |
| Triode Amplification Factor†                  |      | _   | 4     |       |

<sup>†</sup> Triode connection (grid No.2 tied to plate).

#### Beam Power Unit as Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Ratings):    |          |       |
|----------------------------------------------|----------|-------|
| Plate Voltage                                | 400 max  | volts |
| Peak Positive-Pulse Plate Voltage††          | 3500 max | volts |
| Peak Negative-Pulse Plate Voltage            | 0 max    | volts |
| Grid-No.2 Voltage                            | 150 max  | volts |
| DC Grid-No.1 DC Voltage, Negative-bias value | —55 max  | volts |
| Peak Negative-Pulse Grid-No.1 Voltage        | —330 max | volts |
| Average Cathode Current                      | 140 max  | mA    |
| Peak Cathode Current                         | 490 max  | mA    |
| Plate Dissipation.                           | 9 max    | watts |
| Grid-No.2 Input                              | 2.5 max  | watts |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance ......

1 max megohm

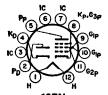
#### Damper Service—Diode Unit

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values):      |          |       |
|-----------------------------------------------|----------|-------|
| Peak Inverse Plate Voltage††                  | 2500 max | volts |
| Peak Plate Current                            | 750 max  | mA    |
| DC Plate Current                              | 125 max  | mA    |
| Plate Dissipation                             | 3.5 max  | watts |
| Peak Heater-Cathode Voltage:                  |          |       |
| Heater negative with respect to cathode       | 2500□max | volts |
| Heater positive with respect to cathode       | 200□□max | volts |
| Bulb Temperature (at hottest point)           | 220 max  | °C    |
| CHARACTERISTICS, Instantaneous Value:         |          |       |
| Tube Voltage Drop for plate current of 250 mA | 21       | volts |

<sup>††</sup> The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

DD The dc component must not exceed 100 volts.



#### DIODE—BEAM POWER TUBE

Duodecar type used as combined damper diode and horizontal deflection amplifier in televison receivers employing series-connected heater strings. Outline 15A, Outlines section. Tube requires duodecar twelve-contact sock-

33**GY**7

et and may be mounted in any position. Heater volts (ac/dc), 33.6; amperes, 0.45; warm-up time (average), 11 seconds.

<sup>•</sup> An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

<sup>□</sup> The dc component must not exceed 400 volts.

#### Beam Power Unit as Class A. Amplifier

#### CHARACTERISTICS.

| CITIZE CALIFORNIA CONTRACTOR CONT |      |      |       |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-------|-------|
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 5000 | 60   | 130   | voits |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 130  | 130  | 130   | volts |
| Grid-No.1 (Control-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | _    | 0    | -22.5 | volts |
| Triode Amplification Factor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |      | 4*    |       |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | _    |      | 10000 | ohms  |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |      | 6500  | μmhos |
| Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      | 320= | 48    | mA    |
| Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |      | 22*  | 2.9   | mA    |
| Grid-No.1 Voltage (Approx.) for plate current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |      |       |       |
| of 1 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 80   |      | 40    | volts |

Grid No.2 tied to plate.

#### Beam Power Unit as Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): | Power Beam Un | it    |
|------------------------------------------|---------------|-------|
| DC Plate Supply Voltage                  | 400 max       | volts |
| Peak Positive-Pulse Plate Voltage#       | 5000 max      | volts |
| Peak Negative-Pulse Plate Voltage        | 0 max         | volts |
| DC Grid-No.2 Voltage                     | 150 max       | volts |
| DC Grid-No.1 Voltage                     | 55 max        | volts |
| Peak Negative-Pulse Grid-No.1 Voltage    | -330 max      | volts |
| Peak Cathode Current                     | 540 max       | mA    |
| Average Cathode Current                  | 155 max       | mA    |
| Plate Dissipation†                       | 9 max         | watts |
| Grid-No.2 Input                          | 3 max         | watts |
| Peak Heater-Cathode Voltage:             |               |       |
| Heater negative with respect to cathode  | 200 max       | volts |
| Heater positive with respect to cathode  | 200 • max     | volts |

#### **MAXIMUM CIRCUIT VALUE:**

Grid-No.1-Circuit Resistance .....

1 max megohm

21

volts

#### Damper Service (Diode Unit)

For operation in a 525-line, 30-frame system

| MAXIMUM RATINGS (Design-Maximum Values): | Diode Unit |       |
|------------------------------------------|------------|-------|
| Peak Inverse Plate Voltage#              | 4200 max   | volts |
| Peak Plate Current                       | 810 max    | mA    |
| DC Plate Current                         | 135 max    | mA    |
| Plate Dissipation                        | 3.8 max    | watts |
| Peak Heater-Cathode Voltages:            |            |       |
| Heater negative with respect to cathode  | 4200≜max   | volts |
| Heater positive with respect to cathode  | 200 • max  | volts |
| Bulb Temperature (At hottest point)      | 200 max    | •c    |
| CHARACTERISTICS, Instantaneous Value:    |            |       |

Tube Voltage Drop for plate current of 250 mA .....

# The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle.

<sup>-</sup> This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

<sup>#</sup> The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

<sup>†</sup> An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

<sup>•</sup> The dc component must not exceed 100 volts.

In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

<sup>▲</sup> The dc component must not exceed 400 volts.

<sup>•</sup> The dc component must not exceed 100 volts.



### **BEAM POWER TUBE**

Duodecar type used as horizontal-© 63 deflection amplifier in television receivers. Outline 15B, Outlines section. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 33; am-

33JV6

peres, 0.3; average warm-up time, 11 seconds; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A<sub>1</sub> Amplifier

| CHARACTERISTICS:                              |      |       |                 |             |
|-----------------------------------------------|------|-------|-----------------|-------------|
| Plate Voltage                                 | 5000 | 60    | 130             | volts       |
| Grid-No.3 (Suppressor-Grid)                   |      | Conne | ected to cathod | e at socket |
| Grid-No.2 (Screen-Grid) Voltage               | 130  | 130   | 130             | volts       |
| Grid-No.1 (Control-Grid) Voltage              | _    | 0     | -20             | volts       |
| Plate Resistance (Approx.)                    | _    | _     | 11000           | ohms        |
| Transconductance                              | _    |       | 9100            | μmhos       |
| Plate Current                                 | _    | 410   | 50              | mA          |
| Grid-No.1 Current                             | -    | 24    | 1.75            | mA          |
| Grid-No.1 Voltage (Approx.) for plate current |      |       |                 |             |
| of 1 mA                                       | 66   | _     | -33             | volts       |
| Triode Amplification Factor*                  | _ `  | _     | 4.7             |             |

#### Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

|  | (Design-Maximum |  |
|--|-----------------|--|
|  |                 |  |
|  |                 |  |
|  |                 |  |

| DC Plate Supply Voltage                   | 770 max   | volts |
|-------------------------------------------|-----------|-------|
| Peak Positive-Pulse Plate Voltage#        | 6000 max  | volts |
| Peak Negative-Pulse Plate Voltage         | -1500 max | volts |
| DC Grid-No. 3 Voltage                     | 70 max    | volts |
| DC Grid-No.2 Voltage                      | 220 max   | volts |
| DC Grid-No.1 Voltage, Negative-bias value | 55 max    | volts |
| Peak Negative-Pulse Grid-No.1 Voltage     | -330 max  | volts |
| Average Cathode Current                   | 230 max   | mA    |
| Peak Cathode Current                      | 800 max   | mA    |
| Plate Dissipation**                       | 18 max    | watts |
| Grid-No.2 Input                           | 3.5 max   | watts |
| Bulb Temperature (At hottest point)       | 220 max   | °C    |

#### **MAXIMUM CIRCUIT VALUES:**

 1 max megohm

- #The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
- \*\* An adequate bias resistor or other means is required to protect the tube in the absence of excitation.



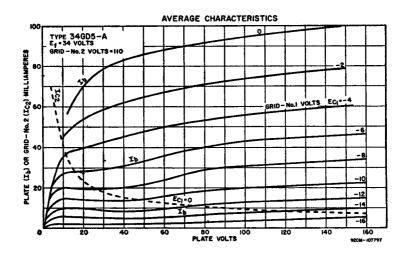
### **BEAM POWER TUBE**

Miniature type used in audio output stages of compact ac/dc radio receivers. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be operated in any position.

**34GD5A** 

| Heater | Voltage | (ac/dc) | <br> | <br> | <br> | <br> | <br> | <br>34 | volts  |
|--------|---------|---------|------|------|------|------|------|--------|--------|
| Heater | Current |         |      |      |      |      |      | 0.1    | ampere |

| Heater Warm-up Time (Average) Peak Heater-Cathode Voltage:                                                                      | 20                 | seconds        |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|
| Heater negative with respect to cathode  Heater positive with respect to cathode  Direct Interelectrode Capacitances (Approx.): | 200 max<br>200=max | volts<br>volts |
| Grid No.1 to Plate                                                                                                              | 0.6                | ρF             |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3  Plate to Cathode, Heater, Grid No.2, and Grid No.3                      | 12<br>9            | pF<br>pF       |
| • The dc component must not exceed 100 volts.                                                                                   |                    |                |
| Class A, Amplifier                                                                                                              |                    |                |
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                        |                    |                |
| Plate Voltage                                                                                                                   | 150 max            | volts          |
| Grid-No.2 (Screen-Grid) Voltage Grid-No.1 (Control-Grid) Voltage:                                                               | 130 max            | volts          |
| Negative-bias value                                                                                                             | 50 max             | volts          |
| Positive-bias value                                                                                                             | 0 max              | volts          |
| Grid-No.2 Input                                                                                                                 | 1.1 max            | watts          |
| Plate Dissipation                                                                                                               | 5 max              | watts          |
| Bulb Temperature (At hottest point)                                                                                             | 250 max            | °C             |



| TYPICAL OPERATION AND CHARACTERISTICS: |       |          |
|----------------------------------------|-------|----------|
| Plate Voltage                          | 110   | volts    |
| Grid-No.2 Voltage                      | 110   | volts    |
| Grid-No.1 Voltage                      |       |          |
| Peak AF Grid-No.1 Voltage              | 7.5   | volts    |
| Zero-Gignot Plata Current              | 7.5   | volts    |
| Zero-Signal Plate Current              | 35    | mA       |
| Zero-Signal Grid-No.2 Current          | 3     | mA       |
| Plate Resistance (Approx.)             | 13000 | ohms     |
| Transconductance                       | 5700  | μmhos    |
| Load Resistance                        | 2500  | ohms     |
| Total Harmonic Distortion              | 10    | per cent |
| Maximum-Signal Power Output            | 1.4   | watts    |
| MAXIMUM CIRCUIT VALUES:                |       |          |
| Grid-No.1-Circuit Resistance:          |       |          |

| Grid-No.1-Circuit Resistance: |                 |
|-------------------------------|-----------------|
| For fixed-bias operation      | 0.1 max megohm  |
| For cathode-bias operation    | o.r max megotin |
| Tor camoue-oras operation     | 0.5 max megohm  |



### **BEAM POWER TUBE**

Miniature type used in output stage of compact, ac/dc radio receivers. Because of its high power sensitivity and high efficiency at plate and screen-grid voltages available in ac/dc receivers, the 35C5 is capable of providing a

35C5

7CV

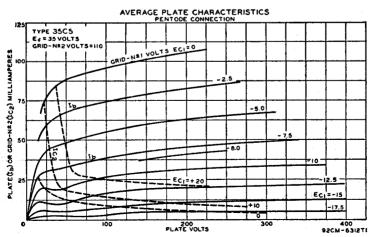
relatively high power output. Except for terminal connections and slightly higher ratings, type 35C5 is equivalent in performance to miniature type 35B5 and, within its maximum ratings, to glass octal type 35L6GT. The basing arrangement of the 35C5 simplifies the problem of meeting Underwriters' Laboratories requirements in the design of ac/dc receivers.

| Heater Voltage (ac/dc)                                 | 35      | volts  |
|--------------------------------------------------------|---------|--------|
| Heater Current                                         | 0.15    | ampere |
| Peak Heater-Cathode Voltage:                           |         |        |
| Heater negative with respect to cathode                | 200 max | volts  |
| Heater positive with respect to cathode                | 200=max | volts  |
| Direct Interelectrode Capacitances (Approx.):          |         |        |
| Grid No.1 to Plate                                     | 0.6     | pF     |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 12      | pF     |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 9       | pF     |
|                                                        |         |        |

• The dc component must not exceed 100 volts.

### Class A, Amplifier

| Plate Voltage                       | 150 max     | volts |
|-------------------------------------|-------------|-------|
| Grid-No.2 (Screen-Grid) Voltage     | 130 max     | volts |
| Plate Dissipation                   | 5.2 max     | watts |
| Grid-No.2 Input                     | 1.1 max     | watt  |
| Bulb Temperature (At hottest point) | 250 max     | °C    |
| TYPICAL OPERATION:                  |             |       |
| Plate Voltage                       | 110         | volts |
| Grid-No.2 Voltage                   | 110         | volts |
| Grid-No.1 (Control-Grid) Voltage    | <b>7.</b> 5 | volts |
| Peak AF Grid-No.1 Voltage           | 7.5         | volts |
| Zero-Signal Plate Current           | 40          | mA    |
| Maximum-Signal Plate Current        | 41          | mA    |
| Zero-Signal Grid-No.2 Current       | 3           | mA    |
| Maximum-Signal Grid-No.2 Current    | 7           | mA    |



| Plate Resistance (Approx.) Transconductance Load Resistance Total Harmonic Distortion Maximum-Signal Power Output | 5800<br>2500<br>10 | ohms  µmhos ohms per cent watts |
|-------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------|
| MAXIMUM CIRCUIT VALUES:                                                                                           |                    |                                 |
| Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation                                 |                    | megohm<br>megohm                |

#### Installation and Application

Type 35C5 requires miniature seven-contact socket and may be mounted in any position. Outline 5D, Outlines section. It is especially important that this tube, like other power-handling tubes, should be adequately ventilated.

The 35-volt heater is designed to operate under the normal conditions of line-voltage variation without materially affecting the performance or serviceability of the 35C5. For operation of the 35C5 in series with other types having 0.15-ampere rating, the current in the heater circuit should be adjusted to 0.15 ampere for the normal supply voltage.

In a series-heater circuit of the "dc-power line" type employing several 0.15-ampere types and one or two 35C5s, the heater(s) of the 35C5(s) should be placed on the positive side of the line. Under these conditions, heater-cathode voltage of the 35C5 must not exceed the value given under maximum ratings. In a series-heater circuit of the "universal" type employing rectifier tube 35W4, one or two 35C5s and several 0.15-ampere types, it is recommended that the heater(s) of the 35C5(s) be placed in the circuit so that the higher values of heater-cathode bias will be impressed on the 35C5(s) rather than on the other 0.15-ampere types. This is accomplished by arranging the 35C5(s) on the side of the supply line which is connected to the cathode of the rectifier, i.e., the positive terminal of the rectified voltage supply. Between this side of the line and the 35C5(s), any necessary auxiliary resistance and the heater of the 35W4 are connected in series.

As a power amplifier (class A<sub>1</sub>), the 35C5 is recommended for use either singly or in push-pull combination in the power-output stage of ac/dc receivers. The operating values shown under typical operation have been determined on the basis that grid-No.1 current does not flow during any part of the input cycle.

### **POWER PENTODE**

# 35EH5

any position.

Miniature type used in the audio output stage of radio and television receivers and in phonographs. This type has unusually high power sensitivity and is capable of providing relatively high power output at low plate and 10 0°2 c,2 70 70,

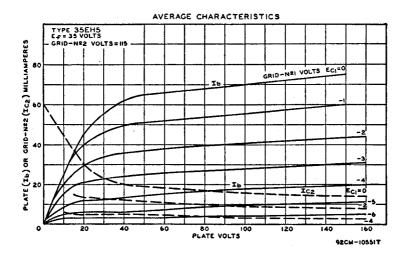
screen-grid voltages with a low af grid-No.1 driving voltage. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in

| any position.                                          |         |         |
|--------------------------------------------------------|---------|---------|
| Heater Voltage (ac/dc)                                 | 35      | volts   |
| Heater Current                                         | 0.15    | amperes |
| Peak Heater-Cathode Voltage:                           |         |         |
| Heater negative with respect to cathode                | 200 max | volts   |
| Heater positive with respect to cathode                | 200 max | volts   |
| Direct Interelectrode Capacitances (Approx.):          |         |         |
| Grid No.1 to Plate                                     | 0.65    | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 17      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 9       | рF      |
|                                                        |         |         |

The dc component must not exceed 100 voits.

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage | 150 max   | volts    |
|--------------------------------------------------------|-----------|----------|
| Grid-No.2 (Screen-Grid) Voltage                        | 130 max   | volts    |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value  | 0 max     | volts    |
| Plate Dissipation                                      | 5 max     | watts    |
| Grid-No.2 Input                                        | 1.75 max  | watts    |
| Bulb Temperature (At hottest point)                    | 225 max   | ""°C     |
| Build Temperature (At noticest point)                  | 225 Illan | ·        |
| TYPICAL OPERATION:                                     |           |          |
| Plate Supply Voltage                                   | 110       | volts    |
| Grid-No.2 Supply Voltage                               | 115       | volts    |
| Cathode-Bias Resistor                                  | 62        | ohms     |
| Peak AF Grid-No.1 Voltage                              | 3         | volts    |
| Zero-Signal Plate Current                              | 32        | mA       |
| Maximum-Signal Plate Current                           | 32        | mA       |
| Zero-Signal Grid-No.2 Current                          | 7.2       | mA       |
| Maximum-Signal Grid-No.2 Current                       | 12        | mA       |
| Plate Resistance (Approx.)                             | 14000     | ohms     |
| Transconductance                                       | 3000      | μmhos    |
| Load Resistance                                        | 3000      | ohms     |
| Total Harmonic Distortion                              | 8         | per cent |
| Maximum-Signal Power Output                            | 1.2       | watts    |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:  |           |          |
| For fixed-bias operation                               | 0.1 max   | megohm   |
| For cathode-bias operation                             |           | megohm   |
| For camoue-oras operation                              | U.J IIIAA | megonin  |





### **BEAM POWER TUBE**

Glass octal type used in output stage of ac/dc radio receivers. Outline 13D, Outlines section. Tube requires octal socket and may be mounted in any position. This type may be supplied with pin No.1 omitted. Refer to minia-

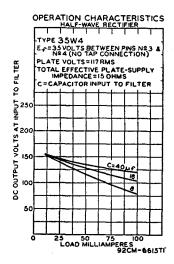
35L6GT

ture type 35C5 for installation, application information, and curves.

|                                                                                         |                                                                                                                           | •                                       | •                   |                      |
|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------|----------------------|
| Heater Current                                                                          | Olfono                                                                                                                    |                                         | 35<br>0.15          | volts<br>ampere      |
| Peak Heater-Cathode V Heater negative with Heater positive with Direct Interelectrode C | th respect to cathode                                                                                                     |                                         | 90 max<br>90 max    | volts<br>volts       |
| Grid No.1 to Plate                                                                      | ode, Heater, Grid No.2, and Grid                                                                                          |                                         | 0.6                 | pF                   |
| Grid No.1 to Catho<br>Plate to Cathode. H                                               | ode, Heater, Grid No.2, and Grid I<br>leater, Grid No.2, and Grid No.3.                                                   | No.3                                    | 13<br>9.5           | pF<br>pF             |
| •                                                                                       |                                                                                                                           |                                         | 2.0                 | -                    |
| MAXIMUM DATINGS                                                                         | Class A, Amplifie                                                                                                         | Г                                       |                     |                      |
|                                                                                         | (Design-Center Values):                                                                                                   |                                         | 200 max             | volts                |
| Grid-No.2 (Screen-Grid)                                                                 | Voltage                                                                                                                   |                                         | 125 max             | volts                |
|                                                                                         |                                                                                                                           |                                         | 8.5 max<br>1.0 max  | watts                |
| TYPICAL OPERATION                                                                       |                                                                                                                           |                                         |                     | watt                 |
| Plate Supply Voltage                                                                    |                                                                                                                           | Fixed Bias<br>110                       | Cathode Bias<br>200 | volts                |
| Grid-No.2 Supply Volta                                                                  | ige                                                                                                                       | 110                                     | 125                 | volts                |
|                                                                                         | ) Voltage                                                                                                                 | <b>7.5</b>                              | 180                 | volts<br>ohms        |
| Peak AF Grid-No.1 Vo                                                                    | ltage                                                                                                                     | 7.5                                     | 8                   | volts                |
| Zero-Signal Plate Curre                                                                 | ent                                                                                                                       | 40                                      | 43                  | mA                   |
| Zero-Signal Grid-No.2                                                                   | Current                                                                                                                   | 41<br>3                                 | 43<br>2             | mA<br>mA             |
| Maximum-Signal Grid-N                                                                   | No.2 Current                                                                                                              | 7                                       | 5.5                 | mA                   |
| Plate Resistance (Appro                                                                 | ······································                                                                                    | 14000<br>5800                           | 34000               | ohms                 |
| Load Resistance                                                                         |                                                                                                                           | 2500                                    | 6100<br>5000        | μmhos<br>ohms        |
| Total Harmonic Distor                                                                   | tion<br>Output                                                                                                            | 10<br>1.5                               | 10<br>3.0           | per cent<br>watts    |
| MAXIMUM CIRCUIT Grid-No1-Circuit Resis For fixed-bias oper For cathode-bias o           | tance:                                                                                                                    |                                         |                     | megohm<br>megohm     |
| 1                                                                                       | HALF-WAVE VACUUM RI                                                                                                       |                                         | "3 <u>-</u>         | )<br>O <sup>HL</sup> |
| 35W4                                                                                    | Miniature type used in pow<br>of ac/dc receivers. Equivale<br>formance to glass-octal type<br>The heater is provided with | ent in per-<br>35Z5GT.                  | NC ONC              | <b>Ж</b> ,           |
|                                                                                         | operation of a panel lamp.                                                                                                | u tup 101                               | 5BQ                 |                      |
| Heater Voltage (ac/dc)                                                                  |                                                                                                                           | •                                       | **                  |                      |
| Panel Lamp Section Heater Current:                                                      | 3 and 4)                                                                                                                  | 35<br>7.5                               | 32<br>5.5           | volts<br>volts       |
| Between Pins 3 and<br>Peak Heater-Cathode                                               |                                                                                                                           | 0.15                                    | 0.15                | ampere<br>ampere     |
| Heater positive with                                                                    | th respect to cathode                                                                                                     |                                         | 360 max<br>360 max  | volts<br>volts       |
| * Without panel lamp.  ** With No.40 or No.4                                            | 7 panel lamp.                                                                                                             |                                         |                     |                      |
|                                                                                         | Half-Wave Rectifie                                                                                                        | ) P                                     |                     |                      |
| MAXIMUM RATINGS                                                                         | Hall-Wave Rectifie<br>(Design-Maximum Values):                                                                            |                                         |                     |                      |
| Peak Inverse Plate Vol                                                                  | tage                                                                                                                      | • • • • • • • • • • • • • • • • • • • • | 360 max<br>660 max  | volts<br>mA          |
| With Panel Lamp                                                                         | and Shunting Resistor                                                                                                     |                                         | 66 max<br>100 max   | mA<br>mA             |
| Without Panel Lan                                                                       | ıp                                                                                                                        |                                         | 110 max             | mA                   |
| Panel-Lamp-Section Vol<br>When Panel Lamp                                               | tage:                                                                                                                     |                                         | 17 max              | volts                |

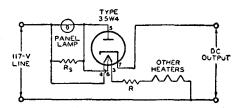
When Panel Lamp Fails .....

### Installation and Application



Tube requires miniature seven-contact socket and may be mounted in any position. Outline 5D, Outlines section. For heater considerations, refer to miniature type 35C5.

With the panel lamp connected as shown in the diagram, the drop across R and all heaters (with panel lamp) should equal 117 volts at 0.15 ampere. The shunting resistor R, is required when dc output current exceeds 60 milliamperes. Values of R<sub>8</sub> for dc output currents greater than 60 milliamperes are given in tabulated data.



| TYPICAL OPERATION WITH PANEL LAMP:†            |     |     |     |     |              |
|------------------------------------------------|-----|-----|-----|-----|--------------|
| AC Plate-Supply Voltage (rms)                  | 117 | 117 | 117 | 117 | volts        |
| Filter-Input Capacitor                         | 40  | 40  | 40  | 40  | $\mu$ F      |
| Minimum Total Effective Plate-Supply Impedance | 15  | 15  | 15  | 15  | ohms         |
| Panel-Lamp Shunting Resistor                   |     | 300 | 150 | 100 | ohm <b>s</b> |
| DC Output Current                              | 60  | 70  | 80  | 90  | mA           |

t No.40 or No.47 panel lamp used in circuit given below with capacitor-input filter.

#### TYPICAL OPERATION WITHOUT PANEL LAMP:

| 11110111 01 DAILETON (VIIII O W 1111 V          |         |         |
|-------------------------------------------------|---------|---------|
| AC Plate-Supply Voltage (rms)                   | 117     | volts   |
| Filter-Input Capacitor                          | 40      | $\mu$ F |
| Minimum Total Effective Plate-Supply Impedance  | 15      | ohms    |
| DC Output Current                               | 100     | mA      |
| DC Output Voltage at Input to Filter (Approx.): |         |         |
| At half-load current (50 mA)                    | 135     | volts   |
| At full-load current (100 mA)                   | 120     | volts   |
| Voltage Regulation (Approx.):                   |         |         |
| Half-load to full-load current                  | 15      | volts   |
| MAXIMUM CIRCUIT VALUES:                         |         |         |
| Panel-Lamp Shunting Resistor:*                  |         |         |
| { 70 mA                                         | 800 max | ohms    |
| For dc output current of \{ 80 mA               | 400 max | ohms    |
| For dc output current of { 70 mA                | 250 max | ohms    |
|                                                 |         |         |

<sup>\*</sup> Required when do output current is greater than 60 milliamperes.



### HALF-WAVE VACUUM RECTIFIER

Glass octal type used in power supply of ac/dc receivers. The heater is provided with a tap for operation of a panel lamp. Outline 13D, Outlines section. Tube requires octal socket and may be mounted in any position. This

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type may be supplied with pin No.1 omitted. For installation and application considerations, refer to miniature type 35W4.

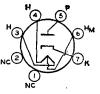
| Heater Voltage (ac/dc):                                                          | •                                     | ••                 |              |
|----------------------------------------------------------------------------------|---------------------------------------|--------------------|--------------|
| Entire Heater (pins 2 and 7)                                                     | 35                                    | 32                 | volts        |
| Panel Lamp Section (pins 2 and 3)                                                | . 7.5                                 | 5.5                | volts        |
| Heater Current: Between Pins 2 and 7                                             | 0.15                                  |                    | ampere       |
| Between Pins 3 and 7                                                             | <del>-</del>                          | 0.15               | ampere       |
| Peak Heater-Cathode Voltage:                                                     |                                       |                    | •            |
| Heater negative with respect to cathode                                          |                                       | 350 max            | volts        |
| Heater positive with respect to cathode                                          |                                       | 350 max            | volts        |
| <ul> <li>Without panel lamp.</li> <li>With No.40 or No.47 panel lamp.</li> </ul> |                                       |                    |              |
| Half-Wave Rectifie                                                               | Г                                     |                    | 1            |
| MAXIMUM RATINGS (Design-Center Values):                                          |                                       |                    |              |
| Peak Inverse Plate Voltage                                                       |                                       | 700 max            | velts        |
| Peak Plate Current                                                               |                                       | 600 max            | mA           |
| With Panel Lamp and Shunting Resistor                                            |                                       | 60 max             | mA           |
| ( Shunting Resistor , , , ,                                                      |                                       | JO MIAA            | mA           |
| Without Panel Lamp                                                               |                                       | 100 max            | mA           |
| Panel-Lamp-Section Voltage (rms): When Panel Lamp Fails                          |                                       | 15 max             | volts        |
| when Faner Lamp Fans                                                             | · · · · · · · · · · · · · · · · · · · | 15 Illax           | VOILB        |
| TYPICAL OPERATION WITH PANEL LAMP:                                               |                                       |                    |              |
| AC Plate-Supply Voltage (rms) 117 117                                            | 117                                   | 117 235            | volts        |
| Filter-Input Capacitor                                                           | 40                                    | 40 40              | $\mu$ F      |
| Supply Impedance                                                                 | 15                                    | 15 100             | ohms         |
| Panel-Lamp Shunting Resistor 300                                                 | 150                                   | 100                | ohms         |
| DC Output Current 60 70                                                          | 80                                    | 90 60              | mA           |
| † No.40 or No.47 panel lamp used in circuit with capacito                        | r-input filte                         | r given under typ  | oe 35W4.     |
| TYPICAL OPERATION WITHOUT PANEL LAMP:                                            |                                       |                    |              |
| AC Plate-Supply Voltage (rms)                                                    | 117                                   | 235                | volts        |
| Filter-Input Capacitor                                                           | 40                                    | 40                 | $\mu$ F      |
| Minimum Total Effective Plate-Supply Impedance                                   | 15<br>100                             | 100<br>100         | ohms<br>mA   |
| DC Output Current                                                                | 100                                   | 100                | ша           |
| At half-load current (50 mA)                                                     | 140                                   | 280                | volts        |
| At full-load current (100 mA)                                                    | 120                                   | 235                | volts        |
| Voltage Regulation (Approx.):                                                    | 20                                    | 45                 | volts        |
| Half-load to full-load current                                                   | 20                                    | 73                 | TOILS        |
| MAXIMUM CIRCUIT VALUES:                                                          |                                       |                    |              |
| Panel-Lamp Shunting Resistor*:                                                   |                                       |                    |              |
| 70 mA                                                                            |                                       | 800 max            | ohms         |
| For dc output current of \ 80 mA                                                 |                                       | 400 max<br>250 max | ohms<br>ohms |
| 70 IIIA                                                                          |                                       |                    |              |

<sup>•</sup> Required when dc output current is greater than 60 milliamperes.

### HALF-WAVE VACUUM RECTIFIER

# **36AM3B**

Miniature type used in power supply of ac/dc receivers. This type has a tapped heater so that the heater section between pins 4 and 6 can be used as a limiting resistance in the rectifier plate circuit. This heater section is not to be



5BQ

used as a panel-lamp shunt. Outline 5D, **Outlines** section. Tube requires miniature seven-contact socket and may be operated in any position.

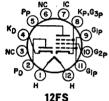
| Heater Voltage (ac/gc):       |     |               |
|-------------------------------|-----|---------------|
| Entire Heater (Pins 3 and 4)  | 36  | volt <b>s</b> |
| Tap Section (Pins 3 and 6)    | 32  | volts         |
| Heater Current (Pins 3 and 6) | 0.1 | · ampere      |
| Heater Warm-up Time (Average) | 20  | seconds       |

| Peak Heater-Cathode Voltage:  Heater negative with respect to cathode  Heater positive with respect to cathode | -350∙max<br>200∗max | volts<br>volts |
|----------------------------------------------------------------------------------------------------------------|---------------------|----------------|
| • The dc component must not exceed 350 volts.                                                                  |                     |                |

• The dc component must not exceed 100 volts.

#### Half-Wave Rectifier

| MAXIMUM RATINGS (Design-Maximum Values):  Peak Inverse Plate Voltage  Peak Plate Current  DC Output Current |         | 365 max<br>580 max<br>82 max | volts<br>mA<br>mA |
|-------------------------------------------------------------------------------------------------------------|---------|------------------------------|-------------------|
| TYPICAL OPERATION WITH CAPACITOR INPUT TO I                                                                 | FILTER: | Ç1                           |                   |
| AC Plate-Supply Voltage (rms)                                                                               | 120     | 117                          | volts             |
| Filter-Input Capacitor                                                                                      | 40      | 40                           | $\mu$ F           |
| Total Effective Plate Supply Resistance                                                                     |         | See                          | text above        |
| DC Output Current                                                                                           | 75      | 75                           | mA                |
| DC Output Voltage                                                                                           | 118     | 105                          | volts             |
| CHARACTERISTICS:                                                                                            |         |                              |                   |
| Tube Voltage Drop for plate current of 150 mA                                                               | 16      | 20                           | volts             |



### DIODE-BEAM POWER TUBE

Duodecar type used in a wide variety of applications in television receivers. The diode unit is used for damper service and the beam power unit for horizontal-deflection amplifier service. Outline 15D, Outlines section. Tube

38HE7

requires duodecar twelve-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc)                                 | 37.8    | volts   |
|--------------------------------------------------------|---------|---------|
| Heater Current                                         | 0.45    | ampere  |
| Heater Warm-up Time (Average)                          | 11      | seconds |
| Peak Heater-Cathode Voltage:                           |         |         |
| Heater negative with respect to cathode                | 200 max | volts   |
| Heater positive with respect to cathode                | 200*max | volts   |
| Direct Interelectrode Capacitances (Approx.):          |         |         |
| Diode Unit:                                            |         |         |
| Plate to Cathode and Heater                            | 7       | рF      |
| Cathode to Plate and Heater                            | 8       | pF      |
| Heater to Cathode                                      | 1.6     | pF      |
| Beam Power Unit:                                       |         |         |
| Grid No.1 to Plate                                     | 0.38    | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 19      | рF      |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | . 8     | ₽₽      |
| * The dc component must not exceed 100 volts.          |         |         |

#### Beam Power Unit as Class A. Amplifier

| CHARACTERISTICS:                                |      |     |      |       |
|-------------------------------------------------|------|-----|------|-------|
| Plate Voltage                                   | 5000 | 50  | 130  | volts |
| Grid-No.2 (Screen-Grid) Voltage                 | 130  | 130 | 130  | voits |
| Grid-No.1 (Control-Grid) Voltage                |      | 0   | 22   | volts |
| Plate Resistance (Approx.)                      | _    | _   | 6200 | ohms  |
| Transconductance                                |      | _   | 8800 | μmhos |
| Grid-No.1 Voltage (Approx.) for plate current   |      |     |      |       |
| of 1 mA                                         | 80   |     | 39   | voits |
| Plate Current                                   |      | 450 | 60   | mA    |
| Grid-No.2 Current                               | _    | 40  | 2.8  | mA    |
| Triode Amplification Factor **                  |      | _   | 4.2  |       |
| ** Triode connection (grid No.2 tied to plate). |      |     |      |       |

### Beam Power Unit as Horizontal-Deflection Amplifier

For operation in a 525-line, 30-frame system

| MAXIMUM | RATINGS | (Design-Maximum | Ratinos): |
|---------|---------|-----------------|-----------|

| Plate Voltage                                | 500 max  | volts |
|----------------------------------------------|----------|-------|
| Peak Positive-Pulse Plate Voltage            | 5000 max | volts |
| Peak Negative-Pulse Plate Voltage            |          | volts |
| Grid-No.2 Voltage                            | 150 max  | volts |
| DC Grid-No.1 DC Voltage, Negative-bias value | -55 max  | volts |
| Peak Negative-Pulse Grid-No.1 Voltage        | —330 max | volts |
| Average Cathode Current                      | 230 max  | mΑ    |
| Peak Cathode Current                         | 800 max  | mA    |
| Plate Dissipation †                          | 10 max   | watts |
| Grid-No.2 Input                              | 3.5 max  | watts |

#### MAXIMUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance

1 max megohm

volts

† An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

#### Damper Service—Diode Unit

For operation in a 525-line, 30-frame system

MAXIMUM RATINGS (Design-Maximum Values):

| Peak Inverse Plate Voltage ††                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4200 max | volts |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------|
| Peak Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1200 max | mA    |
| Average Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 200 max  | mA    |
| Peak Heater-Cathode Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |       |
| Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4200□max | volts |
| Heater positive with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 200□□max | volts |
| Bulb Temperature (at hottest point)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 200 max  | °C    |
| and a compression of the compres |          |       |

CHARACTERISTICS (Instantaneous Value):

†† The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

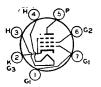
☐ The dc component must not exceed 500 volts.

DD The dc component must not exceed 100 volts.

#### **BEAM POWER TUBE**

50**B**5

Miniature type used in output stage of compact ac/dc receivers. Because of its high power sensitivity at plate and screen-grid voltages available in ac/dc receivers, it is capable of providing a relatively high power output. Outline

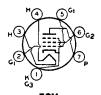


7BZ

5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. Except for basing arrangement, type 50B5 is identical with miniature type 50C5.

#### **BEAM POWER TUBE**

50C5 Related types: 17C5, 25C5 Miniature type used in output stage of compact, ac/dc radio receivers. Because of its high power sensitivity and high efficiency at plate and screengrid voltages available in ac/dc receivers, the 50C5 is capable of provid-



7CV

ing a relatively high power output. Within its maximum ratings, type 50C5 is

volts

mΑ

mA

mA

mA

ohms

50C5

49

50

10

2.3

per cent

0.1 max megohm

0.5 max megohm

watte

10000

2505

equivalent in performance to glass octal type 50L6GT. The basing arrangement of the 50C5 simplifies the problem of meeting Underwriters' Laboratories requirements in the design of ac/dc receivers. Types 17C5 and 25C5 are identical with type 50C5 except for the heater ratings, as shown below.

|                                                    | 1/03       | 2303    | 3003    |         |
|----------------------------------------------------|------------|---------|---------|---------|
| Heater Voltage (ac/dc)                             | 16.8       | 25      | 50      | volts   |
| Heater Current                                     | 0.45       | 0.3     | 0.15    | ampere  |
| Heater Warm-up Time (Average)                      | 11         | _       | _       | seconds |
| Peak Heater-Cathode Voltage:                       |            |         |         |         |
| Heater negative with respect to cathode            | 200 max    | 200 max | 200 max | volts   |
| Heater positive with respect to cathode            | 200 max    | 200 max | 200 max | volts   |
| Direct Interelectrode Capacitances (Approx.):      |            |         |         |         |
| Grid No.1 to Plate                                 |            |         | 0.6     | pF      |
| Grid No.1 to Cathode, Heater, Grid No.2, as        | nd Grid No | .3      | 13      | pF      |
| Plate to Cathode, Heater, Grid No.2, and Gr        | rid No.3   |         | 8.5     | pF      |
| The dc component must not exceed 100 volts.        |            |         |         |         |
| Class A, A                                         | mplifier   |         |         |         |
| MAXIMUM RATINGS (Design-Maximum Values             | ):         |         |         |         |
| Plate Voltage                                      |            |         | 150 max | volts   |
| Grid-No.2 (Screen-Grid) Voltage                    |            |         | 130 max | volts   |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias va |            |         | 0 max   | volts   |
| Plate Dissipation                                  |            |         | 7 max   | watts   |
| Grid-No.2 Input                                    |            |         | 1.4 max | watts   |
| Bulb Temperature (At hottest point)                |            |         | 220 max | °C      |
| TYPICAL OPERATION:                                 |            |         |         |         |
|                                                    |            |         | 120     | volts   |
| Plate Voltage                                      |            |         | 110     | volts   |
| Grid-No.2 Voltage                                  |            |         | 8       | volts   |
| Grid-No.1 (Control-Grid) Voltage                   |            |         | 0       | VOILS   |

Peak AF Grid-No.1 Voltage ......

Zero-Signal Plate Current

Maximum-Signal Plate Current

Zero-Signal Grid-No.2 Current .....

Maximum-Signal Grid-No.2 Current .....

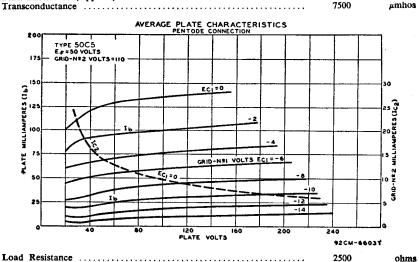
Plate Resistance (Approx.) .....

Total Harmonic Distortion .....

MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation

Maximum-Signal Power Output .....

For cathode-bias operation .....



### **Installation and Application**

Type 50C5 requires miniature seven-contact socket and may be mounted in any position. Outline 5D, **Outlines** section. It is especially important that this tube, like other power-handling tubes, be adequately ventilated.

The 50-volt heater is designed to operate under the normal conditions of line-voltage variation without materially affecting the performance or serviceability of the 50C5. For operation of the 50C5 in series with other types having 0.15-ampere rating, the current in the heater circuit should be adjusted to 0.15 ampere for the normal supply voltage.

In a series-heater circuit of the "dc power line" type employing several 0.15-ampere types and one or two 50C5s, the heater (s) of the 50C5(s) should be placed on the positive side of the line. Under these conditions, heater-cathode voltage of the 50C5 must not exceed the value given under maximum ratings. In a series-heater circuit of the "universal" type employing rectifier tube 35W4, one or two 50C5s, and several 0.15-ampere types, it is recommended that the heater(s) of the 50C5(s) be placed in the circuit so that the higher values of heater-cathode bias will be impressed on the 50C5(s) rather than on the other 0.15-ampere types. This is accomplished by arranging the 50C5(s) on the side of the supply line which is connected to the cathode of the rectifier, i.e., the positive terminal of the rectified voltage supply. Between this side of the line and the 50C5(s), any necessary auxiliary resistance and the heater of the 35W4 are connected in series.

As a power amplifier (class A<sub>1</sub>), the 50C5 is recommended for use either singly or in push-pull combination in the power-output stage of "ac/dc" receivers. The operating values shown under typical operation have been determined on the basis that grid-No.1 current does not flow during any part of the input cycle.

# HALF-WAVE VACUUM RECTIFIER

# 50DC4

Miniature type used in power supply of ac/dc radio receivers. The heater is provided with a tap for operation of a panel lamp. For typical circuit, refer to type 35W4. Outline 5D, Outlines section. Tube requires seven-contact

| <b>"</b> @ |
|------------|
| #3/        |
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| NCE VIVE   |
| NC .       |
| 580        |

| section. Tube requires seve                | cm-contact                      | 304     |        |
|--------------------------------------------|---------------------------------|---------|--------|
| socket and may be mounted in any position. |                                 |         |        |
| Heater Voltage (ac/dc):                    | *                               | **      | volts  |
| Entire Heater (Pins 3 and 4)               | 50                              | 45      | volts  |
| Panel-Lamp Section (Pins 4 and 6)          | 7.5                             | 5.5     | volts  |
| Heater Current:                            |                                 |         |        |
| Between Pins 3 and 4                       | 0.15                            | _       | ampere |
| Between Pins 3 and 6                       | _                               | 0.15    | ampere |
| Peak Heater-Cathode Voltage:               |                                 |         |        |
| Heater negative with respect to cathode    |                                 | 330 max | volts  |
| Heater positive with respect to cathode    | · · · · · · · · · · · · · · · · | 330 max | volts  |
| • Without panel lamp.                      |                                 |         |        |
| **With No.40 or No.47 panel lamp.          |                                 |         |        |
|                                            |                                 |         |        |

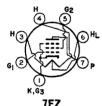
### Half-Wave Rectifier

| Half-wave Rectifier                                     |          |       |
|---------------------------------------------------------|----------|-------|
| MAXIMUM RATINGS (Design-Maximum Values):                |          |       |
| Peak Inverse Plate Voltage                              | 330 max  | volts |
| Peak Plate Current                                      | 720 max  | mA    |
| DC Output Current:                                      |          |       |
| With Panel Lamp and Shunting Resistor Shunting Resistor | 70 max   | mA    |
| With Panel Lamp and Shunting Resistor.                  | 110 max  | mΑ    |
| Without Panel Lamp                                      | 120 max  | mA    |
| Panel-Lamp-Section Voltage (rms):                       |          |       |
| When Panel Lamp Fails                                   | 16.5 max | volts |

| TYPICAL OPERATION WITH PANE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | L LAMP  | i <del>†</del> |     |                        |                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------|-----|------------------------|-------------------------|
| AC Plate-Supply Voltage (rms)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 117     | 117            | 117 | 117                    | volts                   |
| Filter-Input Capacitor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 40      | 40             | 40  | 40                     | μF                      |
| Minimum Total Effective Plate-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |         |                | ••  |                        | F-2                     |
| Supply Impedance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 15      | 15             | 15  | 15                     | ohms                    |
| Panel-Lamp Shunting Resistor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 450     | 200            | 100 | 75                     | ohms                    |
| DC Output Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 70      | 80             | 90  | 100                    | mA                      |
| TYPICAL OPERATION WITHOUT P. AC Plate-Supply Voltage (rms) Filter-Input Capacitor Minimum Total Effective Plate-Supply I DC Output Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | mpedanc |                |     | 117<br>40<br>15<br>110 | volts $\mu F$ ohms $mA$ |
| DC Output Voltage at Input to Filter (A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |                |     | 110                    | 1117 *                  |
| At half-load current (55 mA)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |         |                |     | 130                    | volts                   |
| At full-load current (110 mA)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |         |                |     | 110                    | volts                   |
| Voltage Regulation (Approx.): Half-load to full-load current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |         |                |     | 20                     | volts                   |
| The second of th |         |                |     |                        | 0.5374                  |

<sup>†</sup> No.40 or No.47 panel lamp used in circuit with capacitor-input filter given under type 35W4.

• Required when de output current is greater than 70 milliamperers.



### **POWER PENTODE**

Miniature type used in the audiofrequency power output of radio receivers. Heater is provided with a tap for operation of a panel lamp. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and

50HC6

| may be mounted in any position.                                       |         |            |
|-----------------------------------------------------------------------|---------|------------|
| Heater Voltage (ac/dc)                                                | 50      | volts      |
| Heater Current                                                        | 0.15    | ampere     |
| Heater Tap Voltage (without panel lamp)  Peak Heater-Cathode Voltage: | 7       | volts      |
| Heater negative with respect to cathode                               | 200 max | volts      |
| Heater positive with respect to cathode                               | 200*max | volts      |
| Direct Interelectrode Capacitances (Approx.):                         |         |            |
| Grid No.1 to Plate                                                    | 0.5     | рF         |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3                | 17      | pF         |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3                    | 9       | pF         |
| * The dc component must not exceed 100 volts.                         |         |            |
| MAXIMUM RATINGS (Design-Maximum Values):                              |         |            |
| RMS Heater-Tap Voltage, when panel lamp fails                         | 14 max  | volts      |
| Plate Voltage                                                         | 150 max | volts      |
| Grid-No.2 (Screen-Grid) Voltage                                       | 130 max | volts      |
| Plate Dissipation                                                     | 5.5 max | watts      |
| Grid-No.2 Input                                                       | 2 max   | watts      |
| CHARACTERISTICS:                                                      |         |            |
| Plate Supply Voltage                                                  | 110     | volts      |
| Grid-No.2 Voltage                                                     | 115     | volts      |
| Peak AF Grid-No.1 (Control-Grid) Voltage                              | 3       | volts      |
| Cathode-Bias Resistor                                                 | 62      | ohms       |
| Zero-Signal Plate Current                                             | 42      | mA.        |
| Maximum-Signal Plate Current                                          | 42      | mA.        |
| Zero-Signal Grid-No.2 Current                                         | 11.5    | mA         |
| Maximum-Signal Grid-No.2 Current                                      | 14.5    | mA.        |
| Plate Resistance (Approx.)                                            | 11000   | ohms       |
| Transconductance                                                      | 14600   | $\mu$ mhos |
| Load Resistance                                                       | 3000    | ohms       |
| Total Harmonic Distortion (Approx.)                                   | 7       | per cent   |
| Maximum-Signal Power Output                                           | 1.4     | watts      |

# POWER PENTODE

# 50HK6

Miniature type used in audio-frequency power-output stage of radio receivers. Outline 5D, Outlines section. Tube requires miniature seven-contact socket and may be mounted in any position. The heater is provided with a tap for



7FZ

operation of a panel lamp. Heater volts (ac/dc), 50; amperes, 0.15; tap volts (without panel lamp), 7; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):     |       |     |          |
|----------------------------------------------|-------|-----|----------|
| Plate Voltage                                | 150   | max | volts    |
| Grid-No.2 (Screen-Grid) Voltage              | 130   | max | volts    |
| Plate Dissipation                            | 5.5   | max | watts    |
| Grid-No.2 Input                              | 1.1   | max | watts    |
| RMS Heater-Tap Voltage When Panel Lamp Fails | 14    | max | volts    |
| TYPICAL OPERATION AND CHARACTERISTICS:       |       |     |          |
| Plate Voltage                                | 110   |     | volts    |
| Grid-No.2 Voltage                            | 110   |     | volts    |
| Grid-No.1 (Control-Grid) Voltage             | 7.5   |     | volts    |
| Peak AF Grid-No.1 Voltage                    | 7.5   |     | volts    |
| Zero-Signal Plate Current                    | 49    |     | mA       |
| Maximum-Signal Plate Current                 | 50    |     | mA       |
| Zero-Signal Grid-No.2 Current                | 4     |     | mA       |
| Maximum-Signal Grid-No.2 Current             | 8.5   |     | mAt      |
| Plate Resistance (Approx.)                   | 10000 |     | ohms     |
| Transconductance                             | 7500  |     | μmhos    |
| Load Resistance                              | 2500  |     | ohms     |
| Total Harmonic Distortion (Approx.)          | 9     |     | per cent |
| Maximum-Signal Power Output                  | 1.9   |     | watts    |
| MAXIMUM CIRCUIT VALUES:                      |       |     |          |
| Grid-No.1-Circuit Resistance:                |       |     |          |
| For fixed-bias operation                     | 0.1   | max | megohm   |
| For cathode-bias operation                   | 0.5   | max | megohm   |

### **BEAM POWER TUBE**

50L6GT
Related type:
25L6GT

Glass octal type used in output stage of ac/dc radio receivers. Outline 13D, Outlines section. Tube requires octal socket and may be mounted in any position. This type may be supplied with pin No.1 omitted, Refer to mini-



7AC

ature type 50C5 for installation and application information. Type 25L6GT is identical with type 50L6GT except for the heater ratings, as shown below.

|                                                    | 25L6GT | 50L6GT |        |
|----------------------------------------------------|--------|--------|--------|
| Heater Voltage (ac/dc)                             | 25     | 50     | volts  |
| Heater Current                                     | 0.3    | 0.15   | ampere |
| Peak Heater-Cathode Voltage:                       |        |        |        |
| Heater negative with respect to cathode            | 90 max | 90 max | volts  |
| Heater positive with respect to cathode            | 90 max | 90 max | volts  |
| Direct Interelectrode Capacitances (Approx.):      |        |        |        |
| Grid No.1 to Plate                                 |        | 0.6    | рF     |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid  | No.3   | 15     | pF     |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3 |        | 9.5    | pF     |
|                                                    |        |        |        |

### Class A, Amplifier

| 1                                       |                 |              |            |
|-----------------------------------------|-----------------|--------------|------------|
| MAXIMUM RATINGS (Design-Center Values): |                 |              |            |
| Plate Voltage                           |                 | 200 max      | volts      |
| Grid-No.2 (Screen-Grid) Voltage         |                 | 125 max      | volts      |
| Plate Dissipation                       |                 | 10 max       | watts      |
| Grid-No.2 Input                         |                 | 1.25 max     | watts      |
| TYPICAL OPERATION:                      | Fixed Bias      | Cathode Bias |            |
| Plate Supply Voltage                    | 110             | 200          | volts      |
| Grid-No.2 Supply Voltage                | 110             | 125          | volts      |
| Grid-No.1 (Control-Grid) Voltage        | <del></del> 7.5 |              | volts      |
| Peak AF Grid-No.1 Voltage               | 7.5             | 8.0          | volts      |
| TYPICAL OPERATION AND CHARACTERISTICS:  | Fixed Bias      | Cathode Bias |            |
| Cathode-Bias Resistor                   |                 | 180          | ohms       |
| Zero-Signal Plate Current               | 49              | 46           | mA         |
| Maximum-Signal Plate Current            | 50              | 47           | mA         |
| Zero-Signal Grid-No.2 Current           | 4               | 2.2          | mA         |
| Maximum-Signal Grid-No.2 Current        | 10              | 8.5          | mA         |
| Plate Resistance (Approx.)              | 13000           | 28000        | ohms       |
| Transconductance                        | 8000            | 8000         | $\mu$ mhos |
| Load Resistance                         | 2000            | 4000         | ohms       |
| Total Harmonic Distortion               | 10              | 10           | per cent   |
| Maximum-Signal Power Output             | 2.1             | 3.8          | watts      |



9AD

### SHARP-CUTOFF PENTODE

Miniature type used as audio amplifier in applications requiring reduced microphonics, leakage noise, and hum. Especially useful in the input stages of medium-gain public-address systems, home sound recorders, and general-

5879

purpose audio systems. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For operation as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section.

| Heater Voltage (ac/dc) Heater Current                  | 6.3<br>0.15 | volts<br>ampere |
|--------------------------------------------------------|-------------|-----------------|
| Peak Heater-Cathode Voltage:                           |             |                 |
| Heater negative with respect to cathode                | 100 max     | volts           |
| Heater positive with respect to cathode                | 100 max     | volts           |
| Direct Interelectrode Capacitances:                    |             |                 |
| Pentode Connection:                                    |             |                 |
| Grid No.1 to Plate                                     | 0.11 max    | pF              |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 2.7         | рF              |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 2.4         | pF              |
| Triode Connection*:                                    |             | •               |
| Grid No.1 to Plate                                     | 1.4         | pF              |
| Grid No.1 to Cathode and Heater                        | 1.4         | рF              |
| Plate to Cathode and Heater                            | 0.85        | pF              |
| * Grid No.2 and grid No.3 connected to plate.          |             |                 |

Grid No.2 and grid No.3 connected to plate

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):         | Triode<br>Connection* | Pentode<br>Connection |
|--------------------------------------------------|-----------------------|-----------------------|
| Plate Voltage                                    | 275 max               | 330 max volts         |
| Grid-No.2 (Screen-Grid) Voltage                  | _                     | See curve page 80     |
| Grid-No.2 Supply Voltage                         |                       | 330 max volts         |
| Grid-No.1 (Control-Grid) Voltage:                |                       |                       |
| Negative-bias value                              | 55                    | -55 max volts         |
| Positive-bias value                              | 0 max                 | 0 max volts           |
| Plate Dissipation                                | 1.7 max               | 1.25 max watts        |
| Grid-No.2 Input:                                 |                       |                       |
| For grid-No.2 voltages up to 165 volts           | _                     | 0.25 max watt         |
| For grid-No.2 voltages between 165 and 330 volts |                       | See curve page 80     |

| CHARACTER | ISTICS: |
|-----------|---------|
|-----------|---------|

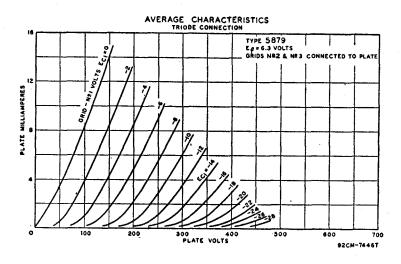
| Plate Voltage                                 | .100  | 250    | 250              | volts        |
|-----------------------------------------------|-------|--------|------------------|--------------|
| Grid No.3                                     | _     | - Cor  | nnected to catho | de at socket |
| Grid-No.2 Voltage                             | _     | _      | 100              | volts        |
| Grid-No.1 Voltage                             | -3    | -8     | 3                | volts        |
| Amplification Factor                          | 21    | 21     | _                |              |
| Plate Resistance (Approx.)                    | 0.017 | 0.0137 | 2                | megohms      |
| Transconductance                              | 1240  | 1530   | 1000             | μmhos        |
| Grid-No.1 Voltage (Approx.) for plate current |       |        |                  | •            |
| of 10 μA                                      |       |        | -8               | volts        |
| Plate Current                                 | 2.2   | 5.5    | 1.8              | mA           |
| Grid-No.2 Current                             |       | -      | 0.4              | mA           |

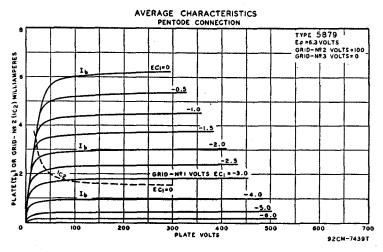
### MAXIMUM CIRCUIT VALUE:

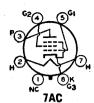
Grid-No.1-Circuit Resistance ......

2.2 max megohms

<sup>•</sup> Grid No.2 and grid No.3 connected to plate.







### **BEAM POWER TUBE**

Glass octal type used in the output stages of radio receivers and audio amplifiers, particularly in the push-pull stages of high-fidelity audio amplifiers. Outline 29M, Outlines section. Tube requires octal socket and may be

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mounted in any position. For typical operation as push-pull class A<sub>1</sub>, class AB<sub>1</sub> (within maximum ratings), and class AB<sub>2</sub> amplifier, and for curves of average plate characteristics, refer to type 6L6GC. Heater volts (ac/dc), 6.3; amperes, 0.9; peak heater-cathode volts, 200 max.

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Center Values): Plate Voltage Grid-No.2 (Screen-Grid) Voltage Plate Dissipation Grid-No.2 Input | Triode Connection* 400 max  — 26 max |      | Connection 400 max 400 max 23 max 3 max |       | volts<br>volts<br>watts<br>watts |
|-------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------|-----------------------------------------|-------|----------------------------------|
| TYPICAL OPERATION AND CHARACTERISTICS:                                                                                  |                                      |      |                                         |       |                                  |
| Plate Voltage                                                                                                           | 250                                  | 300  | 250                                     | 350   | volts                            |
| Grid-No.2 Voltage                                                                                                       | _                                    | _    | 250                                     | 250   | volts                            |
| Grid-No.1 (Control-Grid) Voltage                                                                                        | 18                                   | -20  | 14                                      | -18   | volts                            |
| Peak AF Grid-No.1 Voltage                                                                                               | 18                                   | 20   | 14                                      | 18    | volts                            |
| Zero-Signal Plate Current                                                                                               | 52                                   | 78   | 75                                      | 53    | mA                               |
| Maximum-Signal Plate Current                                                                                            | 58                                   | 85   | 80                                      | 65    | mA                               |
| Zero-Signal Grid-No.2 Current                                                                                           | _                                    | _    | 4.3                                     | 2.5   | mA                               |
| Maximum-Signal Grid-No.2 Current                                                                                        | _                                    |      | 7.6                                     | 8.5   | mA                               |
| Amplification Factor                                                                                                    | 8                                    | _    | _                                       | _     |                                  |
| Plate Resistance (Approx.)                                                                                              | -                                    |      | 30000                                   | 48000 | ohms                             |
| Transconductance                                                                                                        | 5250                                 | _    | 6100                                    | 5200  | $\mu$ mhos                       |
| Load Resistance                                                                                                         | 4000                                 | 4000 | 2500                                    | 4200  | ohms                             |
| Total Harmonic Distortion                                                                                               | 6                                    | 5.5  | 10                                      | 13    | per cent                         |
| Maximum-Signal Power Output                                                                                             | 1.4                                  | 1.8  | 6.7                                     | 11.3  | watts                            |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation                                          |                                      |      | 0.1                                     | max r | negohm                           |
| For cathode-bias operation                                                                                              |                                      |      |                                         |       | negohm                           |

<sup>•</sup> Grid No.2 connected to plate.



# **BEAM POWER TUBE**

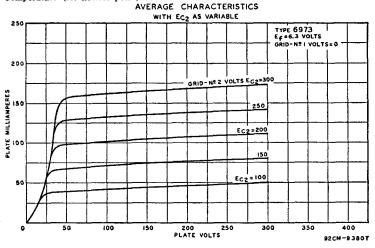
Miniature type used as power amplifier in compact high-fidelity audio equipment. Tube features linear operation over a wide range of power, high power sensitivity, high stability, and low heater power, and is capable of

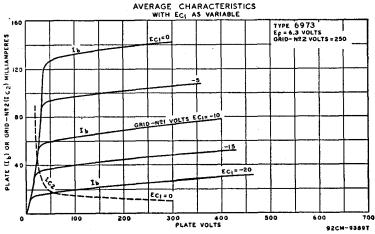
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delivering high power output at low distortion. Double base-pin connections for both grid No.1 and grid No.2 provide cool operation of grids and thus minimize grid emission and permit use of high values of grid-circuit resistance to reduce driving power. Outline 6G, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position.

| Heater Voltage (ac/dc) Heater Current Peak Heater-Cathode Voltage:                                                   | 6.3<br>0.45        | volts<br>ampere |
|----------------------------------------------------------------------------------------------------------------------|--------------------|-----------------|
| Heater negative with respect to cathode Heater positive with respect to cathode  Direct Interelectrode Capacitances: | 200 max<br>200 max | volts<br>volts  |
| Grid-No.1 to Plate                                                                                                   | 0.4 max            | pF              |

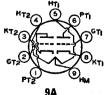
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3  Plate to Cathode, Heater, Grid No.2, and Grid No.3  The dc component must not exceed 100 volts. | 9       | pF<br>pF |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------|
| Class A, Amplifier                                                                                                                                      |         |          |
| CHARACTERISTICS:                                                                                                                                        |         |          |
| Plate Voltage                                                                                                                                           | 250     | volts    |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                         | 250     | voits    |
| Grid-No.1 (Control-Grid) Voltage                                                                                                                        | 15      | volts    |
| Plate Resistance (Approx.)                                                                                                                              | 73000   | ohms     |
| Transconductance                                                                                                                                        | 4800    | μmhos    |
| Plate Current                                                                                                                                           | 46      | mA       |
| Grid-No.2 Current                                                                                                                                       | 3.5     | mA       |
| Grid-No.1 Voltage (Approx.) for plate current of 100 μA                                                                                                 | 40      | volts    |
| Push-Pull Class AB, Amplifier MAXIMUM RATINGS (Design-Maximum Values):                                                                                  |         |          |
| Plate Voltage                                                                                                                                           | 440 max | volts    |
| Grid-No.2 Voltage                                                                                                                                       | 330 max | volts    |
| Plate Dissipation                                                                                                                                       | 12 max  | watts    |
| Grid-No.2 Input                                                                                                                                         | 2 max   | watts    |
| Bulb Temperature (At hottest point)                                                                                                                     | 250 max | °C       |
| buto temperature (At nettest point)                                                                                                                     | 250 max | _        |





| TYPICAL OPERATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |       |         |                                       |         |                                                                                                                       |                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------|---------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| (Values are for two tubes):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       | Fixed   | Bias                                  | Cath    | ode Bias                                                                                                              |                                                                                          |
| Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 250   | 350     | 400                                   | 300     | 310                                                                                                                   | volts                                                                                    |
| Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 250   | 280     | 290                                   | 300     | 310                                                                                                                   | volts                                                                                    |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | -15   | -22     | -25                                   | _       | _                                                                                                                     | volts                                                                                    |
| Cathode-Bias Resistor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15    |         |                                       | 230     | 270                                                                                                                   | ohms                                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |         |                                       | 250     | 2.0                                                                                                                   | O. III                                                                                   |
| Peak AF Grid-No.1-to-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 20    | 4.4     | 50                                    | 48      | 55                                                                                                                    | volts                                                                                    |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 30    | 44      |                                       |         |                                                                                                                       |                                                                                          |
| Zero-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 92    | 58      | 50                                    | 80      | 77                                                                                                                    | mA.                                                                                      |
| Maximum-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 105   | 106     | 107                                   | 96      | 92                                                                                                                    | mA.                                                                                      |
| Zero-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 7     | 3.5     | 2.5                                   | 6       | 5                                                                                                                     | mA                                                                                       |
| Maximum-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 16    | 14      | 13.7                                  | 14      | 14                                                                                                                    | mA                                                                                       |
| Effective Load Resistance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |         |                                       |         |                                                                                                                       |                                                                                          |
| (Plate-to-plate)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 8000  | 7500    | 8000                                  | 5500    | 6000                                                                                                                  | ohms                                                                                     |
| Total Harmonic Distortion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2     | 1.5     | 2                                     | 2       | 4                                                                                                                     | per cent                                                                                 |
| Maximum-Signal Power Output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 12.5  | 20      | 24                                    | 15      | 17                                                                                                                    | watts                                                                                    |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |         |                                       |         | 0.5 max<br>1 max                                                                                                      | megohm<br>meghom                                                                         |
| Push-Pull Class AB, Amplifier  Grid No.2 of Each Tube Connected to Tap on Plate Winding of Output Transformer  MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                                                                                                                                                                                                         |       |         |                                       |         |                                                                                                                       |                                                                                          |
| MAXIMUM RATINGS (Design-Maximu                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ım Va | lues):  |                                       |         |                                                                                                                       |                                                                                          |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ım Va | lues):  |                                       |         | 410 max                                                                                                               | volts                                                                                    |
| MAXIMUM RATINGS (Design-Maximu                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ım Va | lues):  |                                       |         | 410 max<br>12 max                                                                                                     | volts<br>watts                                                                           |
| MAXIMUM RATINGS (Design-Maximu<br>Plate and Grid-No.2 Supply Voltage<br>Plate Dissipation<br>Grid-No.2 Input                                                                                                                                                                                                                                                                                                                                                                                                                                    | ım Va | lues):  |                                       |         | 410 max<br>12 max<br>1.75 max                                                                                         | volts<br>watts<br>watts                                                                  |
| MAXIMUM RATINGS (Design-Maximu<br>Plate and Grid-No.2 Supply Voltage<br>Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ım Va | lues):  | · · · · · · · · · · · · · · · · · · · |         | 410 max<br>12 max                                                                                                     | volts<br>watts<br>watts                                                                  |
| MAXIMUM RATINGS (Design-Maximu<br>Plate and Grid-No.2 Supply Voltage<br>Plate Dissipation<br>Grid-No.2 Input<br>Bulb Temperature (At hottest point)                                                                                                                                                                                                                                                                                                                                                                                             | ım Va | lues):  |                                       |         | 410 may<br>12 may<br>1.75 may<br>250 may                                                                              | volts<br>watts<br>watts                                                                  |
| MAXIMUM RATINGS (Design-Maximum Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point) TYPICAL OPERATION (Values are for                                                                                                                                                                                                                                                                                                                                                                      | ım Va | tubes): | Fixed                                 | Bias    | 410 max<br>12 max<br>1.75 max<br>250 max                                                                              | volts watts watts c c °C                                                                 |
| MAXIMUM RATINGS (Design-Maximu<br>Plate and Grid-No.2 Supply Voltage<br>Plate Dissipation<br>Grid-No.2 Input<br>Bulb Temperature (At hottest point)<br>TYPICAL OPERATION (Values are for<br>Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                | two 1 | lues):  | Fixed 375                             | Bias    | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370                                                          | volts watts watts c watts c °C                                                           |
| MAXIMUM RATINGS (Design-Maximu<br>Plate and Grid-No.2 Supply Voltage<br>Plate Dissipation<br>Grid-No.2 Input<br>Bulb Temperature (At hottest point)<br>TYPICAL OPERATION (Values are for<br>Plate Supply Voltage<br>Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                    | two   | lues):  | Fixed 37                              | Bias    | 410 max<br>12 max<br>1.75 max<br>250 max                                                                              | volts watts watts c °C Gias volts volts                                                  |
| MAXIMUM RATINGS (Design-Maximu<br>Plate and Grid-No.2 Supply Voltage<br>Plate Dissipation<br>Grid-No.2 Input<br>Bulb Temperature (At hottest point)<br>TYPICAL OPERATION (Values are for<br>Plate Supply Voltage                                                                                                                                                                                                                                                                                                                                | two   | lues):  | Fixed 37                              | Bias    | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#                                                     | volts watts watts c watts c °C dias volts volts volts                                    |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point)  TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode-Bias Resistor                                                                                                                                                                                                                                                                                | two ! | dues):  | Fixed 37: —33.:                       | Bias 6  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>—<br>355                                         | volts watts watts C watts C oC Sias volts volts volts ohms                               |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point)  TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage*                                                                                                                                                                                                                                                                                                     | two ! | dues):  | Fixed 37: —33.:                       | Bias 6  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>-<br>355<br>62                                   | volts watts watts C volts volts volts volts volts volts volts                            |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point)  TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode-Bias Resistor                                                                                                                                                                                                                                                                                | two   | dues):  | Fixed 37:33 66                        | Bias (  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>—<br>355                                         | volts watts watts C watts C oC Sias volts volts volts ohms                               |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point)  TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Cathode-Bias Resistor Peak AF Grid-No.1-to-Grid-No.1 Voltage                                                                                                                                                                                                                                         | two   | dues):  | Fixed 37: —33 66 66.                  | Bias 6  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>-<br>355<br>62                                   | volts watts watts C volts volts volts volts volts volts volts                            |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point)  TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage* Cathode-Bias Resistor Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Cathode Current Maximum-Signal Cathode Current                                                                                                                                                                             | two   | tubes): | Fixed 37: —33 6' 69:                  | Bias 6  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>-<br>355<br>62<br>74                             | volts watts watts c watts c °C dias volts volts volts volts ohms volts mA                |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | two   | tubes): | Fixed 37:                             | Bias 6  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>—<br>355<br>62<br>74<br>84                       | volts watts watts c watts c c °C dias volts volts volts ohms volts mA mA                 |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point) TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Grid-No.1 Voltage Cathode-Bias Resistor Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Cathode Current Maximum-Signal Cathode Current Effective Load Resistance (Plate-to-plate Total Harmonic Distortion                                                                                         | two   | alues): | Fixed 37: -33.: -66. 66. 99 12500 11. | Bias 6  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>                                                 | t volts t watts t watts t volts volts volts ohms volts ohms per cent                     |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | two   | alues): | Fixed 37: -33.: -66. 66. 99 12500 11. | Bias 6  | 410 may 12 may 1.75 may 250 may Cathode E 370 # 355 62 74 84 13000                                                    | volts watts watts c oC dias volts volts volts volts mA mA ohms                           |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point) TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Grid-No.1 Voltage Grid-No.1 Voltage Grid-No.1 Voltage Cathode-Bias Resistor Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Cathode Current Maximum-Signal Cathode Current Effective Load Resistance (Plate-to-plate Total Harmonic Distortion Maximum-Signal Power Output MAXIMUM CIRCUIT VALUES: | two   | alues): | Fixed 37: -33.: -66. 66. 99 12500 11. | Bias 6  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>                                                 | t volts t watts t watts t volts volts volts ohms volts ohms per cent                     |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point)  TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage* Cathode-Bias Resistor Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Cathode Current Maximum-Signal Cathode Current Effective Load Resistance (Plate-to-plate Total Harmonic Distortion Maximum-Signal Power Output  MAXIMUM CIRCUIT VALUES:* Grid-No.1-Circuit Resistance:                     | two 1 | alues): | Fixed 37: —33 66 9: 12500             | Bias 55 | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>—<br>355<br>62<br>74<br>84<br>13000<br>1.2<br>15 | t volts t watts t watts t volts volts volts volts ohms volts mA ohms per cent watts      |
| MAXIMUM RATINGS (Design-Maximu Plate and Grid-No.2 Supply Voltage Plate Dissipation Grid-No.2 Input Bulb Temperature (At hottest point) TYPICAL OPERATION (Values are for Plate Supply Voltage Grid-No.2 Supply Voltage Grid-No.1 Voltage Grid-No.1 Voltage Grid-No.1 Voltage Grid-No.1 Voltage Cathode-Bias Resistor Peak AF Grid-No.1-to-Grid-No.1 Voltage Zero-Signal Cathode Current Maximum-Signal Cathode Current Effective Load Resistance (Plate-to-plate Total Harmonic Distortion Maximum-Signal Power Output MAXIMUM CIRCUIT VALUES: | two 1 | tubes): | Fixed 37:33 66 66 9: 1250 18          | Bias 6  | 410 may<br>12 may<br>1.75 may<br>250 may<br>Cathode E<br>370<br>#<br>                                                 | volts watts watts c watts c watts volts volts volts ohms volts mA mA ohms per cent watts |

- \* Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center tap (B+) so as to apply 50 per cent of the plate signal voltage to grid No.2 of each output tube.
- # Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center tap (B+) so as to supply 43 per cent of the plate signal voltage to grid No.2 of each output tube.
- The type of input-coupling network used should not introduce too much resistance in the grid-No.1 circuit. Transformer- or impedance-coupling devices are recommended.



### HIGH-MU TWIN TRIODE

Miniature type used as phase inverter or resistance-coupled amplifier in high-quality, high-fidelity audio amplifiers where low noise and hum are primary considerations. Outline 6B, Outlines section. This type is identical with

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miniature type 12AX7A except that it has a controlled equivalent noise and hum characteristic. For operation as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section.

# EQUIVALENT-NOISE AND HUM VOLTAGE

REFERENCE TO GRID (Each Unit):

| test site to ditte (such ont). |     |         |
|--------------------------------|-----|---------|
| Average Value (rms)†           | 1.8 | $\mu V$ |
| Maximum Value (rms).           | 7   | $\mu V$ |

- † Measured in "true rms" units under following conditions: heater volts (ac), 6.3 (parallel connection); center tap of heater transformer connected to ground; plate supply volts, 250; plate load resistor, 2700 ohms; cathode-bypass capacitor, 100  $\mu$ F; grid resistor, 0 ohms; and amplifier covering frequency range between 25 to 10000 cycles per second.
- Same conditions as for "Average Value" except: cathode resistor is unbypassed and grid resistor, 0.05 megohm.

### **BEAM POWER TUBE**

# 7027A

Glass octal type used in push-pull power amplifier circuits of high-fidelity audio equipment. Tube provides high power sensitivity and high stability and is capable of delivering high power output at low distortion. Double base-



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pin connections for both grid No.1 and grid No.2 provide for flexibility of circuit arrangement and also cool operation of the grids with the result that reverse grid current is minimized. Outline 19F, Outlines section. Tube requires octal socket and may be mounted in any position. It is especially important that this tube, like other power-handling tubes, be adequately ventilated.

| Heater Voltage (ac/dc)                                 |           | 6.3             | volts          |
|--------------------------------------------------------|-----------|-----------------|----------------|
| Heater Current Peak Heater-Cathode Voltage:            | • •       | 0.9             | ampere         |
| Heater negative with respect to cathode                |           | 200 max         | volts          |
| Heater positive with respect to cathode                |           | 200 max         | volts          |
| Direct Interelectrode Capacitances (Approx.):          |           |                 |                |
| Grid No.1 to Plate                                     |           | 1.5             | pF             |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 |           | 10              | рF             |
| Plate to Cathode, Heater, Grid No.2 and Grid No.3      | • •       | 7.5             | pF             |
| ■ The dc component must not exceed 100 volts.          |           |                 |                |
| Class A, Amplifier                                     |           |                 |                |
| CHARACTERISTICS:                                       |           |                 |                |
| Plate Voltage                                          |           | 250             | volts          |
| Grid-No.2 (Screen-Grid) Voltage                        |           | 250             | volts          |
| Grid-No.1 (Control-Grid) Voltage                       |           | 14              | volts          |
| Plate Resistance (Approx.)                             |           | 2500            | ohms           |
| Transconductance Plate Current                         |           | 6000<br>72      | μmhos<br>mA    |
| Grid-No.2 Current                                      |           | 5.              | mA             |
|                                                        | ••        | •               |                |
| Push-Pull Class AB, Amplifier                          |           |                 |                |
| MAXIMUM RATINGS (Design-Maximum Values):               |           |                 |                |
| Plate Voltage                                          |           | 600 max         | volts          |
| Grid-No.2 Voltage                                      |           | 500 max         | volts          |
| Plate Dissipation Grid-No.2 Input                      |           | 35 max<br>5 max | watts<br>watts |
| Glid-No.2 Input                                        | • •       | 3 max           | watts          |
| TYPICAL OPERATION (Values are for two tubes):          |           |                 |                |
|                                                        | Cathode 1 |                 |                |
| Plate Supply Voltage                                   |           | 425             | volts          |
| Grid-No.2 Supply Voltage                               |           | 415             | volts<br>volts |
| Cathode-Bias Resistor 20                               |           | 200             | ohms           |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage 50 60 76 5      |           | 86              | volts          |
| Zero-Signal Plate Current 102 95 100 11                |           | 150             | mA             |
| Maximum-Signal Plate Current 152 194 220 12            |           | 196             | mA             |
|                                                        | 7 5.6     | 8               | mA             |
| Maximum-Signal Grid-No.2 Current 17 19.2 21.4 1        | 6 20      | 20              | mA             |

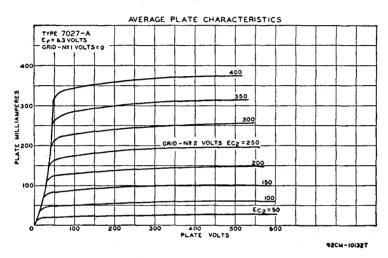
| Effective Load Resistance (Plate-to- |      |      |      |      |      |          |
|--------------------------------------|------|------|------|------|------|----------|
| Plate)                               | 6000 | 6500 | 6600 | 4500 | 3800 | ohms     |
| Total Harmonic Distortion 2          | 1.5  | 2    | 2    | 3.5  | 4    | per cent |
| Maximum-Signal Power Output 34       | 50   | 76   | 32   | 36   | 44   | watts    |
| MAYIMIM CIDCUIT VALUES.              |      |      |      |      |      |          |

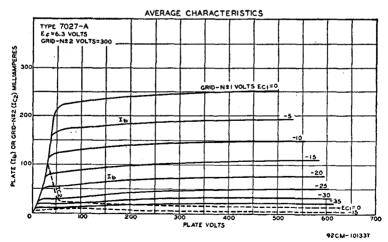
#### MAXIMUM CIRCUIT VALUES:

Grid-No.1-Circuit Resistance:

For fixed-bias operation O.1 max megohm
For cathode-bias operation O.5 max megohm

• The type of input coupling network used should not introduce too much resistance in the grid-No.1 circuit. Transformer- or impedance-coupling devices are recommended.





### Push-Pull Class AB, Amplifier

Grid No.2 of Each Tube Connected to Tap on Plate Winding of Output Transformer MAXIMUM RATINGS (Design-Maximum Values):

| Plate and Grid-No.2 Supply Voltage | 600 max | volts   |
|------------------------------------|---------|---------|
| Plate Dissipation                  | 35 max  | watts - |
| Grid-No.2 Input                    | 4.5 max | watts   |

| TYPICAL OPERATION (Values are for two tubes): |      |              |
|-----------------------------------------------|------|--------------|
| Plate Supply Voltage                          | 410  | volts        |
| Grid-No.2 Supply Voltage                      | •    | volts        |
| Cathode-Bias Resistor                         | 220  | ohm <b>s</b> |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage        | 68   | volts        |
| Zero-Signal Cathode Current                   | 134  | mA           |
| Maximum-Signal Cathode Current                | 155  | mA           |
| Effective Load Resistance (Plate to plate)    | 8000 | ohms         |
| Total Harmonic Distortion                     | 1.6  | per cent     |
| Maximum-Signal Power Output                   | 24   | watts        |
|                                               |      |              |

### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

For cathode-bias operation ......

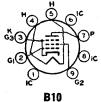
0.5 max megohm

\* Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center tap (B+) so as to apply 43 per cent of the plate signal voltage to grid No.2 of each output tube.

### **POWER PENTODE**

7189

Miniature type used as power amplifier tube in high-fidelity audio equipment. Outline 6G, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3;



Grid-No.2

amperes, 0.76; peak heater-cathode volts, 100 max.

### Class A, Amplifier

| CHARACTERISTICS:                  |       |              |
|-----------------------------------|-------|--------------|
| Plate Voltage                     | 250   | volts        |
| Grid-No.2 (Screen-Grid) Voltage   | 250   | <b>∀olts</b> |
| Grid-No.1 (Control-Grid) Voltage  | 7.3   | volts        |
| Mu-Factor, Grid No.2 to Grid No.1 | 19.5  |              |
| Plate Resistance (Approx.)        | 40000 | ohma         |
| Transconductance                  | 11300 | umhos        |
| Plate Current                     | 48    | mA           |
| Grid-No.2 Current                 | 5.5   | mA           |

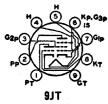
### Push-Pull Class AB, Amplifier

|                                               |         | Special     |          |
|-----------------------------------------------|---------|-------------|----------|
| MAXIMUM RATINGS (Design-Center Values):       |         | Connection• |          |
| Plate Voltage                                 | 400 max | 375 max     | volts    |
| Grid-No.2 Voltage                             | 300 max | •           | volts    |
| Cathode Current                               | 65 max  | 65 max      | mA       |
| Plate Dissipation                             | 12 max  | 12 max      | watts    |
| Zero-Signal Grid-No.2 Input                   | 2 max   | 2 max       | watts    |
| Maximum-Signal Grid-No.2 Input                | 4 max   | 4 max       | watts    |
| TYPICAL OPERATION (Values are for two tubes): |         |             |          |
| Plate Supply Voltage                          | _       | 375         | volts    |
| Plate Voltage                                 | 400     |             | volts    |
| Grid-No.2 Supply Voltage                      | _       |             |          |
| Grid-No.2 Voltage                             | 300     | •           | volts    |
| Grid-No.1 Voltage                             | 15      |             | volts    |
| Cathode-Bias Resistor                         | _       | 220         | ohms     |
| Peak AF Grid-No.1 Voltage                     | 14.8    | 17.7        | volts    |
| Zero-Signal Plate Current                     | 15      | 70          | mA       |
| Maximum-Signal Plate Current                  | 105     | 81          | mA       |
| Zero-Signal Grid-No.2 Current                 | 1.6     | •           | mA       |
| Maximum-Signal Grid-No.2 Current              | 25      | •           | mA       |
| Effective Load Resistance (Plate-to-plate)    | 8000    | 11000       | ohms     |
| Total Harmonic Distortion                     | 4       | 3           | per cent |
| Maximum-Signal Power Output                   | 24      | 16.5        | watts    |

# MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance ......

Fixed Bias 0.3 max Cathode Bias 1 max megohm

- Grid No.2 of each tube connected to tap on plate winding of output transformer.
- Obtained from taps on primary winding of the output transformer. The taps are located on each side of the center tap (B+) so as to supply 43 per cent of the plate signal voltage to grid No.2 of each output tube.



# MEDIUM-MU TRIODE— SHARP-CUTOFF PENTODE

Oh Miniature type used in a wide variety of applications in high-quality, highfidelity audio equipment, particularly in phase-splitters, tone-control amplifiers, and high-gain voltage amplifiers in which low hum and reduced noise

7199

are required. Outline 6B, Outlines section. Tube requires miniature nine-contact socket and may be mounted in any position. For operation as resistance-coupled amplifier, refer to Resistance-Coupled Amplifier section. In direct-coupled voltage-amplifier phase-splitter circuits, the pentode unit should drive the triode unit.

| Heater Voltage (ac/dc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.3      | volt <b>s</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------|
| Heater Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.45     | ampere        |
| Peak Heater-Cathode Voltage:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |               |
| Heater positive with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 200 max  | volts         |
| Heater negative with respect to cathode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 200=max  | volts         |
| Direct Interelectrode Capacitances:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |               |
| Triode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |               |
| Grid to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2        | p <b>F</b>    |
| Grid to Cathode and Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2.3      | pF            |
| Plate to Cathode and Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.3      | рF            |
| Pentode Unit:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |               |
| Grid No.1 to Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.06 max | рF            |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |               |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5        | pF            |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |               |
| Internal Shield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2        | рF            |
| The state of the s |          |               |

The dc component must not exceed 100 volts.

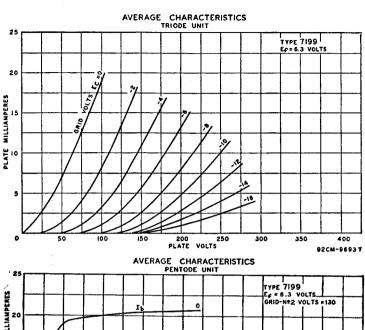
#### **EQUIVALENT-NOISE AND HUM VOLTAGE REFERENCED TO GRID:**

|                     | Triode Unit | Pentode Unit |    |
|---------------------|-------------|--------------|----|
| Median Value (rms)  | 10†         | 35•          | μV |
| Maximum Value (rms) | 150†        | 100◆         | μV |

- † Measured in "true rms" units under the following conditions: heater volts (ac), 6.3; center tap of heater transformer connected to ground; plate-supply volts, 250; plate load resistor, 0.1 megohm; cathode resistor, 1500 ohms; grid resistor, 0.05 megohm; and amplifier covering frequency range between 25 and 10000 cycles per second.
- Same conditions as for triode unit except: grid-No.2 supply volts, 250; grid-No.2 resistor, 0.33 megohm; grid-No.2-bypass capacitor, 0.22  $\mu$ F; cathode resistor, 1200 ohms; and grid-No.1 resistor, 0.05 megohm.

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values): Plate Voltage Grid-No.2 (Screen-Grid) Voltage Grid-No.2 Supply Voltage Grid-No.1 (Control-Grid) Voltage, Positive-bias value Plate Dissipation | Triode Unit  —  330 max  —  0 max  2.4 max | Pentode Unit See curve page 80 330 max volts 330 max volts 0 max volts 3 max watts |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------|
| Grid-No.2 Input: For grid-No.2 voltages up to 165 volts For grid-No.2 voltages between 165 and 330 volts                                                                                | _                                          | 0.6 max watt<br>See curve page 80                                                  |



|               | T           |         | PERM   | UDE 4       | 7811             |                       |                       |                       |                                           |                                                                                                    |                                                       | _                                                                                     |
|---------------|-------------|---------|--------|-------------|------------------|-----------------------|-----------------------|-----------------------|-------------------------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------|
|               |             |         |        |             |                  |                       |                       | TYPE<br>Ec = 0        | 1<br>7199<br>5.3 V                        | LTS_                                                                                               |                                                       |                                                                                       |
|               |             | Tb .    |        |             |                  |                       |                       | GRID-                 | Nº2 V                                     | OLTS :                                                                                             | 130                                                   |                                                                                       |
|               |             |         |        |             |                  |                       |                       |                       |                                           |                                                                                                    |                                                       | Г                                                                                     |
|               |             |         |        |             |                  |                       |                       |                       |                                           |                                                                                                    |                                                       | _                                                                                     |
|               |             |         |        |             | c.= -1           |                       |                       |                       |                                           |                                                                                                    |                                                       |                                                                                       |
|               |             | _GRID-I | 121 40 | 1           | <u> </u>         |                       |                       | _                     |                                           |                                                                                                    |                                                       |                                                                                       |
|               |             |         |        |             |                  | $\neg$                |                       |                       |                                           |                                                                                                    |                                                       | _                                                                                     |
| \\ <u>-</u> : | Ic2         |         |        |             |                  |                       | -2                    |                       |                                           |                                                                                                    |                                                       |                                                                                       |
|               |             | ±       |        | -           | E                | -                     | -                     | -3                    | _                                         |                                                                                                    |                                                       | _                                                                                     |
|               |             |         |        |             |                  |                       |                       | -4                    |                                           |                                                                                                    |                                                       | _                                                                                     |
|               | <del></del> | +       |        | =           |                  |                       |                       |                       | -5                                        |                                                                                                    |                                                       |                                                                                       |
| •             |             | 130     |        |             |                  | U                     | 30                    | U                     | 35                                        |                                                                                                    |                                                       |                                                                                       |
|               |             | 100     | GRID-1 | GRID-Nº1 VO | GRID-Nº1 VOLTS E | GRID-Nº1 VOLTS EC;=-1 | GRID-Nº1 VOLTS Ec;=-1 | GRID-Nº1 VOLTS EC1=-1 | Type  Fe = 1  GRID-Nº1 VOLTS EC =-1   FC2 | TYPE 7199  Eq. 6.3 VG  GRID-Nº1 VOLTS EC;=-1  TC2  C -2  -2  -4  -3  -4  5  100 150 200 250 300 35 | Type 7199  Ef e 6.3 VOLTS  GRID-N21 VOLTS Ec; -1  Tc2 | TYPE 7199  E <sub>F</sub> = 6.3 VOLTS  GRID-Nº2 VOLTS = 130   GRID-Nº2 VOLTS EC1 = -1 |

| CHARACTERISTICS:                              | Triode Unit | Pento | de Unit |            |
|-----------------------------------------------|-------------|-------|---------|------------|
| Plate Supply Voltage                          | 215         | 100   | 220     | volts      |
| Grid-No.2 Supply Voltage                      |             | 50    | 130     | volts      |
| Grid-No.1 Voltage                             | 8.5         | _     |         | volts      |
| Cathode-Bias Resistor                         |             | 1000  | 62      | ohms       |
| Amplification Factor                          | 17          |       | _       |            |
| Plate Resistance (Approx.)                    | 0.0081      | 1     | 0.4     | megohm     |
| Transconductance                              | 2100        | 1500  | 7000    | $\mu$ mhos |
| Grid-No.1 Voltage (Approx.) for plate current |             |       |         |            |
| of 10 μA                                      | <b>-40</b>  | -4    | -       | volts      |
| Plate Current                                 | 9           | 1.1   | 12.5    | · mA       |
| Grid-No.2 Current                             |             | 0.35  | 3.5     | mA         |

### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:\*

For fixed-bias operation

For cathode-bias operation

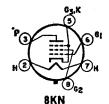
Triode Unit

0.5 max

0.25 max megohm

1.0 max megohm

<sup>\*</sup> If either unit is operated at maximum rated conditions, grid-No.1-circuit resistance for both units should not exceed the stated value.



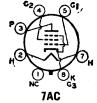
### **POWER PENTODE**

Glass octal type used in the poweroutput stage of high-fidelity audiofrequency amplifier systems. Outline 13F, Outlines section. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3;

7355

amperes, 0.8; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

| Class A, Amplifie                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | r         |             |     |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------------|-----|------------------|
| MAXIMUM RATINGS (Design-Maximum Values):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |             |     |                  |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           | 500         | max | volts            |
| Grid-No.2 (Screen-Grid) Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>.</i>  | 400         | max | volts            |
| Grid-No.1 (Control-Grid) Voltage, Positive-bias value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <i></i>   | 0           | max | voits            |
| Plate Dissipation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           | 18          | max | watts            |
| DC Grid-No.2 Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           | 3.5         | max | volts            |
| Average Cathode Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           | 100         | max | mA               |
| TYPICAL OPERATION AND CHARACTERISTICS:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |             |     |                  |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           | 250         |     | volts            |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           | 225         |     | volts            |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           | -15         |     | volts            |
| Peak AF Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           | 15          |     | volts            |
| Plate Resistance (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           | *42000      |     | ohms             |
| Transconductance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           | 7600        |     | umhos.           |
| Zero-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           | 62          |     | mA               |
| Maximum Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           | 74          |     | mA               |
| Zero-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           | 3.2         |     | mA               |
| Maximum-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           | 16.5        |     | mA               |
| Load Resistance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           | 2500        |     | ohms             |
| Total Harmonic Distortion (Approx.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           | 15          |     | per cent         |
| Maximum-Signal Power Output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           | 9           |     | watts            |
| Grid-No.1 Voltage (Approx.) for plate current of 500 µA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           | 35          |     | volts            |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: For fixed-bias operation For cathode-bias operation  • Grid-No.2 input may reach 7 watts during peak levels of                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           | 1           | max | megohm<br>megohm |
| <del>_</del>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | •         | . MAGNE OLD |     |                  |
| Push-Pull Class AB, An                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | npimer    |             |     |                  |
| MAXIMUM RATINGS: (Same as for Class A <sub>1</sub> Amplifier)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |             |     |                  |
| TYPICAL OPERATION (Values are for two tubes):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |             |     |                  |
| Plate Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 300       | 400         |     | volts            |
| Grid-No.2 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 250       | 300         |     | volts            |
| Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | -21       | -34         |     | volts            |
| Peak AF Grid-No.1 Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 42        | 60          |     | volts            |
| Zero-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 100       | 56          |     | mA               |
| Maximum-Signal Plate Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 185       | 175         |     | mA               |
| Zero-Signal Grid-No.2 Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 5.5       | 3.5         |     | mA               |
| Maximum-Signal Grid-No.2 Current Effective Load Resistance (Plate-to-plate)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 24        | 24          |     | mA               |
| Total Harmonic Distortion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 4000      | 5000        |     | ohms             |
| Maximum-Signal Power Output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2<br>28.5 | 6<br>40     |     | per cent         |
| And the state of the control c | 49.3      | 40          |     | watts            |



# **BEAM POWER TUBE**

Glass octal type used as output amplifier tube in high-quality sound systems. Outline 13D, Outlines section. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.45; peak

**7408** 

heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

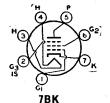
| Class A, Amplifier                                    |      |       |     |          |
|-------------------------------------------------------|------|-------|-----|----------|
| MAXIMUM RATINGS (Design-Maximum Values):              |      | 250   |     | 14       |
| Plate Voltage                                         |      |       | max | volts    |
| Grid-No.2 (Screen-Grid) Voltage                       |      |       | max | volts    |
| Grid-No.2 Input                                       |      |       | max | watts    |
| Plate Dissipation                                     |      | 14    | max | watts    |
| TYPICAL OPERATION AND CHARACTERISTICS:                |      |       |     |          |
| Plate Voltage                                         | 60   | 250   |     | volts    |
| Grid-No.2 Voltage                                     | 250  | 250   |     | volts    |
| Grid-No.1 (Control-Grid) Voltage                      | ő    | -12.5 |     | volts    |
| Peak AF Grid-No.1 Voltage                             |      | 12.5  |     | volts    |
| Zero-Signal Plate Current                             | 100• | 45    |     | mA       |
| Maximum-Signal Plate Current                          |      | 47    |     | mA       |
| Zero-Signal Grid-No.2 Current                         | 22•  | 4.5   |     | mA       |
| Maximum-Signal Grid-No.2 Current                      |      | 7.5   |     | mA       |
| Plate Resistance (Approx.)                            | _    | 50000 |     | ohms     |
| Transconductance                                      | _    | 4100  |     | µmhos    |
| Load Resistance                                       | _    | 5000  |     | ohms     |
| Total Harmonic Distortion                             |      | 3000  |     |          |
| Maximum Signal Downs Output                           |      |       |     | per cent |
| Maximum-Signal Power Output                           | _    | 4.5   |     | watts    |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance: |      |       |     |          |
| For fixed-bias operation                              |      | 0.1   | max | megohm   |
| For cathode-bias operation                            |      | 0.5   | max | megohm   |
| • This value can be measured by a mathematical        |      |       |     |          |

• This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.

# SHARP-CUTOFF PENTODE

**7543** 

Miniature type used in compact audio equipment, especially in low-hum, low-microphonic, high-gain, resistance-coupled-amplifier applications. Outline 5C, Outlines section. This type is identical with miniature type 6AU6A



except that it has a controlled hum characteristic.

### **HUM OUTPUT VOLTAGE:**

† Measured in "true rms" units under the following conditions: heater volts (ac), 6.3; center tap of heater transformer connected to ground; plate and grid-No.2 supply volts, 250; plate load resistor, 0.27 megohm; grid No.3 and internal shield connected to cathode at socket; grid-No.2 resistor, 0.68 megohm; grid-No.1 resistor, 0.1 megohm; cathode resistor, 1000 ohms; grid resistor of following stage, 10 megohms; and stage gain, 340.

• Same conditions as above except cathode resistor is unbypassed and stage gain is 110.

### POWER PENTODE

7591A

Glass octal types used as audio-frequency power-output tube in high-quality audio applications. Outline 13D, Outlines section. Tubes require octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3;



8KQ

amperes, 0.8; peak heater-cathode volts, 200 (the dc component must not exceed 100 volts when the heater is positive with respect to the cathode).

### Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum Values):                          | 550 mm  | 14                                      |
|-------------------------------------------------------------------|---------|-----------------------------------------|
| Plate Voltage                                                     | 550 max | volts                                   |
| Grid-No.2 (Screen-Grid) Voltage                                   | 440 max | volts                                   |
| Cathode Current                                                   | 90 max  | mA                                      |
| Plate Dissipation                                                 | 19 max  | watts                                   |
| Grid-No.2 Input                                                   | 3.3°max | watts                                   |
| TYPICAL OPERATION AND CHARACTERISTICS:                            |         |                                         |
| Plate Voltage                                                     | 300     | volts                                   |
| Grid-No.2 Voltage                                                 | 300     | volts                                   |
| Grid-No.1 (Control-Grid) Voltage                                  | 10      | volts                                   |
| Peak AF Grid-No.1 Voltage                                         | 10      | volts                                   |
| Zero-Signal Plate Current                                         | 60      | mA                                      |
| Maximum-Signal Plate Current                                      | 75      | mA                                      |
| Zero-Signal Grid-No.2 Current                                     | 8       | mA                                      |
| Maximum-Signal Grid-No.2 Current                                  | 15      | mA                                      |
| Triode Amplification Factor*                                      | 16.8    |                                         |
| Plate Resistance (Approx.)                                        | 29000   | ohms                                    |
| Transconductance                                                  | 10200   | μmhos                                   |
| Load Resistance                                                   | 3000    | ohms                                    |
| Total Harmonic Distortion                                         | 13      | per cent                                |
| Maximum-Signal Power Output                                       | 11      | watts                                   |
|                                                                   | ••      | *************************************** |
| MAXIMUM CIRCUIT VALUES: Grid-No.1-Circuit Resistance:             |         |                                         |
| For fixed-bias operation                                          | 0.3 max | megohm                                  |
| For cathode-bias operation                                        | 1 max   | megohm                                  |
| Grid-No 2 input may reach 6 watte during most levels of anoth and |         | _                                       |

- Grid-No.2 input may reach 6 watts during peak levels of speech and music signals.
- \* Triode connection, grid No.2 connected to plate.

### Push-Pull Class AB, Amplifier

#### **MAXIMUM RATINGS:**

(Same as for Class A<sub>1</sub> Amplifier)

#### TYPICAL OPERATION

(Values are for two tubes): Plate Supply Voltage ..... Fixed Bias Cathode Bias Grid-No.2 Supply Voltage ...... 350 450 450 volts Grid-No.1 Supply Voltage 350 400 400 volts Cathode-Bias Resistor -15.5 -21 volts (Common to both cathodes) ..... 200 ohms Peak AF Grid-No.1-to-Grid-No.1 Voltage .... 31 42 28 volts Zero-Signal Plate Current ..... 92 66 82 mA Maximum-Signal Plate Current
Zero-Signal Grid-No.2 Current 130 144 94 mA 13 9.4 11.5 mA Maximum-Signal Grid-No.2 Current ...... 28.6 30 22 mA Effective Load Resistance (Plate-to-plate) .... 6600 6600 9000 ohms Total Harmonic Distortion 1.5 per cent Maximum-Signal Power Output ..... 30 45 28 Watts



### **POWER PENTODE**

Novar type used in output stages of high-fidelity audio amplifiers or radio receivers; used in applications requiring relatively large power output. Outline 11C or 30D, **Outlines** section. Tube requires novar nine-contact

**7868** 

socket and may be operated in any position. It is especially important that this tube, like other power-handling tubes, be adequately ventilated.

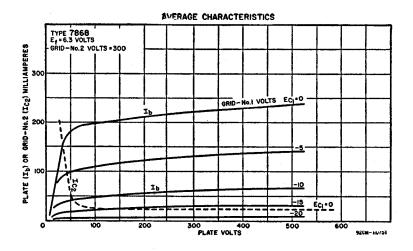
| Heater Current                              | 6.3<br>0.8         | volts          |
|---------------------------------------------|--------------------|----------------|
| Heater Current Peak Heater-Cathode Voltage: | 0.6                | ampere         |
| Heater negative with respect to cathode     | 200 max<br>2000max | volts<br>volts |

| Direct Interelectrode Capacitances (Approx.):          |      |    |
|--------------------------------------------------------|------|----|
| Grid No.1 to Plate                                     | 0.15 | pF |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 11   | pF |
| Plate to Cathode, Heater, Grid No.2, and Grid No.3     | 4.4  | pF |

D The dc component must not exceed 100 volts.

# Class A, Amplifier

| MAXIMUM RATINGS (Design-Maximum System): |         |       |
|------------------------------------------|---------|-------|
| Plate Voltage                            | 550=max | volts |
| Grid-No.2 (Screen-Grid) Voltage          | 440 max | volts |
| Plate Dissipation                        | 19 max  | watts |
| Grid-No.2 Input                          | 3.3 max | watts |
| DC Cathode Current                       | 90 max  | mA    |
| Bulb Temperature (At hottest point)      | 240 max | °C    |



| TYPICAL OPERATION AND CHARACTERISTICS: |       |          |
|----------------------------------------|-------|----------|
| Plate Supply Voltage                   | 300   | volts    |
| Grid-No.2 Voltage                      | 300   | volts    |
| Grid-No.1 (Control-Grid) Voltage       | -10   | volts    |
| Peak AF Grid-No.1 Voltage              | 10    | volts    |
| Zero-Signal Plate Current              | 60    | mA       |
| Maximum-Signal Plate Current           | 75    | mA       |
| Zero-Signal Grid-No.2 Current          | 8     | mA       |
| Maximum-Signal Grid-No.2 Current       | 15    | mA       |
| Plate Resistance (Approx.)             | 29000 | ohms     |
| Transconductance                       | 10200 | μmhos    |
| Effective Load Resistance              | 3000  | ohms     |
| Total Harmonic Distortion              | 13    | per cent |
| Maximum-Signal Power Output            | 11    | watts    |
|                                        |       |          |

#### **MAXIMUM CIRCUIT VALUES:**

Grid-No.1-Circuit Resistance:

For fixed-bias operation 0.3 max megohm
For cathode-bias operation 1 max megohm

<sup>•</sup> In push-pull circuits where the grid No.2 of each tube is connected to a tap on the plate winding of the output transformer, this maximum rating is 440 volts.

<sup>•</sup> Grid No.2 input may reach 6 watts during peak levels of speech and music signals.

### Push-Pull Class AB, Amplifier

### **MAXIMUM RATINGS:**

(Same as for Class A1 Amplifier)

| TYPICAL OPERATION                |       |       |       |      |      | Cathod | le       |
|----------------------------------|-------|-------|-------|------|------|--------|----------|
| (Values are for two tubes):      |       |       | Fixed | Bias |      | Bias   |          |
| Plate Supply Voltage             | 300   | 350   | 400   | 450  | 450  | 450    | volts    |
| Grid-No.2 Supply Voltage         | 300   | 350   | 350   | 350  | 400  | 400    | volts    |
| Grid-No.1 Voltage                | -12.5 | -15.5 | -16   | 16.5 | -21  | · _    | volts    |
| Cathode-Bias Resistor (Common    |       |       |       |      |      |        |          |
| to both cathodes)                | _     | _     | _     | _    | _    | 170    | ohms     |
| Peak AF Grid-No.1-to-            | •     |       |       |      |      |        |          |
| Grid-No.1 Voltage                | 25    | 31    | 32    | 33   | 42   | 31     | volts    |
| Zero-Signal Plate Current        | 74    | 72    | 64    | 60   | 40   | 86     | mA.      |
| Maximum-Signal Plate Current     | 116   | 130   | 135   | 142  | 145  | 94     | mA       |
| Zero-Signal Grid-No.2 Current    | 10    | 9.5   | 8     | 7.2  | 5    | 10     | mA       |
| Maximum-Signal Grid-No.2 Current | 28    | 32    | 28    | 26   | 30   | 20     | mA       |
| Effective Load Resistance        |       |       |       |      |      |        |          |
| (Plate-to-plate)                 | 6600  | 6600  | 6600  | 6600 | 6600 | 10000  | ohms     |
| Total Harmonic Distortion        | 5     | 2.5   | 2     | 2.5  | 5    | 2      | per cent |
| Maximum-Signal Power Output      | 24    | 30    | 34    | 38   | 44   | 28     | watts    |

# Push-Pull Class AB, Amplifier

Grid No.2 of Each Tube Connected to Tap on Plate Winding of Output Transformer\*

| MAXIMUM RATINGS: (Same as for Class A1 Amplifier) | Fixed | Cathode |          |
|---------------------------------------------------|-------|---------|----------|
| TYPICAL OPERATION (Values are for two tubes):     | Bias  | Bias    |          |
| Plate Supply Voltage                              | 400   | 425     | volts    |
| Grid-No.2 Supply Voltage                          | •     | *       | volts    |
| Grid-No.1 Voltage                                 | -20.5 | _       | volts    |
| Cathode-Bias Resistor (Common to both cathodes)   | ~     | 185     | ohms     |
| Peak AF Grid-No.1-to-Grid-No.1 Voltage            | 41    | 42      | volts    |
| Zero-Signal Plate Current                         | 60    | 88      | mA       |
| Maximum-Signal Plate Current                      | 115   | 100     | mA       |
| Zero-Signal Grid-No.2 Current                     | 8     | 12      | mA       |
| Maximum-Signal Grid-No.2 Current                  | 18    | 16      | mA       |
| Effective Load Resistance (Plate-to-plate)        | 6600  | 6600    | ohms     |
| Total Harmonic Distortion                         | 2.5   | 3.5     | per cent |
| Maximum-Signal Power Output                       | 23    | 21      | watts    |

<sup>\*</sup> Grid No.2 supply voltage is obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center tap (B+) so as to apply 50 per cent of the plate signal voltage to the grid No.2 of each output tube.

# RCA Types for

# (Types shown in light face are discontinued.)

| RCA<br>Type  | Name                            | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Filan Unless s types ha  Heate | ter or<br>nent (F)<br>pecified all<br>ve heaters.<br>r with con-<br>armup time.<br>Amperes | Use  Values to right give operating conditions and characteristics for indicated typical use |
|--------------|---------------------------------|---------------------------------|-------------------------------------------|--------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| OZ4          | Full-Wave Gas Rectifier         | 2A                              | 4R                                        |                                |                                                                                            | Rectifier                                                                                    |
| OZ4G         | Full-Wave Gas Rectifier         | 29D                             | 4R                                        |                                |                                                                                            | Rectifier                                                                                    |
| 1A3          | Diode                           | 5C                              | 5AP                                       | 1.4                            | 0.15                                                                                       | Rectifier                                                                                    |
| 1A4P         | Remote-Cutoff Pentode           | 248                             | 4M                                        | 2.0F                           | 0.06                                                                                       | Class A Amplifier                                                                            |
| 1A5GT        | Power Pentode                   | 13D                             | 6X                                        | 1.4F                           | 0.05                                                                                       | Class A Amplifier                                                                            |
| 1A6          | Pentagrid Converter             | 248                             | 6L                                        | 2.0F                           | 0.06                                                                                       | Converter                                                                                    |
| 1A7GT        | Pentagrid Converter             | 14A                             | 72                                        | 1.4F                           | 0.05                                                                                       | Converter                                                                                    |
| 1AC5         | Power Pentode                   | 29A                             | 8CP                                       | 1.25F                          | 0.04                                                                                       | Class A Amplifier                                                                            |
| 1AD5         | Sharp-Cutoff Pentode            | 29A                             | 8CP                                       | 1.25F                          | 0.04                                                                                       | Class A Amplifier                                                                            |
| 1AX2         | Half-Wave Rectifier             | 7A                              | 9Y                                        | 1.4F                           | 0.65                                                                                       | Pulsed Rectifier in TV Receivers                                                             |
| 1B3GT        | Half-Wave Rectifier             | 14E                             | 3C                                        | 1.25F                          | 0.2                                                                                        | Pulsed Rectifier in TV Receivers                                                             |
| 1B4P         | Sharp-Cutoff Pentode            | 24B                             | 4M                                        | 2.0F                           | 0.06                                                                                       | Class A Amplifier                                                                            |
| 185/<br>25\$ | Twin iode-Medium-Mu Triode      | 22 or<br>13H                    | 6M                                        | 2.0F                           | 0.06                                                                                       | Triode Unit as Class A Amplifie                                                              |
| 1B7GT        | Pentagrid Converter             | 14A                             | 7Z                                        | 1.4F                           | 0.10                                                                                       | Converter                                                                                    |
| 1C5GT        | Power Pentode                   | 130                             | 6X                                        | 1.4F                           | 0.10                                                                                       | Class A Amplifier                                                                            |
| 106          | Pentagrid Converter             | 24B                             | 6L                                        | 2.0F                           | 0.12                                                                                       | Converter                                                                                    |
| 1C7G         | Pentagrid Converter             | 23                              | 7Z                                        | 2.0F ·                         | 0.12                                                                                       | Converter                                                                                    |
| 1D5GP        | Remote-Cutoff Pentode           | 23                              | 5Y                                        | 2.0F                           | 0.06                                                                                       | Class A Amplifier                                                                            |
| 1D5GT        | Remote-Cutoff Tetrode           | 23                              | 5R                                        | 2.0F                           | 0.06                                                                                       | Class A Amplifier                                                                            |
| 107G         | Pentagrid Converter             | 23                              | 72                                        | 2.0F                           | 0.06                                                                                       | Converter                                                                                    |
| 1D8GT        | Diode-Triode-Power Pentode      | 14A                             | LA8                                       | 1.4F                           | 0.10                                                                                       | Pentode Unit as Class A<br>Amplifier                                                         |
| 10001        | MINRS-11: ARC.LAMEL LEUFOBG     | 148                             | GA.J                                      | 1.45                           | 0.10                                                                                       | Triode Unit as Class A<br>Amplifier                                                          |
| 1DN5         | Diode-Semiremote-Cutoff Pentode | 5C                              | 68W                                       | 1.4F                           | 0.5                                                                                        | Pentode Unit as Class A<br>Amplifier                                                         |

# Replacement Use

| Plate<br>Sup-<br>ply | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor | Grid<br>Sup-<br>ply        | Grid<br>Cur-<br>rent | Plate<br>Cur-<br>rent | AC Plate<br>Resist-<br>ance | Trans-<br>conduct-<br>ance | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output             | Power<br>Out-<br>put | RCA<br>Type |
|----------------------|-----------------------------------------------------|----------------------------|----------------------|-----------------------|-----------------------------|----------------------------|------------------------------|---------------------------------------------------|----------------------|-------------|
| Volts                | Ohms (\O)                                           | Voits                      | mA                   | mA                    | Ohms                        | Micromhos                  |                              | Ohms                                              | Watts                |             |
|                      | ing-Supply Volta                                    |                            |                      |                       | k voits                     | DC O                       | utput Volt                   | rent, 200 max<br>age, 300 max                     | volts.               | 0Z4         |
| Start<br>DC 0        | ing-Supply Volta<br>Jutput Current,                 | age per Pla<br>75 max., 30 | te, 300<br>min. r    | min. pea<br>nA        | k voits                     | DC O                       | utput Volt                   | rent, 200 max<br>age, 300 max                     | . mA<br>. volts      | 0Z4G        |
|                      | Max. Peak Pla<br>Max. Peak Pla                      |                            | Volts,               | 330                   |                             | Max.<br>Max.               | DC Outpu<br>Peak Hea         | t mA, 0.5<br>ter-Cathode V                        | oits, 140            | 1A3         |
|                      | .,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,             |                            | other c              | haracteris            | tics, refer                 | to Type 1D                 |                              |                                                   |                      | 1A4P        |
| 85<br>90             | 4.5V<br>4.5V                                        | 85<br>90                   | 0.7<br>1.1           | 3.5<br>4.0            | 300000<br>300000            | 800<br>850                 |                              | 25000<br>25000                                    | 0.100<br>0.115       | 1A5GT       |
| 135<br>180           | — 3V<br>— 3V                                        | 67.5<br>67.5               | 2.5<br>2.4           | 1.2<br>1.3            | 400000<br>500000            |                            |                              | 80 max. voits<br>-Grid (1) Resi                   | stor.                | 1A6         |
| 90                   | 0٧                                                  | 45                         | 0.7                  | 0.6                   | 600000                      | Oscilla                    | tor-Grid (1                  | 0 volts, 1.2 m<br>) Resistor, 0.<br>cond., 250 mi | 2 ΜΩ                 | 1A76T       |
| 45<br>67.5           | — 3V<br>— 4.5V                                      | 45<br>67.5                 | 0.2<br>0.4           | 1.0<br>2.0            | 170000<br>150000            | 600<br>750                 |                              | 40000<br>25000                                    | 0.015<br>0.050       | 1AC5        |
| 30<br>67.5           | 0V<br>0V                                            | 30<br>67.5                 | 0.16<br>0.75         | 0.45<br>1.85          | 700000<br>700000            | 430<br>735                 |                              |                                                   |                      | 1AD5        |
|                      | . Peak Inverse F<br>. Peak Plate mA                 |                            | 25000                |                       |                             | Max.                       | Average I                    | Plate mA, 0.5                                     |                      | 1AX2        |
|                      | . Peak inverse F<br>. Peak Plate mA                 |                            | 26000                |                       |                             | Max.                       | Average I                    | Plate mA, 0.5                                     |                      | 1B3GT       |
|                      |                                                     | Fo                         | r other              | character             | ristics, ref                | er to Type 1               | E5GP                         |                                                   |                      | 1B4P        |
|                      |                                                     | Fo                         | r other              | characte              | ristics, ref                | er to Type 1               | H6G                          |                                                   | -                    | 1B5/<br>25S |
|                      |                                                     | Fo                         | r other              | characte              | ristics, ref                | er to Type 1               | A7GT                         |                                                   |                      | 1B7GT       |
| 90                   | 7.5V                                                | 90                         | 3.5                  | 7.8                   | 115000                      | 1550                       |                              | 8000                                              | 0.24                 | 1C5GT       |
|                      |                                                     | Fo                         | r other              | characte              | ristics, ref                | er to Type 1               |                              |                                                   |                      | 106         |
| 135<br>180           | — 3V<br>— 3V                                        | 67.5<br>67.5               | 2.5<br>2.0           | 1.3<br>1.5            | 600000<br>700000            | Anode-<br>4.0 m<br>Conver  | A Oscilla                    | : 180 max<br>tor-Grid (1)<br>scond., 325 m        | Resistor.            | 1C7G        |
| 90<br>180            | { − 3V }                                            | 67.5<br>67.5               | 0.9                  | 2.2<br>2.3            | 600000<br>1 MΩ              | 720<br>750                 |                              |                                                   |                      | 1D5GP       |
|                      |                                                     | For                        | other (              | haracteri             | stics, refe                 | r to Type 1D               | 5GP                          |                                                   |                      | 1D5GT       |
|                      |                                                     | Fo                         | r other              | character             | istics, ref                 | er to Type 1               | A6                           | -                                                 |                      | 1D7G        |
| 90                   | 9V                                                  | 90                         | 1.0                  | 5.0                   |                             | 925                        |                              | 12000                                             | 0.200                | - 1D8GT     |
| 90                   | 0V                                                  |                            | _                    | 1.1                   | 43500                       | 575                        | 25                           |                                                   |                      | - 10001     |
| 67.5                 | OV                                                  | 67.5                       | 0.55                 | 2.1                   | 600000                      | 630                        |                              |                                                   |                      | 1DN5        |
|                      |                                                     | ,                          |                      |                       |                             |                            |                              |                                                   |                      |             |

| RCA<br>Type           | Name                            | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Fil:<br>Unless<br>types I<br># Hear | eater or<br>ament (F)<br>specified all<br>have heaters,<br>ter with con-<br>warmup time.<br>Amperes | Use Values to right give operating conditions and characteristics for indicated typical use |
|-----------------------|---------------------------------|---------------------------------|-------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 1E5GP                 | Sharp-Cutoff Pentode            | 23                              | 5Y                                        | 2.0F                                | 0.06                                                                                                | Class A Amplifier                                                                           |
| 1E7GT                 | Twin Power Pentode              | 13D                             | 8C                                        | 2.0F                                | 0.24                                                                                                | Class A Amplifier                                                                           |
| 1E8                   | Pentagrid Converter             | 29A                             | 8CN                                       | 1.25F                               | 0.04                                                                                                | Converter                                                                                   |
| 1F4                   | Power Pentode                   | 26                              | 5K                                        | 2.0F                                | 0.12                                                                                                | Class A Amplifier                                                                           |
| 1F5G                  | Power Amplifier Pentode         | 25                              | 6X                                        | 2.0F                                | 0.12                                                                                                | Class A Amplifier                                                                           |
| 1F6                   | Twin Diode—Sharp-Cutoff Pentode | 23                              | 6W                                        | 2.0F                                | 0.06                                                                                                | Pentode Unit as Class A<br>Amplifier                                                        |
| 1F7G                  | Twin Diode—Sharp-Cutoff Pentode | 23                              | 7AF                                       | 2.0F                                | 0.06                                                                                                | Pentode Unit as Class A<br>Amplifier                                                        |
| 1G4GT                 | Medium-Mu Triode                | 13D                             | 5\$                                       | 1.4F                                | 0.05                                                                                                | Class A Amplifier                                                                           |
| 1 <b>G</b> 5 <b>G</b> | Power Pentode                   | 25                              | 6X                                        | 2.0F                                | 0.12                                                                                                | Class A Amplifier                                                                           |
| 1G6GT                 | High-Mu Twin Power Triode       | 13D                             | 7AB                                       | 1.4F                                | 0.10                                                                                                | Class B Amplifier                                                                           |
| 1H4G                  | Medium-Mu Triode                | 22                              | 58                                        | 2.0F                                | 0.06                                                                                                | Class A Amplifier Class B Amplifier                                                         |
| 1H5GT                 | Diode—High-Mu Triode            | 14A                             | 5Z                                        | 1.4F                                | 0.05                                                                                                | Triode Unit as Class A Amplifier                                                            |
| 1H6G                  | Twin Diode-Medium-Mu Triode     | 22                              | 7AA                                       | 2.0F                                | 0.06                                                                                                | Triode Unit as Class A Amplifier                                                            |
| 1J3                   | Half-Wave Rectifier             | 14E                             | 3C                                        | 1.25F                               | 0.2                                                                                                 | Pulsed Rectifier in TV Receivers                                                            |
| 1J5G                  | Power Pentode                   | 25                              | 6X                                        | 2.0F                                | 0.12                                                                                                | Class A Amplifier                                                                           |
| 1J6G<br>1J6GT         | Twin-Triode Amplifiers          | 22<br>13F                       | 7AB                                       | 2.0F                                | 0.24                                                                                                | Class B Amplifier                                                                           |
| 1 K3                  | Half-Wave Rectifier             | 148                             | 3C                                        | 1.25F                               | 0.2                                                                                                 | Pulsed Rectifier in TV Receivers                                                            |
| 1L6                   | Pentagrid Converter             | 5C                              | 7DC                                       | 1.4F                                | 0.05                                                                                                | Converter                                                                                   |
| 1LA4                  | Power Pentode                   | 12B                             | 5AD                                       | 1.4F                                | 0.05                                                                                                | Amplifier                                                                                   |
| 1LA6                  | Pentagrid Converter             | 128                             | 7AK                                       | 1.4F                                | 0.05                                                                                                | Converter                                                                                   |
| 1LB4                  | Power Pentode                   | 128                             | 5AD                                       | 1.4F                                | 0.05                                                                                                | Class A Amplifier                                                                           |
| 1LC5                  | Sharp-Cutoff Pentode            | 12B                             | 7A0                                       | 1.4F                                | 0.05                                                                                                | Class A Amplifier                                                                           |
| 1LC6                  | Pentagrid Converter             | 12B                             | 7AK                                       | 1.4F                                | 0.05                                                                                                | Converter                                                                                   |
| 1LD5                  | Diode—Sharp-Cutoff Pentode      | 12B                             | 6AX                                       | 1.4F                                | 0.05                                                                                                | Pentode Unit as Class A<br>Amplifier                                                        |
| 1LE3                  | Medium-Mu Triode                | 12B                             | 4AA                                       | 1.4F                                | 0.05                                                                                                | Class A Amplifier                                                                           |
| 1LG5                  | Remote-Cutoff Pentode           | 12B                             | 7A0                                       | 1.4F                                | 0.05                                                                                                | Class A Amplifier                                                                           |
| 1LH4                  | Diode—High-Mu Triode            | 128                             | 5AG                                       | 1.4F                                | 0.05                                                                                                | Triode Unit as Class A Amplifier                                                            |
| 1LN5                  | Sharp-Cutoff Pentode            | 128                             | 7A0                                       | 1.4F                                | 0.05                                                                                                | Class A Amplifier                                                                           |
| 1N2A                  | Half-Wave Rectifier             | 19A                             | 30                                        | 1.25F                               | 0.2                                                                                                 | Pulsed Rectifier in TV Receivers                                                            |
| 1N5GT                 | Sharp-Cutoff Pentode            | 14A                             | 5 <b>Y</b>                                | 1.4F                                | 0.05                                                                                                | Class A Amplifier                                                                           |
| 1N6G                  | Diode—Power Pentode             | 29A                             | 7AM                                       | 1.4F                                | 0.05                                                                                                | Pentode Unit as Class A<br>Amplifier                                                        |
|                       |                                 |                                 |                                           |                                     |                                                                                                     |                                                                                             |

Types shown in light face are discontinued.

| Plate<br>Sup-<br>ply                                     | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor | Grid<br>Sup-<br>ply                                  | Grid<br>Cur-<br>rent                  | Plate<br>Cur-<br>rent                                         | AC Plate<br>Resist-<br>ance                                                             | Trans-<br>conduct-<br>ance                                                                 | Amplifi-<br>cation<br>Factor                                 | Load<br>for Stated<br>Power<br>Output      | Power<br>Out-<br>put        | RCA<br>Type                                  |
|----------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------|---------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------|-----------------------------|----------------------------------------------|
| Volts                                                    | Ohms (Ω)                                            | Veits                                                | mA                                    | mA                                                            | Ohms                                                                                    | Micrembos                                                                                  |                                                              | Ohms                                       | Watts                       | .,,,,                                        |
| 90                                                       | — 3V                                                | 67.5                                                 | 0.7                                   | 1.6                                                           | 1 ΜΩ                                                                                    | 600                                                                                        |                                                              |                                            |                             | 1E5GF                                        |
| 180                                                      | 3V                                                  | 67.5                                                 | 0.6                                   | 1.7                                                           | 1.5 ΜΩ                                                                                  | 650                                                                                        |                                                              |                                            | 0.575                       |                                              |
| 135<br>45                                                | 7.5V                                                | 135<br>45                                            | 3.5                                   | 10.5<br>0.6                                                   | 400000                                                                                  | Decillat                                                                                   | or Crid (                                                    | 24000<br>1) Resistor,                      | 0.575<br>0.1 MΩ             | 1E7GT                                        |
| 67.5                                                     | ŎÝ                                                  | 67.5                                                 | 1.5                                   | 1.0                                                           | 400000                                                                                  | Convers                                                                                    | ion Trans                                                    | ond., 150 mi                               | cromhos                     | 1E8                                          |
|                                                          |                                                     |                                                      |                                       |                                                               |                                                                                         | to Type 1F                                                                                 | 5 <b>G</b>                                                   |                                            |                             | 1F4                                          |
| 90<br>135                                                | 3V<br>4.5V                                          | 90<br>135                                            | 1.1<br>2.4                            | 4.0<br>8.0                                                    | 240000                                                                                  | 1400                                                                                       |                                                              | 20000                                      | 0.11<br>0.31                | 1F5G                                         |
|                                                          |                                                     | For                                                  | other c                               | haracteris                                                    | stics, refe                                                                             | to Type 1F                                                                                 | 'G                                                           |                                            |                             | 1F6                                          |
| 180                                                      | — 1.5V                                              | 67.5                                                 | 0.7                                   | 2.2                                                           |                                                                                         |                                                                                            |                                                              |                                            |                             | 1F7G                                         |
| 90                                                       | 6V                                                  |                                                      |                                       | 2.3                                                           | 10700                                                                                   | 825                                                                                        | 8.8                                                          |                                            |                             | 1G4G1                                        |
| 90                                                       | — 6V                                                | 90                                                   | 2.5                                   | 8.5                                                           | 133000                                                                                  | 1500                                                                                       |                                                              | 8500                                       | 0.25                        | 1 <b>G</b> 5 <b>G</b>                        |
| 90                                                       | —13.5V                                              | 135                                                  | 2.5                                   | 9.7                                                           | 160000                                                                                  | 1550                                                                                       |                                                              | 9000                                       | 0.55                        | 1G6G1                                        |
| 180                                                      | —13.5V                                              |                                                      |                                       | 3.1                                                           | 10300                                                                                   | 900                                                                                        | 9.3                                                          | 12000                                      | 0.350                       |                                              |
| 157.5                                                    | —15V                                                |                                                      |                                       | 1.00                                                          |                                                                                         |                                                                                            |                                                              | 8000                                       | 2.1†                        | - 1H4G                                       |
| 90                                                       | 0V                                                  |                                                      |                                       | 0.15                                                          | 240000                                                                                  | 275                                                                                        | 65                                                           |                                            |                             | 1H5G                                         |
| 135                                                      | — 3V                                                |                                                      |                                       | 0.8                                                           | 35000                                                                                   | 575                                                                                        | 20                                                           |                                            |                             | 1H6G                                         |
|                                                          | ax. Peak Invers<br>ax. Peak Plate                   |                                                      | olts, 260                             | 00 (Abs.)                                                     |                                                                                         | M                                                                                          | lax. Avera                                                   | ge Plate mA,                               | 0.5                         | 1J3                                          |
| 135                                                      | 16.5V                                               | 135                                                  | 2.0                                   | 7.0                                                           | 105000                                                                                  | 950                                                                                        |                                                              | 13500                                      | 0.45                        | 1J5G                                         |
| 135<br>135                                               | 0V<br>3V                                            |                                                      | _                                     |                                                               |                                                                                         | s for one tu<br>to-plate load                                                              |                                                              | 10000<br>10000                             | 2.1<br>1.9                  | 1J6G<br>1J6GT                                |
| Ma<br>Ma                                                 | ax. Peak Invers<br>ax. Peak Plate                   | e Plate V<br>mA. 50                                  | olts, 260                             | 00 (Abs.)                                                     |                                                                                         | N                                                                                          | lax. Avera                                                   | ge Plate mA,                               | 0.5                         | 1K3                                          |
| 90                                                       | 0V                                                  | 45                                                   | 0.6                                   | 0.5                                                           | 650000                                                                                  | Anode-Grid<br>Oscillator<br>Conversion                                                     | Grid (1)                                                     | max. volts,<br>Resistor, (<br>and, 300 mi  | ).2 ΜΩ                      | 1L6                                          |
|                                                          |                                                     | For                                                  | other ch                              | aracteris                                                     | tics, refer                                                                             | to Type 1A5                                                                                |                                                              |                                            |                             | 1LA4                                         |
| 90                                                       | 0V                                                  | 65                                                   | 0.6                                   | 0.55                                                          | 750000                                                                                  |                                                                                            | i Transcor                                                   | d. (for grid-N<br>O micromhos              | 0. 4                        | 1LA6                                         |
|                                                          | Fo                                                  | r other ch                                           | aracteris                             | tics, ref                                                     | er to Pento                                                                             | de Unit of                                                                                 | ype 1D8G                                                     | T                                          |                             | 1LB4                                         |
|                                                          | 0V<br>0V                                            | 45<br>45                                             | 0.35<br>0.30                          | 1.10<br>1.15                                                  | 700000<br>1 MΩ                                                                          | 750                                                                                        |                                                              |                                            |                             | 11.05                                        |
| 45<br>90                                                 | 0.                                                  | 70                                                   |                                       |                                                               |                                                                                         | 775                                                                                        |                                                              |                                            |                             | 1LC5                                         |
|                                                          | 0V<br>0V                                            | 35<br>35                                             | 0.75<br>0.70                          | 0.70<br>0.75                                                  | 300000<br>650000                                                                        | Anode-Grid<br>Oscillator                                                                   | (2): 50<br>Grid (1)                                          | max. volts,<br>Resistor, (                 | 1.4 mA<br>0.2 MΩ<br>crombos | 1LC6                                         |
| 90<br>45                                                 | 0V                                                  | 35                                                   | 0.75                                  | 0.70                                                          | 300000                                                                                  |                                                                                            | (2): 50<br>Grid (1)<br>Transco                               | max. volts,<br>Resistor, (<br>nd., 275 mi  | 1.4 mA<br>0.2 MΩ<br>cromhos |                                              |
| 90<br>45<br>90<br>90<br>90                               | 0V<br>0V<br>0V                                      | 35<br>35                                             | 0.75<br>0.70                          | 0.70<br>0.75<br>0.6<br>4.5                                    | 300000<br>650000<br>750000                                                              | Anode-Grid<br>Oscillator-<br>Conversion<br>575<br>1300                                     |                                                              | max. volts,<br>Resistor, (<br>and., 275 mi | 1.4 mA<br>0.2 MΩ<br>cromhos | 1LC6                                         |
| 90<br>45<br>90<br>90<br>90<br>90<br>90                   | 0V<br>0V<br>0V<br>0V<br>- 3V<br>0V                  | 35<br>35<br>45<br>———————————————————————————————    | 0.75<br>0.70<br>0.1<br>               | 0.70<br>0.75<br>0.6<br>4.5<br>1.4<br>1.7                      | 300000<br>650000<br>750000<br>11200<br>19000<br>1 ΜΩ                                    | Anode-Grid<br>Oscillator-<br>Conversion<br>575<br>1300<br>760<br>800                       | Transco                                                      | max. volts,<br>Resistor, (<br>nd., 275 mi  | 1.4 mA<br>0.2 MΩ<br>cromhos | 1LC6<br>1LD5<br>1LE3                         |
| 90<br>45<br>90<br>90<br>90<br>90                         | 0V<br>0V<br>0V<br>0V<br>- 3V                        | 35<br>35<br>45<br>———————————————————————————————    | 0.75<br>0.70<br>0.1<br><br>0.4<br>0.9 | 0.70<br>0.75<br>0.6<br>4.5<br>1.4<br>1.7<br>3.7               | 300000<br>650000<br>750000<br>11200<br>19000<br>1 ΜΩ<br>500000                          | Anode-Grid<br>Oscillator-<br>Conversion<br>575<br>1300<br>760<br>800<br>1150               | 14.5<br>14.5                                                 | max. volts, Resistor, ( nd., 275 mi        | 1.4 mA<br>1.2 MΩ<br>cromhos | 1LC6<br>1LD5<br>1LE3<br>1LG5                 |
| 90<br>45<br>90<br>90<br>90<br>90<br>90                   | 0V<br>0V<br>0V<br>0V<br>- 3V<br>0V                  | 35<br>35<br>45<br>———————————————————————————————    | 0.75<br>0.70<br>0.1<br><br>0.4<br>0.9 | 0.70<br>0.75<br>0.6<br>4.5<br>1.4<br>1.7<br>3.7<br>aracteris  | 300000<br>650000<br>750000<br>11200<br>19000<br>1 MΩ<br>500000<br>tics, refer           | Anode-Gric<br>Oscillator<br>Conversion<br>575<br>1300<br>760<br>800<br>1150<br>to Type 1H5 | 14.5<br>14.5                                                 | max. volts, Resistor, ( nd., 275 mi        | 1.4 mA<br>0.2 MΩ<br>cromhos | 1LC6<br>1LD5<br>1LE3<br>1LG5<br>1LH4         |
| 90<br>45<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90 | 0V<br>0V<br>0V<br>- 3V<br>0V<br>1.5V                | 35<br>35<br>45<br>45<br>90<br>For<br>90<br>ate Volts | 0.75<br>0.70<br>0.1<br>               | 0.70<br>0.75<br>0.6<br>4.5<br>1.4<br>1.7<br>3.7<br>aracterist | 300000<br>650000<br>750000<br>11200<br>19000<br>1 MΩ<br>500000<br>tics, refer<br>1.1 MΩ | Anode-Gri<br>Oscillator-<br>Conversion<br>575<br>1300<br>760<br>800<br>1150<br>to Type 1H5 | 14.5<br>14.5<br>14.5<br>———————————————————————————————————— | max. volts, Resistor, ( nd., 275 mi        | 1.4 mA<br>2.2 MΩ<br>cromhos | 1LC6<br>1LD5<br>1LE3<br>1LG5<br>1LH4<br>1LN5 |
| 90<br>45<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90 | 0V<br>0V<br>0V<br>- 3V<br>0V<br>1.5V                | 35<br>35<br>45<br>45<br>90<br>For<br>90<br>ate Volts | 0.75<br>0.70<br>0.1<br>               | 0.70<br>0.75<br>0.6<br>4.5<br>1.4<br>1.7<br>3.7<br>aracterist | 300000<br>650000<br>750000<br>11200<br>19000<br>1 MΩ<br>500000<br>tics, refer<br>1.1 MΩ | Anode-Gri<br>Oscillator-<br>Conversion<br>575<br>1300<br>760<br>800<br>1150<br>to Type 1H5 | 14.5<br>14.5<br>14.5<br>———————————————————————————————————— | nd., 275 mi                                | 1.4 mA<br>0.2 MΩ<br>cromhos | 1LC6<br>1LD5<br>1LE3<br>1LG5<br>1LH4         |

<sup>†</sup> For two tubes at stated plate-to-plate load.

| RCA<br>Type   | Name                                | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Fila Unless types h  Heat trolled | eater or<br>iment (F)<br>specified all<br>ave heaters.<br>er with con-<br>warmup time. | Use Values to right give operating conditions and characteristics for indicated typical use |
|---------------|-------------------------------------|---------------------------------|-------------------------------------------|-----------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 1P5GT         | Remote-Cutoff Pentode               | 14A                             | 5Y                                        | Volts<br>1.4F                     | Amperes<br>0.05                                                                        | Class A Amplifier                                                                           |
| 105GT         | Beam Power Tube                     | 13D                             | 6AF                                       | 1.4F                              | 0.1                                                                                    | Class A Amplifier                                                                           |
| 1R5           | Pentagrid Converter                 | 5C                              | 7AT                                       | 1.4F                              | 0.05                                                                                   | Converter                                                                                   |
| 154           | Power Pentode                       | 5C                              | TAV                                       | 1.4F                              | 0.1                                                                                    | Class A Amplifier                                                                           |
| 155           | Diode-Sharp-Cutoff Pentode          | 5C                              | 6AU                                       | 1.4F                              | 0.05                                                                                   | Pentode Unit as AF Amplifier                                                                |
| 1 <b>T</b> 4  | Remote-Cutoff Pentode               | 5C                              | 6AR                                       | 1.4F                              | 0.05                                                                                   | Class A Amplifier                                                                           |
| 1T5GT         | Beam Power Tube                     | 13D                             | 6X                                        | 1.4F                              | 0.05                                                                                   | Class A Amplifier                                                                           |
| 176           | Diode—Sharp-Cutoff Pentode          | 29A                             | 8DA                                       | 1.25F                             | 0.04                                                                                   | Pentode Unit as Class A<br>Amplifier                                                        |
| 104           | Sharp-Cutoff Pentode                | 5C                              | 6AR                                       | 1.4F                              | 0.05                                                                                   | Class A Amplifier                                                                           |
| 105           | Diode-Sharp-Cutoff Pentode          | 5C                              | 6BW                                       | 1.4F                              | 0.05                                                                                   | Pentode Unit as Class A<br>Amplifier                                                        |
| 17            | Half-Wave Rectifier                 | 22 or<br>13H                    | 4 <b>G</b>                                | 6.3                               | 0.3                                                                                    | With Capacitive-Input Filter                                                                |
| 1X2A          | Half-Wave Rectifier                 | 7A                              | 9Y                                        | 1.25F                             | 0.2                                                                                    | Pulsed Rectifier in TV Receivers                                                            |
| 2A3           | Pawer Triade                        | 27B                             | 4B                                        | 2.5F                              | 2.5                                                                                    | Class A Amplifier Push-Pull Class AB <sub>1</sub> Amplifier                                 |
| 2A5           | Power Pentode                       | 28                              | 68                                        | 2.5                               | 1.75                                                                                   | Amplifier                                                                                   |
| 2A6           | Twin Diode—High-Mu Triode           | 24B                             | 6G                                        | 2.5                               | 0.8                                                                                    | Triode Unit as Amplifier                                                                    |
| 2A7           | Pentagrid Converter                 | 24B                             | 7C                                        | 2.5                               | 0.8                                                                                    | Converter                                                                                   |
| 2AF4A         | Medium-Mu Triode                    | 5B                              | 7DK                                       | 2.35 ⊕                            | 0.6                                                                                    | Class A Amplier                                                                             |
| 287           | Twin Diode—Remote-Cutoff<br>Pentode | 24B                             | 70                                        | 2.5                               | 0.8                                                                                    | Pentode Unit as Amplifier                                                                   |
| 2BN4          | Medium-Mu Triode                    | 5C                              | 7EG                                       | 2.3⊕                              | 0.6                                                                                    | Class A Amplifier                                                                           |
| 2E5           | Electron-Ray Tube                   | 22 or<br>13H                    | 6R                                        | 2.5                               | 0.8                                                                                    | Visual Indicator                                                                            |
| 2EN5          | Twin Diode                          | 5C                              | 7FL                                       | 2.1⊕                              | 0.45                                                                                   | Horizontal Phase Detector                                                                   |
| 3A2           | Half-Wave Rectifier                 | 7A                              | 9DT                                       | 3.15                              | 0.22                                                                                   | Pulsed Rectifier in TV Receivers                                                            |
| 3A3           | Half-Wave Rectifier                 | 14E                             | 8EZ                                       | 3.15                              | 0.22                                                                                   | Pulsed Rectifier in TV Receivers                                                            |
| 3A8GT         | Diode-Triode-Pentode                | 296                             | 8AS                                       | 1.4F<br>2.8F                      | 0.1<br>0.05                                                                            | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                          |
| 3B2           | Half-Wave Rectifier                 | 21C                             | 8GH                                       | 3.15                              | 0.22                                                                                   | Pulsed Rectifier in TV Service                                                              |
| 3BN4          | Medium-Mu Triode                    | 5C                              | 7EG                                       | 3.0⊕                              | 0.45                                                                                   | Class A Amplifier                                                                           |
| 3DT6          | Sharp-Cutoff Pentode                | 5C                              | 7EN                                       | 3.15⊕                             | 0.6                                                                                    | Class A Amplifier                                                                           |
| 3GS8/<br>3BU8 | Sharp-Cutoff Twin Pentode           | 8E                              | SLW                                       | 3.15⊕                             | 0.6                                                                                    | Class A Amplifier (With both sections operating)                                            |
| 3LF4          | Beam Power Tube                     | 12B                             | 6BA                                       | 1.4F<br>2.8F                      | 0.1<br>0.05                                                                            | Class A Amplifier                                                                           |
| 304           | Power Pentode                       | 5C                              | 7BA                                       | 1.4F<br>2.8F                      | 0.1<br>0.05                                                                            | Class A Amplifier                                                                           |
| 3Q5GT         | Beam Power Tube                     | 13D                             | 7AP                                       | 1.4F<br>2.8F                      | 0.1<br>0.05                                                                            | Class A Amplifier                                                                           |
| 3S4           | Power Pentode                       | 5C                              | 7BA                                       | 1.4E<br>2.8F                      | 0.1<br>0.05                                                                            | Class A Amplifier                                                                           |
| 3V4           | Power Pentode                       | 5C                              | 6BX                                       | 1.4F                              | 0.1                                                                                    | Class A Amplifier                                                                           |

| Plate<br>Sup-<br>ply                                     | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor                                                                     | Grid<br>Sup-<br>ply                                                        | Grid<br>Cur-<br>rent                                                   | Plate<br>Cur-<br>rent                                                      | AC Plate<br>Resist-<br>ance                                             | Trans-<br>conduct-<br>ance                                                           | Amplifi-<br>cation<br>Factor                            | Load<br>for Stated<br>Power<br>Output                            | Power<br>Out-<br>put | RCA<br>Type                                                                |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------|
| Voits                                                    | Ohms $(\Omega)$                                                                                                         | Volts                                                                      | mA                                                                     | mA                                                                         | Ohms                                                                    | Micromhas                                                                            |                                                         | Ohms                                                             | Watts                |                                                                            |
| 90                                                       | 0V                                                                                                                      | 90                                                                         | 0.7                                                                    | 2.3                                                                        | 800000                                                                  | 750                                                                                  |                                                         |                                                                  |                      | 1P5GT                                                                      |
| 110                                                      | — 6.6V                                                                                                                  | 110                                                                        | 1.4                                                                    | 10                                                                         | 100000                                                                  | 2200                                                                                 |                                                         | 8000                                                             | 0.4                  | 1Q5GT                                                                      |
| 45<br>90                                                 | 0V<br>0V                                                                                                                | 45<br>67.5                                                                 | 2.1<br>3.5                                                             | 0.7<br>1.5                                                                 | 500000<br>400000                                                        | Convers<br>Convers                                                                   | ion Transi<br>ion Transi                                | cond., 210 μm<br>cond., 280 μm                                   | hos<br>hos           | 1R5                                                                        |
| 45<br>90                                                 | 4.5V<br>7V                                                                                                              | 45<br>67.5                                                                 | 0.8<br>1.4                                                             | 3.8<br>7.4                                                                 | 100000<br>100000                                                        | 1250<br>1575                                                                         |                                                         | 8000<br>8000                                                     | 0.065<br>0.27        | 154                                                                        |
| Plate S<br>resistor                                      | upply, 90 V ag<br>. Grid Bias, 0 v                                                                                      | oplied throlls. Grid                                                       | ough 1<br>Resistor                                                     | MΩ resis<br>, 10 meg                                                       | stor. Scre<br>ohms. Volt                                                | en Supply,<br>age Gain, 66                                                           | 90 V app<br>approx.                                     | lied through                                                     | 3.1 MΩ               | 185                                                                        |
| 45<br>90                                                 | 0V<br>0V                                                                                                                | 45<br>67.5                                                                 | 0.7<br>1.4                                                             | 1.7<br>3.5                                                                 | 350000<br>500000                                                        | 700<br>900                                                                           |                                                         |                                                                  | _                    | 1T4                                                                        |
| 90                                                       | — 6V                                                                                                                    | 90                                                                         | 0.8                                                                    | 6.5                                                                        | 250000                                                                  | 1150                                                                                 |                                                         | 14000                                                            | 0.17                 | 1T5GT                                                                      |
| 45<br>67.5                                               | 0V<br>0V                                                                                                                | 45<br>67.5                                                                 | 0.21                                                                   | 0.75<br>1.6                                                                | 500000<br>400000                                                        | 475<br>600                                                                           |                                                         |                                                                  |                      | 176                                                                        |
| 90                                                       | 0V                                                                                                                      | 90                                                                         | 0.50                                                                   | 1.1                                                                        | 1 ΜΩ                                                                    | 900                                                                                  |                                                         |                                                                  |                      | 104                                                                        |
| 67.5                                                     | OV                                                                                                                      | 67.5                                                                       | 0.4                                                                    | 1.6                                                                        | 600000                                                                  | 625                                                                                  |                                                         |                                                                  |                      | 105                                                                        |
| Max.                                                     | AC Plate Volts<br>DC Output mA,                                                                                         | (RMS), 32                                                                  | 5                                                                      | Min. Tot                                                                   | tal Effecti                                                             | ve Plate-Su                                                                          | pply Impo                                               | dance: Up t<br>325 volts, 75                                     | o 117                | 17                                                                         |
| Max.                                                     | Peak Inverse P<br>Peak Plate mA,                                                                                        | ate Volts,                                                                 | 20000                                                                  | 10110, 0                                                                   | omaio, ac                                                               |                                                                                      |                                                         | late mA, 0.5                                                     |                      | 1X2A                                                                       |
| 250                                                      | -45V                                                                                                                    |                                                                            |                                                                        | 60.0                                                                       | 800                                                                     | 5250                                                                                 | 4.2                                                     | 2500                                                             | 3.5                  |                                                                            |
| 300<br>300                                               | 780Ω□<br>62V                                                                                                            |                                                                            |                                                                        | 80.0□                                                                      |                                                                         |                                                                                      |                                                         | 5000<br>3000                                                     | 10.0†<br>15.0†       | _ 2A3                                                                      |
|                                                          |                                                                                                                         | For                                                                        | other c                                                                |                                                                            | stics, refe                                                             | to Type 6F                                                                           | 6 <b>G</b>                                              |                                                                  |                      | 2A5                                                                        |
|                                                          |                                                                                                                         | For                                                                        | other c                                                                | haracteri                                                                  | stics, refe                                                             | r to Type 6S                                                                         | Q7                                                      |                                                                  |                      | 2A6                                                                        |
|                                                          |                                                                                                                         | Fo                                                                         | r other (                                                              | haracteri                                                                  | istics, refe                                                            | r to Type 6A                                                                         | 18                                                      |                                                                  |                      | 2A7                                                                        |
| 80                                                       | 150Ω                                                                                                                    |                                                                            |                                                                        | 17.5                                                                       | 2100                                                                    | 6500                                                                                 | 13.5                                                    |                                                                  |                      | 2AF4A                                                                      |
|                                                          |                                                                                                                         | For                                                                        | other c                                                                | haracteri                                                                  | stics, refe                                                             | r to Type 6B                                                                         | 8G                                                      |                                                                  |                      | 287                                                                        |
| 150                                                      | 220Ω                                                                                                                    |                                                                            |                                                                        | 9                                                                          | 6300                                                                    | 6800                                                                                 | 43                                                      |                                                                  |                      | 2BN4                                                                       |
|                                                          |                                                                                                                         | Fo                                                                         | r other (                                                              | haracteri                                                                  | istics, refe                                                            | r to Type 6E                                                                         | 5                                                       |                                                                  |                      | 2E5                                                                        |
|                                                          |                                                                                                                         |                                                                            |                                                                        |                                                                            |                                                                         |                                                                                      |                                                         |                                                                  |                      |                                                                            |
| (DC )                                                    | Peak Heater-C<br>olts Not to Exc                                                                                        | eed +100                                                                   | )                                                                      | 0                                                                          |                                                                         | Max.                                                                                 | DC Plate                                                | mA,5                                                             |                      | 2EN5                                                                       |
| Max.                                                     |                                                                                                                         | eed +100<br>late Volts,                                                    | )                                                                      | 0                                                                          |                                                                         |                                                                                      |                                                         | mA,5<br>Plate mA, 1.5                                            |                      | 2EN5<br>3A2                                                                |
| Max.<br>Max.<br>Max.                                     | olts Not to Exc<br>Peak Inverse P                                                                                       | eed +100<br>late Volts,<br>80<br>late Volts                                | 18000                                                                  | 0                                                                          |                                                                         | Max.                                                                                 | Average F                                               |                                                                  |                      |                                                                            |
| Max.<br>Max.<br>Max.<br>Max.<br>Max.                     | oits Not to Exc<br>Peak inverse Pi<br>Peak Plate mA,<br>Peak Inverse P<br>Peak Plate mA,<br>OV                          | eed +100<br>late Volts,<br>80<br>late Volts,<br>88                         | 18000                                                                  | 0.2                                                                        | 200000                                                                  | Max.<br>Max.<br>325                                                                  | Average F                                               | late mA, 1.5                                                     |                      | 3A2<br>3A3                                                                 |
| Max.<br>Max.<br>Max.<br>Max.<br>90                       | Peak Inverse Peak Plate mA, Peak Inverse Peak Inverse Peak Plate mA, OV OV                                              | ceed +100<br>late Volts,<br>80<br>late Volts,<br>88<br>                    | 18000                                                                  |                                                                            | 200000<br>800000                                                        | Max.<br>Max.<br>325<br>750                                                           | Average F<br>Average F<br>65                            | Plate mA, 1.5                                                    | 25000                | <b>3A2 3A3</b> 3A8GT                                                       |
| Max.<br>Max.<br>Max.<br>Max.<br>90                       | oits Not to Exc<br>Peak inverse Pi<br>Peak Plate mA,<br>Peak Inverse P<br>Peak Plate mA,<br>OV                          | seed +100 late Volts, 80 late Volts, 88 90 80 k Inverse                    | 18000<br>, 30000<br>———<br>0.5                                         | 0.2<br>1.5                                                                 | 800000<br>0 (Abs.)                                                      | Max. 325 750 Max. Max.                                                               | Average F  65  DC Invers Average F                      | late mA, 1.5                                                     | 25000                | 3A2<br>3A3<br>3A8GT<br>3B2                                                 |
| Max.<br>Max.<br>Max.<br>Max.<br>90<br>90<br>Max.<br>Max. | olts Not to Exc Peak Inverse P Peak Plate mA, Peak Inverse P Peak Plate mA, OV OV Peak Plate mA, Total DC & Pea         | eeed +100 late Volts, 80 late Volts, 88 90 80 k Inverse                    | 18000<br>, 30000<br>———<br>0.5<br>Plate Vo                             | 0.2<br>1.5<br>olts, 35000<br>haracteris                                    | 800000<br>D (Abs.)<br>stics, refer                                      | Max. 325 750 Max. Max. to Type 6Bl                                                   | Average F  65  DC Invers Average F                      | Plate mA, 1.5 Plate mA, 1.7 ———————————————————————————————————— | 25000                | 3A2<br>3A3<br>3A8GT<br>3B2<br>3BN4                                         |
| Max.<br>Max.<br>Max.<br>Max.<br>90                       | Volts Not to Exc<br>Peak Inverse Pl<br>Peak Plate ma,<br>Peak Inverse P<br>Peak Plate ma,<br>OV<br>OV<br>Peak Plate ma. | seed +100 late Volts, 80 late Volts, 88 90 80 k Inverse                    | 18000<br>, 30000<br>———<br>0.5                                         | 0.2<br>1.5                                                                 | 800000<br>0 (Abs.)                                                      | Max. 325 750 Max. Max.                                                               | Average F  65  DC Invers Average F                      | Plate mA, 1.5 Plate mA, 1.7 ———————————————————————————————————— | 25000                | 3A2<br>3A3<br>3A8GT<br>3B2<br>3BN4<br>3DT6                                 |
| Max.<br>Max.<br>Max.<br>Max.<br>90<br>90<br>Max.<br>Max. | olts Not to Exc Peak Inverse P Peak Plate mA, Peak Inverse P Peak Plate mA, OV OV Peak Plate mA, Total DC & Pea         | eeed +100 late Volts, 80 late Volts, 88 90 80 k Inverse For                | 18000<br>, 30000<br><br>0.5<br>Plate Vo<br>other c<br>2.1              | 0.2<br>1.5<br>olts, 35000<br>haracteris                                    | 800000<br>D (Abs.)<br>stics, refer<br>150000                            | Max. 325 750 Max. Max. to Type 6Bl                                                   | Average F 65 DC Invers Average P                        | Plate mA, 1.5 Plate mA, 1.7 ———————————————————————————————————— | 25000                | 3A2<br>3A3<br>3A8GT<br>3B2<br>3BN4<br>3DT6<br>3GS8/                        |
| Max.<br>Max.<br>Max.<br>Max.<br>90<br>90<br>Max.<br>Max. | olts Not to Exc Peak Inverse P Peak Plate mA, Peak Inverse P Peak Plate mA, OV OV Peak Plate mA, Total DC & Pea         | eed +100 late Volts, 80 late Volts, 88 90 80 k Inverse For ot              | 18000<br>, 30000<br>—————————————————————————————————                  | 0.2<br>1.5<br>olts, 35000<br>haracteris<br>1.1                             | 800000<br>D (Abs.)<br>stics, refer<br>150000<br>s, refer to             | Max.  Max.  325  750  Max.  Max.  to Type 6BI  515                                   | Average F  Average F  65  DC Invers Average F  N4  48U8 | Plate mA, 1.5 Plate mA, 1.7 ———————————————————————————————————— | 25000                | 3A2<br>3A3<br>3A8GT<br>3B2<br>3BN4<br>3DT6                                 |
| Max.<br>Max.<br>Max.<br>Max.<br>90<br>90<br>Max.<br>Max. | olts Not to Exc Peak Inverse P Peak Plate mA, Peak Inverse P Peak Plate mA, OV OV Peak Plate mA, Total DC & Pea         | eed +100 late Volts, 80 late Volts, 88 90 80 k Inverse For 100 For ot      | 18000<br>, 30000<br>—————————————————————————————————                  | 0.2<br>1.5<br>hts, 35000<br>haracteris<br>1.1<br>acteristic                | 800000  D (Abs.) stics, refer 150000 s, refer to                        | Max.  Max.  325  750  Max.  Max.  10 Type 6BI  515  Type 4GS8/                       | Average F Average F 65  DC Invers Average P N4          | Plate mA, 1.5 Plate mA, 1.7 ———————————————————————————————————— | 25000                | 3A2<br>3A3<br>3A8GT<br>3B2<br>3BN4<br>3DT6<br>3GS8/<br>3BU8                |
| Max.<br>Max.<br>Max.<br>Max.<br>90<br>90<br>Max.<br>Max. | olts Not to Exc Peak Inverse P Peak Plate mA, Peak Inverse P Peak Plate mA, OV OV Peak Plate mA, Total DC & Pea         | eed +100 late Volts, 80 late Volts, 88 90 80 k Inverse For 100 For ot      | 18000<br>, 30000<br>—————————————————————————————————                  | 0.2<br>1.5<br>hts, 35000<br>haracteris<br>1.1<br>acteristic                | 800000  D (Abs.) stics, refer 150000 s, refer to                        | Max.  Max.  325  750  Max. Max.  Type 6BI  515  Type 4GS8/  to Type 3Q5              | Average F Average F 65  DC Invers Average P N4          | Plate mA, 1.5 Plate mA, 1.7 ———————————————————————————————————— |                      | 3A2<br>3A3<br>3A8GT<br>3B2<br>3BN4<br>3DT6<br>3GS8/<br>3BU8<br>3LF4        |
| Max. Max. Max. Max. 90 90 Max. Max. Max. 150             | olts Not to Exc Peak Inverse Peak Plate mA, Peak Plate mA, OV OV Peak Plate mA, Total DC & Pea                          | seed +100 late Volts, 80 late Volts, 88 90 80 k Inverse For 100 For ot For | 18000 , 30000  0.5  Plate Voorher ci 2.1  her char  other cr r other c | 0.2<br>1.5<br>olts, 35000<br>haracteris<br>1.1<br>acteristic<br>haracteris | 800000 D (Abs.) stics, refer 150000 s, refer to tics, refer stics, refe | Max.  Max.  325 750  Max. Max.  to Type 6BI 515  Type 4GS8/ to Type 3Q5 r to Type 3V | Average F Average F 65  DC Invers Average P N4          | e Plate mA, 1.1  e Plate wA, 1.1  e Plate Voits, late mA, 1.1    | 0.40                 | 3A2<br>3A3<br>3A8GT<br>3B2<br>3BN4<br>3D16<br>3GS8/<br>3BU8<br>3LF4<br>3Q4 |

| RCA<br>Type            | Name                                     | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Fil<br>Unless<br>types<br>Hea | eater or<br>ament (F)<br>specified all<br>have heaters.<br>ter with con-<br>warmup time. | Use  Values to right give operating conditions and characteristics for Indicated typical use |
|------------------------|------------------------------------------|---------------------------------|-------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| 4805                   |                                          |                                 |                                           | Volts                         | Amperes                                                                                  | -                                                                                            |
| 4BC5                   | Sharp-Cutoff Pentode                     | 5C                              | 7BD                                       | 4.2⊕                          | 0.45                                                                                     | Class A Amplifier                                                                            |
| 4DT6                   | Sharp-Cutoff Pentode                     | 5C                              | 7EN                                       | 4.2 ⊕                         | 0.45                                                                                     | Class A Amplifier                                                                            |
| 4GS8                   | Sharp-Cutoff Pentode                     | 6E                              | 9LW                                       | 4.2⊕                          | 0.45                                                                                     | Class A Amplifier                                                                            |
| 4GS8/<br>4BU8          | Sharp-Cutoff Twin Pentode                | 6E                              | SLW                                       | 4.2⊕                          | 0.45                                                                                     | Class A Amplifier<br>(With both sections operating)                                          |
| 5AS4                   | Full-Wave Rectifier                      | 27A                             | 5T                                        | 5.0F                          | 3.0                                                                                      | With Capacitive-Input Filter                                                                 |
| 5AU4                   | Full-Wave Rectifier                      | 19 <b>G</b>                     | 5 <b>T</b>                                | 5.0F                          | 3.75                                                                                     | With Capacitive-Input Filter With Inductive-Input Filter                                     |
| 5AW4                   | Full-Wave Rectifier                      | 19H                             | 5T                                        | 5.0F                          | 3.7                                                                                      | Rectifier                                                                                    |
| 5AZ4                   | Full-Wave Rectifier                      | 12C                             | 51                                        | 5.0F                          | 2.0                                                                                      | Rectines                                                                                     |
| JHLY                   |                                          | 126                             |                                           | J.UF                          | 2.0                                                                                      | Triode Unit as Class A Amplifie                                                              |
| 5BE8                   | Medium-Mu Triode-Sharp-Cutoff<br>Pentode | <b>6B</b>                       | SEG                                       | 4.7⊕                          | 0.6                                                                                      | Pentode Unit as Class A Amplifier                                                            |
| 5BT8                   | Twin-Diode-Sharp-Cutoff Pentode          | 6B                              | 9FE                                       | 4.7 ⊕                         | 0.6                                                                                      | Class A Amplifier                                                                            |
| 5CL8                   | Medium-Mu Triode-                        | 6B                              | 9FX                                       | 4.7 ⊕                         | 0.6                                                                                      | Triode Unit as Class A Amplifie                                                              |
| 5CM8                   | High-Mu Triode—Sharp-Cutoff<br>Pentode   | <b>6</b> B                      | 9FZ                                       | 6.3⊕                          | 0.45                                                                                     | Triode Unit as Class A Amplifier  Pentode Unit as Class A Amplifier                          |
| 5DH8                   | High-Mu Triode—Sharp-Cutoff<br>Pentode   | <b>6</b> B                      | 9EG                                       | 5.2⊕                          | 0.6                                                                                      | Triode Unit as Class A Amplifier  Pentode Unit as Class A  Amplifier                         |
| 5T4                    | Full-Wave Rectifier                      | 4                               | 5T                                        | 5.0F                          | 2.0                                                                                      | With Capacitive-Input Filter With Inductive-Input Filter                                     |
| 5U4G                   | Full-Wave Rectifier                      | 27B                             | 5T                                        | 5.0F                          | 3.0                                                                                      | With Capacitive-Input Filter                                                                 |
| 5V3                    | Full-Wave Rectifier                      | 19E                             | 5T                                        | 5.0F                          | 3.8                                                                                      | With Capacitive-Input Filter                                                                 |
| 313                    |                                          | 132                             | •                                         | J.01                          | 5.0                                                                                      | With Inductive Input Filter                                                                  |
| 5W4<br>5W4GT           | Full-Wave Rectifier                      | 2B<br>13E                       | 5T<br>5T                                  | 5.0F                          | 1.5                                                                                      | With Capacitive-Input Filter                                                                 |
| 5X4G                   | Full-Wave Rectifier                      | 27B                             | 5Q                                        | 5.0F                          | 3.0                                                                                      |                                                                                              |
| 5Y3G                   | Full-Wave Rectifier                      | 25                              | 5T                                        | 5.0F                          | 2.0                                                                                      | With Capacitive-Input Filter                                                                 |
| 5Y4G<br>5Y4GA<br>5Y4GT | Full-Wave Rectifier                      | 25<br>19E<br>13E                | 5Q<br>5Q<br>5Q                            | 5.0F                          | 2.0                                                                                      |                                                                                              |
| 5Z3                    | Full-Wave Rectifier                      | 27B                             | 4C                                        | 5.0F                          | 3.0                                                                                      |                                                                                              |
| 5Z4                    | Full-Wave Rectifier                      | 28                              | 5L                                        | 5.0                           | 2.0                                                                                      | With Capacitive-Input Filter With Inductive-Input Filter                                     |
| 6A3                    | Power Triede                             | 27B                             | 40                                        | 6.3F                          | 1.0                                                                                      | Amplifier                                                                                    |
| 6A6                    | High-Mu Twin Power Triode                | 28                              | 7B                                        | 6.3                           | 0.8                                                                                      | Amplifier                                                                                    |
| UNU                    |                                          |                                 |                                           | 0.5                           | 0.0                                                                                      | Ampiniei                                                                                     |

| Plate<br>Sup-<br>ply                                         | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor                                                                                                                                                                                                                                                                                                                                    | Grid<br>Sup-<br>ply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Grid<br>Cur-<br>rent                                                            | Plate<br>Cur-<br>rent                                                                             | AC Plate<br>Resist-<br>ance                                                                                                                                              | Trans-<br>conduct-<br>ance                                                                                                                                    | Amplifi-<br>cation<br>Factor                                                           | Load<br>for Stated<br>Power<br>Output                                                                                                                                                                     | Power<br>Out-<br>put                                           | RCA<br>Type                                        |
|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------|
| Voits                                                        | Ohms (Ω)                                                                                                                                                                                                                                                                                                                                                                               | Volts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | mA                                                                              | mA                                                                                                | Ohms                                                                                                                                                                     | Micromhos                                                                                                                                                     |                                                                                        | Ohms                                                                                                                                                                                                      | Watts                                                          |                                                    |
| 250                                                          | 180Ω                                                                                                                                                                                                                                                                                                                                                                                   | 150                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2.1                                                                             | 7.5                                                                                               | 800000                                                                                                                                                                   | 5700                                                                                                                                                          |                                                                                        |                                                                                                                                                                                                           |                                                                | 4BC5                                               |
| 150                                                          | 56Ω                                                                                                                                                                                                                                                                                                                                                                                    | 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2.1                                                                             | 1.1                                                                                               | 150000                                                                                                                                                                   | 515                                                                                                                                                           |                                                                                        |                                                                                                                                                                                                           |                                                                | 4DT6                                               |
|                                                              |                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 | racteristic                                                                                       |                                                                                                                                                                          | Type 4GS8/                                                                                                                                                    |                                                                                        |                                                                                                                                                                                                           |                                                                | 4 <b>6</b> S8                                      |
| 100                                                          |                                                                                                                                                                                                                                                                                                                                                                                        | 67.5<br>67.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6.0<br>3.6                                                                      | 2.0                                                                                               |                                                                                                                                                                          | io. 3 volts, e<br>io. 3 volts, e                                                                                                                              |                                                                                        |                                                                                                                                                                                                           |                                                                | 46S8                                               |
| 100                                                          | :                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 |                                                                                                   |                                                                                                                                                                          | nicroamperes                                                                                                                                                  |                                                                                        | m, o                                                                                                                                                                                                      |                                                                | - 4BU8                                             |
|                                                              | AC Volts per<br>Peak Inverse                                                                                                                                                                                                                                                                                                                                                           | Plate (RMS),                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                 | Max.                                                                                              | DC Outpu                                                                                                                                                                 |                                                                                                                                                               | Min.                                                                                   | Total Effect.<br>d. per Plate,                                                                                                                                                                            |                                                                | 5AS4                                               |
| Max.                                                         | . DC Output m.<br>Total Effect, S                                                                                                                                                                                                                                                                                                                                                      | A, 325 for AC<br>Supply Imped                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Voits                                                                           | per Plate<br>late 50 ol                                                                           | , 400<br>hms                                                                                                                                                             |                                                                                                                                                               |                                                                                        | e Volts, 1400<br>nA per Plate,                                                                                                                                                                            | 1075                                                           |                                                    |
|                                                              | . DC Output m.<br>. Peak Inverse                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 |                                                                                                   |                                                                                                                                                                          |                                                                                                                                                               |                                                                                        |                                                                                                                                                                                                           | 1075                                                           | 5AU4                                               |
|                                                              |                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 | Max                                                                                               |                                                                                                                                                                          |                                                                                                                                                               |                                                                                        |                                                                                                                                                                                                           |                                                                | C ANAL.                                            |
| Max.                                                         | Peak Inverse                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 |                                                                                                   |                                                                                                                                                                          | . Peak Plate                                                                                                                                                  |                                                                                        | late, 750                                                                                                                                                                                                 |                                                                | 5AW                                                |
| 150                                                          | 560                                                                                                                                                                                                                                                                                                                                                                                    | For rati                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ings an                                                                         |                                                                                                   | ristics, re<br>5000                                                                                                                                                      | fer to Type :                                                                                                                                                 | 5Y3GT<br>40                                                                            | <del></del>                                                                                                                                                                                               |                                                                | 5AZ4                                               |
|                                                              | 56Ω                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 | 18                                                                                                |                                                                                                                                                                          | 8500                                                                                                                                                          | 40                                                                                     |                                                                                                                                                                                                           |                                                                | 5BE8                                               |
| 250                                                          | 68Ω                                                                                                                                                                                                                                                                                                                                                                                    | 110                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3.5                                                                             | 10                                                                                                | 400000                                                                                                                                                                   | 5200                                                                                                                                                          |                                                                                        |                                                                                                                                                                                                           |                                                                |                                                    |
| 200                                                          | 180Ω                                                                                                                                                                                                                                                                                                                                                                                   | 150                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2.8                                                                             | 9.5                                                                                               | 300000                                                                                                                                                                   | 6200                                                                                                                                                          |                                                                                        |                                                                                                                                                                                                           |                                                                | 5BT8                                               |
| 125                                                          | <u> </u>                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 | 14                                                                                                | 5000                                                                                                                                                                     | 8000                                                                                                                                                          | 40                                                                                     |                                                                                                                                                                                                           |                                                                | 5CL8                                               |
|                                                              |                                                                                                                                                                                                                                                                                                                                                                                        | F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | or othe                                                                         | r cha~acte                                                                                        | eristics, re                                                                                                                                                             | fer to 6CM8                                                                                                                                                   |                                                                                        |                                                                                                                                                                                                           |                                                                | 5CM                                                |
| 250                                                          | 390Ω                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 | 7.3                                                                                               | 12000                                                                                                                                                                    | 4400                                                                                                                                                          | 53                                                                                     |                                                                                                                                                                                                           |                                                                | - 5DH8                                             |
| 125                                                          | 56Ω                                                                                                                                                                                                                                                                                                                                                                                    | 125                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3.8                                                                             | 13.5                                                                                              | 150000                                                                                                                                                                   | 8600                                                                                                                                                          |                                                                                        |                                                                                                                                                                                                           |                                                                | - วมกด                                             |
|                                                              | AC Volts per                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 450                                                                             |                                                                                                   | DC Outpu<br>Peak Plat                                                                                                                                                    |                                                                                                                                                               |                                                                                        | Total Effect.<br>d. per Plate,                                                                                                                                                                            |                                                                | 5T4                                                |
|                                                              | Peak Inverse                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                 |                                                                                                   |                                                                                                                                                                          |                                                                                                                                                               |                                                                                        |                                                                                                                                                                                                           |                                                                |                                                    |
| Max.                                                         | Peak Inverse<br>AC Volts per                                                                                                                                                                                                                                                                                                                                                           | Plate (RMS),                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 550                                                                             | Max.                                                                                              | DC Outpu                                                                                                                                                                 | t mA, 225                                                                                                                                                     |                                                                                        | Value of Inp                                                                                                                                                                                              | ut Choke,                                                      | 314                                                |
| Max.<br>Max.<br>Max.                                         | Peak Inverse                                                                                                                                                                                                                                                                                                                                                                           | Plate (RMS),<br>Volts, 1550<br>Plate (RMS),                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                 | Max.<br>Max.<br>Max.                                                                              | DC Outpu<br>Peak Plat<br>DC Outpu<br>Peak Plat                                                                                                                           | t mA, 225<br>e mH, 675<br>t mA, 225                                                                                                                           | Min.<br>Min.                                                                           |                                                                                                                                                                                                           | Supply                                                         |                                                    |
| Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.                 | Peak Inverse AC Volts per Peak Inverse AC Volts per Peak Inverse AC Volts per Peak Inverse Peak Inverse                                                                                                                                                                                                                                                                                | Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1400<br>Min. To                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 450<br>425<br>Ital Effe                                                         | Max.<br>Max.<br>Max.<br>Max.                                                                      | Peak Plat<br>DC Outpu<br>Peak Plat                                                                                                                                       | t mA, 225<br>e mH, 675<br>t mA, 225<br>e mA, 675<br>Max.<br>Max.<br>ser Plate, 56                                                                             | Min.<br>Min.<br>Impe<br>DC Output<br>Peak Plate<br>ohms                                | Value of Inp<br>10 henrie<br>Total Effect<br>d. per Plate,<br>mA, 350<br>mA per Plat                                                                                                                      | s<br>Supply<br>170 ohms                                        | 5040                                               |
| Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.                 | Peak Inverse AC Volts per Peak Inverse AC Volts per Peak Inverse AC Volts per                                                                                                                                                                                                                                                                                                          | Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1400<br>Min. To<br>Plate (RMS),<br>Volts, 1400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 450<br>425<br>stal Effe<br>500                                                  | Max.<br>Max.<br>Max.<br>Max.                                                                      | Peak Plat DC Outpu Peak Plat y Imped. p                                                                                                                                  | t mA, 225<br>e mH, 675<br>t mA, 225<br>e mA, 675<br>Max.<br>Max.<br>er Plate, 56<br>Max.                                                                      | Min. Impe DC Output Peak Plate ohms DC Output                                          | Value of Inp<br>10 henrie<br>Total Effect<br>d. per Plate,<br>mA, 350<br>mA per Plat                                                                                                                      | Supply<br>170 ohms<br>e, 1200                                  | <b>5040</b><br>5 <b>V</b> 3                        |
| Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.         | Peak Inverse AC Volts per AC Volts per                                                                                                                                                                                                                                                                   | Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1400<br>Min. To<br>Plate (RMS),<br>Volts, 1400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 450<br>425<br>stal Effe<br>500                                                  | Max.<br>Max.<br>Max.<br>Max.<br>ect. Suppi                                                        | Peak Plat DC Outpu Peak Plat y Imped. p                                                                                                                                  | t mA, 225<br>e mH, 675<br>t mA, 225<br>e mA, 675<br>Max.<br>Max.<br>er Plate, 56<br>Max.<br>Max.<br>10 henries                                                | Min.  Min.  Impe DC Output Peak Plate ohms DC Output Peak Plate                        | Value of Inp<br>10 henrie<br>Total Effect.<br>d. per Plate,<br>mA, 350<br>mA per Plat<br>mA, 350                                                                                                          | s<br>Supply<br>170 ohms<br>e, 1200                             | <b>5040</b><br>5 <b>V</b> 3                        |
| Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max. | Peak Inverse AC Volts per Peak Inverse                                                                                                                                                                                                                                         | Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1400<br>Min. To<br>Plate (RMS),<br>Volts, 1400<br>Volts, 1400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 450<br>425<br>stal Effe<br>500<br>Min. Va                                       | Max. Max. Max. Max. Max. Max. Max. Max.                                                           | Peak Plat DC Outpu Peak Plat y Imped. p put Choke, DC Output s, refer to                                                                                                 | t mA, 225<br>e mH, 675<br>t mA, 225<br>e mA, 675<br>Max.<br>Max.<br>er Plate, 56<br>Max.<br>10 henries<br>mA, 100<br>Type 5U4G                                | Min. Impe DC Output Peak Plate ohms DC Output Peak Plate Ma                            | Value of Inp<br>10 henrie<br>Total Effect.<br>d. per Plate,<br>mA, 350<br>mA per Plat<br>mA, 350<br>mA per Plat<br>x. Peak Plate                                                                          | s<br>Supply<br>170 ohms<br>e, 1200<br>e, 1200<br>e mA,300      | 5 <b>V</b> 46                                      |
| Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max. | Peak Inverse AC Volts per AC Volts per                                                                                                                                                                                                               | Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1400<br>Min. Tc<br>Plate (RMS),<br>Volts, 1400<br>Volts, 1400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 450<br>425<br>stal Effe<br>500<br>Min. Va                                       | Max. Max. Max. Max. Max. Max. Max. Max.                                                           | Peak Plat DC Output Peak Plat y Imped. p put Choke, DC Output t, refer to DC Output                                                                                      | t mA, 225<br>e mH, 675<br>t mA, 225<br>e mA, 675<br>Max.<br>Max.<br>er Plate, 56<br>Max.<br>10 henries<br>mA, 100<br>Type 5U4G<br>t mA, 125                   | Min. Impe DC Output Peak Plate ohms DC Output Peak Plate Ma                            | Value of Inp<br>10 henrie<br>Total Effect.<br>d. per Plate,<br>mA, 350<br>e mA per Plat<br>mA, 350<br>e mA per Plat<br>x. Peak Plate                                                                      | s<br>Supply<br>170 ohms<br>e, 1200<br>e, 1200<br>e mA,300      | 5V3<br>5W4<br>5W40<br>5X40                         |
| Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max. | Peak Inverse AC Volts per Peak Inverse                                                                                                                                                                                                                                         | Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1400<br>Min. To<br>Plate (RMS),<br>Volts, 1400<br>Volts, 1400<br>Plate (RMS),<br>Volts, 1400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 450<br>425<br>stal Effe<br>500<br>Min. Va                                       | Max. Max. Max. Max. Max. Max. Max. Max.                                                           | Peak Plat DC Outpu Peak Plat y Imped. p put Choke, DC Output s, refer to                                                                                                 | t mA, 225<br>e mH, 675<br>t mA, 225<br>e mA, 675<br>Max.<br>Max.<br>Max.<br>10 henries<br>mA, 100<br>Type 5U4G<br>t mA, 125<br>e mA, 440                      | Min. Min. Impe DC Output Peak Plate Ohms DC Output Peak Plate Ma Min. Impe             | Value of Inp<br>10 henrie<br>Total Effect.<br>d. per Plate,<br>mA, 350<br>mA per Plat<br>mA, 350<br>mA per Plat<br>x. Peak Plate                                                                          | s Supply 170 ohms re, 1200 re, 1200 re mA,300 Supply 50 ohms   | 5V3<br>5W4<br>5W4<br>5Y30<br>5Y46<br>5Y46          |
| Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max. | Peak Inverse AC Volts per Peak Inverse                                                                                                                                                                                     | Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1550<br>Plate (RMS),<br>Volts, 1400<br>Min. Tc<br>Plate (RMS),<br>Volts, 1400<br>Volts, 1400<br>Plate (RMS),<br>Volts, 1400<br>375 (5Y4G),<br>400 (5Y4GA,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 450<br>425<br>stal Effe<br>500<br>Min. Va<br>For oth<br>350                     | Max. Max. Max. Max. Max. Max. Max. Max.                                                           | Peak Plat DC Output Peak Plat y Imped. p put Choke, DC Output t, refer to DC Output                                                                                      | t mA, 225<br>e mH, 675<br>t mA, 225<br>e mA, 675<br>Max.<br>Max.<br>er Plate, 56<br>Max.<br>10 henries<br>mA, 100<br>Type 5U4G<br>t mA, 125<br>e mA, 440      | Min. Min. Impe DC Output Peak Plate Ohms DC Output Peak Plate Ma Min. Impe             | Value of Inp<br>10 henrie<br>Total Effect.<br>d. per Plate,<br>mA, 350<br>e mA per Plat<br>x. Peak Plate<br>Total Effect.<br>d. per Plate,                                                                | s Supply 170 ohms re, 1200 re, 1200 re mA,300 Supply 50 ohms   | 5V3<br>5W4<br>5W4<br>5Y30<br>5Y46<br>5Y46          |
| Max. Max. Max. Max. Max. Max. Max. Max.                      | Peak Inverse AC Volts per Peak Inverse Volts per | Plate (RMS), Volts, 1550 Plate (RMS), Volts, 1550 Plate (RMS), Volts, 1550 Min. To Plate (RMS), Volts, 1400  Volts, 1400  Plate (RMS), Volts, 1400  Plate (RMS), Volts, 1400  375 (5Y4G), 400 (5Y4GA, 1400)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 450<br>425<br>421 Effe<br>500<br>Min. Va<br>For oth<br>350<br>5Y4GT<br>For oth  | Max. Max. Max. Max. ect. Suppliate of Inj Max. er ratings Max. Max. Max. Max. Max. Max. Max. Max. | Peak Plat DC Output Peak Plat y Imped. p put Choke, DC Output i, refer to DC Output Peak Plat c, refer to Output m/ak Plate m                                            | t mA, 225 e mH, 675 t mA, 225 e mH, 675 Max. Max. Max. 10 henries mA, 100  Type 5U4G t mA, 125 e mA, 440  For other  Type 5U4G A, 125 A, 375                  | Min. Min. Impe DC Output Peak Plate ohms DC Output Peak Plate Ma Min. Impe Tatings, re | Value of Inp<br>10 henrie<br>Total Effect.<br>d. per Plate,<br>mA, 350<br>e mA per Plat<br>mA, 350<br>e mA per Plat<br>x. Peak Plate<br>Total Effect.<br>d. per Plate,<br>otal Effect St<br>per Plate, 56 | s Supply 170 ohms e, 1200 e, 1200 e mA,300 Supply 50 ohms 573G | 5V3<br>5W4<br>5W46<br>5X46<br>5Y46<br>5Y46<br>5Y46 |
| Max. Amax. Max. Max. Max. Max. Max. Max. Max. M              | Peak Inverse AC Volts per                                                                                          | Plate (RMS), Volts, 1550 Plate (RMS), Volts, 1550 Plate (RMS), Volts, 1400 Min. Tc Plate (RMS), Volts, 1400 Volts, 1400 Volts, 1400  Plate (RMS), 1400 375 (5Y4G), 400 (5Y4GA, 1400 Liate (RMS), 3 Liate | 450<br>425<br>421 Effe<br>500<br>Min. Va<br>For oth<br>350<br>5Y4GT<br>For oth  | Max. Max. Max. Max. Max. Max. Max. Max.                                                           | Peak Plat DC Output Peak Plat y Imped. p put Choke, DC Output c, refer to DC Output Peak Plat c, refer to Output m/                                                      | t mA, 225 e mH, 675 t mA, 225 e mA, 675 Max. ser Plate, 56 Max. 10 henries mA, 100  Type 5U4G t mA, 125 e mA, 440  For other  Type 5U4G  A, 125 A, 375 A, 125 | Min. Min. Impe DC Output Peak Plate ohms DC Output Peak Plate Ma Min. Impe Tatings, re | Value of Inp. 10 henrie Total Effect. d. per Plate, mA, 350 e mA per Plat x. Peak Plate Total Effect. d. per Plate, efer to Type total Effect Si                                                          | s Supply 170 ohms e, 1200 e, 1200 e mA,300 Supply 50 ohms 573G | 5V3 5W4 5W4 5Y4 5Y4 5Y4 5Y4 5Y4 5Y4 5Y4 5Y4 5Y4 5Y |
| Max. Amax. Max. Max. Max. Max. Max. Max. Max. M              | Peak Inverse AC Volts per Peak Inverse Peak Plate mA, Peak Plate mA, AC Volts per Peak Inverse V AC Volts per P                                                                                                                                      | Plate (RMS), Volts, 1550 Plate (RMS), Volts, 1550 Plate (RMS), Volts, 1400 Min. Tc Plate (RMS), 1400 Volts, 1400 Volts, 1400 375 (5Y4G), 400 (5Y4GA, 400 (5Y4GA, 1400 (st. 1400 | 450<br>425<br>425<br>500<br>Min. Va<br>For oth<br>350<br>5Y4GT<br>For oth<br>50 | Max. Max. Max. Max. Max. Max. Max. Max. Max.                                                      | Peak Plat DC Outpur Peak Plat y Imped. p put Choke, DC Output s, refer to DC Output Peak Plat s, refer to Output m/ ak Plate m Output m/ ak Plate m Output m/ ak Plate m | t mA, 225 e mH, 675 t mA, 225 e mA, 675 Max. ser Plate, 56 Max. 10 henries mA, 100  Type 5U4G t mA, 125 e mA, 440  For other  Type 5U4G  A, 125 A, 375 A, 125 | Min. Impe DC Output Peak Plate ohms DC Output Peak Plate Ma Min. Impe ratings, ro      | Value of Inp. 10 henrie Total Effect. d. per Plate, mA, 350 e mA per Plat x. Peak Plate Total Effect. d. per Plate, otal Effect. d. per Plate, otal Effect Salue of Input                                 | s Supply 170 ohms e, 1200 e, 1200 e mA,300 Supply 50 ohms 573G | 5V3 5W4 5W4 5Y46 5Y46 5Y46 5Y46                    |

| RCA<br>Type                 | Name                                     | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Fil<br>Unless<br>types<br>⊕ Hea | eater or ament (F) specified all have heaters. ter with con- warmup time. Amperes | Use<br>Values to right give operat-<br>ing conditions and character-<br>istics for indicated typical use |
|-----------------------------|------------------------------------------|---------------------------------|-------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>6A7</b><br>6A7S          | Pentagrid Converter                      | 248<br>248                      | 7C                                        | 6.3                             | 0.3                                                                               | Converter                                                                                                |
| <b>6A8</b><br>6A8G<br>6A8GT | Pentagrid Converter                      | 3<br>23<br>14A                  | 8A<br>8A<br>8A                            | 6.3                             | 0.3                                                                               | Converter                                                                                                |
| 6AB5/<br>6N5                | Electron-Ray Tube                        | 22 or<br>13H                    | 6R                                        | 6.3                             | 0.15                                                                              | Visual Indicator                                                                                         |
| 6AB7                        | Sharp-Cutoff Pentode                     | 2A                              | 8N                                        | 6.3                             | 0.45                                                                              | Class A Amplifier                                                                                        |
|                             |                                          |                                 |                                           |                                 |                                                                                   | Class B Amplifier                                                                                        |
| 6AC5GT                      | High-Mu Power Triede                     | 13D                             | 6Q                                        | 6.3                             | 0.4                                                                               | Dynamic-Coupled Amplifier With<br>76 Driver                                                              |
| 6AC7                        | Sharp-Cutoff Pentode                     | 2A                              | 8N                                        | 6.3                             | 0.45                                                                              | Class A Amplifier                                                                                        |
| 6AD6G                       | Electron-Ray Tube                        | 29E                             | 7AG                                       | 6.3                             | 0.15                                                                              | Visual Indicator                                                                                         |
| 6AD7G                       | Low-Mu Triode—Power Pentode              | 25                              | 8AY                                       | 6.3                             | 0.85                                                                              | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 6AE5GT                      | Low-Mu Triode                            | 130                             | 8Q                                        | 6.3                             | 0.3                                                                               | Class A Amplifier                                                                                        |
| 6AE6G                       | Twin-Plate Control Tube                  | 22                              | 7AH                                       | 6.3                             | 0.15                                                                              | Remote Cutoff Triode                                                                                     |
|                             |                                          |                                 |                                           |                                 |                                                                                   | Sharp-Cutoff Triode                                                                                      |
| 6AE7GT                      | Twin-Input Triode                        | 13D                             | 7AX                                       | 6,3                             | 0.5                                                                               | Class A Amp.                                                                                             |
| 6AH4GT                      | Low-Mu Triode                            | 13D                             | 8EL                                       | 6.3                             | 0.75                                                                              | Vertical Deflection Amplifier                                                                            |
| 6AH6                        | Sharp-Cutoff Pentode                     | 5C                              | 78K                                       | 6.3                             | 0.45                                                                              | Class A Amplifier                                                                                        |
| 6AL7GT                      | Electron-Ray Tube                        | 13C                             | 8CH                                       | 6.3                             | 0.15                                                                              | Visual Indicator                                                                                         |
| 6AM4                        | High-Mu Triode                           | 6A                              | 9BX                                       | 6.3                             | 0.225                                                                             | Class A Amplifier                                                                                        |
| 6AM8                        | DiodeSharp-Cutoff Pentode                | 6B                              | 9CY                                       | 6.3<br>6.3⊕                     | 0.45<br>0.45                                                                      | Diode Unit Pentode Unit as Class A Amplifier                                                             |
| 6AN8                        | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 68                              | 9DA                                       | 6.3<br>6.3⊕                     | 0.45<br>0.45                                                                      | Triode Unit as Class A Amplifier Pentrode Unit as Class A Amplifier                                      |
| 6AQ5                        | Beam Power Tube                          | 5D                              | 7BZ                                       | 6.3<br>6.3⊕                     | 0.45<br>0.45                                                                      | Single Tube Class A Amplifier Push-Pull Class A Amplifier                                                |
| 6AQ6                        | Twin-Diode-High-Mu Triode                | 5C                              | 7BT                                       | 6.3                             | 0.15                                                                              | Triode Unit as Class A Amplifier                                                                         |
| 6AQ7GT                      | Twin-Diode—High-Mu Triode                | 13D                             | 8CK                                       | 6.3                             | 0.3                                                                               | Triode Unit as Class A Amplifier                                                                         |
| 6AR5                        | Power Pentode                            | 5D                              | 6CC                                       | 6.3                             | 0.4                                                                               | Class A Amplifier                                                                                        |
| 6AS11                       | Dual Triode—Sharp-Cutoff<br>Pentode      | 8B                              | 12DP                                      | 6.3                             | 1.05                                                                              | Dual Triode Unit as Class A<br>Amplifier<br>Pentode Unit as Class A<br>Amplifier                         |
| 6AT8                        | Medium-Mu Triode—                        | 6B                              | 9DW                                       | 6.3                             | 0.45                                                                              | Triode Unit as Class A Amplifier                                                                         |
| 6AU4GT                      | Half-Wave Rectifier                      | 13 <b>G</b>                     | 406                                       | 6.3                             | 1.8                                                                               | Television Damper Service                                                                                |
| 6AU6                        | Sharp-Cutoff Pentode                     | 5C                              | 7BK                                       | 6.3<br>6.3⊕                     | 0.3<br>0.3                                                                        | Class A Amplifier                                                                                        |
|                             |                                          |                                 |                                           |                                 |                                                                                   |                                                                                                          |

| Plate<br>Sup-<br>ply<br>Volts | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor<br>Ohms (Ω) | Grid<br>Sup-<br>ply<br>Volts | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA    | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>conduct-<br>ance<br>Micromhos   | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output<br>Ohms | Power<br>Out-<br>put<br>Watts | RCA<br>Type          |
|-------------------------------|-----------------------------------------------------------------|------------------------------|----------------------------|--------------------------------|-------------------------------------|-------------------------------------------|------------------------------|-----------------------------------------------|-------------------------------|----------------------|
|                               |                                                                 |                              |                            |                                |                                     | er to Type 6/                             | 48                           |                                               |                               | <b>6A7</b><br>6A7S   |
| 250                           | — 3V                                                            | 100                          | 2.7                        | 3.5                            | 360000                              | Anode-Gri<br>Oscillator<br>Transcond      | -Grid (1)                    | 0 max. V,<br>Res. Co                          | 4.0 mA<br>onversion           | 6A8<br>6A8G<br>6A8GT |
| Grid B                        | Target Supply                                                   | olts; Shac<br>v == 135       | dow Ang                    | le, 0°.<br>riode Pl            | Bias, O v<br>ate Resist             | olts; Angle,<br>or = 1.0 M                | 90°; Pla<br>MΩ Target        | te Current, Current =                         | 1.9 mA                        | 6AB5/                |
| 300                           | 3V                                                              | 200                          | 3.2                        | 12.5                           | 700000                              | 5000                                      | 50 ; F(a)                    | e Current,                                    | U.13 IIIA                     | 6AB7                 |
| 250<br>250                    | OV<br>Bias for I<br>Average I                                   | ooth 6AC50                   | GT and 70                  | 5.0 □<br>6 is deve<br>iver = 5 |                                     | oupling circuperes                        | uit                          | 10000<br>7000                                 | 8.0†<br>3.7                   | 6AC5G                |
| 300                           | 160Ω                                                            | 150                          | 2.5                        | 10.0                           | 1.0                                 | 9000                                      |                              |                                               |                               | 6AC7                 |
| Ta                            | orget Voltage, 1<br>Current, 1.2                                | 50 volts.<br>mA Contro       | Control-E<br>I-Electro     |                                |                                     |                                           |                              | le, 135°; Tar<br>ırrent, 3 mA                 | get                           | 6AD6G                |
| 250                           | 25V                                                             |                              |                            | 3.7                            | 19000                               | 325                                       | 6                            |                                               |                               | - 6AD70              |
| 250                           | 16.5V                                                           | 250                          | 6.5                        | 34.0                           | 80000                               | 2500                                      | ******                       | 7000                                          | 3.2                           |                      |
| 95                            | —15V                                                            |                              |                            | 7.0                            | 3500                                | 1200                                      | 4.2                          |                                               |                               | 6AE5G                |
| 250<br>250<br>250             | 1.5V<br>35V<br>1.5V                                             | _=                           |                            | 6.5<br>0.01<br>4.5             | 25000<br><br>35000                  | 950                                       | 25<br>33                     |                                               |                               | - 6 <b>AE</b> 60     |
| 250                           | — 9.5V                                                          |                              |                            | 0.01                           |                                     |                                           |                              |                                               |                               | 04570                |
| 250                           | -13.5V                                                          |                              |                            | 10.0                           | 4650                                | 3000                                      | 14                           |                                               | 2000                          | 6AE7G                |
| Max.                          | DC Plate Volts DC Cathods mA                                    | , 500                        |                            |                                |                                     | iax. Peak Po<br>Iax. Plate Di             |                              | Plate Volts<br>7.5 watts                      | , 2000                        | 6AH4G                |
| 300                           | 160Ω                                                            | 150                          | 2.5                        | 10.0                           | 500000                              | 9000                                      |                              |                                               |                               | 6AH6                 |
| Grid                          | rt Voltage, 315<br>Voltage = 0 vo<br>ode Bias Res., 3           | lts                          | approx.                    |                                | Deflec                              | /oltage for F<br>:ting-Electro<br>tage, O | attern Cut<br>des—No. 1      | off, —7 voits<br>, No. 2 and i                | approx.<br>No. 3              | 6AL7G                |
| 200                           | 100Ω                                                            |                              |                            | 10                             | 8700                                | 9800                                      | 85                           |                                               |                               | 6AM4                 |
|                               | Ma                                                              | x. DC Pla                    | te mA, 5                   | Max.                           | Peak Hea                            | ter-Cathode                               | Volts, ±20                   | 0                                             |                               | - 6AM8               |
| 125                           | 56Ω                                                             | 125                          | 3.2                        | 12.5                           | _                                   | 7800                                      |                              |                                               |                               | UAWIO                |
| 150                           | — 3V                                                            |                              |                            | 15                             | 4500                                | 4700                                      | 31                           |                                               |                               | 6AN8                 |
| 125                           | 56Ω                                                             | 125                          | 3.8                        | 12                             | 170000                              | 7800                                      |                              |                                               | . —                           | UANO                 |
| 180<br>250                    | — 8.5V<br>—12.5V                                                | 180<br>250                   | 3.0<br>4.5                 | 29.0<br>45.0                   | 50000<br>50000                      | 3700<br>4100                              |                              | 5500<br>5000                                  | 2.0<br>4.5                    | 6AQ5                 |
| 250                           | 15V                                                             | 250                          | 5.0□                       | 70.0 🗆                         | 60000                               | 4100                                      |                              | 10000                                         | 10.0†                         | ONUD                 |
| 100<br>250                    | 1V<br>3V                                                        |                              |                            | 0.8<br>1.0                     | 61000<br>58000                      | 1150<br>1200                              | 70<br>70                     |                                               |                               | 6AQ6                 |
| 250                           | — 3V<br>— 2V                                                    |                              |                            | 2.3                            | 44000                               | 1600                                      | 70                           |                                               |                               | 6AQ7G                |
| 250                           | —18V                                                            | 250                          | 5.5                        | 32.0                           | 90000                               | 2300                                      |                              | 7600                                          | 3.4                           | 6AR5                 |
| 200<br>200                    | 220Ω<br>2V                                                      |                              |                            | 9.2<br>7                       | 4400<br>12400                       | 4400<br>5500                              | 41<br>68                     |                                               |                               | - 6AS11              |
| 200                           | 125                                                             | 125                          | 5.2                        | 24                             | 70000                               | 10500                                     |                              |                                               |                               | UNU I                |
| 125                           | - 1V                                                            |                              |                            | 12                             | 6000                                | 6500                                      | 40                           |                                               |                               | 6AT8                 |
| Max.                          | Peak Inverse P<br>Peak Plate mA,                                | 1050                         | · · ·                      |                                |                                     | Max.                                      | Average P<br>Plate Diss      | late mA, 175<br>ipation 6.0 w                 | ratts                         | 6AU4G                |
| 100<br>250                    | 150Ω<br>68Ω                                                     | 100<br>150                   | 2.1<br>4.3                 | 5.0<br>10.6                    | 500000<br>1.0                       | 3900<br>5200                              |                              |                                               | _                             | 6AU6                 |

<sup>†</sup> For two tubes at stated plate-to-plate load.

| RCA<br>Type  | Name                                          | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Heater or Filament (F) Unless specified all types have heaters.  Heater with con- trolled warmup time.  Volts Amperes |              | Use<br>Values to right give operat-<br>ing conditions and character-<br>istics for indicated typical use |
|--------------|-----------------------------------------------|---------------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------|
| 6AU7         | Medium-Mu Twip Triede                         | 68                              | 9A                                        | 3.15<br>6.3                                                                                                           | 0.6<br>0.3   | Each Unit as Class A Amplifier                                                                           |
|              | Madium Mu Tainda - Obras A & M                |                                 | ·                                         | 0.5                                                                                                                   | 0.3          | Triode Unit as Class A Amplifier                                                                         |
| 6AU8         | Medium-Mu Triode—Sharp-Cutoff<br>Pentode      | 6E                              | 9DX                                       | 6.3⊕                                                                                                                  | 0.6          | Pentode Unit as Class A<br>Amplifier                                                                     |
| 6AV5GT       | Beam Power Tube                               | 13D                             | 6CK                                       | 6.3                                                                                                                   | 1.2          | Horizontal Deflection Amplifier                                                                          |
| 6AW8         | High-Mu Triode—Sharp-Cutoff<br>Pentode        | 6E                              | 9DX                                       | 6.3⊕                                                                                                                  | 0.6          | Triode Unit as Class A Amplifier  Pentode Unit as Class A  Amplifier                                     |
| 6AX4GT       | Half-Wave Rectifier                           | 13D                             | 4CG                                       | 6.3                                                                                                                   | 1.2          | Television Damper Service                                                                                |
| 6AX8         | Medium-Mu Triode—Semiremote<br>Cutoff Pentode | <b>6</b> B                      | 9AE                                       | 6.3                                                                                                                   | 0.45         | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 6AY11        | Twin Diode—High-Mu Twin Triode                | 8A                              | 12DA                                      | 6.3                                                                                                                   | 0.69         | Each Triode Unit as Class A<br>Amplifier                                                                 |
| 6B4G         | Power-Triode                                  | 27B                             | 5\$                                       | 6.3F                                                                                                                  | 1.0          | Class A Amplifier                                                                                        |
| 685          | Direct-Coupled Power Triode                   | 26                              | 6AS                                       | 6.3                                                                                                                   | 0.8          | Class A Amplifier                                                                                        |
| 6B6G         | Twin-Diode—High-Mu Triode                     | 23                              | 77                                        | 6.3                                                                                                                   | 0.3          | Triode Unit as Amplifier                                                                                 |
| 687<br>687\$ | Twin-DiodeRemote-Cutoff<br>Pentode            | 24B<br>24B                      | 70                                        | 6.3                                                                                                                   | 0.3          | Pentode Unit as Amplifier                                                                                |
| 6B8          | Twin-Diode—Semiremote-Cutoff<br>Pentode       | 3                               | 8E                                        | 6.3                                                                                                                   | 0.3          | Pentode Unit as Amplifier                                                                                |
| 6B8G         | Twin Diode—Semiremote-Cutoff<br>Pentode       | 23                              | 8E                                        | 6.3                                                                                                                   | 0.3          | Pentode Unit as Class A<br>Amplifier                                                                     |
| 6BD4         | Sharp-Cutoff Beam Triode                      | 21C                             | 8FU                                       | 6.3                                                                                                                   | 0.6          | Voltage-Control                                                                                          |
| 6BD4A        | Sharp-Cutoff Beam Triode                      | 21C                             | 8FU                                       | 6.3                                                                                                                   | 0.6          | Voltage-Control                                                                                          |
| 6BD6         | Remote-Cutoff Pentode                         | 5C                              | 7BK                                       | 6.3                                                                                                                   | 0.3          | Class A Amplifier                                                                                        |
| 6BF5         | Beam Power Tube                               | 5D                              | 7BZ                                       | 6.3                                                                                                                   | 1.2          | Class A Amplifier                                                                                        |
| 6BF6         | Twin-Diode-Medium-Mu Triode                   | 5C                              | 7BT                                       | 6.3                                                                                                                   | 0.3          | Triode Unit as Class A Amplifier                                                                         |
| 6BG6GA       | Beam Power Tube                               | 28B<br>21B                      | 5BT<br>5BT                                | 6.3                                                                                                                   | 0.9          | Horizontal Deflection Amplifier                                                                          |
| 6BK4         | Sharp-Cutoff Beam Triode                      | 218                             | 8GC                                       | 6.3                                                                                                                   | 0.2          | Voltage-Control                                                                                          |
| 6BK5         | Beam Power Tube                               | 6E                              | 9BQ                                       | 6.3                                                                                                                   | 1.2          | Class A Amplifier                                                                                        |
| 6BK7A        | Medium-Mu Twin Triodes                        | 6B                              | 9AJ                                       | 6.3<br>6.3⊕                                                                                                           | 0.45<br>0.45 | Each Unit as Class A Amplifier                                                                           |
| 6BL4         | Half-Wave Rectifier                           | 13F                             | 8GB                                       | 6.3                                                                                                                   | 3.0          | Television Damper Service                                                                                |
| 6BL7GT       | Medium-Mu Twin Triode                         | 13D                             | 8BD                                       | 6.3                                                                                                                   | 1.5          | Vertical Deflection Amplifier                                                                            |
| 6BN4         | Medium-Mu Triode                              | 5C                              | 7EG                                       | 6.3                                                                                                                   | 0.2          | Class A Amplifier                                                                                        |
| 6BQ6GT       | Beam Power Tube                               | 14D                             | 6AM                                       | 6.3                                                                                                                   | 1.2          | Horizontal Deflection Amplifier                                                                          |
| 6BQ7         | Medium-Mu Twin Triode                         | <b>6</b> B                      | LAG                                       | 6.3                                                                                                                   | 0.4          | Each Unit as Class A Amplifier                                                                           |
| 6BR8         | Medium-Mu Triode—Sharp-Cutoff<br>Pentode      | 6B                              | 9FA                                       | 6.3<br>6.3⊕                                                                                                           | 0.45<br>0.45 | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 6BV8         | Twin Diode-Medium-Mu Triode                   | 6B                              | 9FJ                                       | 6.3⊕                                                                                                                  | 0.6          | Triode Unit as Class A Amplifier                                                                         |

Types shown in light face are discontinued.

| Plate<br>Sup-<br>ply                                                                                                                    | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor                                                                                                                                                                                                                                                                                                                                                             | Grid<br>Sup-<br>ply                                                                                                       | Grid<br>Cur-<br>rent                                              | Plate<br>Cur-<br>rent                          | AC Plate<br>Resist-<br>ance                                                                               | Trans-<br>conduct-<br>ance                                                                                                                                         | Amplifi-<br>cation<br>Factor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Load<br>for Stated<br>Power<br>Output                                                                                                                                                                                  | Power<br>Out-<br>put                                               | RCA<br>Type                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Voits                                                                                                                                   | Ohms (\O)                                                                                                                                                                                                                                                                                                                                                                                                       | Volts                                                                                                                     | mA                                                                | mA                                             | Ohms                                                                                                      | Micromhos                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Ohms                                                                                                                                                                                                                   | Watts                                                              |                                                                                                    |
| 100                                                                                                                                     | 0V                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                           |                                                                   | 11.8                                           | 6250                                                                                                      | 3500                                                                                                                                                               | 19.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                        |                                                                    | 6AU7                                                                                               |
| 250<br>150                                                                                                                              | — 8.5V<br>150Ω                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                           |                                                                   | 10.5<br>9                                      | 7700<br>8200                                                                                              | 2200<br>4900                                                                                                                                                       | 40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                        |                                                                    | - UNU1                                                                                             |
| 200                                                                                                                                     | 82Ω                                                                                                                                                                                                                                                                                                                                                                                                             | 125                                                                                                                       | 3.4                                                               | 15                                             | 150000                                                                                                    | 7000                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                        |                                                                    | ~ 6AU8                                                                                             |
| Max.                                                                                                                                    | DC Plate Volt                                                                                                                                                                                                                                                                                                                                                                                                   | s, 550                                                                                                                    |                                                                   |                                                | Max.                                                                                                      | Peak Positiv                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ate Volts, 550                                                                                                                                                                                                         | 0 (Abs.)                                                           | 6AV5G                                                                                              |
| Max.<br>200                                                                                                                             | DC Cathode m<br>— 2V                                                                                                                                                                                                                                                                                                                                                                                            | A, 110                                                                                                                    |                                                                   | 4                                              | Max.                                                                                                      | Plate Dissipa<br>4000                                                                                                                                              | tion, 11 v                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | watts                                                                                                                                                                                                                  |                                                                    |                                                                                                    |
| 150                                                                                                                                     | 150Ω                                                                                                                                                                                                                                                                                                                                                                                                            | 150                                                                                                                       | 3.5                                                               | 13                                             | 200000                                                                                                    | 9500                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                        |                                                                    | ~ 6AW8                                                                                             |
|                                                                                                                                         | 6AW                                                                                                                                                                                                                                                                                                                                                                                                             | 8A Feature                                                                                                                | s a plati                                                         | e current                                      | characteri                                                                                                | stic with a c                                                                                                                                                      | ontrolled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                        |                                                                    | -                                                                                                  |
| Max.                                                                                                                                    | Peak Inverse<br>Peak Plate mA<br>DC Plate mA,                                                                                                                                                                                                                                                                                                                                                                   | A. 750                                                                                                                    | , 4400                                                            |                                                |                                                                                                           | Peak Heater                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | /olts: { -4400<br>+300<br>exceed 900 vol                                                                                                                                                                               |                                                                    | 6AX4G                                                                                              |
| 150                                                                                                                                     | 560Ω                                                                                                                                                                                                                                                                                                                                                                                                            | 123                                                                                                                       |                                                                   | 18                                             | 5000                                                                                                      | 8500                                                                                                                                                               | 40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                        |                                                                    |                                                                                                    |
| 250                                                                                                                                     | 120Ω                                                                                                                                                                                                                                                                                                                                                                                                            | 110                                                                                                                       | 3.5                                                               | 10                                             | 400000                                                                                                    | 4800                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                        |                                                                    | ~ GAX8                                                                                             |
| 250                                                                                                                                     | 2V                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                           |                                                                   | 1.2                                            | 52700                                                                                                     | 1900                                                                                                                                                               | 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                        |                                                                    | 6AY11                                                                                              |
| 250                                                                                                                                     | _45V                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                           |                                                                   | 60                                             | 800                                                                                                       | 5250                                                                                                                                                               | 4.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2500                                                                                                                                                                                                                   | 3.5                                                                | 6B4G                                                                                               |
|                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                 | For                                                                                                                       | other o                                                           | haracter                                       | stics, refe                                                                                               | to Type 6N                                                                                                                                                         | 6G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                        |                                                                    | 6B5                                                                                                |
|                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                           |                                                                   |                                                |                                                                                                           | r to Type 6S                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                        |                                                                    | 6B6G                                                                                               |
|                                                                                                                                         | ut Triode: Pl                                                                                                                                                                                                                                                                                                                                                                                                   | ate Volts,<br>ate Volts,<br>00 ohms; F                                                                                    | 300 max.                                                          | .; Piate n                                     | n <b>A, 45; Pi</b> a                                                                                      | e mA, 8; AF<br>te Res., 2400                                                                                                                                       | Signal Vo<br>30 ohms;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | olts (Peak), 21<br>Load Resistand                                                                                                                                                                                      | е,                                                                 | 6B7<br>6B7S                                                                                        |
|                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                           |                                                                   |                                                |                                                                                                           |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                        |                                                                    |                                                                                                    |
| <del></del>                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                           |                                                                   |                                                |                                                                                                           | r to Type 12                                                                                                                                                       | C8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                        |                                                                    | 6B8                                                                                                |
| 250                                                                                                                                     | 3V                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                           |                                                                   |                                                |                                                                                                           | r to Type 12<br>1125                                                                                                                                               | C8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                        |                                                                    | 6B8G                                                                                               |
| 250<br>Max.<br>Max.                                                                                                                     | — 3V                                                                                                                                                                                                                                                                                                                                                                                                            | For<br>125<br>s, 20000                                                                                                    | 2.3                                                               | character<br>9                                 | istics, refe                                                                                              | 1125<br>Max.                                                                                                                                                       | DC Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | mA, 1.5<br>sipation, 20.0                                                                                                                                                                                              | watts                                                              | 6B8G                                                                                               |
| Max.<br>Max.                                                                                                                            | — 3V DC Plate Voits Unregulated D                                                                                                                                                                                                                                                                                                                                                                               | 125<br>s, 20000<br>C Supply V                                                                                             | 2.3<br>oits, 40                                                   | 9<br>000                                       | istics, refe                                                                                              | 1125<br>Max.<br>Max.<br>Max.                                                                                                                                       | DC Plate<br>Plate Dis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | sipation, 20.0<br>mA, 1.5                                                                                                                                                                                              |                                                                    | 688G<br>68D4                                                                                       |
| Max.<br>Max.<br>Max.<br>Max.                                                                                                            | — 3V                                                                                                                                                                                                                                                                                                                                                                                                            | 125<br>s, 20000<br>C Supply V                                                                                             | 2.3<br>oits, 40                                                   | 9<br>000                                       | istics, refe                                                                                              | 1125<br>Max.<br>Max.<br>Max.                                                                                                                                       | DC Plate<br>Plate Dis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | sipation, 20.0                                                                                                                                                                                                         |                                                                    | 688G<br>68D4                                                                                       |
| Max.<br>Max.<br>Max.<br>Max.                                                                                                            | — 3V  DC Plate Voits Unregulated D  DC Plate Voits Unregulated D                                                                                                                                                                                                                                                                                                                                                | For<br>125<br>s, 20000<br>iC Supply V<br>s, 27000<br>C Supply V                                                           | 2.3<br>oits, 40                                                   | 9<br>000<br>000                                | 600000                                                                                                    | 1125<br>Max.<br>Max.<br>Max.<br>Max.                                                                                                                               | DC Plate<br>Plate Dis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | sipation, 20.0<br>mA, 1.5                                                                                                                                                                                              |                                                                    | 6B8G<br>6BD4                                                                                       |
| Max.<br>Max.<br>Max.<br>250                                                                                                             | — 3V  DC Plate Voits Unregulated D  DC Plate Volts Unregulated D  — 3V                                                                                                                                                                                                                                                                                                                                          | 125<br>s, 20000<br>C Supply V<br>s, 27000<br>C Supply V<br>100                                                            | 2.3<br>Folts, 400<br>olts, 550<br>3.0                             | 9<br>000<br>000<br>9.0                         | 600000<br>800000                                                                                          | 1125<br>Max.<br>Max.<br>Max.<br>Max.<br>2000                                                                                                                       | DC Plate<br>Plate Dis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | sipation, 20.0<br>mA, 1.5<br>sipation, 25.0                                                                                                                                                                            | watts<br>———————————————————————————————————                       | 6B8G<br>6BD4<br>6BD4<br>6BD6                                                                       |
| Max.<br>Max.<br>Max.<br>250<br>110<br>250                                                                                               | — 3V  DC Plate Voits Unregulated D  DC Plate Voits Unregulated D  — 3V  — 7.5V                                                                                                                                                                                                                                                                                                                                  | 125 s, 20000 C Supply V s, 27000 C Supply V 100 110                                                                       | 2.3<br>Folts, 400<br>olts, 550<br>3.0                             | 9<br>000<br>000<br>9.0<br>36.0<br>9.5<br>Max   | 800000<br>12000<br>8500                                                                                   | 1125<br>Max.<br>Max.<br>Max.<br>Max.<br>2000<br>7500                                                                                                               | DC Plate<br>Plate Dis<br>DC Plate<br>Plate Dis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | sipation, 20.0<br>mA, 1.5<br>sipation, 25.0<br>————————————————————————————————————                                                                                                                                    | watts<br>———————————————————————————————————                       | 6B8G<br>6BD4<br>6BD6<br>6BF5<br>6BF6<br>6BG66                                                      |
| Max.<br>Max.<br>Max.<br>250<br>110<br>250<br>Max.<br>Max.                                                                               | - 3V  DC Plate Voits Unregulated D  DC Plate Voits Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Voits DC Cathode m                                                                                                                                                                                                                                                                                               | 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 A, 110                                                         | 2.3<br>folts, 400<br>folts, 550<br>3.0<br>4.0                     | 9<br>000<br>000<br>9.0<br>36.0<br>9.5<br>Max   | 800000<br>12000<br>8500                                                                                   | Max. Max. Max. Max. 2000 7500 1900 itive-Pulse P sipation, 20 Max.                                                                                                 | DC Plate<br>Plate Dis<br>DC Plate<br>Plate Dis<br>16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | sipation, 20.0 mA, 1.5 sipation, 25.0 2500 Power ( 300 mill s, 6600 (Abs.)                                                                                                                                             | 1.9<br>Dutput,<br>iwatts                                           | 6B8G<br>6BD4<br>6BD6<br>6BF5<br>6BF6<br>6BG66                                                      |
| Max.<br>Max.<br>Max.<br>250<br>110<br>250<br>Max.<br>Max.<br>Max.                                                                       | - 3V  DC Plate Voits Unregulated D  DC Plate Voits Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Voits                                                                                                                                                                                                                                                                                                            | 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 A, 110                                                         | 2.3<br>folts, 400<br>folts, 550<br>3.0<br>4.0                     | 9<br>000<br>000<br>9.0<br>36.0<br>9.5<br>Max   | 800000<br>12000<br>8500                                                                                   | Max. Max. Max. Max. 2000 7500 1900 itive-Pulse P sipation, 20 Max.                                                                                                 | DC Plate<br>Plate Dis<br>DC Plate<br>Plate Dis<br>16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | sipation, 20.0 mA, 1.5 sipation, 25.0  2500  Power ( 300 mills, 6600 (Abs.)                                                                                                                                            | 1.9<br>Dutput,<br>iwatts                                           | 6B8G<br>6BD4/<br>6BD6/<br>6BF5<br>6BF6<br>6BG6G                                                    |
| Max.<br>Max.<br>Max.<br>250<br>110<br>250<br>Max.<br>Max.                                                                               | - 3V  DC Plate Voit: Unregulated D  DC Plate Voit: Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Voit: C Cathode m  DC Plate Voit: Unregulated D                                                                                                                                                                                                                                                                  | 125 s, 20000 C Supply V s, 27000 110 110 s, 700 A, 110 s, 27000 C Supply V                                                | 2.3 (oits, 40) (oits, 55) 3.0 4.0                                 | 9<br>0000<br>000<br>9.0<br>36.0<br>9.5<br>Max  | 800000<br>800000<br>12000<br>8500<br>. Peak Pos.                                                          | Max. Max. Max. Max. 2000 7500 1900 itive-Pulse P sipation, 20  Max. Max. Max.                                                                                      | DC Plate<br>Plate Dis<br>DC Plate<br>Plate Dis<br>16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | sipation, 20.0 mA, 1.5 sipation, 25.0  2500 Power ( 300 mill s, 6600 (Abs.) mA, 1.6 sipation, 25 W 6500 Grid-No. for Cuto:                                                                                             | 1.9 Dutput, iwatts  atts 3.5 1 Volts                               | 6B8G<br>6BD4<br>6BD4/<br>6BD6<br>6BF5<br>6BF6<br>6BG66<br>6BK4<br>6BK5                             |
| Max.<br>Max.<br>Max.<br>250<br>110<br>250<br>Max.<br>Max.<br>Max.<br>250<br>150                                                         | - 3V  DC Plate Voit: Unregulated D  DC Plate Voit: Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Voit: Unregulated D  C 2thode m  DC Plate Voit: Unregulated D                                                                                                                                                                                                                                                    | For 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 A, 110 s, 27000 C Supply V 250 Plate Volts, 1200           | 2.3  rother c 2.3  rotts, 400  rotts, 550 3.0 4.0  roits, 600 3.5 | 9 000 000 9.0 36.0 9.5 Max Max 000 35          | 800000<br>12000<br>8500<br>12000<br>8500<br>Peak Posi<br>Plate Dis                                        | 1125 Max. Max. Max. 2000 7500 1900 Sipation, 20 Max. Max. 8500 9300 Peak Heater-                                                                                   | DC Plate Plate Dis DC Plate Plate Dis DC Plate Plate Volts watts DC Plate Plate Dis A3 Cathode V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | sipation, 20.0 mA, 1.5 sipation, 25.0  2500  Power ( 300 mill s, 6600 (Abs.)  mA, 1.6 sipation, 25 W 6500  Grid-No. for Cuto.                                                                                          | 1.9 Dutput, iwatts  atts 3.5 1 Volts                               | 6B8G<br>6BD4<br>6BD4/<br>6BD6<br>6BF5<br>6BF6<br>6BG66<br>6BK4<br>6BK5                             |
| Max.<br>Max.<br>Max.<br>250<br>110<br>250<br>Max.<br>Max.<br>Max.<br>250<br>150<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max.<br>Max. | - 3V  DC Plate Volt: Unregulated D  DC Plate Volt: Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Volt: DC Cathode m.  DC Plate Volt: 56Ω  Peak Inverse I Peak Plate mA, DC Plate Wolt: DC Plate Wolt:                                                                                                                                                                                                             | For 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 A, 110 s, 7000 C Supply V 250 Plate Voits, 1200 200 s, 500 | r other c<br>2.3<br>folts, 400<br>folts, 55(<br>3.0<br>4.0<br>    | 9 000 000 9.0 36.0 9.5 Max Max 000 35          | 800000  800000  12000  8500  Peak Pos. Plate Dis  100000  4600  Max. I *DC co                             | 1125 Max. Max. Max. 2000 7500 1900 Stive-Pulse Psipation, 20 Max. 8500 9300 Peak Heater- pmponent no Peak Positivi                                                 | DC Plate Plate Dis DC Plate Plate Dis DC Plate Plate Dis 16 Plate Volts Watts DC Plate Plate Dis 43 Cathode V t to excee-Pulse Pl                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | mA, 1.6 sipation, 25.0  Power ( 300 mill s, 6600 (Abs.)  mA, 1.6 sipation, 25 W 6500 Grid-No. for Cuto' (olts: { 4500* ded —900 volts ate Volts, 200                                                                   | uvatts  1.9  Dutput, liwatts  atts 3.5 1 Volts ff, —11 (Abs.)      | 6B8G<br>6BD4/<br>6BD6<br>6BF5<br>6BF6<br>6BG6G<br>6BK4<br>6BK5<br>6BK7/<br>6BL4                    |
| Max. Max. Max. Max. Max. Max. Max. Max.                                                                                                 | - 3V  DC Plate Voit: Unregulated D  DC Plate Voit: Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Voits DC Cathode m  DC Plate Voits CG  Feak Inverse I  Peak Plate mA  DC Plate Voits DC Cathode m  DC Plate Voits CG  DC Plate Voits CG  Peak Inverse I  Peak Plate mA  DC Plate Voits DC Cathode m                                                                                                              | For 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 A, 110 s, 7000 C Supply V 250 Plate Voits, 1200 200 s, 500 | r other c<br>2.3<br>folts, 400<br>folts, 55(<br>3.0<br>4.0<br>    | 9 000 9.0 9.0 9.5 Max Max 000 35 18            | 800000  800000  12000  8500  Peak Pos. Plate Dis  100000  4600  Max. I  DC Co                             | 1125  Max. Max. Max. 2000 7500 1900  itive-Pulse Psipation, 20  Max. Max. 8500 9300  Peak Heater- component no                                                     | DC Plate Plate Dis DC Plate A3 Cathode V t to excee- Pulse Pl tion (Eacl                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | sipation, 20.0 mA, 1.5 sipation, 25.0  2500 Power ( 300 mill s, 6600 (Abs.)  mA, 1.6 sipation, 25 W 6500 Grid-No. for Cuto folts: { —4500° ed —900 voits                                                               | uvatts  1.9  Dutput, liwatts  atts 3.5 1 Volts ff, —11 (Abs.)      | 6B8G<br>6BD4/<br>6BD6<br>6BF5<br>6BF6<br>6BG6G<br>6BK4<br>6BK7/<br>6BL4<br>6BL7G                   |
| Max. Max. Max. 250 110 250 Max. Max. 250 150 Max. Max. Max. Max. Max. Max. Max. Max.                                                    | - 3V  DC Plate Voits Unregulated D  DC Plate Voits Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Voits Unregulated D  C Cathode m  DC Plate Voits Unregulated D  - 5V  56Ω  Peak Inverse I Peak Plate mA, DC Plate Wolts DC Cathode m  DC Plate Voits DC Cathode m  DC Plate Wolts DC Plate Wolts DC Plate Wolts DC Plate Voits DC Plate Voits DC Plate Voits DC Plate Voits  220Ω  DC Plate Voits DC Plate Voits | For 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 C Supply V 250 Plate Voits, 1200 s, 500 A. (Each Ui        | r other c<br>2.3<br>folts, 400<br>folts, 55(<br>3.0<br>4.0<br>    | 9 000 000 9.0 36.0 9.5 Max Max 000 35          | 800000  800000  12000  8500  Peak Posi. Plate Dis  100000  4600  Max. I  6300  Max. F                     | 1125 Max. Max. Max. 2000 7500 1900 itive-Pulse Psipation, 20 Max. 8500 9300 Peak Heater- component no Peak Positive Plate Dissipa 6800 Peak Positive               | DC Plate Plate Dis DC Plate Plate Dis DC Plate Plate Dis DC Plate Dis DC Plate Plate Dis DC Plate Plate Dis A3 Cathode V t to excee Pulse Pl tion (Eacl A3Pulse Pl                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | sipation, 20.0 mA, 1.5 sipation, 25.0  2500 Power ( 300 mill s, 6600 (Abs.)  mA, 1.6 sipation, 25 W 6500 Grid-No. for Cuto rolts: { —4500° ed —900 volts ate Volts, 2000 h Unit), 10 wat                               | atts 3.5 1 Volts #, —11 (Abs.)                                     | 6B8G<br>6BD4/<br>6BD6<br>6BF5<br>6BF6<br>6BG6G<br>6BK4<br>6BK7/<br>6BL4<br>6BL7G<br>6BN4           |
| Max. Max. Max. 250 1110 250 Max. Max. 250 150 Max. Max. 150 Max. Max. Max. Max. Max. Max. Max. Max.                                     | — 3V  DC Plate Voit: Unregulated D  DC Plate Voit: Unregulated D  — 3V  — 7.5V  — 9V  DC Plate Voits DC Cathode m  DC Plate Voits Foak Inverse I  Peak Plate mA  DC Plate Voits DC Cathode m  COPIATE Voits                                                         | For 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 c Supply V 250 Plate Voits, 1200 s, 500 A. (Each Ui        | r other c<br>2.3<br>folts, 400<br>folts, 55(<br>3.0<br>4.0<br>    | 9 000 9.0 9.0 9.5 Max Max 000 35 18            | 800000  800000  12000  8500  Peak Posi. Plate Dis  100000  4600  Max. I  6300  Max. F                     | 1125  Max. Max. Max. 2000 7500 1900  Itive-Pulse Psipation, 20  Max. 8500 9300  Peak Heater- omponent no Peak Positive- Plate Dissipa 6800                         | DC Plate Plate Dis DC Plate Plate Dis DC Plate Plate Dis DC Plate Dis DC Plate Plate Dis DC Plate Plate Dis A3 Cathode V t to excee Pulse Pl tion (Eacl A3Pulse Pl                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | sipation, 20.0 mA, 1.5 sipation, 25.0  2500 Power ( 300 mill s, 6600 (Abs.)  mA, 1.6 sipation, 25 W 6500 Grid-No. for Cutor roits: { +300 ed —900 volts ate Volts, 200 h Unit), 10 wat ate Volts, 5500 svatts Grid-No. | ustts 1.9 Dutput, liwatts  atts 3.5 1 Volts #, -11 (Abs.) D (Abs.) | 6B8G<br>6BD4/<br>6BD6<br>6BF5<br>6BF6<br>6BG6G<br>6BK4<br>6BK7/<br>6BL4<br>6BL7G<br>6BN4           |
| Max. Max. Max. 250 110 250 Max. Max. 250 150 Max. Max. Max. Max. Max. Max. Max. Max.                                                    | - 3V  DC Plate Voits Unregulated D  DC Plate Voits Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Voits Unregulated D  C Cathode m  DC Plate Voits Unregulated D  - 5V  56Ω  Peak Inverse I Peak Plate mA, DC Plate Wolts DC Cathode m  220Ω  DC Plate Voits DC Cathode m                                                                                                                                          | For 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 c Supply V 250 Plate Voits, 1200 s, 500 A. (Each Ui        | r other c<br>2.3<br>folts, 400<br>folts, 55(<br>3.0<br>4.0<br>    | 9 000 000 9.0 36.0 9.5 Max Max 000 35 18 Abs.) | 800000  800000  12000  8500  Peak Posi. Plate Dis  100000  4600  Max. I  6300  Max. I  6300               | 1125 Max. Max. Max. 2000 7500 1900 itive-Pulse P sipation, 20 Max. 8500 9300 Peak Heater- omponent no Peak Positive Plate Dissipa 6800 Peak Positive Plate Dissipa | DC Plate Plate Dis DC Plate Plate Dis DC Plate Plate Dis DC Plate Dis DC Plate Plate Dis DC Plate Plate Dis A3 Cathode V t to excee Pulse Plate Cathode V d Se-Pulse Plate DC  | sipation, 20.0 mA, 1.5 sipation, 25.0  Power ( 300 mill s, 6600 (Abs.)  mA, 1.6 sipation, 25 W 6500 Grid-No. for Cuto: 'olts: { 4500" ed —900 volts ate Volts, 2006 h Unit), 10 wat ate Volts, 5500 and Volts, 5500    | ustts 1.9 Dutput, liwatts  atts 3.5 1 Volts #, -11 (Abs.) D (Abs.) | 6B8G<br>6BD4/<br>6BD6/<br>6BF5<br>6BF6<br>6BG6G<br>6BK4<br>6BK7/<br>6BL4<br>6BL7G<br>6BN4<br>6BQ6G |
| Max. Max. 250 110 250 Max. Max. 250 150 Max. Max. 150 Max. Max. 150                                                                     | - 3V  DC Plate Voits Unregulated D  DC Plate Voits Unregulated D  - 3V  - 7.5V  - 9V  DC Plate Voits Unregulated D  C Cathode m  DC Plate Voits Unregulated D  - 5V  56Ω  Peak Inverse I  Peak Plate mA  DC Plate Woits DC Cathode mA  DC Plate Voits DC Cathode mA  220Ω  DC Plate Voits DC Cathode mA  220Ω                                                                                                   | For 125 s, 20000 C Supply V s, 27000 C Supply V 100 110 s, 700 c Supply V 250 Plate Voits, 1200 s, 500 A. (Each Ui        | r other c<br>2.3<br>folts, 400<br>folts, 55(<br>3.0<br>4.0<br>    | 9 000 000 9.0 36.0 9.5 Max Max 000 35 18 Nbs.) | 800000  800000  12000  8500  Peak Posi. Plate Dis  100000  4600  Max. I  6300  Max. I  6300  Max. I  6300 | 1125 Max. Max. Max. 2000 7500 1900 itive-Pulse P sipation, 20 Max. 8500 9300 Peak Heater- omponent no Peak Positive Plate Dissipa 6800 Peak Positive Plate Dissipa | DC Plate Plate Dis DC Plate Plate Dis DC Plate Plate Dis DC Plate Dis DC Plate Plate Dis DC Plate Plate Dis DC Plate Plate Dis DC Plate Dis DC Plate Plate Dis DC Plate Plate Dis DC Plate Plate Dis DC Plate DC P | sipation, 20.0 mA, 1.5 sipation, 25.0  2500 Power ( 300 mill s, 6600 (Abs.)  mA, 1.6 sipation, 25 W 6500 Grid-No. for Cutor roits: { +300 ed —900 volts ate Volts, 200 h Unit), 10 wat ate Volts, 5500 svatts Grid-No. | ustts 1.9 Dutput, liwatts  atts 3.5 1 Volts #, -11 (Abs.) D (Abs.) | 6B8G<br>6BD4/<br>6BD6/<br>6BF5<br>6BF6<br>6BG6G<br>6BK4<br>6BK7/<br>6BL4<br>6BL7G<br>6BN4<br>6BQ6G |

f For two tubes at stated plate-to-plate load.

| RCA<br>Type                            | Name                                     | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Filan Unless s types hav  Heate | ter or<br>nent (F)<br>pecified all<br>ve heaters.<br>r with con-<br>armup time.<br>Amperes | Use  Values to right give operating conditions and characteristics for indicated typical use |
|----------------------------------------|------------------------------------------|---------------------------------|-------------------------------------------|---------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| 68W4                                   | Full-Wave Rectifier                      | 6E                              | 901                                       | 6.3                             | 0.9                                                                                        | With Capacitive Input Filter                                                                 |
|                                        |                                          |                                 |                                           |                                 |                                                                                            | With Inductive Input Filter                                                                  |
| 6BX7GT                                 | Medium-Mu Twin Triede                    | 13D                             | 8BD                                       | 6.3                             | 1.5                                                                                        | Vertical Deflection Oscillator                                                               |
| 00A7 <b>Q</b> 1                        | MCDION MO I WIN THOUS                    | 100                             |                                           | 0.5                             | 1.5                                                                                        | Vertical Deflection Amplifier                                                                |
| 6BY5GA                                 | Full-Wave Rectifier                      | 18B                             | 6CN                                       | 6.3                             | 1.6                                                                                        | Television Damper Service                                                                    |
| 6BZ8                                   | Medium-Mu Twin Triode                    | <b>6</b> B                      | 9AJ                                       | 6.3                             | 0.4                                                                                        | Each Unit as Class A Amplifier                                                               |
| 6 <b>C5</b><br>6 <b>C</b> 5 <b>G</b> T | Medium-Ma Triode                         | 2A<br>14A                       | 6Q<br>6Q                                  | 6.3                             | 0.3                                                                                        | Class A Amplifier                                                                            |
| 606                                    | Sharp-Cutoff Pentode                     | 24A                             | 6F                                        | 6.3                             | 0.3                                                                                        | Amplifier Detector                                                                           |
| 607                                    | Twin-Diode—Medium-Mu Triode              | 24B                             | 7 <b>6</b>                                | 6.3                             | 0.3                                                                                        | Triode Unit as Class A Amplifier                                                             |
| 6C8 <b>G</b>                           | Medium-Mu Twin-Triode                    | 23                              | 86                                        | 6.3                             | 0.3                                                                                        | Each Unit as Class A Amplifier                                                               |
| 6CB5                                   | Beam Power Tube                          | 28A                             | 8GD                                       | 6.3                             | 2.5                                                                                        | Horizontal Deflection Amplifier                                                              |
| 6CD6G                                  | Beam Power Tube                          | 28B                             | 5BT                                       | 6.3                             | 2.5                                                                                        | Horizontal Deflection Amplifier                                                              |
| 6CG8                                   | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 6B                              | 9 <b>G</b> F                              | 6.3<br>6.3⊕                     | 0.45<br>0.45                                                                               | Pentode Unit as Class A Amplifier  Pentode Unit as Class A  Amplifier                        |
| 6CH8                                   | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 6B                              | 9FT                                       | 6.3                             | 0.45                                                                                       | Pentode Unit as Class A Amplifier  Pentode Unit as Class A  Amplifier                        |
| 6CK4                                   | Low-Mu Triode                            | 13F                             | 81B                                       | 6.3                             | 1.25                                                                                       | Vertical Deflection Amplifier                                                                |
| 6CL8                                   | Medium-Mu Triode—Sharp-Cutoff<br>Tetrode | 6B                              | 9FX                                       | 6.3⊕                            | 0.45                                                                                       | Triode Unit as Class A Amplifier Tetrode Unit as Class A Amplifier                           |
| 6CM8                                   | High-Mu Triode—Sharp-Cutoff<br>Pentode   | 6B                              | 9FZ                                       | 6.3⊕                            | 0.45                                                                                       | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                           |
| 6D6                                    | Remote-Cutoff Pentode                    | 24A                             | 6F                                        | 6.3                             | 0.3                                                                                        | Amplifier Mixer                                                                              |
| 6 <b>D</b> 7                           | Sharp-Cutoff Pentode                     | 24A                             | 7H                                        | 6.3                             | 0.3                                                                                        | Amplifier Detector                                                                           |
| 6D8G                                   | Pentagrid Converter                      | 23                              | 8A                                        | 6.3                             | 0.15                                                                                       | Converter                                                                                    |
| 6DC8                                   | Twin Diede—Remote-Cutoff<br>Pentode      | 6E                              | 9HE                                       | 6.3                             | 0.3                                                                                        | Class A Amplifier                                                                            |
| 6DM4                                   | Half-Wave Rectifier                      | 13 <b>G</b>                     | 4C <b>G</b>                               | 6.3                             | 1.2                                                                                        | Damper Service                                                                               |
| 6DN6                                   | Beam Power Tube                          | 21B                             | 5BT                                       | 6.3                             | 2.5                                                                                        | Horizontal Deflection Amplifier                                                              |
| 6DQ4                                   | Half-Wave Rectifier                      | 13F                             | 4CE                                       | 6.3                             | 1.2                                                                                        | Damper Service                                                                               |
| 6DQ6A                                  | Beam Power Tube                          | 28                              | 6AM                                       | 6.3                             | 1.2                                                                                        | Horizontal Deflection Amplifier                                                              |
| 6DT6                                   | Sharp-Cutoff Pentode                     | 5C                              | 7EN                                       | 6.3                             | 0.3                                                                                        | Class A Amplifier                                                                            |
| 6DW5                                   | Beam Power Tube                          | 66                              | 9CK                                       | 6.3                             | 1.2                                                                                        | Vertical Deflection Amplifier                                                                |
| 6DZ7                                   | Twin Pewer Pentode                       | 19B                             | 918                                       | 6.3                             | 1.52                                                                                       | Class A Amplifier  Both Units as Push-Pull Class AB1 Amplifier                               |
| 6E6                                    | Twin Power Amplifier                     | 26                              | 7B                                        | 6.3                             | 0.6                                                                                        | Push-Pull Class A Amplifier                                                                  |
| 6E7                                    | Remote-Cutoff Pentode                    | 24A                             | 7H                                        | 6.3                             | 0.3                                                                                        | Amplifier                                                                                    |

| Plate<br>Sup-<br>ply<br>Voits | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor<br>Ohms (Ω) | Grid<br>Sup-<br>ply<br>Volts | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>conduct-<br>ance<br>Micromhos | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output<br>Ohms   | Power<br>Out-<br>put<br>Watts | RCA<br>Type         |
|-------------------------------|-----------------------------------------------------------------|------------------------------|----------------------------|-----------------------------|-------------------------------------|-----------------------------------------|------------------------------|-------------------------------------------------|-------------------------------|---------------------|
| Max.                          | AC Volts per I<br>Peak Inverse                                  | Volts, 1275<br>Tota          | Effect                     | . Supply                    | Imped, per                          | Max<br>Max<br>Plate, 82 oh              | . Peak Pi<br>ms              | put mA, 62.5<br>late mA, per Pla                | ite, 350                      | - 6BW4              |
| Max.<br>Max.                  | AC Volts per i<br>Peak Inverse                                  | Volts, 1275                  | •                          | ilue of In                  | put Choke.                          | Max<br>Max<br>10 henries                | c. DC Out                    | tput mA, 62.5<br>Plate mA per Pla               | ate, 350                      | 00111               |
| Max.                          | DC Plate Volts<br>Plate Dissipat                                | s. 500                       |                            |                             |                                     |                                         | M                            | ax. DC Cathode                                  | mA, 180                       |                     |
| Max.                          | DC Plate Volts                                                  | s, 500                       | Ma                         | x. Peak F                   | ositíve-Pu                          | ise Plate Vol                           | ts, 2000                     | (Abs.)                                          |                               | - 6BX7G             |
|                               | DC Cath. mA,<br>Peak Inverse                                    |                              |                            |                             | Dissipation                         | : 10 watts ei                           | ther plat                    | e; 12 watts bot                                 | h plates                      |                     |
| Max.                          | Peak Plate mA<br>DC Plate mA,                                   | . 525                        |                            |                             | Max.                                | Peak Heater-                            | Cathode                      | Volts: $\begin{cases} -450 \\ +100 \end{cases}$ |                               | 6BY5G/              |
| 125                           | 100Ω                                                            |                              |                            | 10                          | 5600                                | 8000                                    | 45                           |                                                 |                               | 6BZ8                |
| 250                           | — 8V                                                            |                              |                            | 8.0                         | 10000                               | 2000                                    | 20                           | <u> </u>                                        |                               | <b>6C5</b><br>6C5GT |
|                               |                                                                 | Foi                          | other                      | character                   | istics, ref                         | er to Type 6J                           | 7                            |                                                 |                               | 6C6                 |
| 250                           | <u> </u>                                                        |                              |                            | 4.5                         | 16000                               | 1250                                    | 20                           |                                                 |                               | 6C7                 |
| 250                           | — 4.5V                                                          | 700                          |                            | 3.2                         | 22500                               | 1600                                    | 36                           |                                                 |                               | 6C8G                |
| Max.                          | DC Plate Volts<br>DC Cathode m.                                 | A, 200                       |                            |                             | Max.                                | Plate Dissipa                           | tion, 23                     | iate Volts, 6800<br>Watts                       | (ADS.)                        | 6CB5                |
| <u>max.</u>                   | DC Plate Volts<br>DC Cathode m                                  | s, 700<br>A, 200             |                            |                             | Max.                                | Plate Dissipa                           | tion, 20                     | iate Volts, 7000<br>watts                       |                               | 6CD6G               |
| 100<br>250                    | <u> </u>                                                        | 105                          |                            | 12                          | 6000                                | 6500                                    | 40                           |                                                 |                               | - 6CG8              |
| 200                           | — 1V<br>— 6V                                                    | 125                          | 2.2                        | 9                           | 300000                              | 5500                                    |                              |                                                 |                               |                     |
| 200                           | 180Ω                                                            | 150                          | 2.8                        | 13<br>9.5                   | 5750<br>300000                      | 3300<br>6200                            | 19                           |                                                 |                               | - 6CH8              |
| Max.                          | DC Plate Volts                                                  | , 550                        |                            |                             | Max.                                | Peak Positive                           | -Pulse P                     | late Volts, 2000                                | (Abs.)                        | COVA                |
| Max.<br>125                   | Peak Cathode  — 1V                                              | mA, 350                      |                            | 14                          | Max.<br>5000                        | Plate Dissipa<br>8000                   | tion, 12<br>40               | watts                                           |                               | 6CK4                |
| 125                           |                                                                 | 125                          | 4                          | 12                          | 120000                              | 6000                                    | 40                           |                                                 |                               | - 6CL8              |
| 250                           |                                                                 | 123                          |                            | 1.8                         | 50000                               | 2000                                    | 100                          | <del></del>                                     |                               |                     |
| 250                           | 180Ω                                                            | 150                          | 2.8                        | 9.5                         | 600000                              | 6200                                    |                              |                                                 | <del></del>                   | - 6CM8              |
|                               |                                                                 | For                          | other c                    | haracteri                   | stics, refe                         | r to Type 6U7                           | 'G                           |                                                 |                               | 6D6                 |
|                               |                                                                 | For                          | other                      | character                   | istics, refe                        | er to Type 6J                           |                              |                                                 |                               | 6D7                 |
| 250                           | — 3V                                                            | 100                          | 2.7                        | 3.5                         | 360000                              | Anode-Grid<br>Oscillator-<br>Transcond  | Grid (1)                     | 50 max. volts,<br>Resistor. Con<br>cromhos.     | 4 mA<br>version               | 6D8G                |
| 250                           | 2V                                                              | 100                          | 2.7                        | 9                           | 1                                   | 3800                                    |                              |                                                 |                               | 6DC8                |
| Max.                          | Peak Inverse F<br>Peak Heater—<br>Peak Heater—                  | Cathode Vol                  | ts, -50                    | 000 (DC C                   | eak Plate r                         | Not to Excee                            | ed 900 Vo                    | Plate mA, 175                                   |                               | 6DM4                |
| Max.<br>Max.                  | DC Plate Volts<br>DC Cathode m/                                 | , 700<br>4, 200              | 13, 70                     | 30 100 00                   | Max.                                |                                         | -Pulse P                     | ate Volts, 6600                                 | (Abs.)                        | 6DN6                |
| Max.                          | Peak Inverse \ Peak Plate mA                                    | olts. 5500                   |                            |                             |                                     |                                         | Max. DC                      | Plate mA, 175<br>te Dissipation,                | 6 watts                       | 6DQ4                |
| Max.                          | DC Plate Volts<br>DC Cathode m/                                 | . 770                        |                            |                             | Max.                                |                                         | -Puise Pi                    | ate Volts, 6000                                 |                               | 6DQ6A               |
| 150                           | 560Ω                                                            | 100                          | 2.1                        | 1.1                         | 150000                              | 515                                     |                              |                                                 |                               | 6DT6                |
| Max.<br>Max.                  | DC Plate Volts<br>DC Cathode m                                  | , 330<br>A, 65               |                            |                             |                                     | Max. Peak I<br>Max. Piate               | Positive-I<br>Dissipati      | Pulse Plate Volt<br>on, 11 watts                | s, 2200                       | 6DW5                |
| 250                           | — 7.3V                                                          | 250                          | 5.5                        | 48                          | 38000                               | 11300                                   |                              |                                                 |                               | . CD77              |
| 400<br>300                    | —11V<br>120Ω                                                    |                              | 13<br>15                   | 100<br>80                   |                                     |                                         |                              | 9000                                            | 18<br>12                      | 6DZ7                |
| 250                           | 27.5V                                                           |                              |                            |                             |                                     |                                         |                              | 14000                                           | 1.60†                         | 6E6                 |
|                               |                                                                 | For                          | other c                    | haracteris                  | tics, refer                         | to Type 6U7                             | G                            |                                                 |                               | 6E7                 |

| RCA<br>Type          | Name                                     | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Fila<br>Unless<br>types h<br># Heat | ater or<br>ment (F)<br>specified all<br>ave heaters.<br>er with con-<br>varmup time.<br>Amperes | Use<br>Values to right give operat-<br>ing conditions and character-<br>istics for indicated typical use |
|----------------------|------------------------------------------|---------------------------------|-------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 6EH8                 | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 6B                              | 91 <b>6</b>                               | 6.3⊕                                | 0.45                                                                                            | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 6EV7                 | High-Mu Twin Triode                      | 6E                              | 9LP                                       | 6.3                                 | 0.6                                                                                             | Relay Control                                                                                            |
| 6EX6                 | Beam Power Tube                          | 21B                             | 5BT                                       | 6.3⊕                                | 2.25                                                                                            | Horizontal Deflection Amplifier                                                                          |
| 6EY6                 | Beam Power Tube                          | 13F                             | 7AC                                       | 6.3⊕                                | 0.68                                                                                            | Vertical Deflection Amplifier                                                                            |
| 6EZ5                 | Beam Power Tube                          | 13F                             | 7AC                                       | 6.3                                 | 0.8                                                                                             | Vertical Deflection Amplifier                                                                            |
| <b>6F5</b><br>6F5GT  | High-Mu Triode                           | 3<br>14A                        | 5M<br>5M                                  | 6.3                                 | 0.3                                                                                             | Class A Amplifier                                                                                        |
| 6F6G<br>6F6GT        | Power Pentode                            | 25<br>13F                       | 75<br>75<br>75                            | 6.3                                 | 0.7                                                                                             | Pentode Class A Amplifier Triode□ Class A Amplifier Pentode Push-Pull Class A Amplifier                  |
| 6F7                  | Low-Mu Triode—Remote-Cutoff<br>Pentode   | 248                             | 7E                                        | 6.3                                 | 0.3                                                                                             | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 6F8 <b>G</b>         | Medium-Mu Twin Triode                    | 23                              | 86                                        | 6.3                                 | 0.6                                                                                             | Each Unit as Class A Amplifier                                                                           |
| 6FE5                 | Beam Power Tube                          | 13 <b>G</b>                     | 8KB                                       | 6.3                                 | 1.2                                                                                             | Class A Amplifier                                                                                        |
| 6FQ7                 | Medium-Mu Twin Triode                    | 6E                              | 9LP                                       | 6.3⊕                                | 0.6                                                                                             | Each Unit as Class A Amplifier                                                                           |
| 6FV8                 | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 6B                              | 9FA                                       | 6.3⊕                                | 0.45                                                                                            | Triode Unit as Class A Amplifier  Pentode Unit as Class A  Amplifier                                     |
| 6FW8                 | Medium-Mu Twin Triode                    | 68                              | 9A)                                       | 6.3                                 | 0.4                                                                                             | Each Unit as Class A Amplifier                                                                           |
| 666G                 | Power Pentade                            | 22                              | 7\$                                       | 6.3                                 | 0.15                                                                                            | Pentode Class A Amplifier                                                                                |
| 6 <b>G</b> 11        | Beam Power Tube—Sharp-Cutoff<br>Pentode  | 8B                              | 12BU                                      | 6.3                                 | 1.2                                                                                             | Beam Power Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                   |
| 6GH8                 | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 6B                              | 9AE                                       | 6.3⊕                                | 0.45                                                                                            | Triode Unit as Horiz, Defl. Osc.  Pentode Unit as Horiz, Defl. Osc.                                      |
| 6GJ5                 | Novar Beam Power Tube                    | 18A                             | 9QK                                       | 6.3                                 | 1.2                                                                                             | Horizontal Deflection Amplifier                                                                          |
| 6GJ8                 | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 6B                              | <b>9</b> AE                               | 6.3⊕                                | 0.6                                                                                             | Triode Unit as Class A Amplifier  Pentode Unit as Class A  Amplifier                                     |
| 6GY8                 | Triple High-Mu Triode                    | 6B                              | 9LY                                       | 6.3                                 | 0.45                                                                                            | Each Unit as Class A Amplifier                                                                           |
| 6H6GT                | Twin Diode                               | 13B                             | 7Q<br>7Q                                  | 6.3                                 | 0.3                                                                                             | Voltage Doubler  Half-Wave Rectifier                                                                     |
| 6J5<br>6J5GT         | Medium-Mu Triode                         | 2A<br>13D                       | 6Q<br>6Q                                  | 6.3                                 | 0.3                                                                                             | Class A Amplifier                                                                                        |
|                      |                                          |                                 |                                           | 6.2                                 | 0.46                                                                                            | Each Unit as Class A Amplifier                                                                           |
| 616                  | Medium-Mu Twin Triode                    | 5C                              | 7BF                                       | 6.3<br>6.3⊕                         | 0.45<br>0.45                                                                                    | Push-Pull Class C Amplifier                                                                              |
| 6J7<br>6J7G<br>6J7GT | Sharp-Cutoff Pentode                     | 3<br>23<br>14A                  | 7R<br>7R<br>7R                            | 6.3                                 | 0.3                                                                                             | Pentode Class A RF Amplifier                                                                             |

<sup>☐</sup> For two tubes.

| Plate<br>Sup-<br>ply<br>Volts | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor<br>Ohms (Ω) | Grid<br>Sup-<br>ply<br>Volts | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>conduct-<br>ance<br>Micromhos | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output<br>Ohms | Power<br>Out-<br>put<br>Watts | RCA<br>Type          |
|-------------------------------|-----------------------------------------------------------------|------------------------------|----------------------------|-----------------------------|-------------------------------------|-----------------------------------------|------------------------------|-----------------------------------------------|-------------------------------|----------------------|
| 125                           | <u> </u>                                                        |                              |                            | 13.5                        |                                     | 7500                                    | 40                           |                                               |                               | 6EH8                 |
| 125                           | <b>— 1V</b>                                                     | 125                          | 4                          | 12                          | 170000                              | 6000                                    |                              |                                               |                               | DENO                 |
| 250<br>150                    | 0V<br>0V                                                        |                              |                            | 18.5<br>10.0                |                                     | olts for Plat                           |                              |                                               |                               | 6EV7                 |
| 175                           | —30V                                                            | 175                          | 3.3                        | 67                          | 8500                                | 7700                                    | <del></del>                  |                                               |                               | 6EX6                 |
| 250                           | —17.5V                                                          | 250                          | 3                          | 44                          | 60000                               | 4400                                    |                              |                                               |                               | 6EY6                 |
| 250                           | 20V                                                             | 250                          | 3.5                        | 43                          | 50000                               | 4100                                    |                              |                                               |                               | 6EZ5                 |
| 100<br>250                    | 1V<br>2V                                                        |                              |                            | 0.4<br>0.9                  | 85000<br>66000                      | 1150<br>1500                            | 100<br>100                   |                                               |                               | <b>6F5</b><br>6F5G   |
| 250                           | —16.5V                                                          | 250                          | 6.5                        | 34.0                        | 80000                               | 2500                                    |                              | 7000<br>7000                                  | 3.2<br>4.8                    |                      |
| 285<br>250                    | 20V<br>20V                                                      | 285                          | 7.0                        | 38.0                        | 78000<br>2600                       | 2550<br>2600                            | 6.8                          | 4000                                          | 0.85                          | - 6F6G<br>- 6F6G     |
| 315                           | 24V                                                             | 285                          | 12.0 🗆                     | 62.0□                       |                                     |                                         |                              | 10000                                         | 11.0†                         | - orou               |
| 100                           | — 3V                                                            |                              |                            | 3.5                         | 16000                               | 500                                     | 8                            |                                               |                               | - 053                |
| 250                           | — 3V                                                            | 100                          | 1.5                        | 6.5                         | 850000                              | 1100                                    | <del></del>                  |                                               |                               | - 6F7                |
|                               |                                                                 | F                            | or other                   | character                   | istics, ref                         | er to Type 6J                           | 15                           |                                               |                               | 6F8G                 |
| 145                           | —16V                                                            | 145                          | 18                         | 100                         | 8000                                | 9500                                    |                              | 1000                                          | 5.6                           | 6FE5                 |
| 250                           | 8V                                                              |                              |                            | 9                           | 7700                                | 2600                                    | 20                           |                                               |                               | 6FQ7                 |
| 125                           | — 1V                                                            |                              |                            | 14                          | 5000                                | 8000                                    | 40                           |                                               |                               | - 6FV8               |
| 125                           | — 1V ·                                                          | 125                          | 4                          | 12                          | 200000                              | 6500                                    | · —                          |                                               | <del></del>                   | OF VO                |
| 100                           | 1.27                                                            |                              |                            | 15                          | 2500                                | 13000                                   | 33                           |                                               |                               | 6FW8                 |
| 180                           | — 9V                                                            | 180                          | 2.5                        | 15.0                        | 175000                              | 2300                                    |                              | 10000                                         | 1.1                           | 6G66                 |
| 120                           | — 8V                                                            | 110                          | 4                          | 49                          | 10000                               | 7500                                    |                              | 2500                                          | 2.3                           | - 6G11               |
| 150                           | 150Ω                                                            | 150                          | 3.5                        | 15                          | 20000                               | 9500                                    |                              |                                               |                               |                      |
|                               | DC Plate Volts                                                  |                              |                            | Man                         |                                     | ax. Plate Dis<br>hode mA, 300           |                              | 2.5 watts<br>. Plate                          |                               | - 6GH8               |
| Max.                          | DC Plate Volts,<br>Peak NegPuis                                 | e Grid Vo                    | lts, 175                   | Max                         | DC Catho                            | de mA, 20                               | Diss                         | ipation, 2.5 w                                | atts                          |                      |
| 250                           | —22.5V                                                          | 150                          | 2.1                        | 70                          | 15000                               | 7100                                    | <u> </u>                     |                                               |                               | 6GJ5                 |
| 125<br>125                    | — 1V<br>— 1V                                                    | 125                          | 4.5                        | 13.5<br>12                  | 5000<br>150000                      | 8500<br>7500                            | 40                           |                                               |                               | - 6GJ8               |
| 125                           | IV<br>IV                                                        | 123                          | 4.3                        | 4.5                         | 14000                               | 4500                                    | 63                           |                                               |                               | 6GY8                 |
| Max.                          | AC Supply Vol                                                   | s per Plat                   | e (RMS).                   | 150                         |                                     | Max.                                    | DC Outpu                     | t mA, 8. min.                                 |                               | 0010                 |
| Min.<br>Max.                  | Total Effect. PI<br>AC Plate Volts<br>DC Output mA,             | (RMS), 15                    | y Imped.<br>50             | per Plate                   | Min. Total                          | e, 30 ohms;<br>Effective Pl             | full wave,<br>ate-Supply     | 15 ohms<br>Impedance:<br>rolts, 40 ohms       |                               | - 6H6G               |
| 90<br>250                     | 0V<br>8V                                                        | =                            |                            | 10<br>9                     | 6700<br>7700                        | 3000<br>2600                            | 20<br>20                     |                                               |                               | 6J5<br>6J5G1         |
| 100                           |                                                                 | both unit                    | :s)                        | 8.5                         | 7100                                | 5300                                    | 38                           |                                               |                               |                      |
| 150                           | —10V                                                            |                              |                            | 30                          |                                     | urrent, 16 m<br>g Power, 0.3            |                              |                                               | 3.5                           | - 6J6                |
| 100<br>250                    | 3V<br>3V                                                        | 100<br>100                   | 0.5<br>0.5                 | 2.0<br>2.0                  | 1.0<br>1.0                          | 1185<br>1225                            |                              | _                                             |                               | 6J7<br>6J7G<br>6J7G1 |

<sup>†</sup> For two tubes at stated plate-to-plate load.

| RCA<br>Type                 | Name                                     | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Fill<br>Unless<br>types<br>⊕ Hea | eater or ament (F) specified all have heaters, ter with con- warmup time. Amperes | Use Values to right give operat- ing conditions and character- istics for indicated typical use |
|-----------------------------|------------------------------------------|---------------------------------|-------------------------------------------|----------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 6J8G                        | Triode-Heptode Converter                 | 23                              | 8H                                        | 6.3                              | 0.3                                                                               | Triode Unit as Oscillator                                                                       |
|                             |                                          |                                 |                                           |                                  |                                                                                   | Heptode Unit as Mixer                                                                           |
| 6JE6                        | Beam Power Tube                          | 18B                             | 9QL                                       | 6.3                              | 2.5                                                                               | Horizontal Deflection Amplifier                                                                 |
| 6JG6                        | Beam Power Tube                          | 17B                             | 9QU                                       | 6.3                              | 1.6                                                                               | Horizontal Deflection Amplifier                                                                 |
| 6K5GT                       | High-Mu Triode                           | 14A                             | 5U                                        | 6.3                              | 0.3                                                                               | Class A Amplifier                                                                               |
| <b>6K7</b><br>6K7G<br>6K7GT | Remote-Cutoff Pentode                    | 3<br>23<br>14A                  | 7R<br>7R<br>7R                            | 6.3                              | 0.3                                                                               | Class A Amplifier                                                                               |
| 6K8                         |                                          | 3                               | 8K                                        |                                  |                                                                                   | Triode Unit as Oscillator                                                                       |
| 6K8G<br>6K8GT               | Triode-Hexode Converter                  | 23                              | 8K<br>8K                                  | 6.3                              | 0.3                                                                               | Hexode Unit as Mixer                                                                            |
| 6K11                        | Twin High-Mu Triode—<br>Medium-Mu Triode | 8A                              | 12BY                                      | 6.3⊕                             | 0.6                                                                               | Twin Unit as Class A Amplifier                                                                  |
| 6KL8                        | Diode—Sharp-Cutoff Pentode               | 6E                              | 9LQ                                       | 6.3                              | 0.3                                                                               | Class A Amplifier Pentode Unit as Class A Amplifier                                             |
| 6L5G                        | Medium-Mu Triode                         | 22                              | 99                                        | 6.3                              | 0.15                                                                              | Class A Amplifier                                                                               |
|                             |                                          |                                 | 7AC                                       |                                  |                                                                                   | Single-Tube Class A Amplifier                                                                   |
| 6L6G<br><b>6L6GB</b>        | Beam Power Tube                          | 27B<br>19D                      | 7AC<br>7AC<br>7AC<br>7AC                  | 6.3                              | 0.9                                                                               | Push-Pull Class A Amplifier                                                                     |
|                             |                                          |                                 |                                           |                                  |                                                                                   | Push-Pull Class AB1 Amplifier                                                                   |
| <b>6L7</b><br>6L7G          | Pentagrid Mixer                          | 3<br>23                         | 7T<br>7T                                  | 6.3                              | 0.3                                                                               | Mixer Service                                                                                   |
| 6N6G                        | Direct-Coupled Power Triode              | 25                              | 7AU                                       | 6.3                              | 0.8                                                                               | Class A Amplifier                                                                               |
| 6N7<br>6N7GT                | Medium-Mu Twin Power Triode              | 2B<br>13D                       | 8B<br>8B                                  | 6.3                              | 0.8                                                                               | Class A Amplier (as Driver) Class B Amplifier                                                   |
| 6P5GT                       | Medium-Mu Triode                         | 13D                             | 60                                        | 6.3                              | 0.3                                                                               | Amplifier Detector                                                                              |
| 6P7G                        | Low-Mu Triode—Remote-Cutoff<br>Pentode   | 23                              | 7U                                        | 6.3                              | 0.3                                                                               | Amplifier and Converter                                                                         |
| <b>6Q7</b><br>6Q7G<br>6Q7GT | Twin Diode High-Mu Triode                | 3<br>23<br>14A                  | 7V<br>7V<br>7V                            | 6.3                              | 0.3                                                                               | Triode Unit as Class A Amplifier                                                                |
| 6Q11                        | Twin High-Mu Triode—<br>Medium-Mu Triode | 8A                              | 12BY                                      | 6.3⊕                             | 0.6                                                                               | Twin Unit as Class A Amplifier<br>Class A Amplifier                                             |
| 6R7<br>6R7G<br>6R7GT        | Twin Diode-Medium-Mu Tricde              | 3<br>23<br>14A                  | 7V<br>7V<br>7V                            | 6.3                              | 0.3                                                                               | Triode Unit as Class A Amplifie                                                                 |
| 684                         | Medium-Mu Triode                         | 8E                              | 9AC                                       | 6.3<br>6.3⊕                      | 0.6<br>0.6                                                                        | Vertical Deflection Amplifier                                                                   |
| 6S7<br>6S7G                 | Remote-Cutoff Pentode                    | 3<br>23                         | 7R<br>7R                                  | 6.3                              | 0.15                                                                              | Class A Amplifier                                                                               |
| 6S8GT                       | Triple Diode-High-Mu Triode              | 14C                             | 8CB                                       | 6.3                              | 0.3                                                                               | Triode Unit as Class A Amplifie                                                                 |
| 6SA7GT                      | Pentagrid Converter                      | 13D                             | 8R<br>8AD                                 | 6.3                              | 0.3                                                                               | Mixer                                                                                           |
| 6SB7Y                       | Pentagrid Converter                      | 2A                              | 8R                                        | 6.3                              | 0.3                                                                               | Mixer                                                                                           |
| 6SC7                        | High-Mu Twin Triode                      | 2A                              | 85                                        | 6.3                              | 0.3                                                                               | Each Unit as Amplifier                                                                          |
| 6SF5<br>6SF5GT              | High-Mu Triede                           | 2A<br>13D                       | 6AB<br>6AB                                | 6.3                              | 0.3                                                                               | Class A Amplifier                                                                               |

| Plate<br>Sup-<br>ply | Grid Bias<br>Voits (V)<br>or<br>Cathode<br>Resistor | Grid<br>Sup-<br>ply  | Grid<br>Cur-<br>rent | Plate<br>Cur-<br>rent | AC Plate<br>Resist-<br>ance | Trans-<br>conduct-<br>ance                      | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output | Power<br>Out-<br>put | RCA<br>Type                 |
|----------------------|-----------------------------------------------------|----------------------|----------------------|-----------------------|-----------------------------|-------------------------------------------------|------------------------------|---------------------------------------|----------------------|-----------------------------|
| Volts                | Ohms $(\Omega)$                                     | Volts                | mA                   | mA                    | Ohms                        | Micromhos                                       |                              | Ohms                                  | Watts                |                             |
| 100<br>250           | Triode-Gr                                           | id Resisto<br>O ohms | r,                   | 4<br>5                |                             |                                                 | _                            |                                       |                      | 6J8G                        |
| 230                  | 3000                                                |                      | other cl             |                       | tics, refer                 | to Type 6JE                                     | 6 <b>A</b>                   |                                       |                      | 6JE6                        |
|                      |                                                     | For                  | other ch             | aracteris             | tics, refer                 | to Type 6JG                                     | 36A                          |                                       |                      | 6JG6                        |
| 250                  | — 3V                                                | 100                  | 2.8                  | 1.4                   | 1.5                         |                                                 |                              | ond., 290 mic                         | romhos               |                             |
| 250                  | — 3V                                                |                      |                      | 1.1                   | 50000                       | 1400                                            | 70                           |                                       |                      | 6K5GT                       |
| <b>2</b> 50          | <b>— 3V</b>                                         | 125                  | 2.6                  | 10.5                  | 600000                      | 1650                                            |                              |                                       |                      | 6K7<br>6K7G<br>6K7GT        |
| 100                  | Grid Res.                                           | , 50000 of           | ms                   | 3.8                   | Tric                        | de-Grid & H                                     | exode-Grid                   | Current, 0.1                          | 5 mA                 | 6K8                         |
| 100<br>250           | — 3V                                                | 100<br>100           | 6.2<br>6.0           | 2.3<br>2.5            | 400000<br>600000            | Convers                                         | ion Transc                   | ond., 325 mic<br>ond., 350 mic        | romhos<br>romhos     | 6K8G<br>6K8GT               |
| 250<br>250           | — 2V<br>— 8.5V                                      |                      |                      | 1.2                   | 62500                       | 1600<br>2200                                    | 100<br>17                    |                                       |                      | - 6K11                      |
| 100                  | 0                                                   | 100                  | 2.2                  | 10.5<br>5.5           | 7700<br>555000              | 4300                                            | Grid-No.                     | 1 Volts for p<br>nt of 10 μA,         |                      | 6KL8                        |
| 250                  | <b></b> 9V                                          |                      |                      | 8.0                   | 9000                        | 1900                                            | 17                           |                                       |                      | 6L5G                        |
| 250<br>250           | —14V<br>168Ω                                        | 250<br>250           | 5.0<br>5.4           | 72.0<br>75.0          |                             |                                                 |                              | 2500<br>2500                          | 6.5<br>6.5           |                             |
| 270<br>270           | 17.5V<br>124Ω□                                      | 270<br>270           | 11.0 D               | 134.0 D               |                             | =                                               |                              | 5000<br>5000                          | 17.5†<br>18.5†       | - 6L6G<br>- <b>6L6GB</b>    |
| 360<br>360           | —22.5V<br>248Ω□                                     | 270<br>270           | 5.0 🗆<br>5.0 🗆       | 88.0□<br>88.0□        |                             |                                                 |                              | 6600<br>9000                          | 26.5†<br>24.5†       |                             |
| 250                  | — 6V                                                | 150                  | 9.2                  | 2.3                   | Grid                        | illator-Grid (<br>d-No. 3 Peak<br>oversion Tran | Swing, 16                    |                                       |                      | <b>6L7</b><br>6L7G          |
| Outpo                | ut Triode: Plate<br>le: Plate Volts,                | Volts, 30            | 0; Plate             | mA, 45; I             | Load, 7000                  | ohms                                            |                              |                                       | 4.0                  | 6N6G                        |
| 250                  | — 5V                                                | 300; Giiu            | Voits, U             | 6.0                   | 11300                       | 3100                                            | 35                           | 20000                                 | exceeds              | 6N7                         |
| 300                  | <u> </u>                                            | Powe                 | Outnut               | 7.0                   | 11000                       | 3200<br>d plate-to-pla                          | 35                           | or more<br>8000                       | 0.4<br>10.0          | - 6N7GT                     |
| 300                  |                                                     |                      |                      |                       |                             | er to Type 7                                    |                              | 0000                                  | 10.0                 | 6P5GT                       |
|                      |                                                     | F                    | or other o           | haracteri             | istics, refe                | er to Type 6                                    | F7                           |                                       |                      | 6P7G                        |
| 100<br>250           | 1V<br>3V                                            |                      |                      | 0.8<br>1.1            | 58000<br>58000              | 1200<br>1200                                    | 70<br>70                     |                                       |                      | <b>607</b><br>607G<br>607GT |
| 250                  | — 2V                                                |                      |                      | 1.2                   | 62500                       | 1600                                            | 100                          |                                       |                      |                             |
| 150                  | 07                                                  |                      |                      | 22                    | 7000                        | 2500                                            | 18                           |                                       |                      | - 6Q11                      |
| 250                  | <u> </u>                                            |                      | _                    | 9.5                   | 8500                        | 1900                                            | 16                           |                                       |                      | <b>6R7</b><br>6R7G<br>6R7GT |
|                      | DC Plate Volts<br>DC Cathode mA                     |                      |                      |                       |                             | Peak Positiv<br>Plate Dissip                    |                              | ate Volts, 220                        | 00                   | 6S4                         |
| 250                  | — 3V                                                | 100                  | 2.0                  | 8.5                   | 1.0                         | 1750                                            |                              |                                       |                      | 6S7<br>6S7G                 |
| 250                  | — 2V                                                |                      |                      | 0.9                   | 91000                       | 1100                                            | 100                          |                                       |                      | 6S8GT                       |
| 250                  | Self-<br>Excited                                    | 100                  | 8.5                  | 3.5                   | 1.0                         | Conver                                          | sion Trans                   | or, 20000 ohn<br>cond., 450 mi        | cromhos              | 6SA7G1                      |
| 100                  | <b>— 1V</b>                                         | 100                  | 10.2                 | 3.6                   | 500000                      |                                                 |                              | or, 20000 chn<br>cond., 950 mi        |                      | 6SB7Y                       |
| 250                  | 2V                                                  |                      |                      | 2.0                   | 53000                       | 1325                                            | 70                           |                                       |                      | 6SC7                        |
| 250                  | — 2 <b>V</b>                                        |                      |                      | 0.9                   | 66000                       | 1500                                            | 100                          |                                       |                      | 6SF5<br>6SF5GT              |
|                      |                                                     |                      |                      |                       |                             |                                                 |                              |                                       |                      |                             |

<sup>†</sup> For two tubes at stated plate-to-plate load.

| RCA<br>Type    | Name                                     | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Filam Unless sp types hav  # Heater | ter or<br>lent (F)<br>pecified all<br>re heaters.<br>r with con-<br>armup time.<br>Amperes | Use<br>Values to right give operat-<br>ing conditions and character-<br>istics for indicated typical use |
|----------------|------------------------------------------|---------------------------------|-------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 6SF7           | Diode—Remote-Cutoff Pentode              | 2A                              | 7AZ                                       | 6.3                                 | 0.3                                                                                        | Pentode Unit as Class A<br>Amplifier                                                                     |
| 6SG7           | Semiremote-Cutoff Pentode                | 2A                              | 8BK                                       | 6.3                                 | 0.3                                                                                        | Class A Amplifier                                                                                        |
| 6SH7           | Sharp-Cutoff Pentode                     | 2A                              | 8BK                                       | 6.3                                 | 0.3                                                                                        | Class A Amplifier                                                                                        |
| 6SJ7GT         | Sharp-Cutoff Pentode                     | 13D                             | 8N<br>8N                                  | 6.3                                 | 0.3                                                                                        | Class A Amplifier                                                                                        |
| 6SK7<br>6SK7GT | Remote-Cutoff Pentode                    | 2A<br>13D                       | 8N<br>8N                                  | 6.3                                 | 0.3                                                                                        | Class A Amplifier                                                                                        |
| 6SN7GT         | Madium Mu Turin Talada                   | 13D                             | 400                                       | 6.3<br>6.3                          | 0.6                                                                                        | Each Unit as Class A Amplifier                                                                           |
| 6SN7<br>Gta    | Medium-Mu Twin Triode                    | 130                             | 8BD                                       | 6.3⊕                                | 0.6<br>0.6                                                                                 | Each Unit as Vertical Amplifier                                                                          |
| 6SQ7GT         | Twin-Diode—High-Mu Triode                | 13D                             | 8Q<br>8Q                                  | 6.3                                 | 0.3                                                                                        | Triode Unit as Class A Amplifier                                                                         |
| 6SR7           | Twin Diode—Medium-Mu Triode              | 2A                              | 80                                        | 6.3                                 | 0.3                                                                                        | Triode Unit as Class A Amplifier                                                                         |
| <b>6SS7</b>    | Remote-Cutoff Pentode                    | 2A                              | 8N                                        | 6.3                                 | 0.15                                                                                       | Class A Amplifier                                                                                        |
| 6ST7           | Twin Diode—Medium-Mu Triode              | 2A                              | 8Q                                        | 6.3                                 | 0.15                                                                                       | Triode Unit as Amplifier                                                                                 |
| 6SZ7           | Twin Diode—High-Mu Triode                | 2A                              | 8Q                                        | 6.3                                 | 0.15                                                                                       | Triode Unit as Class A Amplifier                                                                         |
| 6T4            | Medium-Mu Triode                         | 5D                              | 70K                                       | 6.3                                 | 0.225                                                                                      | Oscillator in UHF TV Receivers                                                                           |
| 017            | Meniam-Mn Itione                         | 70                              | , , , ,                                   | , 0.3                               | 0.223                                                                                      | Class A Amplifier                                                                                        |
| 6T7G           | Twin Diode—High-Mu Triode                | 22                              | 7٧                                        | 6.3                                 | 0.15                                                                                       | Triode Unit as Class A Amplifier                                                                         |
| 6T8            | Triple Diode—High-Mu Triode              | 6B                              | 9E                                        | 6.3<br>6.3⊕                         | 0.45<br>0.45                                                                               | Triode Unit as Class A Amplifier                                                                         |
| <b>6</b> U5    | Electron-Ray Tube                        | 13H                             | 6R                                        | 6.3                                 | 0.3                                                                                        | Visual Indicator                                                                                         |
| 6U7G           | Remote-Cutoff Pentode                    | 28J                             | 7R                                        | 6.3                                 | 0.3                                                                                        | Class A Amplifier                                                                                        |
| 6U8            | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 6B                              | 9AE                                       | 6.3<br>6.3⊕                         | 0.45<br>0.45                                                                               | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 6V6GT          | Beam Power Tube                          | 13D                             | 7AC<br>7AC<br>7AC                         | 6.3<br>6.3<br>6.3⊕                  | 0.45<br>0.45<br>0.45                                                                       | Single-Tube Class A Amplifier  Push-Pull Class AB1 Amplifier                                             |
| 6V7G           | Twin DiodeLow-Mu Triode                  | 23                              | 77                                        | 6.3                                 | 0.3                                                                                        | Triode Unit as Amplifier                                                                                 |
| 6W7G           | Sharp-Cutoff Pentode                     | 23                              | 7R                                        | 6.3                                 | 0.15                                                                                       | Class A Amplifier                                                                                        |
|                |                                          |                                 | 23                                        |                                     |                                                                                            | With Capacitive-Input Filter                                                                             |
| 6X5            | Full-Wave Rectifier                      | 28                              | 6S<br>6S                                  | 6.3                                 | 0.6                                                                                        | With Inductive-Input Filter                                                                              |
| 6Y5            | Full-Wave Rectifier                      | 22 or<br>13H                    | <b>6</b> J                                | 6.3                                 | 0.8                                                                                        | With Capacitive-Input Filter                                                                             |
| 6Y7G           | High-Mu Twin Power Triode                | 22                              | 8B                                        | 6.3                                 | 0.6                                                                                        | Class B Amplifier                                                                                        |
| 6Z5            | Full-Wave Rectifier                      | 22                              | 6K                                        | 6.3<br>12.6                         | 0.8<br>0.4                                                                                 | With Capacitive-Input Filter                                                                             |
| 6Z7G           | High-Mu Twin Power Triode                | 22                              | 8B                                        | 6.3                                 | 0.3                                                                                        | Class B Amplifier                                                                                        |
| 6ZY5G          | Full-Wave Rectifier                      | 22                              | 68                                        | 6.3                                 | 0.3                                                                                        | With Capacitive-Input Filter                                                                             |
| 7 <b>A</b> 4   | Medium-Mu Triode                         | 12B                             | 5AC                                       | 6.3                                 | 0.3                                                                                        | Amplifier                                                                                                |
| 7A5            | Beam Power Tube                          | 12C                             | 6AA                                       | 6.3                                 | 0.75                                                                                       | Class A Amplifier                                                                                        |
| 7A6            | Twin Biode                               | 12B                             | 7AJ                                       | 6.3                                 | 0.15                                                                                       | Detector Rectifier                                                                                       |

| Plate<br>Sup-<br>ply<br>Voits | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor<br>Ohms (Ω) | Grid<br>Sup-<br>ply<br>Volts | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>conduct-<br>ance<br>Micrombos | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output<br>Ohms | Power<br>Out-<br>put<br>Watts | RCA<br>Type             |
|-------------------------------|-----------------------------------------------------------------|------------------------------|----------------------------|-----------------------------|-------------------------------------|-----------------------------------------|------------------------------|-----------------------------------------------|-------------------------------|-------------------------|
| 100                           | — 1V                                                            | 100                          | 3.4                        | 12.0                        | 200000                              | 1975                                    |                              |                                               |                               | 6SF7                    |
| 250<br>100                    | 1V<br>1V                                                        | 100                          | 3.3                        | 12.4<br>8.2                 | 700000<br>250000                    | 2050<br>4100                            |                              |                                               |                               | 6SG7                    |
| 250                           | 2.5V                                                            | 150                          | 3.4<br>2.1                 | 8.2<br>9.2<br>5.3           | 1.0<br>350000                       | 4000<br>4000                            |                              |                                               |                               |                         |
| 100<br>250                    | — 1V<br>— 1V                                                    | 100<br>150                   | 4.1                        | 10.8                        | 900000                              | 4900                                    |                              |                                               |                               | 6SH7                    |
| 100<br>250                    | — 3V                                                            | 100<br>100                   | 0.9<br>0.8                 | 2.9<br>3.0                  | 700000<br>1.0                       | 1575<br>1650                            |                              |                                               |                               | 6SJ7GT                  |
| 100<br>250                    | — 1V<br>— 3V                                                    | 100<br>100                   | 4.0<br>2.6                 | 13.0<br>9.2                 | 120000<br>800000                    | 2350<br>2000                            | _                            |                                               |                               | 6SK7<br>6SK7 <b>G</b> T |
| 90<br>250                     | V<br>V                                                          |                              |                            | 10.0<br>9.0                 | 6700<br>7700                        | 3000<br>2600                            | 20<br>20                     |                                               |                               | 6SN7GT                  |
| Max.                          | DC Plate Vol                                                    |                              |                            | x. Plate D                  | issipation:                         | 5 watts eith                            | er plate;                    | 7.5 watts bot                                 | h plates                      | - 6SN7<br>GTA           |
| 100                           | Peak Cathode — 1V                                               | mA, /U                       | Ma                         | 0.5                         | 110000                              | se Plate Volt<br>925                    | 100                          |                                               |                               | 6SQ7GT                  |
| 250                           | 2V                                                              |                              |                            | 1.1                         | 85000                               | 1175                                    | 100                          |                                               |                               | 6SR7                    |
| 250<br>250                    | — 9V<br>— 3V                                                    | 100                          | 2.0                        | 9.5                         | 8500<br>1.0                         | 1900<br>1850                            | 16                           |                                               |                               | 6SS7                    |
| 230                           |                                                                 |                              |                            |                             | <del></del>                         | r to Type 6SF                           | R7                           |                                               |                               | 6ST7                    |
| 100                           | — 1V<br>— 3V                                                    |                              |                            | 0.8                         | 54000                               | 1300                                    | 70<br>70                     | <del></del>                                   |                               | 6SZ7                    |
|                               | DC Plate Vol<br>DC Cathode r                                    |                              |                            | 1.0                         |                                     | 1200<br>. Grid mA, 8<br>. Plate Dissi   |                              | 5 watts                                       |                               | 6T4                     |
| 80                            | 150Ω<br>— 3V                                                    |                              |                            | 18<br>1.2                   | 62000                               | 7000<br>1050                            | 13<br>65                     |                                               |                               |                         |
| 250<br>300                    | 3V<br>4580Ω                                                     |                              | =                          |                             | Resistor,*                          |                                         | 03                           | Gain per sta                                  | ge, 40                        | - 6T7G                  |
| 100<br>250                    | - 1V<br>3V                                                      |                              | _                          | 0.8<br>1.0                  | 54000<br>58000                      | 1300<br>1200                            | 70<br>70                     |                                               |                               | 6T8                     |
| Plate                         | & Target Sur<br>Bias, —22 vo                                    | ply, 250 volt                | s. Trio                    | de Plate R                  | esistor, 1.                         | 0 MΩ Target                             | Current,                     | 4.0 mA<br>t 0.24 mA                           |                               | 6U5                     |
| 250                           | — 3V                                                            | 100                          | 2.0                        | 8.2                         | 800000                              | 1600                                    |                              |                                               |                               | 6U7G                    |
| 125                           | <u> </u>                                                        |                              |                            | 13.5                        |                                     | 7500                                    | 40                           |                                               |                               | - (110                  |
| 125                           | <del></del> 1V                                                  | 110                          | 3.5                        | 9.5                         | 200000                              | 5000                                    |                              |                                               |                               | 608                     |
| 250<br>315                    | —12.5V<br>—13V                                                  | 250<br>225                   | 4.5<br>2.2                 | 45.0<br>34.0                | 50000<br>80000                      | 4100<br>3750                            |                              | 5000<br>8500                                  | 4.5<br>5.5                    | - 6V6GT                 |
| 250<br>285                    | —15V<br>—19V                                                    | 250<br>285                   | 5.0 a<br>4.0 a             | 70.0□<br>70.0□              |                                     |                                         |                              | 10000<br>8000                                 | 10.0†<br>14.0†                |                         |
|                               |                                                                 | For                          | other                      | character                   | istics, ref                         | er to Type 85                           |                              |                                               |                               | 6V7G                    |
| 250                           | — 3V                                                            | 100                          | 0.5                        | 2.0                         | 1.5                                 | 1225                                    |                              | T-4-1 F#1                                     |                               | 6W7G                    |
| Max.                          | AC Volts per<br>Peak Inverse                                    | Volts, 1250                  | 325                        | Max.                        | DC Outpu<br>Peak Plat               | e mA, 245                               | Imp                          | Total Effect.<br>ed. per Plate,               | 525 ohms                      | - 6X5                   |
|                               | AC Volts per<br>Peak Inverse                                    |                              | 400                        | max.<br>Max.                | DC Outpu<br>Peak Plat               | t ma, /u<br>:e m <b>ā, 24</b> 5         | Min.                         | . Value of Inp<br>10 henrie                   |                               |                         |
|                               |                                                                 | Max.<br>Max.                 | AC Vol<br>DC Out           | ts per Pla<br>put mA, 5     | te (RMS),<br>O                      | 350                                     |                              |                                               | ,                             | 6Y5                     |
|                               |                                                                 |                              |                            |                             |                                     | er to Type 79                           |                              |                                               |                               | 6Y7G                    |
|                               |                                                                 | Max.<br>Max.                 | AC Vol<br>DC Out           | ts per Pla<br>tput mA, 6    | te (RMS),<br>O                      | 230                                     |                              |                                               |                               | 6Z5                     |
| 180                           | 0V                                                              |                              |                            | for one to                  | ıbe at stat                         | ed plate-to-p                           |                              | 12000                                         | 4.2                           | 6Z7G                    |
| Max.                          | Peak Inverse                                                    | Volts, 1250                  |                            | Max.<br>Max.                | DC Outpu<br>Peak Plat               | t mA, 40<br>e mA, 120                   |                              | n. Total Effec<br>ed. per Plate,              |                               | 6ZY5G                   |
|                               |                                                                 |                              |                            |                             |                                     | r to Type 6J                            | 5                            |                                               |                               | 7A4                     |
| 110<br>125                    | — 7.5 <b>V</b><br>— 9V                                          | 110<br>125                   | 3.0<br>3.3                 | 40.0<br>44.0                | 16000<br>17000                      | 5800<br>6000                            |                              | 2500<br>2700                                  | 1.5<br>2.2                    | 7 <b>A</b> 5            |
| Max.                          | AC Voltage p                                                    | er Plate, 150                | ) Voits                    | , RMS                       |                                     | Max. DC Ou                              | tput Curr                    | ent per plate,                                | 8 mA                          | 7A6                     |
|                               |                                                                 |                              |                            |                             |                                     |                                         |                              |                                               |                               |                         |

| RCA<br>Type  | Name                                | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Filar Unless s types ha  Heate | ater or<br>nent (F)<br>pecified all<br>ve heaters.<br>er with con-<br>varmup time.<br>Amperes | Use Values to right give operating conditions and characteristics for indicated typical use |
|--------------|-------------------------------------|---------------------------------|-------------------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 7 <b>A</b> 7 | Remote-Cutoff Pentode               | 12B                             | 8V                                        | 6.3                            | 0.3                                                                                           | Class A Amplifier                                                                           |
| 7A8          | Octode Converter                    | 12B                             | 80                                        | 6.3                            | 0.15                                                                                          | Converter                                                                                   |
| 7AD7         | Power Pentode                       | 12C                             | V8                                        | 6.3                            | 0.6                                                                                           | Class A Amplifier                                                                           |
| 7AF7         | Medium-Mu Twin Triode               | 12B                             | 8AC                                       | 6.3                            | 0.3                                                                                           | Each Unit as Class A Amplifier                                                              |
| 7AG7         | Sharp-Cutoff Pentode                | 12B                             | 87                                        | 6.3                            | 0.15                                                                                          | Class A Amplifier                                                                           |
| 7AH7         | Sharp-Cutoff Pentode                | 12B                             | 87                                        | 6.3                            | 0.15                                                                                          | Class A Amplifier                                                                           |
| 7B4          | High-Mu Triode                      | 12B                             | 5AC                                       | 6.3                            | 0.3                                                                                           | Amplifier                                                                                   |
| 7B5          | Power Pentode                       | 12C                             | 6AE                                       | 6.3                            | 0.4                                                                                           | Class A Amplifier                                                                           |
| 7B6          | Twin Diode—High-Mu Triode           | 12B                             | 8W                                        | 6.3                            | 0.3                                                                                           | Triode Unit as Amplifier                                                                    |
| 7B7          | Remote-Cutoff Pentode               | 12B                             | 87                                        | 6.3                            | 0.15                                                                                          | Class A Amplifier                                                                           |
| 7B8          | Pentagrid Converter                 | 128                             | 8X                                        | 6.3                            | 0.3                                                                                           | Converter                                                                                   |
| 7C5          | Beam Power Tube                     | 12C                             | 6AA                                       | 6.3                            | 0.45                                                                                          | Class A Amplifier                                                                           |
| 7C6          | Twin Diode—High-Mu Triode           | 12B                             | 8W                                        | 6.3                            | 0.15                                                                                          | Triode Unit as Class A Amplifier                                                            |
| 7C7          | Sharp-Cutoff Pentode                | 12B                             | 87                                        | 6.3                            | 0.15                                                                                          | Class A Amplifier                                                                           |
| 7E6          | Twin Diode-Medium-Mu Triode         | 12B                             | 8W                                        | 6.3                            | 0.3                                                                                           | Triode Unit as Amplifier                                                                    |
| 7E7          | Twin Diode—Remote-Cutoff<br>Pentode | 12B                             | 8AE                                       | 6.3                            | 0.3                                                                                           | Pentode Unit as Class A<br>Amplifier                                                        |
| 7EY6         | Beam Power Tube                     | 13F                             | 7AC                                       | 7.2⊕                           | 0.6                                                                                           | Vertical Deflection Amplifier                                                               |
| 7F7          | High-Mu Twin Triode                 | 128                             | BAC                                       | 6.3                            | 0.3                                                                                           | Each Unit as Amplifier                                                                      |
| 7F8          | Medium-Mu Twin Triode               | 12A                             | 8BW                                       | 6.3                            | 0.3                                                                                           | Each Unit as Class A Amplifier                                                              |
| 7G7          | Sharp-Cutoff Pentode                | 12B                             | 87                                        | 6.3                            | 0.45                                                                                          | Class A Amplifier                                                                           |
| 747          | Semiremote-Cutoff Pentode           | 12B                             | 87                                        | 6.3                            | 0.3                                                                                           | Class A Amplifier                                                                           |
| 717          | Triode-Heptode Converter            | 12B                             | 8BL                                       | 6.3                            | 0.3                                                                                           | Triode Unit as Oscillator  Heptode Unit as Mixer                                            |
| 7 K 7        | Twin Diade-High-Mu Triode           | 12B                             | 8BF                                       | 6.3                            | 0.3                                                                                           | Triode Unit as Class A Amplifier                                                            |
| 7L7          | Sharp-Cutoff Pentode                | 12B                             | 87                                        | 6.3                            | 0.3                                                                                           | Class A Amplifier                                                                           |
| 7N7          | Medium-Mu Twin-Triode               | 12C                             | 8AC                                       | 6.3                            | 0.6                                                                                           | Each Unit as Class A Amplifier                                                              |
| 707          | Pentagrid Converter                 | 12B                             | 8AL                                       | 6.3                            | 0.3                                                                                           | Converter                                                                                   |
| 7R7          | Twin Diode—Remote-Cutoff<br>Pentode | 12B                             | 8AE                                       | 6.3                            | 0.3                                                                                           | Pentode Unit as Class A<br>Amplifier                                                        |
| 7\$7         | Triode-Heptode Converter            | 12B                             | 8BL                                       | 6.3                            | 0.3                                                                                           | Triode Unit as Oscillator Heptode Unit as Mixer                                             |
| 777          | Sharp-Cutoff Pentode                | 12B                             | 87                                        | 6.3                            | 0.45                                                                                          | Class A Amplifier                                                                           |
| 7W7          | Sharp-Cutoff Pentode                | 12B                             | 8BJ                                       | 6.3                            | 0.45                                                                                          | Class A Amplifier                                                                           |
| 7X7          | Twin Diode-High-Mu Triode           | 12C                             | 8BZ                                       | 6.3                            | 0.3                                                                                           | Triode Unit as Class A Amplifier                                                            |
| 7Y4          | Fulf-Wave Rectifier                 | 12B                             | 5AB                                       | 6.3                            | 0.5                                                                                           | With Capacitive-Input Filter                                                                |
| 7Z4          | Full-Wave Rectifier                 | 12C                             | 5AB                                       | 6.3                            | 0.9                                                                                           | With Capacitive-Input Filter                                                                |
| 8FQ7         | Medium-Mu Twin Triode               | 6E                              | 9LP                                       | 8.4⊕                           | 0.45                                                                                          | Vertical and Horizontal<br>Deflection Oscillators                                           |
| 9BR7         | Twin Diode—High-Mu Triode           | 6B                              | 9C F                                      | 4.7 ⊕<br>9.4                   | 0.6<br>0.3                                                                                    | Triode Unit as Class A Amplifier                                                            |
|              |                                     |                                 |                                           |                                |                                                                                               |                                                                                             |

Types shown in light face are discontinued.

| Plate<br>Sup-<br>ply | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor | Grid<br>Sup-<br>ply  | Grid<br>Cur-<br>rent | Plate<br>Cur-<br>rent | AC Plate<br>Resist-<br>ance | Trans-<br>conduct-<br>ance | Amplifi-<br>cation<br>Factor            | Load<br>for Stated<br>Power<br>Output   | Power<br>Out-<br>put | RCA<br>Type |
|----------------------|-----------------------------------------------------|----------------------|----------------------|-----------------------|-----------------------------|----------------------------|-----------------------------------------|-----------------------------------------|----------------------|-------------|
| Volts                | Ohms $(\Omega)$                                     | Volts                | mA                   | mA                    | Ohms                        | Micromhos                  |                                         | Ohms                                    | Watts                |             |
|                      |                                                     | For                  | other c              | haracteris            | tics, refer                 | to Type 6S                 |                                         |                                         |                      | 7A7         |
| 250                  | — 3V                                                | 100                  | 3.2                  | 3.0                   | 700000                      | Oscillator                 | id (2): 250<br>-Grid No.<br>scond., 550 | max. volts,<br>1 Resistor.<br>micromhos | 4.2 mA<br>Conver-    | 7A8         |
| 300                  | 68Ω                                                 | 150                  | 7.0                  | 28.0                  | 300000                      | 9500                       |                                         |                                         |                      | 7AD7        |
| 250                  | 10V                                                 |                      |                      | 9.0                   | 7600                        | 2100                       | 16                                      |                                         |                      | 7AF7        |
| 250                  | 250Ω                                                | 250                  | 2.0                  | 6.0                   | 1 meg.                      | 4200                       |                                         |                                         |                      | 7AG7        |
| 250                  | 250Ω                                                | 250                  | 1.9                  | 6.8                   | 1 meg.                      | 3300                       |                                         |                                         |                      | 7AH7        |
| *                    |                                                     | For                  | other c              | haracteris            | tics, refe                  | r to Type 65               | SF5                                     |                                         |                      | 784         |
|                      |                                                     | For                  | other cl             | naracteris            | tics, refer                 | to Type 6K                 | .6GT                                    |                                         |                      | 7B5         |
|                      |                                                     | For                  | other c              | haracteris            | tics, refe                  | r to Type 6S               | SQ7                                     |                                         |                      | 7B6         |
| 250                  | 3V                                                  | 100                  | 1.7                  | 8.5                   | 750000                      | 1750                       |                                         |                                         |                      | 7B7         |
|                      |                                                     | For                  | other                | characteri            | stics, refe                 | r to Type 6                | A8                                      |                                         |                      | 7B8         |
|                      |                                                     | For                  | other                | characteri            | stics, refe                 | r to Type 6                | V6                                      |                                         |                      | 7C5         |
| 250                  | _ iv                                                |                      |                      | 1.3                   | 100000                      | 1000                       | 100                                     |                                         |                      | 7C6         |
| 250                  | — 3V                                                | 100                  | 0.5                  | 2.0                   | 2.0                         | 1300                       |                                         |                                         |                      | 707         |
|                      |                                                     |                      |                      |                       | tics, refe                  | r to Type 68               | BF6                                     |                                         |                      | 7E6         |
| 250                  | 330Ω                                                | 100                  | 1.6                  | 7.5                   | 700000                      | 1300                       |                                         |                                         |                      | 7E7         |
|                      |                                                     | For                  | other c              | haracteris            | tics, refe                  | r to Type 68               | Y6                                      |                                         |                      | 7EY         |
|                      |                                                     | For                  | ther ch              | aracterist            | ics, refer                  | to Type 6SI                | L7GT                                    | , , , , , , , , , , , , , , , , , , , , |                      | 7F7         |
| 250                  | 500Ω                                                |                      |                      | 6.0                   |                             | 3300                       | 48                                      |                                         |                      | 7F8         |
| 250                  | 2V                                                  | 100                  | 2.0                  | 6.0                   | 800000                      | 4500                       |                                         |                                         |                      | 7G7         |
| 100                  | 1.5V                                                | 100                  | 2.6                  | 7.5                   | 350000                      | 4000                       |                                         |                                         |                      | 7H7         |
| 250                  | 180Ω                                                | 150<br>rid Resisto   | 3.2                  | 10.0                  | 800000                      | 4000                       |                                         |                                         |                      |             |
| 250                  |                                                     | na kesisto<br>O ohms | ١,                   | 5.0                   | Trie                        | ode-Grid & 1               | leptode-Gri                             | d Current, 0.4                          | 1 mA                 | 717         |
| 250                  | — 3V                                                | 100                  | 2.8                  | 1.4                   | 1.5                         | Conv                       | ersion Tran                             | scond., 290 μ                           | mhos                 |             |
| 250                  | 2V                                                  |                      |                      | 2.3                   | 44000                       | 1600                       | 70                                      |                                         |                      | 7K7         |
| 100<br>250           | — 1V<br>— 1.5V                                      | 100<br>100           | 2.4<br>1.5           | 5.5<br>4.5            | 100000<br>1.0               | 3000<br>3100               |                                         |                                         |                      | 7L7         |
| 230                  |                                                     |                      |                      |                       |                             | to Type 6Si                | N7GT                                    |                                         |                      | 7N7         |
| 250                  | — 2V                                                | 100                  | 8.5                  | 3.5                   | 1.0                         | Grid                       | No. 1 Res                               | istor, 20000 o<br>scond., 450 µ         |                      | 7Q7         |
| 250                  | 1V                                                  | 100                  | 2.1                  | 5.7                   | 1.0                         | 3200                       |                                         |                                         |                      | 7R7         |
| 100                  | Triode-G                                            | rid Resisto          | r.                   | 3.0                   |                             |                            |                                         |                                         | <u></u>              |             |
| 250                  | 5000                                                | 00 ohms              | <u> </u>             | 5.0                   |                             |                            |                                         |                                         |                      | 787         |
| 250                  | 2V                                                  | 100                  | 3.0                  | 1.8                   | 1.25                        |                            | ersion Tran                             | scond., 525 µ                           | mhos                 | 71/7        |
| 300                  | 160Ω                                                | 150                  | 3.9                  | 10.0                  | 300000                      | 5800                       |                                         |                                         |                      | 797         |
|                      |                                                     | FO                   | r other              |                       |                             | er to Type 7               |                                         |                                         |                      | 7W7         |
| 250                  | <u> </u>                                            |                      |                      | 1.9                   | 67000                       | 1500                       | 100                                     |                                         |                      | 7X7         |
| Max.                 | Peak Inverse                                        | Voits, 125           | 0                    | Max.                  |                             |                            |                                         | k. Peak Plat                            |                      | <u>7Y4</u>  |
| Max.                 | Peak Inverse V                                      | olts, 1250           |                      |                       |                             | it mA, 100<br>te mA, 300   |                                         | Total Effec.<br>ed. per Plate,          |                      | 724         |
|                      |                                                     | For                  | other (              | haracteri             | stics, refe                 | r to Type 6                | FQ7                                     |                                         |                      | 8FQ         |
| 250                  | 200Ω                                                |                      |                      | 10                    | 10900                       | 4000                       | 60                                      |                                         |                      | 9BF         |

<sup>†</sup> For two tubes at stated plate-to-plate load.

<sup>☐</sup> For two tubes.

| RCA<br>Type                   | Name                                     | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Fil<br>Unless<br>types t<br>⊕ Hea | eater or ament (F) specified all have heaters. ter with con- warmup time. Amperes | Use<br>Values to right give operat-<br>ing conditions and character-<br>istics for indicated typical use |
|-------------------------------|------------------------------------------|---------------------------------|-------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| acrs                          | Medium-Mu Triode—Sharp-Cutoff<br>Tetrode | 6B                              | 9FX                                       | 9.5⊕                              | 0.3                                                                               | Triode Unit as Class A Amplifier Tetrode Unit as Class A Amplifier                                       |
| 10                            | Power Triode                             | 27B                             | - 4D                                      | 7.5F                              | 1.25                                                                              | Class A Amplifier                                                                                        |
| 1008                          | High-Mu Triode—Sharp-Cutoff<br>Pentode   | 6B                              | 9DA                                       | 10.5⊕                             | 0.3                                                                               | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 11<br>12                      | Detector Amplifier                       | 4F<br>4D                        | 4F<br>4D                                  | 1.1F                              | 0.25                                                                              | Class A Amplifier                                                                                        |
| 12A5                          | Power Pentode                            | 22 or<br>13H                    | 7F                                        | 6.3<br>12.6                       | 0.6<br>0.3                                                                        | Class A Amplifier                                                                                        |
| 12A7                          | Rectifier—Power Pentode                  | 24B                             | 7K                                        | 12.6                              | 0.3                                                                               | Pentode Unit as Class A<br>Amplifier                                                                     |
|                               |                                          |                                 |                                           |                                   |                                                                                   | Half-Wave Rectifier                                                                                      |
| 12A8GT                        | Pentagrid Converter                      | 14A                             | A8                                        | 12.6                              | 0.15                                                                              | Converter                                                                                                |
| 12AC6                         | Remote-Cutoff Pentode                    | 5C                              | 7BK                                       | 10.0<br>to<br>15.9                | 0.15<br>approx.<br>at 12.6 V                                                      | Class A Amplifier                                                                                        |
| 12AD6                         | Pentagrid Converter                      | 5C                              | 7CH                                       | 10.0<br>to<br>15.9                | 0.15<br>approx.<br>at 12.6 V                                                      | Converter                                                                                                |
| 12AE6                         | Twin Diode—Medium-Mu Triode              | 5C                              | 7BT                                       | 10.0<br>to<br>15.9                | 0.15<br>approx.<br>at 12.6 V                                                      | Triode Unit as Class A Amplifier                                                                         |
| 12AE6A                        | Twin Diode-Medium-Mu Triode              | 5C                              | 7BT                                       | 10.0<br>to<br>15.9                | 0.15<br>approx.<br>at 12.6 V                                                      | Triode Unit as Class A Amplifier                                                                         |
| 12AE7                         | Dual Triode                              | 6B                              | 9.4                                       | 10.0                              | 0.45                                                                              | Unit No. 1 as Class A Amplifier                                                                          |
| 1ZME/                         | Duai IIIQue                              | O.D                             | JA                                        | to<br>15.9                        | approx.<br>at 12.6 V                                                              | Unit No. 2 as Class A Amplifier                                                                          |
| 12AF6                         | Remote-Cutoff Pentode                    | 5C                              | 7BK                                       | 10.0<br>to<br>15.9                | 0.15<br>approx.<br>at 12.6 V                                                      | Class A Amplifier                                                                                        |
| 12AH7<br>GT                   | Medium-Mu Twin Triode                    | 13C                             | 8BE                                       | 12.6                              | 0.15                                                                              | Each Unit as Class A Amplifier                                                                           |
| 12AJ6                         | Twin Diode-Medium-Mu Triode              | 5C                              | 7BT                                       | 10.0<br>to<br>15.9                | 0.15<br>approx.<br>at 12.6 V                                                      | Triode Unit as Class A Amplifier                                                                         |
|                               |                                          |                                 |                                           |                                   |                                                                                   | Triode Unit as Class A Amplifier                                                                         |
| 12AL8                         | Medium-Mu Triode—Power<br>Tetrode        | 6E                              | <b>96</b> S                               | 10.0<br>to<br>15.9                | 0.55<br>approx.<br>at 12.6 V                                                      | Tetrode Unit as Class A<br>Amplifier                                                                     |
| 12AU7                         | Medium-Mu Twin Triode                    | 6B                              | 9A                                        | 6.3<br>12.6                       | 0.3<br>0.15                                                                       | Each Unit as Class A Amplifier                                                                           |
| 12AV7                         | Medium-Mu Twin Triode                    | 6B                              | 9A                                        | 6.3<br>12.6                       | 0.45<br>0.225                                                                     | Each Unit as Class A Amplifier                                                                           |
| 12AX4-<br>GT<br>12AX4-<br>GTA | Half-Wave Rectifier                      | 13D<br>13D                      | 4CG                                       | 12.6<br>12.6⊕                     | 0.6<br>0.6                                                                        | Television Damper Service                                                                                |
| 12AX7                         | High-Mu Twin-Triode                      | 6B                              | 9A                                        | 6.3<br>12.6                       | 0.3<br>0.15                                                                       | Each Unit as Class A Amplifier                                                                           |
| 12AZ7                         | High-Mu Twin-Triode                      | 6B                              | 9A                                        | 6.3<br>12.6                       | 0.45<br>0.225                                                                     | Each Unit as Class A Amplifier                                                                           |
| 12B8GT                        | High-Mu Triode—Remote-Cutoff<br>Pentode  | <del>-</del>                    | 8T                                        | 12.6                              | 0.3                                                                               | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |

| Plate<br>Sup- | Grid Bias<br>Volts (V)<br>or<br>Cathode                                | Grid<br>Sup-                               | Grid<br>Cur-    | Plate<br>Cur- | AC Plate<br>Resist- | Trans-<br>conduct-                           | Amplifi-<br>cation                   | Load<br>for Stated<br>Power           | Power<br>Gut-     | RCA                           |
|---------------|------------------------------------------------------------------------|--------------------------------------------|-----------------|---------------|---------------------|----------------------------------------------|--------------------------------------|---------------------------------------|-------------------|-------------------------------|
| ply           | Resistor                                                               | ply                                        | rent            | . ent         | ance                | ance                                         | Factor                               | Output                                | put               | Type                          |
| Volts         | Ohms (Ω)                                                               | Voits                                      | mA              | mA<br>        | Ohms                | Micromhos                                    |                                      | Ohms                                  | Watts             |                               |
| 125           | 56Ω                                                                    |                                            |                 | 15            | 5000                | 8000                                         | 40                                   |                                       |                   | - 9CL8                        |
| 125           | <u> </u>                                                               | 125                                        | 4               | 12            | 100000              | 5800                                         |                                      |                                       |                   | - 10                          |
| 425<br>250    | —40V<br>390Ω                                                           |                                            |                 | 18.0<br>7.3   | 5000<br>12000       | 1600<br>4400                                 | 8.0<br>53                            | 10200                                 | 1.6               | 10                            |
| 135           | 100Ω                                                                   | 135                                        | 3.2             | 11.5          | 190000              | 8000                                         |                                      |                                       |                   | 10C8                          |
| 135           | 10.5V                                                                  |                                            |                 | 3             | 15500               | 440                                          |                                      | <del></del>                           |                   | 11<br>12                      |
| 180           | —25V                                                                   | 180                                        | 8.0             | 45.0          | 35000               | 2400                                         |                                      | 3300                                  | 3.4               | 12A5                          |
| 135           | —13.5V                                                                 | 135                                        | 2.5             | 9.0           | 100000              | 975                                          |                                      | 13500                                 | 0.55              |                               |
|               |                                                                        | AC Plate \                                 | oltage          |               |                     |                                              | 125 Vol                              | Its, RMS                              |                   | - 12A7                        |
|               | Maximum                                                                |                                            |                 |               |                     | to Type 6A8                                  |                                      | li amperes_                           |                   | 12A8G1                        |
| 12.6          |                                                                        | 12.6                                       | .2              | .55           | 500000              | 730                                          |                                      | 1 Supply Vol<br>1 Res., 2.2 n         | ts, 0<br>negohms} | 12AC6                         |
| 12.6          | Self-<br>excited                                                       | 12.6                                       | 1.5             | 0.45          | 1                   | Grid-<br>Convers                             | No. 1 Resi<br>ion Transco            | stor, 33000 o<br>ond., 260 mic        | hms<br>romhos     | 12AD6                         |
| 12.6          | 0V                                                                     | _                                          | _               | 0.75          | 15000               | 1000                                         | 15                                   |                                       |                   | 12AE6                         |
| 12.6          | 0V                                                                     |                                            |                 | 1             | 13000               | 1300                                         | 16.7                                 |                                       |                   | 12AE6A                        |
| 12.6          | Grid Res.                                                              | 1.5 megoh                                  | ms              | 1.9           | 3150                | 4000                                         | 13.0                                 |                                       |                   | - 12AE7                       |
| 12.6          | Grid Res                                                               | s. 1 megahr                                | n               | 7.5           | 985                 | 6500                                         | 6.4                                  |                                       |                   | 1271                          |
| 12.6          | <del></del>                                                            | 12.6                                       | 0.45            | 1.1           | 350000              | 1500                                         | {Grid-No.<br>{Grid-No.               | 1 Supply Vol<br>1 Res., 2.2 n         | ts, 0<br>negohms} | 12AF6                         |
| 180           | — 6.5V                                                                 |                                            |                 | 7.6           | 8400                | 1900                                         | 16                                   |                                       |                   | 12AH7<br>GT                   |
| 12.6          | {Grid-No. 1 St<br>Grid-No. 1 Re                                        | upply Volts<br>es., 2.2 me                 | , 0<br>gohms}   | 0.75          | 45000               | 1200                                         | 55                                   |                                       |                   | 12AJ6                         |
| 12.6          | — 0.9V<br>(across 2.2                                                  | megohm r                                   | es.)            | .5            | 13000               | 1000                                         | 13                                   |                                       |                   |                               |
| Grid-         | No. 2 (Control<br>(across 2.2 m<br>No. 1 (Space-Ch<br>scond. (Grid-No. | Grid) Volts,<br>egohm res.)<br>narge Grid) | —.5<br>Voits, 1 | 2.6<br>µmhos  | Ar<br>Gr<br>Pl      | npl. Factor (<br>id-No. 1 mA<br>ate Resistan | Grid-No. 2<br>, 75 Pla<br>ce, 480 oh | to Plate) 7.2<br>ite mA, 40<br>ms     | !                 | 12AL8                         |
| 100<br>250    | 0V<br>— 8.5V                                                           |                                            |                 | 11.8<br>10.5  | 6250<br>7700        | 3100<br>2200                                 | 19.5<br>17                           |                                       |                   | 12AU7                         |
| 150           | 56Ω                                                                    |                                            |                 | 18            | 48000               | 8500                                         | 41                                   | Cutoff Volt                           | s, —12            | 12AV7                         |
| Max.          | Peak Inverse F<br>Peak Plate mA<br>DC Plate mA                         | Plate Volts,<br>, 750<br>, 125             | 4400            |               | Max. P<br>DC con    | 'eak Heater-I<br>nponent mus                 | Cathode Vo<br>t not exce             | elts: { -4400<br>+300<br>ed 900 volts |                   | 12AX4-<br>GT<br>12AX4-<br>GTA |
| 100<br>250    | — 1V<br>— 2V                                                           |                                            |                 | 0.5<br>1.2    | 80000<br>62500      | 1250<br>1600                                 | 100<br>100                           |                                       |                   | 12AX7                         |
| 100<br>250    | 270Ω<br>200Ω                                                           |                                            | =               | 3.7<br>10.0   | 15000<br>10900      | 4000<br>5500                                 | 60<br>60                             |                                       |                   | 12AZ7                         |
| 90            | 07                                                                     |                                            |                 | 2.8           | 37000               | 2400                                         | 90                                   |                                       |                   | 10000                         |
| 90            | <b>— 3V</b>                                                            | 90                                         | 2               | 7             | 200000              | 1800                                         |                                      |                                       |                   | 12B8GT                        |

| RGA<br>Type            | Name                                       | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Filation types had trolled w | ater or<br>ment (F)<br>specified all<br>ave heaters.<br>er with con-<br>varmup time. | Use Values to right give operating conditions and characteristics for indicated typical use |
|------------------------|--------------------------------------------|---------------------------------|-------------------------------------------|------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 12BA7                  | Pentagrid Converter                        | 6E                              | 8CT                                       | Volts<br>12.6                | Amperes                                                                              | Converting                                                                                  |
| 12BD6                  | Remote-Cutoff Pentode                      | 5C                              | 7BK                                       | 12.6                         | 0.15                                                                                 | Class A Amplifier                                                                           |
| 12BF6                  | Twin Diode—Medium-Mu Triode                | 5C                              | 7BT                                       |                              |                                                                                      | Class A Amplifier                                                                           |
|                        | <del></del>                                |                                 |                                           | 12.6<br>6.3⊕                 | 0.15                                                                                 | Triode Unit as Class A Amplifier                                                            |
| 12BH7                  | Medium-Mu Twin Triode                      | 6E                              | 9A                                        | 12.6                         | 0.3                                                                                  | Vertical Deflection Amplifier                                                               |
| 12BK5                  | Beam Power Tube                            | - 8E                            | 9BQ                                       | 12.6⊕<br>10.0                | 0.6                                                                                  | Class A Amplifier                                                                           |
| 12BL6                  | Remote-Cutoff Pentade                      | 5C                              | 78K                                       | to<br>15.9                   | approx.<br>at 12.6V                                                                  | Class A Amplifier                                                                           |
| 12BR7                  | Twin Diode—High-Mu Triode                  | 6B                              | 9CF                                       | 6.3<br>12.6                  | 0.45<br>0.225                                                                        | Triode Unit as Class A Amplifier                                                            |
| 12BV7                  | Sharp-Cutoff Pentode                       | 6E                              | 9BF                                       | 6.3<br>12.6                  | 0.6<br>0.3                                                                           | Class A Amplifier                                                                           |
| 12BW4                  | Full-Wave Rectifier 🗻                      | 6E                              | 9DJ                                       | 6.3                          | 0.9                                                                                  | With Capactive Input Filter With Inductive Input Filter                                     |
| 12BY7                  | Sharp-Cutoff Pentode                       | 8E                              | 9BF                                       | 6.3⊕<br>12.6                 | 0.6                                                                                  | Class A Amplifier                                                                           |
| 12C8                   | Twin Diode—Semiremote-Cutoff<br>Pentode    | 3                               | 8E                                        | 12.6                         | 0.3                                                                                  | Pentode Unit as RF Amplifier                                                                |
| 12CN5                  | Remote-Cutoff Pentode                      | 50                              | 7CV                                       | 10.0<br>to 4<br>15.9         | 0.45<br>approx.<br>at 12.6V                                                          | Class A Amplifier                                                                           |
| 12CT8                  | Medium-Mu Triode—Sharp-Cutoff<br>Pentode   | GE                              | 9DA                                       | 12.6⊕                        | 0.3                                                                                  | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                          |
| 12CX6                  | Remote-Cutoff Pentode                      | 5C                              | 7BK                                       | 10.0<br>to<br>15.9           | 0.15<br>approx.<br>at 12.6V                                                          | Class A Amplifier                                                                           |
| 12DE8                  | Diode-Remote-Cutoff Pentode                | 68                              | 9HG                                       | 10.0<br>to<br>15.9           | 0.2<br>approx.<br>at 12.6V                                                           | Pentode Unit as Class A<br>Amplifier                                                        |
| 12DK7                  | Twin Diode—Power Tetrode                   | 6E                              | 9HZ                                       | 10.0<br>to<br>15.9           | 0.5<br>approx.<br>at 12.6V                                                           | Tetrode Unit as Class A<br>Amplifier                                                        |
| 12DL8                  | Twin Diode—Power Tetrode                   | 6E                              | 9HR                                       | 10.0<br>to<br>15.9           | 0.55<br>approx.<br>at 12.6V                                                          | Tetrode Unit as Class A<br>Amplifier                                                        |
| 12DM4                  | Half-Wave Rectifier                        | 13F                             | 4CG                                       | 12.6⊕                        | 0.6                                                                                  | Television Damper Service                                                                   |
| 12DQ6A                 | Beam Power Tube                            | 20                              | 6AM                                       | 12.6⊕                        | 0.6                                                                                  | Horizontal Deflection Amplifier                                                             |
| 12DQ7                  | Power Pentode                              | 6E                              | 9BF                                       | 6.3⊕<br>12.5                 | 0.6<br>0.3                                                                           | Class A Amplifier                                                                           |
| <b>12057</b><br>12057A | Twin Diode—Power Tetrode                   | 6E<br>6E                        | 93U                                       | 10.0<br>to<br>15.9           | 0.4<br>approx,<br>at 12.6V                                                           | Tetrode Unit as Class A<br>Amplifier                                                        |
|                        |                                            |                                 |                                           | 10.0                         |                                                                                      | Didoe Units                                                                                 |
| 12007                  | Twin Diode—Power Tetrode                   | 6B                              | 81X                                       | 10.0<br>to<br>15.9           | 0.25<br>approx.<br>at 12.6V                                                          | Tetrode Unit as Class A<br>Amplifier                                                        |
| 12DV8                  | Twin Diode—Power Tetrode                   | 6E                              | 9HR                                       | 10.0<br>to<br>15.9           | 0.375<br>approx.<br>at 12.6V                                                         | Class A Amplifier                                                                           |
| 12DW7                  | Dual Triode                                | <b>6B</b>                       | 9A                                        | 12.6<br>6.3                  | 0.15<br>0.3                                                                          | Unit No. 1 as Class A Amplifier Unit No. 2 as Class A Amplifier                             |
| 12DY8                  | Medium-Mu Triode—<br>Remote-Cutaff Tetrode | 6B                              | 91D                                       | 10.0<br>to<br>15.9           | 0.35<br>approx.<br>at 12.6V                                                          | Triode Unit as Class A Amplifier<br>Tetrode Unit as Signal Seeker<br>Relay                  |
| 12EA6                  | Remote-Cutoff Pentode                      | 5C                              | 7BK                                       | 10.0<br>to<br>15.9           | 0.19<br>approx.<br>at 12.6V                                                          | Class A Amplifier                                                                           |
|                        |                                            |                                 |                                           |                              |                                                                                      |                                                                                             |

| Plate<br>Sup-<br>ply<br>Volts | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor<br>Ohms (Ω)  | Grid<br>Sup-<br>ply<br>Volts                  | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>conduct-<br>ance<br>Micromhos   | Amplifi-<br>cation<br>Factor        | Load<br>for Stated<br>Power<br>Output<br>Ohms   | Power<br>Out-<br>put<br>Watts | RCA<br>Type            |
|-------------------------------|------------------------------------------------------------------|-----------------------------------------------|----------------------------|-----------------------------|-------------------------------------|-------------------------------------------|-------------------------------------|-------------------------------------------------|-------------------------------|------------------------|
|                               |                                                                  | For                                           | other o                    | haracteris                  | stics, refer                        | to Type 6E                                | 3A7                                 |                                                 |                               | 12BA7                  |
|                               |                                                                  | For                                           | other c                    | haracteris                  | stics, refer                        | to Type 6E                                | 3D6                                 |                                                 |                               | 12BD6                  |
| 250                           | <u> </u>                                                         |                                               |                            | 9.5                         | 8500                                | 1900                                      | 16                                  | Power Out<br>300 milliw                         | atts                          | 12BF6                  |
| Max.<br>Max.                  | DC Plate Volts<br>DC Plate mA,                                   | , 450<br>20                                   |                            | Abso<br>Max                 | lute Max.<br>Plate Dis              | Peak Positi<br>sipation (Ea               | ve-Pulse Pl                         | ate Volts, 1500                                 |                               | 12BH7                  |
| 250                           | — 5V                                                             | 250                                           | 3.5                        | 35                          | 100000                              | 8500                                      |                                     | 6500                                            | 3.5                           | 12BK5                  |
| 12.6                          | Grid-No. 1<br>Supply<br>Volts, 0                                 | 12.6                                          | 0.5                        | 1.35                        | 500000                              | 1350                                      | for<br>m                            | I and Grid-No.<br>transcond. of<br>icromhos, —5 |                               | 12BL6                  |
| 100<br>250                    | 270Ω<br>200Ω                                                     |                                               |                            | 3.7<br>10                   | 15000<br>10900                      | 4000<br>5500                              | 60<br>60                            |                                                 | _                             | 12BR7                  |
| 250<br>250                    | 68Ω<br>— 8V                                                      | 150<br>180                                    | 6                          | 27<br>0.5                   | 85000                               | 13000                                     |                                     |                                                 |                               | 12BV7                  |
|                               |                                                                  |                                               | or othe                    |                             | rietice re                          | fer to 6BW4                               |                                     |                                                 |                               | 12BW4                  |
|                               |                                                                  |                                               |                            |                             | <del></del>                         |                                           | <u> </u>                            | ···                                             |                               |                        |
| 250                           | 100Ω                                                             | 180                                           | 5.75                       | 26                          | 93000                               | 11000                                     |                                     |                                                 |                               | 12BY7                  |
| 250                           | 3V                                                               | 125                                           | 2.3                        | 10                          | 600000                              | 1325                                      |                                     |                                                 |                               | 12C8                   |
| 12.6                          |                                                                  | 12.6                                          | 3.5                        | 4.5                         | 40000                               | 3800                                      | ∫Grid-No.<br>∫Grid-No.              | 1 Supply Volts<br>1 Res., 2.2 me                | , 0 }<br>gohms}               | 12CN5                  |
| 150                           | 150Ω                                                             |                                               |                            | 9                           | 8200                                | 4900                                      | 40                                  |                                                 |                               | 12CT8                  |
| 200                           | 82Ω                                                              | 125                                           | 3.4                        | 15                          | 150000                              | 7000                                      |                                     |                                                 |                               | 12010                  |
| 12.6                          | Grid-No. 1<br>Supply<br>Voits, 0                                 | 12.6                                          | 1.4                        | 3                           | 40000                               | 3100                                      |                                     | 1 Volts for of 10 μA, —4                        |                               | 12CX6                  |
| 12.6                          |                                                                  | 12.6                                          | 0.5                        | 1.3                         | 300000                              | 1500                                      |                                     | 1 Supply Volt<br>1 Res., 2.2 me                 |                               | 12DE8                  |
| 12.6                          |                                                                  | 12.6                                          | 1                          | 6                           | 4000                                | 5000                                      |                                     | 3500                                            | 0.010                         | 12DK7                  |
| 12.6                          | Grid-No. 2 (Co<br>(across 2.<br>Grid-No. 1 (Sp<br>Transcond. (Gr | 2 megohm<br>ace-Charge                        | resistor<br>Grid) \        | ·)<br>/oits, 12.6           | nhos                                | Ampl. Factorid-No. 1<br>Plate Resis       | mA, 75                              | . 2 to Plate) 7.<br>Plate mA, 40<br>ohms        |                               | 12DL8                  |
|                               |                                                                  |                                               | other c                    | haracteris                  |                                     | to Type 6D                                |                                     |                                                 |                               | 12DM4                  |
| Max.<br>Max.                  | DC Plate Volts,<br>DC Cathode mA                                 | , 700<br>, 140                                |                            |                             | Max<br>Max                          | . Peak Posi<br>. Plate Diss               | tive-Pulse F<br>ipation, 15         | Plate Volts, 600<br>watts                       | 00 (Abs.)                     | 12DQ6A                 |
| 200                           | 68Ω                                                              | 125                                           | 5.6                        | 26                          | 53000                               | 10500                                     |                                     |                                                 |                               | 12DQ7                  |
| 12.6                          | 12.6V                                                            | -0.5<br>(across<br>2.2<br>megohm<br>resistor) | 75<br>(Grid-<br>No. 1)     | 35                          | 500                                 | 19000<br>(Grid-<br>No. 2<br>to Plate)     | 9.1<br>(Grid-<br>No. 2<br>to Plate) |                                                 |                               | <b>12DS7</b><br>12DS7A |
|                               |                                                                  | Dioc                                          | de Plate                   | mA, with                    | 10 Volts                            | Applied, 3 r                              | nA                                  |                                                 |                               |                        |
| 12.6                          |                                                                  | 12.6                                          | 1.5                        | 12                          | 6000                                | 6200                                      | `                                   | 2700                                            | 0.025                         | 12 <b>DU</b> 7         |
| Grid-<br>Trans                | No. 2 (Control G<br>No. 1 (Space-Chascond. (Grid-No.             | arge Grid)                                    | Volts, 1                   | .2.6<br>µmhos               | Gr<br>Pi                            | np!, Factor<br>id-No. 1 m#<br>ate Resista | N, 53<br>nce, 900 oh                | to Plate) 7.6<br>Plate mA, 9<br>ms              |                               | 12DV8                  |
| 250<br>250                    | 2V<br>8.5V                                                       |                                               | ==                         | 1.2                         | 62500<br>7700                       | 2200                                      | 100                                 |                                                 |                               | 12DW7                  |
| 12.6                          |                                                                  |                                               |                            | 1.2                         | 10000                               | 2000                                      | 20                                  |                                                 |                               |                        |
| 10<br>15                      |                                                                  | 10<br>15                                      |                            | 5 min.<br>3 max.            | Grid No. 1                          | resistor 1                                | 0 megohms                           | . Plate Load 7<br>Plate Load 70                 |                               | 12DY8                  |
| 12.6                          | -                                                                | 12.6                                          | 1.4                        | 3.2                         | 32000                               | 3800                                      | Grid-No.<br> Grid-No.               | 1 Supply Volts<br>1 Res., 10 me                 | , 0 )                         | 12EA6                  |

|        |                                         | line<br>(see<br>p. 513) | Dia-<br>gram<br>(see<br>p. 488) | types<br>⊕ Hea     | lament (F) specified all have heaters. iter with con- warmup time. Amperes | Values to right give operat-<br>ing conditions and character-<br>istics for indicated typical use |
|--------|-----------------------------------------|-------------------------|---------------------------------|--------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 12EC8  | Medium-Mu Triode-                       | 6B                      | 9FA                             | 10.0<br>to         | 0.225<br>approx.                                                           | Triode Unit as Class A Amplifier                                                                  |
|        | Semiremote-Cutoff Pentode               | •••                     | 31.7                            | 15.9               | at 12.6V                                                                   | Pentode Unit as Class A<br>Amplifier                                                              |
| 12ED5  | Beam Power Tube                         | 5D                      | 7CV                             | 12.6⊕              | 0.45                                                                       | Class A Amplifier                                                                                 |
| 12EG6  | Pentagrid Amplifier                     | 5C                      | 7CH                             | 10.0<br>to<br>15.9 | 0.15<br>approx.<br>at 12.6V                                                | Class A Amplifier                                                                                 |
| 12EK6  | Remote-Cutoff Pentode                   | 5C                      | 7BK                             | 10.0<br>to<br>15.9 | 0.19<br>approx.<br>at 12.6V                                                | Class A Amplifier                                                                                 |
| 12EL6  | Twin Diede—High-Mu Triode               | 5C                      | 7FB                             | 10.0<br>to<br>15.9 | 0.15<br>approx.<br>at 12.6V                                                | Class A Amplifier                                                                                 |
| 12EM6  | DiodePower Tetrode                      | 6E                      | 944                             | 10.0<br>to<br>15.9 | 0.5<br>approx.<br>at 12.6V                                                 | Class A Amplifier                                                                                 |
| 12EN6  | Beam Power Tube                         | 13D                     | 7AC                             | 12.6⊕              | 0.6                                                                        | Vertical Deflection Amplifier                                                                     |
| 12F5GT | High-Mu Triode                          | 14A                     | 5M                              | 12.6               | 0.15                                                                       | Amplifier                                                                                         |
| 12F8   | Twin Diode—Remote-Cutoff<br>Pentode     | <b>6</b> B              | 9FH                             | 10.0<br>to<br>15.9 | 0.15<br>approx.<br>at 12.6V                                                | Pentode Unit as Class A<br>Amplifier                                                              |
| 12FK6  | Twin Diode—Low-Mu Triode                | 5C                      | 7BT                             | 10.0<br>to<br>15.9 | 0.15<br>approx.<br>at 12.6 V                                               | Triode Unit as Class A Amplifier                                                                  |
| 12FM6  | Twin DiodeMedium-Mu Triode              | 5C                      | 7BT                             | 10.0<br>to<br>15.9 | 0.15<br>approx.<br>at 12.6V                                                | Triode Unit as Class A Amplifier                                                                  |
| 12FV7  | Medium-Mu Twin Triode                   | 6E                      | 9A                              | 6.3<br>12.6        | 0.9<br>0.45                                                                | Each Unit as Class A Amplifier                                                                    |
| 12FX8  | Medium-Mu Triode—Pentagrid<br>Converter | 60                      | 9KV                             | 10.0<br>to         | 0.3<br>approx.                                                             | Triode Unit as Class A Amplifier                                                                  |
|        |                                         |                         |                                 | 15.9               | at 12.6V                                                                   | Pentagrid Unit as Converter                                                                       |
| 12GA6  | Pentagrid Converter                     | 5C                      | 7CH                             | 10.0<br>to<br>15.9 | 0.15<br>approx.<br>at 12.6V                                                | Converter                                                                                         |
| 12GC6  | Beam Power Tube                         | 20                      | 8JX                             | 12.6               | 0.6                                                                        | Horizontal Deflection Amplifier                                                                   |
| 12GJ5  | Novar Beam Power Tube                   | 18A                     | 9QK                             | 12.6⊕              | 0.6                                                                        | Horizontal Deflection Amplifier                                                                   |
| 12J5GT | Medium-Mu Triode                        | 13D                     | 6Q                              | 12.6               | 0.15                                                                       | Amplifier                                                                                         |
| 12J7GT | Sharp-Cutoff Pentode                    | 14A                     | 7R                              | 12.6               | 0.15                                                                       | Amplifier                                                                                         |
| 12J8   | Twin Diode—Power Tetrode                | 6B                      | 9GC                             | 10.0<br>to<br>15.9 | 0.325<br>approx.<br>at 12.6V                                               | Tetrode Unit as Class A<br>Amplifier                                                              |
| 12K5   | Power Tetrode                           | 5D                      | 7EK                             | 10.0<br>to<br>15.9 | 0.4<br>approx.<br>at 12.6V                                                 | Class A Amplifier                                                                                 |
| 12K7GT | Remote-Cutoff Pentode                   | 14A                     | 7R                              | 12.6               | 0.15                                                                       | Amplifier                                                                                         |
| 12K8   | Triode-Hexode Converter                 | 3                       | 8K                              | 12.6               | 0.15                                                                       | Oscillator Mixer                                                                                  |
| 12KL8  | Diode—Sharp-Cutoff Pentode              | 6E                      | 9LQ                             | 12.6⊕              | 0.15                                                                       | Pentode Unit as Class A<br>Amplifier                                                              |
| 12L6GT | Beam Power Tube                         | 13D                     | 7AC                             | 12.6 ⊕             | 0.6                                                                        | Class A Amplifier                                                                                 |
| 12Q7GT | Twin Diode—High-Mu Triode               | 14A                     | 79                              | 12.6               | 0.15                                                                       | Triode Unit as Amplifier                                                                          |
| 12R5   | Beam Power Tube                         | 5D                      | 7CV                             | 12.6⊕              | 0.6                                                                        | Vertical Deflection Amplifier                                                                     |

| Plate<br>Sup-<br>ply<br>Volts | Grid Bias Volts (V) or Cathode Resistor Ohms (Ω)      | Grid<br>Sup-<br>ply<br>Volts      | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>conduct-<br>ance<br>Micromhos   | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output<br>Ohms | Power<br>Out-<br>put<br>Watts | RCA<br>Type |
|-------------------------------|-------------------------------------------------------|-----------------------------------|----------------------------|-----------------------------|-------------------------------------|-------------------------------------------|------------------------------|-----------------------------------------------|-------------------------------|-------------|
| 12.6                          | 4700Ω<br>(Grid Res.)                                  |                                   |                            | 2.4                         | 6000                                | 4700                                      | 25                           |                                               |                               | 10506       |
| 12.6                          |                                                       | 12.6                              | 0.28                       | 0.66                        | 750000                              | 2000                                      | Grid No.                     | 1 Res., 330                                   | 00 ohms                       | - 12EC8     |
| 1.25                          | 4.5V                                                  | 125                               | 7                          | 37                          | 14000                               | 8500                                      | <del></del>                  | 4500                                          | 1.5                           | 12ED5       |
| 12.6                          | — 0.6V†                                               | 12.6                              | 2.8                        | .55                         | 150000                              | 800                                       | †Bias vol                    | Grid No. 3<br>tage across<br>megohms          |                               | 12EG6       |
| 12.6                          |                                                       | 12.6                              | 1.7                        | 4                           | 50000                               | 4200                                      | Grid-No.                     | 1 Supply<br>1 Res. (By<br>2.2 megohms         | Volts, O<br>passed),          | 12EK6       |
| 12.6                          | ov                                                    |                                   |                            | 0.75                        | 45000                               | 1200                                      | 55                           |                                               |                               | 12ELG       |
| 12.6                          | _                                                     | 12.6                              | 1                          | 6                           | 4000                                | 5000                                      | Grid-No.                     | 1 Res., 2.2                                   | megohms                       | 12EM6       |
| Max.                          | Peak PosPulse<br>Peak NegPuls<br>Peak Cathode n       | e Grid Vol                        | 200<br>ts, <b>2</b> 50     |                             |                                     |                                           | Plate Diss<br>DC Plate V     | ipation, 7 w:<br>/olts, 300                   | atts                          | 12EN6       |
|                               |                                                       | For                               | other c                    | haracteri                   | stics, refer                        | to Type 6F                                | 5GT                          |                                               |                               | 12F5G       |
| 12.6                          | 0V                                                    | 12.6                              | 0.38                       | 1                           | 330000                              | 1000                                      | Grid-No.<br>cond. of         | 1 Volts fo<br>10 microm                       | r trans-<br>hos, —5           | 12F8        |
| 12.6                          | Grid Res.                                             | oly Volts,<br>(Bypassed<br>egohms | 0<br>),                    | 1.3                         | 6200                                | 1200                                      | 7.4                          |                                               |                               | 12FK        |
| 12.6                          | ov                                                    |                                   |                            | 1                           | 7700                                | 1300                                      | 10                           |                                               |                               | 12FM6       |
| 100                           | — 2V                                                  |                                   |                            | 16                          | 2250                                | 9600                                      | 21.5                         |                                               |                               | 12FV7       |
| 12.6                          |                                                       |                                   |                            | 1.3                         | 7150                                | 1400                                      | 10                           | Grid F<br>2.2 me                              |                               | .054        |
| 12.6                          |                                                       | 12.6                              | 1.25                       | 0.29                        | 500000                              | Grid N<br>Conver                          | o. 3 Res.,<br>sion Transc    | 2.2 megohr                                    |                               | - 12FX8     |
| 12.6                          | 1.6V                                                  | 12.6                              | 0.8                        | 0.3                         | 1                                   |                                           |                              | 33000 ohms<br>cond., 140                      |                               | 12GA6       |
| Max.<br>Max.                  | DC Plate Volts,<br>DC Cathode mA                      | 770<br>. 175                      |                            |                             |                                     | Max. Peak<br>Max. Plate                   |                              | se Plate Vol<br>17.5 watts                    | ts, 6500                      | 12GCE       |
|                               |                                                       |                                   | other                      | characteri                  | stics, refe                         | r to Type 6G                              |                              |                                               |                               | 12GJ5       |
|                               |                                                       | For                               | other o                    | haracteri                   | stic <b>s,</b> refer                | to Type 6J5                               | GT                           |                                               |                               | 12J5G1      |
|                               |                                                       | Fo                                | r other                    | characte                    | ristics, ref                        | er to Type 6                              | J7GT                         |                                               |                               | 12J7G1      |
| 12.6                          | <b>— 0V</b>                                           | 12.6                              | 1.5                        | 12                          | 6000                                | 5500                                      |                              | 2700                                          | 0.02                          | 12J8        |
| Grid-I                        | late Volts, 12.6<br>No. 1 (Space- Cl<br>late mA, 40   | harge Grid                        |                            | 12.6                        | l Grid) Volt<br>Ampli<br>Transi     | ts, —.5<br>fication Fact<br>cond., Grid-N | tor, Grid-No                 | esistance, 4<br>. 2 to Plate,<br>te, 15000 µr | 7.2                           | 12K5        |
|                               |                                                       | . Fo                              | r other                    | characte                    | ristics, ref                        | er to Type 6                              | K7GT                         |                                               |                               | 12K7G       |
|                               | <del></del>                                           | Fo                                | r other                    | character                   | istics, ref                         | er to Type 6                              | К8                           |                                               |                               | 12K8        |
|                               |                                                       | F0                                | r other                    |                             | istics, see                         | Type 6KL8                                 |                              |                                               |                               | 12KL8       |
| 110<br>200                    | — 7.5V<br>180Ω                                        | 110<br>125                        | 4.0<br>2.2                 | 49<br>46                    | 13000<br>28000                      | 8000<br>8000                              |                              | 2000<br>4000                                  | 2.1<br>3.8                    | 12L66       |
|                               |                                                       |                                   |                            |                             |                                     | er to Type 6                              | Q7GT                         | - <del></del>                                 |                               | 12Q7G       |
| Max.                          | DC Plate Volts,<br>Peak Cathode m<br>Plate Dissipatio | 1A, 155                           | tts                        |                             | Max.                                | Peak NegF<br>Grid-No. 2 \<br>Peak Positiv | /olts, 150                   |                                               |                               | 12R5        |

| RCA<br>Type          | Name                                                 | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Unless<br>types<br>⊕ Hea<br>trolled | leater or<br>lament (F)<br>specified all<br>have heaters.<br>ter with con-<br>warmup time. | Use  Values to right give operating conditions and characteristics for indicated typical use |
|----------------------|------------------------------------------------------|---------------------------------|-------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| 12S8GT               | Triple Biode-High-Mu Triode                          | 14B                             | 8CB                                       | Volts<br>12.6                       | Amperes<br>0.15                                                                            | Triode Unit as Class A Amplifier                                                             |
| 12SA7<br>GT          | Pentagrid Converter                                  | 13D                             | 8R<br>8AD                                 | 12.6                                | 0.15                                                                                       | Converter                                                                                    |
| 12SC7                | High-Mu Twin Triode                                  | 2A                              | 88                                        | 12.6                                | 0.15                                                                                       | Each Unit as Class A Amplifier                                                               |
| 128F5<br>128F5<br>GT | High-Mu Triode                                       | 2A<br>13D                       | 6AB<br>6AB                                | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 12SF7                | Diode-Remote-Cutoff Pentode                          | 2A                              | 7AZ                                       | 12.6                                | 0.15                                                                                       | Pentode Unit as Amplifier                                                                    |
| 12S <b>G</b> 7       | Semiremote-Cutoff Pentode                            | 2A                              | 8BK                                       | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 12SH7                | Remate-Cutoff Pentode                                | 3                               | 8BK                                       | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 12SJ7<br>GT          | Sharp-Cutoff Pentode                                 | 13D                             | 8N<br>8 <del>N</del>                      | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 12SK7<br>12SK7<br>GT | Remote-Cutoff Pentode                                | 2A<br>13D                       | 8N<br>8N                                  | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 12SN7<br>GT          | Medium-Mu Twin Triode                                | 13D                             | 8BD                                       | 12.6                                | 0.3                                                                                        | Each Unit as Class A Amplifier                                                               |
| 12SQ7<br>GT          | Twin Diode—High-Mu Triode                            | 130                             | 8Q<br>8Q                                  | 12.6                                | 0.15                                                                                       | Triode Unit as Class A Amplifier                                                             |
| 12SR7<br>12SR7<br>GT | Twin Diode—Medium-Mu Triode                          | 2A<br>13D                       | 8Q<br>8Q                                  | 12.6                                | 0.15                                                                                       | Triode Unit as Class A Amplifier                                                             |
| 1207                 | Medium-Mu Twin Triode                                | 6B                              | 7CK                                       | 10.0<br>to<br>15.9                  | 0.15<br>approx.<br>at 12.6V                                                                | Each Unit as Class A Amplifier                                                               |
| 12Z3                 | Half-Wave Rectifier                                  | 22                              | 4 <b>G</b>                                | 12.6                                | 0.3                                                                                        | With Capacitive-Input Filter                                                                 |
| 14 <b>A</b> 4        | Medium-Mu Triode                                     | 128                             | 5AC                                       | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 14A5                 | Beam Power Tube                                      | 12B                             | 6AA                                       | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 14A7                 | Remote-Cutoff Pentode                                | 12B                             | 87                                        | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 14AF7                | Medium-Mu Twin-Triode                                | 12B                             | 8AC                                       | 12.6                                | 0.15                                                                                       | Each Unit as Class A Amplifier                                                               |
| 14B6                 | Twin Diode—High-Mu Triode                            | 12B                             | 8W                                        | 12.6                                | 0.15                                                                                       | Triode Unit as Class A Amplifier                                                             |
| 14B8                 | Pentagrid Converter                                  | 12B                             | BX                                        | 12.6                                | 0.15                                                                                       | Converter                                                                                    |
| 14C5                 | Beam Power Tube                                      | 12C                             | 6AA                                       | 12.6                                | 0.225                                                                                      | Class A Amplifier                                                                            |
| 14C7                 | Sharp-Cutoff Pentode                                 | 12B                             | 87                                        | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 14 <b>E</b> 6        | Twin Diode-Medium-Mu Triode                          | 12B                             | 8W                                        | 12.6                                | 0.15                                                                                       | Triode Unit as Class A Amplifier                                                             |
| 14E7                 | Twin Diode—Remote-Cutoff Pentode                     | 12B                             | BAE                                       | 12.6                                | 0.15                                                                                       | Pentode Unit as Class A<br>Amplifier                                                         |
| 14F7                 | High-Mu Twin Triede                                  | 12B                             | 8AC                                       | 12.6                                | 0.15                                                                                       | Each Unit as Class A Amplifier                                                               |
| 14F8                 | Medium-Mu Twin Triode                                | 12A                             | 88W                                       | 12.6                                | 0.15                                                                                       | Each Unit as Class A Amplifier                                                               |
| 14H7                 | Semiremote-Cutoff Pentode                            | 128                             | 87                                        | 12.6                                | 0.15                                                                                       | Class A Amplifier                                                                            |
| 14J7<br>14N7         | Triode-Heptode Converter                             | 12B                             | 8BL                                       | 12.6                                | 0.15                                                                                       | Converter  Each Unit as Class A Amplifier                                                    |
| 14N7<br>14Q7         | Medium-Mu Twin Triode                                | 12C<br>12B                      | 8AC<br>8AL                                | 12.6                                | 0.3                                                                                        | Converter                                                                                    |
| 14 <b>47</b><br>14R7 | Pentagrid Converter Twin Diode—Remote-Cutoff Pentode | 12B                             | BAE                                       | 12.6                                | 0.15                                                                                       | Pentode Unit as Class A<br>Amplifier                                                         |
| 15                   | Sharp-Cutoff Pentode                                 | 248                             | 5F                                        | 2.0                                 | 0.22                                                                                       | Class A Amplifier                                                                            |
| 17AX4<br>GT          | Half-Wave Rectifier                                  | 13D                             | 4C <b>G</b>                               | 16.8⊕                               | 0.45                                                                                       | Television Damper Service                                                                    |

| Plate<br>Sup-<br>ply<br>Velts | Volts (V)<br>or<br>Cathode<br>Resistor<br>Ohms (Ω) | Grid<br>Sup-<br>ply<br>Volts | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>conduct-<br>ance<br>Micromhos | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output<br>Ohms | Power<br>Out-<br>put<br>Watts                  | RCA<br>Type          |
|-------------------------------|----------------------------------------------------|------------------------------|----------------------------|-----------------------------|-------------------------------------|-----------------------------------------|------------------------------|-----------------------------------------------|------------------------------------------------|----------------------|
| 250                           | 2V                                                 |                              |                            | 0.9                         | 91000                               | 1100                                    | 100                          |                                               |                                                | 12S8G1               |
| 230                           |                                                    | Fo                           | or other                   |                             |                                     | er to Type 6                            |                              |                                               | -                                              | 12SA7<br>GT          |
|                               |                                                    | Fo                           | r other                    | characte                    | ristics, ref                        | er to Type 6                            | SC7                          |                                               |                                                | 12SC7                |
|                               |                                                    |                              |                            |                             |                                     |                                         |                              |                                               |                                                | 12SF5                |
|                               |                                                    | F                            | r other                    | characte                    | ristics, ref                        | er to Type 6                            | SF5                          |                                               |                                                | 12SF5<br>GT          |
|                               |                                                    | Fo                           | r other                    | characte                    | istics, ref                         | er to Type 6                            | SF7                          |                                               |                                                | 12SF7                |
| -                             |                                                    | Fo                           | r other                    | character                   | istics, ref                         | er to Type 6                            | SG7                          |                                               |                                                | 12567                |
|                               |                                                    | Fo                           | r other                    | characte                    | ristics, ref                        | er to Type 6                            | SH7                          |                                               |                                                | 12SH7                |
|                               |                                                    | Fo                           | r other                    | characte                    | ristics, ref                        | er to Type 6                            | SJ7                          |                                               |                                                | 12SJ7<br>GT          |
|                               |                                                    | F                            | or other                   | characte                    | ristics, ref                        | er to Type 6                            | SK7                          |                                               |                                                | 12SK7<br>12SK7<br>GT |
|                               |                                                    | Fo                           | or other                   | characte                    | ristics, ref                        | er to Type 6                            | J5                           |                                               | <del></del>                                    | 12SN7<br>GT          |
|                               |                                                    | Fo                           | r other                    | characte                    | ristics, ref                        | er to Type 6                            | SQ7                          |                                               | <u>,                                      </u> | 12SQ7<br>GT          |
|                               |                                                    | F                            | or other                   | characte                    | ristics, ref                        | er to Type 6                            | SR7                          |                                               |                                                | 12SR7<br>12SR7<br>GT |
| 12.6                          | 0V                                                 |                              |                            | 1                           | 12500                               | 1600                                    | 20                           |                                               |                                                | 1207                 |
|                               |                                                    |                              |                            | May DC                      | Output mA                           | 55                                      |                              |                                               |                                                | 12Z3                 |
| <del></del>                   |                                                    | Fr                           | r other                    |                             |                                     | er to Type 6                            | 15                           |                                               |                                                | 14A4                 |
| 250                           | —12.5V                                             | 250                          | 5.5                        | 32                          | 70000                               | 3000                                    |                              | 7500                                          | 2.8                                            | 14A5                 |
| 100                           | — 1V                                               | 100                          | 4.0                        | 13.0<br>9.2                 | 120000                              | 2350                                    |                              |                                               |                                                | 14A7                 |
| 250                           | 3V                                                 | 100                          | 2.6                        |                             | 800000                              | 2000                                    | A F 7                        |                                               |                                                | 14AF7                |
|                               |                                                    |                              |                            |                             |                                     | er to Type 7                            |                              |                                               | <del>`</del>                                   | 14B6                 |
|                               |                                                    |                              |                            |                             |                                     | er to Type 6                            |                              |                                               |                                                | 1488                 |
| 315                           | —13V                                               | 225                          | 2.2                        | 34.0                        | 80000                               | er to Type 6<br>3750                    | no                           | 8500                                          | 5.5                                            | 14C5                 |
| 010                           |                                                    |                              |                            |                             |                                     | er to Type 6                            | \$17                         | 0.500                                         | 3.3                                            | 14C7                 |
|                               |                                                    |                              |                            |                             |                                     | er to Type 6                            |                              |                                               | •                                              | 14E6                 |
| 250                           | 330Ω                                               | 100                          |                            | 7.5                         | 700000                              | <del> </del>                            | D10                          |                                               |                                                | 14E7                 |
| 200                           | 33071                                              |                              | 1.6                        |                             |                                     | 1300                                    |                              |                                               |                                                |                      |
| 050                           | 500.0                                              | FC                           | r other                    |                             | istics, refe                        | er to Type 6                            |                              |                                               |                                                | 14F7                 |
| 250                           | 500Ω                                               |                              |                            | 6.0                         |                                     | 3300                                    | 48                           |                                               |                                                | 14F8                 |
|                               |                                                    |                              |                            |                             |                                     | r to Type 7                             |                              |                                               |                                                | 14H7                 |
|                               | <del></del>                                        |                              |                            |                             |                                     | er to Type 7                            |                              |                                               |                                                | 14J7                 |
|                               |                                                    | •                            |                            |                             |                                     | er to Type 6                            |                              |                                               |                                                | 14N7<br>14Q7         |
|                               |                                                    |                              |                            |                             |                                     | er to Type 6<br>er to Type 7            |                              |                                               |                                                | 14 <b>47</b>         |
| 100                           | 1.57                                               |                              |                            |                             |                                     |                                         |                              |                                               |                                                |                      |
| 135<br>May                    | - 1.5V<br>Peak Inverse P                           | 67.5                         | 0.3                        | 1.85                        | 800000                              | 750<br>Peak Heater                      | Cathoda 1                    | /oits: (4000                                  |                                                | 15                   |
|                               |                                                    |                              | . 4460                     |                             | max.                                | reak meater                             | -varnoge V                   | uncs: 1 —4000                                 |                                                | 17AX4                |

| RCA<br>Type           | Name                                     | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Filan<br>Unless s<br>types ha<br>• Heate | nter or<br>nent (F)<br>pecified all<br>ve heaters.<br>r with con-<br>armup time.<br>Amperes | Use<br>Values to right give operat-<br>ing conditions and character-<br>istics for indicated typical use |
|-----------------------|------------------------------------------|---------------------------------|-------------------------------------------|------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 17DM4                 | Half-Wave Rectifier                      | 13 <b>G</b>                     | 4CG                                       | 16.8⊕                                    | 0.45                                                                                        | Television Damper Service                                                                                |
| 17DQ6A                | Beam Power Tube                          | 20                              | 6AM                                       | 16.8⊕                                    | 0.45                                                                                        | Horizontal Deflection Amplifier                                                                          |
| 17GJ5                 | Novar-Beam Power Tube                    | 18A                             | 9QK                                       | 16.8⊕                                    | 0.45                                                                                        | Horizontal Deflection Amplifier                                                                          |
| 17H3                  | Half-Wave Rectifier                      | 6E                              | 9FK                                       | 17.5⊕                                    | 0.3                                                                                         | Television Damper Service                                                                                |
| 17JG6                 | Beam Power Tube                          | 17B                             | 9QU                                       | 16.8⊕                                    | 0.6                                                                                         | Horizontal Deflection Amplifier                                                                          |
| 17LD8                 | Medium-Mu Triode—Sharp-Cutoff<br>Pentode | 10F                             | 907                                       | 16.8⊕                                    | 0.45                                                                                        | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 18A5                  | Beam Power Tube                          | 13F                             | 6CK                                       | 18.5⊕                                    | 0.3                                                                                         | Horizontal Deflection Amplifier                                                                          |
| 18FW6                 | Remote-Cutoff Pentode                    | 5C                              | 7CC<br>7CC                                | 18.0<br>18.0⊕                            | 0.1<br>0.1                                                                                  | Class A Amplifier                                                                                        |
| 18FX6                 | Pentagrid Converter                      | 5C                              | 7CH<br>7CH                                | 18.0<br>18.0 ⊕                           | 0.1<br>0.1                                                                                  | Converter                                                                                                |
| 18FY6                 | Twin Diode—High-Mu Triode                | 5C                              | 7BT<br>7BT                                | 18.0<br>18.0⊕                            | 0.1<br>0.1                                                                                  | Triode Unit as Class A Amplifier                                                                         |
| 19                    | High-Mu Twin Power Triode                | 22 or<br>13H                    | 6C                                        | 2.0F                                     | 0.26                                                                                        | Amplifier                                                                                                |
| 19AU4<br>GTA          | Half-Wave Rectifier                      | 136                             | 4CG                                       | 18.9⊕                                    | 0.6                                                                                         | Television Damper Service                                                                                |
| 19BG6G<br>19BG6<br>GA | Beam Power Tube                          | 27B                             | 5BT                                       | 18.9                                     | 0.3                                                                                         | Horizontal Deflection Amplifier                                                                          |
| 19J6                  | Medium-Mu Twin Triode                    | 5C                              | 7BF                                       | 18.9                                     | 0.15                                                                                        | Each Unit as Class A Amplifier                                                                           |
| 1918                  | Triple Diode—High-Mu Triode              | _                               | 9E                                        | 18.9                                     | 0.15                                                                                        | Triode Unit as Class A Amplifier                                                                         |
| 20                    | Power Triode                             |                                 | 4D                                        | 3.3F                                     | 0.132                                                                                       | Class A Amplifier                                                                                        |
| 20EQ7                 | Diode—Remote-Cutoff Pentode              | 6E                              | SLQ                                       | 20.0                                     | 0.1                                                                                         | Pentode Unit as Class A<br>Amplifier                                                                     |
| 21EX6                 | Beam Power Tube                          | 21B                             | 5BT                                       | 21.5⊕                                    | 0.6                                                                                         | Horizontal Deflection Amplifier                                                                          |
| 22                    | Sharp-Cutoff Tetrode                     | 29K                             | 4K                                        | 3.3F                                     | 0.132                                                                                       | Screen-Grid RF Amplifier                                                                                 |
| 22JG6                 | Beam Power Tube                          | 17B                             | 900                                       | 22⊕                                      | 0.45                                                                                        | Horizontal Deflection Amplifier                                                                          |
| 24A                   | Sharp-Cutoff Tetrode                     | 29K                             | 5E                                        | 2.5                                      | 1.75                                                                                        | Screen-Grid RF Amplifier                                                                                 |
| 25A6<br>25A6GT        | Power Pentode                            | 2B<br>13D                       | 7\$<br>7\$                                | 25.0                                     | 0.3                                                                                         | Class A Amplifier                                                                                        |
| 25A7GT                | Rectifier—Power Pentode                  | 13D                             | 8F                                        | 25.0                                     | 0.3                                                                                         | Pentode Unit as Class A Amplifier Half-Wave Rectifier                                                    |
| 25AC5<br>GT           | High-Mu Power Triode                     | 13D                             | 60                                        | 25.0                                     | 0.3                                                                                         | Amplifier                                                                                                |
| 25B5                  | Direct-Coupled Power Amplifier           |                                 | 60                                        | 25.0                                     | 0.3                                                                                         | Amplifier                                                                                                |
| 25B6G                 | Power Pentode                            | 25                              | 7\$                                       | 25.0                                     | 0.3                                                                                         | Class A Amplifier                                                                                        |
| 25B8GT                | High-Mu Triode—Remote-Cutoff<br>Pentode  | 13D                             | 8T                                        | 25.0                                     | 0.15                                                                                        | Triode Unit as Class A Amplifier Pentode Unit as Class A Amplifier                                       |
| 25BK5                 | Beam Power Tube                          | 68                              | 9BQ                                       | 25                                       | 0.3                                                                                         | Class A Amplifier                                                                                        |
| 25BQ6<br>GT           | Beam Power Tube                          | 14D                             | 6AM                                       | 25.0                                     | 0.3                                                                                         | Horizontal Deflection Amplifier                                                                          |
| 25C6G                 | Beam Power Tube                          | 25                              | 7AC                                       | 25.0                                     | 0.3                                                                                         | Class A Amplifier                                                                                        |
| 25CD6<br>GA           | Beam Power Tube                          | 21B                             | SBT<br>SBT                                | 25 ⊕<br>25 ⊕                             | 0.6                                                                                         | Horizontal Deflection Amplifier                                                                          |

| Plate<br>Sup-<br>ply<br>Voits | Grid Bias Volts (V) or Cathode Resistor Ohms (Ω) | Grid<br>Sup-<br>ply<br>Voits | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>conduct-<br>ance<br>Micromhos | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output<br>Ohms | Power<br>Out-<br>put<br>Watts | RCA<br>Type                 |
|-------------------------------|--------------------------------------------------|------------------------------|----------------------------|-----------------------------|-------------------------------------|-----------------------------------------|------------------------------|-----------------------------------------------|-------------------------------|-----------------------------|
|                               |                                                  |                              |                            | r rating                    | s. refer to                         | Type 6DM4                               |                              |                                               |                               | 17DM4                       |
| Max.                          | DC Plate Volts                                   | 700                          |                            |                             | Max.                                | Peak Positiv                            |                              | late Volts, 600                               | 0 (Abs.)                      | 17DQ6#                      |
| мах.                          | DC Cathode mA                                    | , 140                        | For oth                    | er rating                   |                                     | Plate Dissip<br>Type 6GJ5               | ation, 15                    | watts                                         |                               | 17GJ5                       |
| Max.                          | Peak Inverse P                                   | late Volts                   |                            |                             |                                     | Average Plat<br>Plate Dissip            | te mA, 75                    | -44-                                          |                               | 17H3                        |
| Max.                          | Peak Plate mA,                                   |                              | other ch                   | aracteris                   |                                     | to Type 17J                             |                              | atts                                          |                               | 17JG6                       |
| 150                           | 5V                                               |                              |                            | 3.3                         | 11300                               | 1900                                    | 21.5                         |                                               |                               | - 47100                     |
| 120                           | — 8V                                             | 110                          | 4                          | 46                          | 11700                               | 7100                                    |                              | -                                             |                               | 17LD8                       |
| Max.<br>Max.                  | DC Plate Volts<br>DC Cathode mA                  | , 350<br>90                  |                            |                             |                                     | Peak PosP<br>Plate Dissip               |                              |                                               |                               | 18A5                        |
| 100                           | 68Ω                                              | 100                          | 4.4                        | 11                          | 250000                              | 4400                                    | —                            |                                               |                               | 18FW6                       |
| 100                           | — 1.5V                                           | 100                          | 6.2                        | 2.3                         | 400000                              | Grid I<br>Conve                         | No. 1 Resi<br>ersion Trar    | stor, 20000 oh<br>nscond., 480 µ              | ms<br>mhos                    | 18FX6                       |
| 100                           | <b>— 1V</b>                                      |                              |                            | 0.6                         | 77000                               | 1300                                    | 100                          |                                               |                               | 18 <b>FY</b> 6              |
|                               |                                                  | Fo                           | r other c                  | haracteri                   | istics, refe                        | r to Type 1J                            | 6GT                          |                                               |                               | 19                          |
|                               |                                                  |                              | For other                  | ratings,                    | refer to T                          | ype 6AU4GT                              | A                            |                                               |                               | 19AU4<br>GTA                |
| Max.<br>Max.                  | DC Plate Volts<br>DC Plate Curre                 | , 700<br>ent, 110 m          | Α.                         |                             | Max.<br>Max.                        | Peak Positi<br>Plate Dissip             | ve-Pulse P<br>pation, 20     | late Voits, 660<br>watts                      | 00 (Abs.)                     | 19BG6<br>19BG6<br>GA        |
| 100                           | 50Ω (For the specifi                             |                              |                            | 8.5                         | 7100                                | 5300                                    | 38                           |                                               |                               | 19J6                        |
|                               |                                                  | Fo                           | or other o                 | haracter                    | istics, ref                         | er to Type 6                            | T8A                          |                                               |                               | 19T8                        |
| 135                           | 22.5V                                            |                              |                            | 6.5                         | 6300                                | 525                                     | 3.3                          | 6500                                          | 0.110                         | 20                          |
|                               |                                                  | Fo                           | or other o                 | haracter                    | istics, ref                         | er to Type 6                            | EQ7                          |                                               |                               | 20EQ7                       |
|                               |                                                  |                              |                            | er rating                   | gs, refer to                        | Type 6EX6                               |                              |                                               |                               | 21EX6                       |
| 135                           | 1.5V                                             | 67.5                         | 1.3<br>(Max.)              | 3.7                         | 325000                              | 500                                     |                              |                                               |                               | 22                          |
|                               |                                                  | For                          |                            | naracteri                   | stics, refe                         | r to Type 22                            | JG6A                         |                                               |                               | 22160                       |
| 250                           | — 3V                                             | 90                           | 1.7<br>(Max.)              | 4.0                         | 600000                              | 1050                                    |                              |                                               |                               | 24A                         |
| 95                            | —15V                                             | 95                           | 4                          | 20                          | 45000                               | 2000                                    |                              | 4500                                          | 0.9                           | 25A6<br>25A6G               |
| 100                           | —15V                                             | 100                          | 4.0                        | 20.5                        | 50000                               | 1800                                    |                              | 4500                                          | 0.77                          | 25A7                        |
| Max.                          | AC Plate Volts                                   | (RMS), 1                     | 17                         | Max. [                      | OC Output                           | mA, 75                                  | Max.Pea                      | ak Plate mA, 4                                | 50                            | - GT                        |
| 110                           | +15V (                                           | Grid mA,                     | 7)                         | 15                          | 15200                               | 3800                                    | 58                           |                                               |                               | 25ACS<br>GT                 |
|                               |                                                  |                              | r other c                  |                             |                                     | r to Type 25                            | N6G                          |                                               |                               | 25B5                        |
| 200                           | 23V                                              | 135                          | 1.8                        | 62.0                        | 18000                               | 5000                                    |                              | 2500                                          | 7.1                           | 25B60                       |
| 100                           | 1V<br>3V                                         | 100                          | 2.0                        | 7.6                         | 75000<br>185000                     | 1500<br>2000                            | 112                          |                                               |                               | <sup>-</sup> 25 <b>B</b> 8G |
|                               |                                                  | F                            | or other                   | haracter                    | istics, ref                         | er to Type 6                            | вк5                          |                                               |                               | 25BK                        |
|                               | DC Plate Volts<br>DC Cathode m                   |                              | -                          |                             |                                     | . Peak Posit<br>issipation, 1           |                              | Plate Volts, 60                               | 000 (Abs.)                    | 25BQ<br>GT                  |
|                               |                                                  | F                            | or other                   | character                   | ristics, ref                        | er to Type 6                            | Y6G                          |                                               |                               | 25C60                       |
|                               |                                                  |                              |                            |                             |                                     |                                         |                              |                                               |                               | 25CD6                       |

| RCA<br>Type | Name                           | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Fila<br>Unless s<br>types ha<br>⊕ Heate | ater or<br>ment (F)<br>specified all<br>ave heaters.<br>or with con-<br>varmup time.<br>Amperes | Use<br>Values to right give operat-<br>ing conditions and character-<br>istics for indicated typical use |
|-------------|--------------------------------|---------------------------------|-------------------------------------------|-----------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 25EC6       | Beam Power Tube                | 21A                             | 5BT                                       | 25.0 ⊕                                  | 0.6                                                                                             | Horizontal Deflection Amplifier                                                                          |
| 25L6        | Beam Power Tube                | 2B                              | 7AC                                       | 25.0                                    | 0.3                                                                                             | Amplifier                                                                                                |
| 25L6GT      | Beam Power Tube                | 13D                             | 7AC                                       | 25.0                                    | 0.3                                                                                             | Amplifier                                                                                                |
| 25N6G       | Direct-Coupled Power Amplifier | -                               | 7W                                        | 25.0                                    | 0.3                                                                                             | Class A Amplifier                                                                                        |
| 25W4GT      | Half-Wave Rectifier            | 13D                             | 40 <b>G</b>                               | 25.0                                    | 0.3                                                                                             | Television Damper Service                                                                                |
| 25Y5        | Rectifier-Doubler              | 22 or<br>13H                    | 6E                                        | 25.0                                    | 0.3                                                                                             | Half-Wave Rectifier                                                                                      |
| 25Z5        | Rectifier-Doubler              | 22 or<br>13H                    | 6E                                        | 25.0                                    | 0.3                                                                                             | Rectifier-Doubler                                                                                        |
| 2576        | Rectifier-Doubler              | 2B                              | 7Q                                        | 25.0                                    | 0.3<br>0.3                                                                                      | Voltage Doubler                                                                                          |
| 25Z6GT      | KEC?!#E!-DOGBIE!               | 13D                             | 79                                        | 25.0                                    | 0.3                                                                                             | Half-Wave Rectifier                                                                                      |
| 26          | Medium-Mu Triode               | 26                              | 4D                                        | 1.5F                                    | 1.05                                                                                            | Class A Amplifier                                                                                        |
| 27          | Low-Mu Triode                  | 22 or<br>13H                    | 5A                                        | 2.5                                     | 1.75                                                                                            | Class A Amplifier                                                                                        |
| 30          | Medium-Mu Tricde               | 22 or<br>13H                    | 4D                                        | 2.0F                                    | 0.06                                                                                            | Amplifier                                                                                                |
| 31          | Power Triode                   | 22 or<br>13H                    | 4D                                        | 2.0F                                    | 0.13                                                                                            | Class A Amplifier                                                                                        |
| 32          | Sharp-Cutoff Tetrode           | 29K                             | 4K                                        | 2.0F                                    | 0.06                                                                                            | Class A Amplifier                                                                                        |
| 32ET5       | Power Pentode                  | 5D                              | 7CV                                       | 32.0                                    | 0.1                                                                                             | Class A Amplifier                                                                                        |
| 32L7GT      | Rectier—Beam Power Tube        | 14A                             | 8Z                                        | 32.5                                    | 0.3                                                                                             | Class A Amplifier Half-Wave Rectifier                                                                    |
| 33          | Power Pentode                  | 25                              | 5K                                        | 2.5F                                    | 0.26                                                                                            | Class A Amplifier                                                                                        |
| 34          | Remote-Cutoff Pentode          | 29K                             | 4M                                        | 2.0F                                    | 0.06                                                                                            | Screen-Grid RF Amplifier                                                                                 |
| 34GD5       | Beam Power Tube                | 5D                              | 7CV                                       | 34.0                                    | 0.1                                                                                             | Class A Amplifier                                                                                        |
| 35          | Remote-Cutoff Tetrode          | 29K                             | 7CV<br>SE                                 | 34.0⊕<br>2.5                            | 1.75                                                                                            | Screen-Grid RF Amplifier                                                                                 |
| 35A5        | Beam Power Tube                | 12C                             | 6AA                                       | 35.0                                    | 0.15                                                                                            | Single-Tube Class A Amplifier                                                                            |
| 35B5        | Beam Power Tube                | 5D                              | 7BZ                                       | 35.0                                    | 0.15                                                                                            | Class A Amplifier                                                                                        |
| 35DZ8       | High-Mu Triode—Power Pentode   | 6Н                              | 91E                                       | 35.0                                    | 0.15                                                                                            | Triode Unit as Class A Amplifie Pentode Unit as Class A Amplifier                                        |
| 35GL6       | Beam Power Tube                | 5D                              | 7FZ                                       | 35.0                                    | 0.15                                                                                            | Class A Amplifier                                                                                        |
| 35Y4        | Half-Wave Rectifier Heater Tap | 12C                             | 5AL<br>Pilot Bet                          | 35.0<br>ween Pins                       | 0.15<br>1 and 4                                                                                 | With Capacitive-Input Filter                                                                             |
| 35Z3        | Half-Wave Rectifier            | 12C                             | 4Z                                        | 35.0                                    | 0.15                                                                                            | With Capacitive-Input Filter                                                                             |
| 35Z4GT      | Half-Wave Rectifier            | 13D                             | 5AA                                       | 35.0                                    | 0.15                                                                                            | With Capacitive-Input Filter                                                                             |
| 36          | Sharp-Cutoff Tetrode           | 24B                             | 5E                                        | 6.3                                     | 0.3                                                                                             | Screen-Grid RF Amplifier                                                                                 |
| 36AM3       | Half-Wave Rectifier            | 50                              | 5BQ                                       | 36.0                                    | 0.1                                                                                             | With Capacitive-Input Filter                                                                             |
| 36AM3A      | Half-Wave Rectifier            | 5D                              | 5BQ<br>5BQ                                | 36.0<br>36.0 ⊕                          | 0.1<br>0.1                                                                                      | With Capacitive-Input Filter                                                                             |
| 37          | Medium-Mu Triode               | 22 or<br>13H                    | 5A                                        | 6.3                                     | 0.3                                                                                             | Class A Amplifier                                                                                        |
| 38          | Power Pentode                  | 248                             | 5F                                        | 6.3                                     | 0.3                                                                                             | Class A Amplifier                                                                                        |
| 39/44       | Remote-Cutoff Pentode          | 248                             | 5F                                        | 6.3                                     | 0.3                                                                                             | Class A Amplifier                                                                                        |
|             |                                |                                 |                                           |                                         |                                                                                                 |                                                                                                          |

| Plate<br>Sup-<br>ply | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor      | Grid<br>Sup-<br>ply    | Grid<br>Cur-<br>rent | Plate<br>Cur-<br>rent | AC Plate<br>Resist-<br>ance | Trans-<br>conduct-<br>ance     | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output | Power<br>Out-<br>put | RCA<br>Type          |
|----------------------|----------------------------------------------------------|------------------------|----------------------|-----------------------|-----------------------------|--------------------------------|------------------------------|---------------------------------------|----------------------|----------------------|
| Voits                | Ohms (Ω)                                                 | Voits                  | mA                   | mA                    | Ohms                        | Micromhos                      | , 40 (0)                     | Ohms                                  | Watts                | ,,,,,                |
|                      | . DC Plate Volts,<br>. DC Cathode mA                     |                        | **                   | <del></del>           |                             | . Peak Posit<br>. Piate Dissi  |                              | Plate Volts, 7                        | 00 (Abs.)            | 25EC6                |
| 110<br>200           | — 7.5V<br>— 8V                                           | 110<br>110             | 4 2                  | 49<br>50              | 13000<br>30000              | 9000<br>9500                   | _                            | 2000<br>3000                          | 2.1<br>4.3           | 25L6                 |
| 200                  |                                                          |                        |                      |                       |                             | to Type 50L                    | <br>6GT                      | 3000                                  | 4.0                  | 25L6GT               |
| Outp                 | out Triode: Plate<br>de: Plate Volts,                    | Volts, 18<br>100: Grid | 0; Plate<br>Volts. 0 | mA, 46;<br>: A-F Sig  | Load, 4000<br>nai Voits (   | ohms<br>Peak), 29.7:           | Plate mA.                    | 5.8                                   | 3.8                  | 25N6G                |
| Max                  | . Peak Inverse P<br>. Peak Plate mA,<br>. DC Plate mA, 1 | late Volts             |                      |                       | Max.                        | Peak Heater-                   | Cathode V                    |                                       | (Abs.)               | 25W4GT               |
|                      | . DC Output mA                                           |                        | 75                   |                       |                             |                                |                              |                                       |                      | 25Y5                 |
|                      | * ··· ···                                                |                        | For oti              | ner rating            | s, refer to                 | Type 25Z6                      |                              |                                       |                      | 25 <b>Z</b> 5        |
| Max<br>Max           | . AC Volts per P<br>. DC Output mA,                      | late (RMS<br>75        | ), 117               | Min<br>Wav            | . Total Eff<br>e, 30 ohms   | ective Plate-<br>s; Full-Wave, | Supply Im<br>15 ohms         | pedance: Half                         | -                    | 25Z6                 |
| Max                  | . AC Volts per P<br>. DC Output mA                       | ate (RMS               |                      | Min                   | . Total Eff                 | ect. Supply I                  | mped. per                    | Plate: at 117<br>235 volts, 100       |                      | _<br>25Z6 <b>G</b> T |
| 180                  | —14.5V                                                   |                        |                      | 6.2                   | 7300                        | 1150                           | 8.3                          |                                       |                      | 26                   |
| 250                  | 21V                                                      | _                      |                      | 5. <b>2</b>           | 9250                        | 975                            | 9.0                          |                                       |                      | 27                   |
|                      |                                                          | Foi                    | other o              | haracter              | istics, refe                | r to Type 1H                   | 4G                           |                                       |                      | 30                   |
| 180                  | —30V                                                     |                        | _                    | 12.3                  | 3600                        | 1050                           | 3.8                          | 5700                                  | 0.375                | 31                   |
| 180<br>(Max.)        | — 3V                                                     | 67.5                   | 0.4                  | 1.7                   | 1.0                         | 650                            |                              |                                       |                      | 32                   |
| 110                  | 7.5V                                                     | 110                    | 2.8                  | 30                    | 21500                       | 5500                           |                              | 2800                                  | 1.2                  | 32ET5                |
| 90                   | 7V<br>Maximi                                             | 90<br>Im AC PI         | 2.0<br>ate Vol       | 27.0<br>tage          | 17000                       | 4800                           | <br>25 Volts.                | 2600<br>RMS                           | 1.0                  | - 32L7GT             |
| 180                  | Maximu<br>—18V                                           | ım DC Ou               | tput Cu<br>5.0       | 22.0                  | 55000                       | 1750                           | 60 Millia                    | amperes<br>6000                       | 1.4                  | 33                   |
| 180                  | — 3V                                                     | 67.5                   | 1.0                  | 2.8                   | 1.0                         | 620                            |                              | 0000                                  | 1.4                  | 34                   |
| 110                  | min.<br>7.5V                                             | 110                    | 3                    | 35                    | 13000                       | 5700                           |                              | 2500                                  | 1.4                  | 34GD5                |
| 250                  | 3V                                                       | 90                     | 2.5*                 | 6.5                   | 13000                       | 1050                           |                              | 2,00                                  | 1.4                  | 35                   |
|                      | min.                                                     |                        |                      |                       | ristins ref                 | er to Type 3                   | 51 SGT                       | <del></del>                           |                      | 35A5                 |
|                      |                                                          |                        |                      |                       |                             | er to Type 35                  |                              |                                       |                      | 35B5                 |
| 120                  | 1500Ω                                                    |                        |                      | 0.8                   |                             | 1400                           | 100                          |                                       |                      | 25070                |
| 140                  | 180Ω                                                     | 120                    | 6                    | 45                    |                             | 7500                           |                              | 2500                                  | 2.0                  | 35DZ8                |
| 110                  | — 7.5V                                                   | 110                    | 3                    | 45                    | 12000                       | 7500                           |                              | 2500                                  | 1.8                  | 35GL6                |
| <del></del>          |                                                          |                        |                      |                       |                             | er to Type 3                   | 5W4                          |                                       |                      | 35Y4                 |
| Max                  | . DC Output mA,                                          |                        | or other             |                       | refer to Ty<br>. Total Eff  |                                | Supply Im                    | pedance: Up 1                         | to 117               | 3523                 |
| 100                  | — 1.5V                                                   | 55                     |                      | vol1                  | ts, 15 ohms<br>550000       | ; at 235 volt<br>850           | s, 100 ch                    | ms                                    |                      | 35Z4GT               |
| 250<br>AC P          | - 3V<br>Plate Volts (RMS                                 | 90                     | 1.7                  | 3.2                   | 550000                      | 1080<br>Peak Inverse           | Volts, 36                    | 55                                    |                      | 36                   |
| Max                  | . DC Output mA,<br>. AC Plate Volts                      | 82                     | 20                   |                       | Tube                        | Voltage Drop                   | for Plate                    | mA, 150, 20                           |                      | 36AM3                |
| Max                  | . DC Output mA,                                          | 82                     |                      |                       |                             |                                |                              | 65<br>mA, 150, 16                     | volts                | 36AM3A               |
| 250                  | —18V                                                     |                        |                      | 7.5                   | 8400                        | 1100                           | 9.2                          |                                       |                      | 37                   |
| 250                  | —25V                                                     | 250                    | 3.8                  | 22.0                  | 100000                      | 1200                           |                              | 10000                                 | 2.50                 | 38                   |
| 250                  | min.                                                     | 90                     | 1.4                  | 5.8                   | 1.0                         | 1050                           |                              |                                       |                      | 39/44                |

| RCA<br>Type                                   | Name                                                                                           | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Filar Unless s types ha  Heate trolled w | ater or<br>ment (F)<br>specified all<br>eve heaters.<br>er with con-<br>varmup time. | Use Values to right give operating conditions and characteristics for indicated typical use                                                                                                                   |
|-----------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------|------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40                                            | Medium-Mu Triode                                                                               | 56                              | 4D                                        | Volts<br>5.0F                            | Amperes<br>0.25                                                                      | Oless A Amelian                                                                                                                                                                                               |
| 41                                            | Power Pentode                                                                                  | 22 or                           |                                           |                                          |                                                                                      | Class A Amplifier                                                                                                                                                                                             |
|                                               |                                                                                                | 13H                             | 6B                                        | 6.3                                      | 0.4                                                                                  | Amplifier                                                                                                                                                                                                     |
| 42                                            | Power Pentode                                                                                  | 28                              | 6B                                        | 6.3                                      | 0.7                                                                                  | Amplifier                                                                                                                                                                                                     |
| 43                                            | Power Pentode                                                                                  | 28                              | 6B                                        | 25.0                                     | 0.3                                                                                  | Amplifier                                                                                                                                                                                                     |
| 45                                            | Power Triode                                                                                   | 26                              | 4D                                        | 2.5F                                     | 1.5                                                                                  | Class A Amplifier                                                                                                                                                                                             |
| 45Z3                                          | Half-Wave Rectifier Half-Wave Rectifier                                                        | 5C<br>13D                       | 5AM<br>6AD                                | 45.0<br>45.0                             | 0.075                                                                                | Half-Wave Rectifier                                                                                                                                                                                           |
| 45Z5GT                                        | Heater Tap for Pilot                                                                           |                                 |                                           | reen Pins 2                              | 0.15<br>2 and 3                                                                      | With Capacitive-Input Filter                                                                                                                                                                                  |
| 46                                            | Dual-Grid Power Amplifier                                                                      | 27B                             | 5C                                        | 2.5F                                     | 1.75                                                                                 | Class A Amplifier                                                                                                                                                                                             |
| 47                                            | Power Pentode                                                                                  | 27B                             | 5B                                        | 2.5F                                     | 1.75                                                                                 | Class A Amplifier                                                                                                                                                                                             |
| 48                                            | Power Tetrode                                                                                  | 27B                             | 6A                                        | 30.0                                     | 0.4                                                                                  | Class A Amplifier                                                                                                                                                                                             |
| 49                                            | Dual-Grid Power Amplifier                                                                      | 26                              | 5C                                        | 2.0F                                     | 0.12                                                                                 | Class A Amplifier                                                                                                                                                                                             |
| 50                                            | Power Triode                                                                                   | 29L                             | 4D                                        | 7.5F                                     | 1.25                                                                                 | Class A Amplifier                                                                                                                                                                                             |
| 50A5                                          | Beam Power Tube                                                                                | 12C                             | 6AA                                       | 50.0                                     | 0.15                                                                                 | Class A Amplifier                                                                                                                                                                                             |
| 50C6G                                         | Beam Power Tube                                                                                | 25                              | 7AC                                       | 50.0                                     | 0.15                                                                                 | Single-Tube Class A Amplifier                                                                                                                                                                                 |
| 50FE5                                         | Beam Power Tube                                                                                | 13G                             | 8KB                                       | 50.0                                     | 0.15                                                                                 | Class A Amplifier                                                                                                                                                                                             |
| 50FK5                                         | Power Pentode                                                                                  | 5D                              | 7CV                                       | 50.0                                     | 0.1                                                                                  | Class A Amplifier                                                                                                                                                                                             |
| 50X6                                          | Rectifier-Doubler                                                                              | 12C                             | 7DX                                       | 50.0                                     | 0.15                                                                                 | Rectifier-Doubler                                                                                                                                                                                             |
| 50Y6GT                                        | Rectifier-Doubler                                                                              | 130                             | 70                                        | 50.0                                     | 0.15                                                                                 | Rectifier-Doubler                                                                                                                                                                                             |
| 50Y7GT                                        | Rectifier-Doubler<br>Heater Tap for Pilot                                                      | 13D                             | <b>SAN</b><br>ilot Betv                   | 50.0<br>reen Pins 6                      | 0.15<br>5 and 7                                                                      | Voltage Doubler                                                                                                                                                                                               |
|                                               | -                                                                                              |                                 |                                           |                                          |                                                                                      | Half-Wave Rectifier                                                                                                                                                                                           |
| 50Z7G                                         | Rectifier-Doubler<br>Heater Tap for Pilot                                                      | 22<br>P                         | 8AN<br>ilot Retv                          | 50.0<br>een Pins 6                       | 0.15<br>Sand 7                                                                       | Voltage Doubler                                                                                                                                                                                               |
| 53                                            | High-Mu Twin Power Triode                                                                      | 26                              | 7B                                        | 2.5                                      | 2.0                                                                                  | Half-Wave Rectifier Amplifier                                                                                                                                                                                 |
| 70L7GT                                        | Rectifier-Beam Power Tube                                                                      | 13F                             | 8AA                                       | 70.0                                     | 0.15                                                                                 | Amplifier Unit as Class A<br>Amplifier                                                                                                                                                                        |
|                                               |                                                                                                |                                 | v-÷                                       | 70.0                                     | 0.13                                                                                 | Half-Wave Rectifier                                                                                                                                                                                           |
| 75                                            | Twin Diode—High-Mu Triode                                                                      | 248                             | 6G                                        | 6.3                                      | 0.3                                                                                  | Amplifier                                                                                                                                                                                                     |
| 78                                            | Remote-Cutoff Pentode                                                                          | 24B                             | 6F                                        | 6.3                                      | 0.3                                                                                  | Amplifier Mixer                                                                                                                                                                                               |
|                                               |                                                                                                |                                 |                                           | 0.3                                      | 0.3                                                                                  | Ampilitei Mixer                                                                                                                                                                                               |
| 80                                            | Full-Wave Rectifier                                                                            | 26                              | 4C                                        | 5.0F                                     | 2.0                                                                                  | With Capacitive-Input Fifter                                                                                                                                                                                  |
| 80                                            |                                                                                                |                                 | 4C                                        |                                          |                                                                                      |                                                                                                                                                                                                               |
| 80<br>84/6Z4                                  |                                                                                                | 26<br>22 or                     | 4C<br>50                                  |                                          |                                                                                      | With Capacitive-Input Filter                                                                                                                                                                                  |
| 84/6Z4                                        | Full-Wave Rectifier                                                                            | 26                              |                                           | 5.0F                                     | 2.0                                                                                  | With Capacitive-Input Filter With Inductive-Input Filter With Capacitive-Input Filter With Inductive-Input Filter                                                                                             |
| 84/6Z4<br>117L7<br>GT/                        | Full-Wave Rectifier                                                                            | 26<br>22 or                     |                                           | 5.0F                                     | 2.0                                                                                  | With Capacitive-Input Filter With Inductive-Input Filter With Capacitive-Input Filter With Inductive-Input Filter Amplifier Unit as Class A Amplifier                                                         |
| 84/6Z4<br>117L7                               | Full-Wave Rectifier Full-Wave Rectifier                                                        | 26<br>22 or<br>13H              | 50                                        | 5.0F<br>6.3                              | 2.0                                                                                  | With Capacitive-Input Filter With Inductive-Input Filter With Capacitive-Input Filter With Inductive-Input Filter Amplifier Unit as Class A                                                                   |
| 84/6Z4<br>117L7<br>GT/<br>M7GT                | Full-Wave Rectifier Full-Wave Rectifier                                                        | 26<br>22 or<br>13H              | 50                                        | 5.0F<br>6.3                              | 2.0                                                                                  | With Capacitive-Input Filter With Inductive-Input Filter With Capacitive-Input Filter With Inductive-Input Filter Amplifier Unit as Class A Amplifier                                                         |
| 84/6Z4<br>117L7<br>GT/<br>M7GT<br>117N7<br>GT | Full-Wave Rectifier  Full-Wave Rectifier  Rectifier-Beam Power Tube  Rectifier-Beam Power Tube | 22 or<br>13H                    | 5D<br>8AO<br>8AV                          | 5.0F<br>6.3                              | 0.5                                                                                  | With Capacitive-Input Filter With Inductive-Input Filter With Capacitive-Input Filter With Inductive-Input Filter Amplifier Unit as Class A Amplifier Half-Wave Rectifier Amplifier Unit as Class A           |
| 84/6Z4<br>117L7<br>GT/<br>M7GT                | Full-Wave Rectifier  Full-Wave Rectifier  Rectifier-Beam Pewer Tube                            | 26<br>22 or<br>13H              | 50<br>8A0                                 | 5.0F<br>6.3                              | 0.5                                                                                  | With Capacitive-Input Filter With Inductive-Input Filter With Capacitive-Input Filter With Inductive-Input Filter Amplifier Unit as Class A Amplifier Half-Wave Rectifier Amplifier Unit as Class A Amplifier |

| Plate<br>Sup-<br>ply<br>Voits                                                                                                                                                                      | Grid Bias Volts (V) or Cathode Resistor Ohms $(\Omega)$                                                                                                                                                                                                                                                                                                     | Grid<br>Sup-<br>ply<br>Volts                                                                                                                                                   | Srid<br>Cur-<br>rent<br>mA                                                                                                                                                                                                                                                         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Lead<br>for Stated<br>Power<br>Output<br>Ohms                                                                                                                                                      | Power<br>Out-<br>put<br>Watts                                                                                     | RCA<br>Type                                                                           |
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| 275                                                                                                                                                                                                | —56V                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                |                                                                                                                                                                                                                                                                                    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| Max.                                                                                                                                                                                               | Peak Inverse V                                                                                                                                                                                                                                                                                                                                              | olts, 350                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Max. 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Pea                                                                   | k Plate mA,                                                                                                                                                                                        | 390                                                                                                               | 45Z3                                                                                  |
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| 250                                                                                                                                                                                                | —33V                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                |                                                                                                                                                                                                                                                                                    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| 250                                                                                                                                                                                                | 450Ω                                                                                                                                                                                                                                                                                                                                                        | 250                                                                                                                                                                            | 6.0                                                                                                                                                                                                                                                                                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| Max. AC<br>Max. DC<br>Max. AC                                                                                                                                                                      | Voits per Plate<br>Output mA, 65<br>Voits per Plate                                                                                                                                                                                                                                                                                                         | (RMS), 11                                                                                                                                                                      | For othe<br>7<br>5 Min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Min. 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| Max. AC<br>Max. DC<br>Max. AC<br>Max. DC<br>Max. DC                                                                                                                                                | Voits per Plate<br>Output mA, 65<br>Voits per Plate<br>Output mA per F<br>Output mA, 65                                                                                                                                                                                                                                                                     | (RMS), 11<br>(RMS), 23<br>Plate, 65                                                                                                                                            | For othe<br>7<br>5 Min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Min. 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| Max. AC<br>Max. DC<br>Max. AC<br>Max. DC<br>Max. DC                                                                                                                                                | Voits per Plate<br>Output mA, 65<br>Voits per Plate<br>Output mA per I                                                                                                                                                                                                                                                                                      | (RMS), 11<br>(RMS), 23<br>Plate, 65<br>Plate, 65                                                                                                                               | For othe<br>7<br>5 Min<br>volt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Min. 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Plate-<br>ns; at 150                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ype 25Z6GT<br>e Piate-Supp<br>Supply Impe<br>volts, 40 ohr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ed. per Pia<br>ms; at 235                                                  | te: At 117                                                                                                                                                                                         | nms                                                                                                               | <b>50Y6GT 50Y7GT</b> 50Z7G                                                            |
| Max. AC<br>Max. DC<br>Max. AC<br>Max. DC<br>Max. DC                                                                                                                                                | Voits per Plate<br>Output mA, 65<br>Voits per Plate<br>Output mA per F<br>Output mA, 65                                                                                                                                                                                                                                                                     | (RMS), 11<br>(RMS), 23<br>Plate, 65<br>Plate, 65                                                                                                                               | For othe<br>7<br>5 Min<br>volt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Min. 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| Max. AC<br>Max. DC<br>Max. AC<br>Max. DC<br>Max. DC                                                                                                                                                | Voits per Plate<br>Output mA, 65<br>Voits per Plate<br>Output mA per F<br>Output mA, 65                                                                                                                                                                                                                                                                     | (RMS), 11<br>(RMS), 23<br>Plate, 65<br>Plate, 65                                                                                                                               | For othe<br>7<br>5 Min<br>volt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Min. 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| Max. AC<br>Max. DC<br>Max. AC<br>Max. DC<br>Max. DC<br>Max. DC                                                                                                                                     | Volts per Plate<br>Output mA, 65<br>Volts per Plate<br>Output mA per 1<br>Output mA, 65<br>Output mA per F                                                                                                                                                                                                                                                  | (RMS), 11<br>(RMS), 23<br>Plate, 65<br>Plate, 65<br>F0<br>110                                                                                                                  | For other of the rother of Man                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Min. Tot<br>Plate, 19<br>1. Total E<br>ts, 15 ohr<br>character<br>40.0<br>x. DC Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | , refer to T<br>cal Effective<br>5 ohms<br>ffec. Plate-<br>ms; at 150<br>istics, refe<br>15000<br>tput mA, 70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ype 2526GT<br>e Plate-Supp<br>Supply Impe<br>volts, 40 ohr<br>r to Type 6N<br>7500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | d. per Pla<br>ms; at 235                                                   | te: At 117<br>volts, 100 of                                                                                                                                                                        | 1.8                                                                                                               | 50Y6GT<br>50Y7GT<br>50Z7G<br>53                                                       |
| Max. AC<br>Max. DC<br>Max. AC<br>Max. DC<br>Max. DC<br>Max. DC                                                                                                                                     | Volts per Plate<br>Output mA, 65<br>Volts per Plate<br>Output mA per f<br>Output mA, 65<br>Output mA per f                                                                                                                                                                                                                                                  | (RMS), 11<br>(RMS), 23<br>Plate, 65<br>Plate, 65<br>F0<br>110                                                                                                                  | For other of 3.0  Man Total E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Min. Tot<br>Plate, 19<br>I. Total E<br>Is, 15 ohr<br>Character<br>40.0<br>x. DC Ouffect. Pla                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | , refer to 1 cal Effective comms ffec. Plate ns; at 150 distics, refe 15000 tput mA, 70 ate-Supply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ype 2526GT<br>e Piate-Supp<br>Supply Impe<br>volts, 40 ohr<br>r to Type 6N<br>7500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | nd. per Pia<br>ns; at 235<br>17<br>Max. Peak                               | te: At 117<br>volts, 100 oh<br>2000                                                                                                                                                                | 1.8                                                                                                               | 50Y6GT<br>50Y7GT<br>50Z7G<br>53                                                       |
| Max. AC<br>Max. DC<br>Max. AC<br>Max. DC<br>Max. DC<br>Max. DC                                                                                                                                     | Volts per Plate<br>Output mA, 65<br>Volts per Plate<br>Output mA per f<br>Output mA, 65<br>Output mA per f                                                                                                                                                                                                                                                  | (RMS), 11<br>(RMS), 23<br>Plate, 65<br>Plate, 65<br>Fo<br>110<br>350<br>Min.                                                                                                   | For other  5 Min volt  r other of 3.0  Ma Total E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Min. Tot<br>Plate, 19<br>I. Total E<br>Is, 15 ohr<br>Character<br>40.0<br>x. DC Our<br>ffect. Pla<br>haracteri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | , refer to 1 cal Effective comms ffec. Plate- ms; at 150  istics, refe  15000 tput mA, 70 stics, refer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ype 2526GT e Plate-Supp Supply Impe volts, 40 ohr r to Type 6N 7500 mped., 15 o                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | d. per Pia<br>ns; at 235<br>17<br>Max. Peak<br>hms                         | te: At 117<br>volts, 100 oh<br>2000                                                                                                                                                                | 1.8                                                                                                               | 50Y6GT<br>50Y7GT<br>50Z7G<br>53<br>70L7GT                                             |
| Max. AC<br>Max. DC<br>Max. AC<br>Max. DC<br>Max. DC<br>Max. DC<br>110<br>Max. Pea                                                                                                                  | Volts per Plate Output mA, 65 Volts per Plate Output mA per f Output mA, 65 Output mA per f  7.5V k Inverse Volts, per Plate (RMS)                                                                                                                                                                                                                          | (RMS), 11<br>(RMS), 23<br>Plate, 65<br>Fo<br>110<br>350<br>Min.<br>Fol                                                                                                         | For other  5 Min volt  r other of 3.0  Ma Total E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | min. Tot<br>Plate, 19<br>1. Total E<br>ts, 15 ohn<br>Character<br>40.0<br>x. DC Our<br>ffect. Platharacteric<br>characteric                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | , refer to 1 cal Effective 5 ohms ffec. Plate- ms; at 150  istics, refe  15000 tput mA, 70 iste-Supply stics, refer istics, refer istics, referent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ype 2526GT e Piate-Supp Supply Impe voits, 40 ohr  r to Type 6N  7500 n to Type 6S r to Type 6S r to Type 6S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | d. per Pia<br>ms; at 235<br>17<br>Max. Peak<br>hms<br>Q7                   | te: At 117 volts, 100 of  2000  Plate mA, 42  Total Effect                                                                                                                                         | 1.8<br>0                                                                                                          | 50Y6GT<br>50Y7GT<br>50Z7G<br>53<br>70L7GT<br>75<br>78                                 |
| Max. AC Max. DC Max. AC Max. DC Max. DC Max. DC Max. DC Max. DC  110 Max. Pea AC Volts Max. Pea AC Volts                                                                                           | Voits per Plate Output mA, 65 Voits per Plate Output mA per I Output mA, 65 Output mA per I  - 7.5V k inverse Voits, per Plate (RMS) per Plate (RMS)                                                                                                                                                                                                        | (RMS), 11<br>(RMS), 23<br>Plate, 65<br>Plate, 65<br>F0<br>110<br>350<br>Min.<br>F01<br>400<br>, 500                                                                            | For other  5 Min volt  r other of 3.0 Ma Total E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Min. Tot<br>Plate, 19<br>I. Total E<br>Is, 15 ohr<br>Character<br>40.0<br>x. DC Out<br>ffect. Platharacteri<br>Characteri<br>DC Outp<br>Max. Pec<br>Max. DC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | , refer to 1 al Effectivis fones fon | ype 2526GT e Plate-Supp Supply Impe volts, 40 ohr r to Type 6N 7500 ) Imped., 15 o r to Type 6S r to Type 6S r to Type 6S A, 440                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Id. per Pia<br>ms; at 235<br>I7<br>Max. Peak<br>hms<br>Q7<br>(7            | te: At 117 volts, 100 of  2000  Plate mA, 42  Total Effect d. per Plate, Value of Ing                                                                                                              | 1.8<br>0<br>Supply<br>50 ohms                                                                                     | 50Y6GT<br>50Y7GT<br>50Z7G<br>53<br>70L7GT<br>75                                       |
| Max. AC Max. DC  110 Max. Pea AC Volts Max. Pea AC Volts AC Volts AC Volts AC Volts AC Volts                                                       | Volts per Plate Output mA, 65 Volts per Plate Output mA per 8 Output mA, 65 Output mA per F  - 7.5V k Inverse Volts, per Plate (RMS) k Inverse Volts, per Plate (RMS) per Plate (RMS) per Plate (RMS)                                                                                                                                                       | (RMS), 23 Plate, 65 Plate, 65 Fo 110 350 Min. Foi 1400 , 500 1400 , 325                                                                                                        | For other  5 Min volt  r other of 3.0 Ma Total E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Min. Tot<br>Plate, 19<br>I. Total Ets, 15 ohr<br>character<br>40.0<br>x. DC Our<br>ffect. Platharacteri<br>characteri<br>DC Outpy<br>Max. Per<br>Max. Per<br>DC Outpy<br>Max. Per<br>DC Outpy<br>Max. Per<br>DC Outpy<br>Max. Per<br>DC Outpy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | , refer to 1 al Effective ffec. Plate- ms; at 150  istics, refe- 15000 tput mA, 70 ste-Supply stics, refer istics, refer istics, refer at mA, 125 ak Plate m, ut mA, 125 ak Plate m, ut mA, 60 ut mA, 60 ut mA, 60 ut mA, 60                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | r to Type 6N A, 440 , 125                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | nd. per Plams; at 235  17  Max. Peak hms  Q7  (7  Min. Impu                | te: At 117 volts, 100 of  2000  Plate mA, 42  Total Effect d. per Plate, Value of Inp 10 henrie otal Effect. \$                                                                                    | 1.8<br>0<br>. Supply<br>50 ohms<br>but Choke,<br>Supply                                                           | 50Y6GT<br>50Y7GT<br>50Z7G<br>53<br>70L7GT<br>75<br>78                                 |
| Max. AC Max. DC Max. DC Max. DC Max. DC Max. DC Max. DC  110 Max. Pea AC Volts Max. Pea AC Volts Max. Pea AC Volts Max. Pea AC Volts AC Volts AC AC Volts AC A | Volts per Plate Output mA, 65 Volts per Plate Output mA per f Output mA per f  - 7.5V k Inverse Volts, per Plate (RMS)                                                                                                  | (RMS), 11 (RMS), 23 Plate, 65 Fo 110 350 Min. F00 1400 1400 1350 1250 1450                                                                                                     | For other  5 Min volt  r other of 3.0 Ma Total E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | min. Tot Plate, 19.  Total Ets., 15 ohr Character  40.0  x. DC Outpharacter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | , refer to 1 tal Effectivic 5 ohms ffec. Plate- ffec. Pla | ype 2526GT e Piate-Supp Supply Impe voits, 40 ohr  r to Type 6N 7500  mped., 15 o r to Type 6K r to Type 6K r, 440 , 125 , 440 A, 180 , 60                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ad. per Plans; at 235  17  Max. Peak hms  Q7  (7  Min. Imple Min.          | te: At 117 volts, 100 of  2000  Plate mA, 42  Total Effect d. per Plate, 10 henrie otal Effect. S ed. per Plate, Value of In,                                                                      | 1.8 0 Supply 50 ohms but Choke, Supply 150 ohms put                                                               | 50Y6GT<br>50Y7GT<br>50Z7G<br>53<br>70L7GT<br>75<br>78<br>80                           |
| Max. AC Max. DC Max. DC Max. DC Max. DC Max. DC Max. DC  110 Max. Pea AC Volts Max. Pea AC Volts Max. Pea AC Volts Max. Pea AC Volts AC Volts AC AC Volts AC A | Volts per Plate Output mA, 65 Volts per Plate Output mA per f Output mA, 65 Output mA per f  - 7.5V k Inverse Volts, per Plate (RMS)                                                   | (RMS), 11 (RMS), 23 Plate, 65 Fo 110 350 Min. F00 1400 1400 1350 1250 1450                                                                                                     | For other  5 Min volt  r other of 3.0 Ma Total E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | min. Tot Plate, 19.  Character  40.0  Character  AD.0  Character   | , refer to 1 tal Effectivic 5 ohms ffec. Plate- ffec. Pla | ype 2526GT e Piate-Supp Supply Impe volts, 40 ohr  r to Type 6N 7500  mped., 15 o r to Type 6K r to Type 6K r, 125 A, 440 A, 180 A, 180 A, 180                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ad. per Plans; at 235  17  Max. Peak hms  Q7  (7  Min. Imple Min.          | te: At 117 volts, 100 of  2000  Plate mA, 42  Total Effect ed. per Plate, 10 henrie otal Effect. 8 d. per Plate,                                                                                   | 1.8 0 Supply 50 ohms but Choke, Supply 150 ohms put                                                               | 50Y6GT<br>50Y7GT<br>50Z7G<br>53<br>70L7GT<br>75<br>78<br>80                           |
| Max. AC Max. DC Max. DC Max. DC Max. DC Max. DC Max. DC  110 Max. Pea AC Voits Max. Pea AC Voits Max. Pea AC Voits Max. Peal Max. Peal Max. AC                                                     | Volts per Plate Output mA, 65 Volts per Plate Output mA per f Output mA per f Output mA per f  - 7.5V k Inverse Volts, per Plate (RMS) k Inverse Volts, - 5.2V Plate Volts (RMS)                                        | (RMS), 11 (RMS), 23 Plate, 65  Plate, 65  Fo  110  350  Min.  Foi  1400  , 500  , 325  1250  , 450  105  3), 117                                                               | For other of 3.0  Total E other of other of other othe | min. Tot Plate, 12.  Total Ets, 15 ohr August Augus | , refer to 1 tal Effectivic 5 ohms ffec. Plate- ffec. Pla | Type 2526GT e Plate-Supp Supply Impe volts, 40 ohr  r to Type 6N  7500  n to Type 6N  r to Type 6N  x, 125  x, 440  x, 125  x, 440  x, 180  x, 180  x, 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Adax. Peak hms  Adax. Peak hms  African Min. Imperior Min.  The Min.  Min. | te: At 117 volts, 100 of  2000 Plate mA, 42  Total Effect d. per Plate, Value of Int 10 henic otal Effect. S d. per Plate, Value of Int Choke, 10 hei 4000 Total Effect.                           | 1.8 0 Supply 50 ohms put Choke, s Supply 150 ohms put thoke, s Supply 150 ohms put thries 0.85 Plate-             | 50Y6GT 50Y7GT 50Z7G 53 70L7GT 75 78 80 84/6Z4                                         |
| Max. AC Max. AC Max. AC Max. DC Max. DC Max. DC Max. DC Max. DC  110 Max. Pea AC Volts Max. Pea AC Volts Max. Peal AC Volts Max. Peal 105 Max. AC                                                  | Volts per Plate Output mA, 65 Volts per Plate Output mA per f Output mA, 65 Output mA per f  - 7.5V k Inverse Volts, per Plate (RMS) k Inverse Volts, | (RMS), 11 (RMS), 23 Plate, 65  Plate, 65  Fo  110  350  Min.  Foi  1400  , 500  , 325  1250  , 450  105  3), 117                                                               | For other of 3.0  Total E other of other of other othe | min. Tot Plate, 12.  Total Ets, 15 ohr August Augus | , refer to 1 al Effectivic ffec. Plate- ms; at 150  istics, refe  15000 tput mA, 70 ste-Supply stics, refei sistics, refei sistics, refei sistics, refei at mA, 125 ak Plate mi ut mA, 60 ak Plate mi ut mA, 60 output mA ak Plate mi 17000 Output mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Type 2526GT e Plate-Supp Supply Impe volts, 40 ohr  r to Type 6N  7500  n to Type 6N  r to Type 6N  x, 125  x, 440  x, 125  x, 440  x, 180  x, 180  x, 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Adax. Peak hms  Adax. Peak hms  African Min. Imperior Min.  The Min.  Min. | te: At 117 volts, 100 of  2000  Plate mA, 42  Total Effect d. per Plate, Value of Ing 10 henrie otal Effect. S, d. per Plate, Value of In Choke, 10 hei 4000                                       | 1.8 0 Supply 50 ohms put Choke, s Supply 150 ohms put thoke, s Supply 150 ohms put thries 0.85 Plate-             | 50Y6GT 50Y7GT 50Z7G 53 70L7GT 75 78 80 84/6Z4 117L7 GT/ M7/GT                         |
| Max. AC Max. DC  110 Max. Pea AC Volts Max. Pea AC Volts Max. Pea AC Volts Max. Pea AC Volts Max. Pea 100 Max. AC                                  | Voits per Piate Output mA, 65 Voits per Piate Output mA per f Output mA per f Output mA per f  - 7.5V k Inverse Voits,  per Piate (RMS) k Inverse Voits, per Piate (RMS) k Inverse Voits, per Piate (RMS) k Inverse Voits, per Piate (RMS) k Inverse Voits, - 5.2V Piate Voits (RMS) k Inverse Voits (RMS) k Inverse Voits (RMS)                            | (RMS), 11 (RMS), 23 Plate, 65 Plate, 65 Fo 110 350 Min. Foi 1400 , 500 1400 , 500 1400 , 325 , 450 1250 , 450 1250 , 350 100 S), 117                                           | For other  S Min volt  r other (  3.0  Ma Total Er other cur other (                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | min. Tot Plate, 19.  Character 40.0  X. DC Out ffect. Plate haracter in the character in th | , refer to 1 al Effectivic ffec. Plate- ms; at 150  istics, refer  15000 tput mA, 70 ste-Supply stics, refer istics, refer istic | ype 2526GT e Plate-Supp Supply Impe volts, 40 ohr  r to Type 6N 7500 ) mped., 15 o r to Type 6K A, 440 A, 125 A, 440 A, 180 A, 60 A, 180 A, 18 | od. per Plans; at 235  17                                                  | Total Effect d. per Plate, Value of Int 10 heri cotal Effect. S d. per Plate, Value of Int 10 heri otal Effect. S d. per Plate, Value of Int Choke, 10 her 4000 Total Effect. ly Imped., 15        | 1.8  0  Supply 50 ohms but Choke, supply 150 ohms put 150 ohms put 150 ohms put 150 ohms put 150 ohms 1.2  Plate- | 50Y6GT<br>50Y7GT<br>50Z7G<br>53<br>70L7GT<br>75<br>78<br>80<br>84/6Z4<br>117L7<br>GT/ |
| Max. AC Max. DC  110 Max. Pea AC Volts Max. Pea AC Volts Max. Pea AC Volts Max. Pea AC Volts Max. Pea 100 Max. AC                                  | Voits per Plate Output mA, 65 Voits per Plate Output mA, 65 Output mA, 65 Output mA per I  - 7.5V k Inverse Voits, per Plate (RMS) k Inverse Voits, - 5.2V Plate Voits (RMS) k inverse Voits, - 6V Plate Voits (RMS)                                     | (RMS), 11 (RMS), 23 Plate, 65 Fo 110 350 Min. Foi 1400 , 500 1400 , 350 1250 1250 105 \$\$ \$\$ \$\$ \$\$ 105 \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ | For other 7  S Min voit r other 0 3.0 Total Er other cur other 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | min. Tot Plate, 19.  Character 40.0  X. DC Outpress haracter DC Outpress haracter DC Outpress Max. DC Max. Pet Max. Pet Max. DC Max. Pet Max. Pet Max. DC Max. Pet Ma | , refer to 1 al Effectivic siffec. Plate- ms; at 150  istics, refer 15000 tput mA, 70 ste-Supply stics, refer istics, refer istics, refer ut mA, 125 ak Plate m Output mA Ak Plate m 17000 Output mA ak Plate m 17000 Output mA ak Plate m 17000 Output mA ak Plate m 16000 Output mA ak Plate m 16000 Output mA ak Plate m 16000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ype 2526GT e Plate-Supp Supply Impe volts, 40 ohr  r to Type 6N 7500 ) mped., 15 o r to Type 6K A, 440 A, 125 A, 440 A, 180 A, 60 A, 180 A, 18 | Adax. Peak Adax. Peak Amin. Amin. Amin. Amin. Amin. Amin. Amin. Supp       | te: At 117 volts, 100 of  2000  Plate mA, 42  Total Effect ed. per Plate, Value of Int 10 henrie otal Effect. d. per Plate, Value of Int Choke, 10 hei  4000  Total Effect, 15 3000  Total Effect. | 1.8  0  Supply 50 ohms but Choke, supply 150 ohms put 150 ohms put 150 ohms put 150 ohms put 150 ohms 1.2  Plate- | 50Y6GT 50Y7GT 50Z7G 53 70L7GT 75 78 80 84/6Z4 117L7 GT/ M7GT 117N7                    |

| RCA<br>Type   | Name                | Out-<br>line<br>(see<br>p. 513) | Basing<br>Dia-<br>gram<br>(see<br>p. 488) | Filan<br>Unless s<br>types ha<br>• Heate | nter or<br>nent (F)<br>pecified all<br>ive heaters.<br>r with con-<br>armup time.<br>Amperes | Use Values to right give operating conditions and characteristics for indicated typical use |  |  |
|---------------|---------------------|---------------------------------|-------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--|--|
| 117Z4<br>GT   | Half-Wave Rectifier | 29F                             | 5AA                                       | 117                                      | 0.04                                                                                         | With Capacitive-Input Filter                                                                |  |  |
| 11726         | Rectifier-Doubler   | 130                             | 70                                        | 117                                      | 0.075                                                                                        | Voltage Doubler                                                                             |  |  |
| GT            |                     |                                 |                                           |                                          | 0.073                                                                                        | Half-Wave Rectifier                                                                         |  |  |
| 7027          | Beam Power Tube     | 19F                             | 8HY                                       | 6.3                                      | 0.9                                                                                          | Push-Pull Class AB <sub>1</sub> Amplifier                                                   |  |  |
|               |                     |                                 |                                           |                                          |                                                                                              | Push-Pull Class AB1 Amplifier                                                               |  |  |
| 7247          | Dual Triode         | 6B                              | 9A                                        | 12.6                                     | 0.15                                                                                         | Unit No. 1 as Class A Amplifier                                                             |  |  |
| 1441          | Dual IIIuue         | 90                              | 3A                                        | 6.3                                      | 0.3                                                                                          | Unit No. 2 as Class A Amplifier                                                             |  |  |
| 7591          | Beam Power Tube     | 13D                             | 8KQ                                       | 6.3                                      | 0.8                                                                                          | Class A Amplifier                                                                           |  |  |
| 7331          | Dealn Fower 1496    | 130                             | ova                                       | 0.3                                      | V.8                                                                                          | Push-Pull Class AB <sub>1</sub> Amplifier                                                   |  |  |
| 7695          | Beam Power Tube     | 130                             | 9PX                                       | 50                                       | 0.15                                                                                         | Class A Amplifier                                                                           |  |  |
| 1000          | DESIN LAMEL LUNG    | 190                             | ar A                                      | JU                                       | 0.13                                                                                         | Push-Pull Class AB <sub>1</sub> Amplifier                                                   |  |  |
| EM84/<br>6FG6 | Electron—Ray Tube   | 6F                              | 9GA                                       | 6.3                                      | 0.27                                                                                         | Visual Indicator                                                                            |  |  |

<sup>☐</sup> For two tubes.

Types shown in light face are discontinued.

| Plate<br>Sup-<br>ply<br>Voits | Grid Bias<br>Volts (V)<br>or<br>Cathode<br>Resistor<br>Ohms (Ω)            | Grid<br>Sup-<br>ply<br>Volts | Grid<br>Cur-<br>rent<br>mA | Plate<br>Cur-<br>rent<br>mA | AC Plate<br>Resist-<br>ance<br>Ohms | Trans-<br>cenduct-<br>ance<br>Micromhos | Amplifi-<br>cation<br>Factor | Load<br>for Stated<br>Power<br>Output<br>Ohms                       | Power<br>Out-<br>put<br>Watts | RCA<br>Type   |
|-------------------------------|----------------------------------------------------------------------------|------------------------------|----------------------------|-----------------------------|-------------------------------------|-----------------------------------------|------------------------------|---------------------------------------------------------------------|-------------------------------|---------------|
| Max. Pea                      | k Inverse Volts,                                                           | , 350                        |                            |                             | Output mA<br>ak Plate m             |                                         |                              | . Total Effect<br>ply Imped., 3                                     |                               | 117Z4<br>GT   |
| AC Volts                      | per Plate (RMS<br>it mA, 60<br>per Plate (RMS<br>it mA per Plate,          | ), 235                       | H                          | alf-Wave,<br>lin. Tot       | 30 ohms;<br>al Effect.              | Full-Wave,<br>Supply                    | 15 ohms<br>Imped. pe         | e per Plate:<br>er Plate: /<br>235 voits, 10                        | At 117                        | 117Z6<br>GT   |
| 450                           | —30V                                                                       | 350                          | 3.4□                       | 95 🗆                        |                                     |                                         |                              | 6000                                                                | 50                            |               |
| 400<br>380                    | 200Ω<br>180Ω                                                               | 300<br>380                   | 7□<br>5.6□                 | 112口<br>138口                |                                     |                                         |                              | 6600<br>4500                                                        | 32<br>36                      | -<br>7027     |
| 410                           | 220Ω                                                                       |                              |                            | mA, 134                     |                                     |                                         |                              | 8000                                                                | 24                            |               |
| 250                           | 2V                                                                         |                              |                            | 1.2                         | 62500                               | 1600                                    | 100                          |                                                                     |                               | - 7247        |
| 250                           | 8.5V                                                                       |                              |                            | 10.5                        | 7700                                | 2200                                    | 17                           |                                                                     |                               |               |
| 300                           | 10V                                                                        | 300                          | 8                          | 60                          | 29000                               | 10200                                   |                              | 3000                                                                | 11                            | - 7591        |
| 450                           | 200Ω                                                                       | 400                          | 11.5                       | 82                          | 7000                                | 11000                                   |                              | 9000                                                                | 28†                           |               |
| 130                           | 11V                                                                        | 130                          | 5                          | 100                         | 7000                                | 11000                                   |                              | 1100                                                                | 4.5                           | - 7695        |
| Triod                         | 50Ω<br>le Plate Supply<br>de-Plate Resista<br>de Grid-Supply V<br>Max. Len | nce, 1 MG<br>olts, —22       | ?                          | 210<br>Triode I             | Plate mA, 0<br>when triod           | 0.06<br>le grid resi                    | Triode-Grid<br>Fluorescen    | 1500<br>t-Target Volt<br>I Resistance,<br>t Target mA,<br>1.14 inch | 0.47 MΩ                       | EM84/<br>6FG6 |

<sup>†</sup> For two tubes at stated plate-to-plate load.

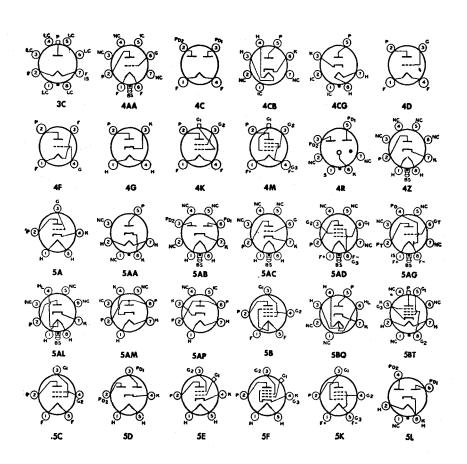
# Basing Diagrams for RCA Replacement and Discontinued Types

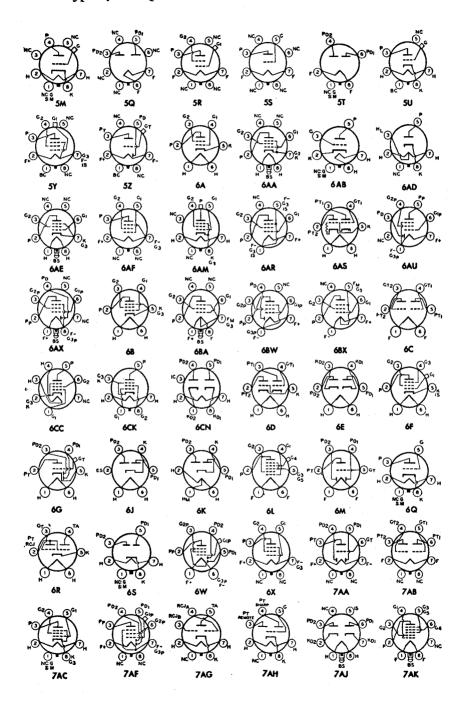
## LEGEND FOR BASE AND ENVELOPE CONNECTION DIAGRAMS

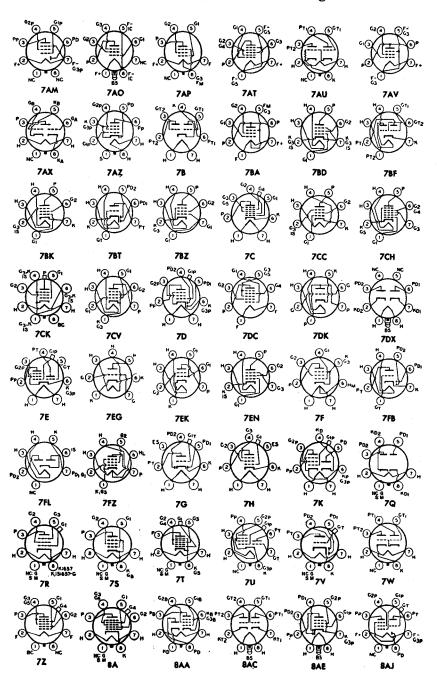
**Bottom Views** 

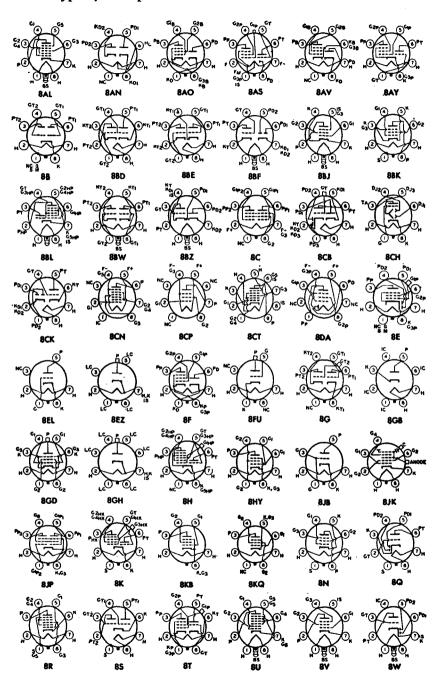
Subscripts B, D, HP, HX, P, T, and TR indicate, respectively, beam unit, diode unit, heptode unit, hexode unit, pentode unit, triode unit, and tetrode unit in multi-unit types.

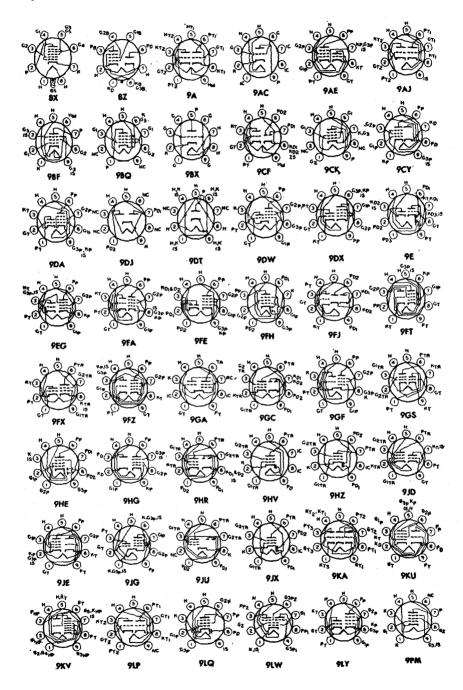
BC - Base Sleeve FT = Fluorescent Target HS = Heater Shield P . = Plate (Anode) G =Grid IC -Internal Connection- RC = Ray-Control Electrode BS - Base Shell H = Heater D] - Deflecting Electrode Do Not Use S = Shell HL = Heater Tap for ES — External Shield IS -Internal Shield TA - Target Panel Lamp F - Filament K = Cathode U - Unit H<sub>M</sub> = Heater Mid-Tap FM - Filament Mid-Tap NC = No Connection =Gas-Type Tube

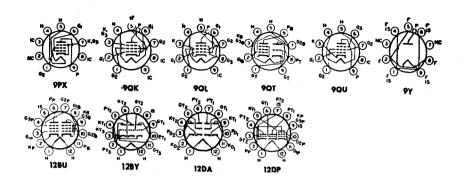






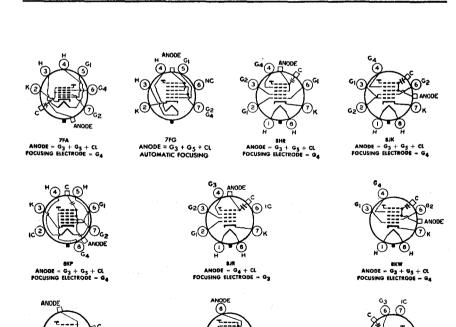






### BASING DIAGRAMS FOR RCA PICTURE TUBES

(See page 495 for data.)



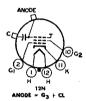
ANODE = G3 + G5 + CL FOCUSING ELECTRODE = G4

ANODE = G3 + G5 + CL FOCUSING ELECTRODE = G4 ANODE

ANODE = G4 + CL FOCUSING ELECTRODE = G3



ANODE - G<sub>3</sub> + CL



G2G(7)



ANODE = G2 + G4 + CL FOCUSING ELECTRODE = G3



12L ANODE =  $G_3 + G_5 + CL$  FOCUSING ELECTRODE =  $G_4$ 



125 ANODE = G<sub>3</sub> + G<sub>5</sub> + CL AUTOMATIC FOCUSING

(14AL) G4 + G5 OVER PIN No. 2 +ANODE Ennetreme. Lannect High-Voltage Supply to this Cap and also connect 50,000 - ehm resistor between this Cop and the Cap over Pin No. 1. FOCUSING ELECTRODE - G3

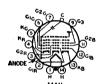


ANODE = G<sub>2</sub> + G<sub>4</sub> + CL FOCUSING ELECTRODE = G<sub>3</sub>





ANODE = G4 + G5 + CL + R
FOCUSING ELECTRODE = G3



ULTOR = G<sub>4</sub> + G<sub>5</sub> + CL FOCUSING ELECTRODE = G<sub>3</sub>



ANODE =  $G_5 + G_6 + CL$ FOCUSING ELECTRODE =  $G_3$ 

## RCA PICTURE TUBE CHARACTERISTICS CHART

| RCA<br>Type | Aluminized<br>Screen | Heater<br>Volts/m& | Envelo       | Grea<br>Defle:<br>Ang<br>(A <i>ppi</i><br>pe< Degr | tion<br>le <sup>b</sup><br>ox.) | Focusing<br>Method | Approx.<br>Tube<br>Weight<br>Pounds | Maximum<br>Over-all<br>Length<br>Inches | Basing* | Design<br>Maximum<br>Anodeo<br>Volts | PM<br>Ion-Trap<br>Magnet<br>Requires |
|-------------|----------------------|--------------------|--------------|----------------------------------------------------|---------------------------------|--------------------|-------------------------------------|-----------------------------------------|---------|--------------------------------------|--------------------------------------|
|             |                      | Silvera            | ama          | Types                                              | for                             | Blac               | k-and                               | -White                                  | TV      |                                      |                                      |
| 5TP44       | Yes                  | 6.3/600            | • G          | 50                                                 |                                 | E                  | 1.2                                 | 12.12                                   | 12C     | 29500                                | No                                   |
| 7JP4        | No                   | 6.3/600            | • 6          |                                                    |                                 | Ē                  | 3                                   | 14.88                                   | 14R     | 6500                                 | No                                   |
| 8DP4        | No                   | 6.3/600            | ■ 6          | 90                                                 | 1                               | Ē                  | 3                                   | 10.750                                  | 12AB    | 9000                                 | Yes                                  |
| 9QP4A       | No                   | 4.7/300            | ■ (          | 70                                                 |                                 | Ε                  | 3.5                                 | 13.062                                  | 12AD    | 7500                                 | Yes                                  |
| 108P4A      | No .                 | 6.3/600            | • (          | 3 50                                               |                                 | M                  | 10                                  | 18                                      | 12N     | 12000                                | Yes                                  |
| 10FP4A      | Yes                  | 6.3/600            | • 6          | 50                                                 |                                 | M                  | 10                                  | 18                                      | 12N     | 13000                                | No                                   |
| 12BNP4A     | Yes                  | 6.3/450            | - (          | 3 11                                               | 0                               | Ε                  | 5                                   | 9.598                                   | 8HR     | 15000                                | No                                   |
| 12KP4A      | Yes                  | 6.3/600            | • 6          |                                                    |                                 | M                  | 12                                  | 18                                      | 12N     | 13000                                | No                                   |
| 14ATP4      | Yes                  | 8.4/450            | <b>=</b> (   | 90                                                 |                                 | Ε                  | 8.5                                 | 13.500                                  | 12L     | 15500                                | No                                   |
| 14CP4B      | Yes                  | 6.3/600            | <b>*</b> (   | <u> </u>                                           |                                 | M                  | 10.5                                | 16.844                                  | 12N     | 15500                                | No                                   |
| 14WP4       | Yes                  | 6.3/600            | <b>II</b> (  | 90                                                 | 1                               | E                  | 8.5                                 | 13.500                                  | 12L     | 15500                                | No                                   |
| 16ANP4      | Yes                  | 6.3/600            |              | 3 <sup>q</sup> 11                                  | 4                               | Ε                  | 8.5                                 | 10.75                                   | 8HR     | 18000                                | No                                   |
| 16AP4A      | No                   | 6.3/600            | • 1          | 1 53                                               |                                 | M                  | 11                                  | 22.31                                   | 12D     | 15500                                | Yes                                  |
| 16AYP4      | Yes                  | 6.3/450            | ■ (          | 11                                                 | 4                               | E                  | 8.5                                 | 10.561                                  | 8HR     | 20000                                | No                                   |
| 16BGP4      | Yes                  | 6.3/450            | <b>=</b> (   | §** 11                                             | 4                               | Ε                  | 8.5                                 | 10.50                                   | 8HR     | 20000                                | No                                   |
| 16DP4A      | No                   | 6.3/600            | • (          | 60                                                 |                                 | М                  | 15                                  | 21                                      | 12D     | 16500                                | Yes                                  |
| 16GP4B      | No                   | 6.3/600            | • 1          | 1 70                                               |                                 | M                  | 11                                  | 17.69                                   | 12D     | 15500                                | Yes                                  |
| 16LP4A      | No                   | 6.3/600            | • (          |                                                    |                                 | M                  | 14.5                                | 22.625                                  | 12N     | 15500                                | Yes                                  |
| 16RP4B      | Yes                  | 6.3/600            |              |                                                    |                                 | М                  | 16                                  | 19.125                                  | 12N     | 17500                                | No                                   |
| 16TP4       | No                   | 6.3/600            | <b>II</b> (  |                                                    |                                 | M                  | 16                                  | 18.50                                   | 12N     | 15500                                | Yes                                  |
| 16WP4A      | No                   | 6.3/600            | • (          |                                                    |                                 | М                  | 16.5                                | 18.125                                  | 12N     | 17500                                | Yes                                  |
| 17BJP4      | Yes                  | 6.3/600            | ■ (          |                                                    |                                 | Ε                  | 15                                  | 15                                      | 12L     | 17500                                | No                                   |
| 17BP4D      | Yes                  | 6.3/600            | <b>II</b> (  |                                                    |                                 | М                  | 18                                  | 19.56                                   | 12N     | 17500                                | No                                   |
| 17CDP4      | Yes                  | 8.4/450            | ■ (          |                                                    | )                               | E                  | 10                                  | 12.81 <b>2</b>                          | 8HR     | 17500                                | No                                   |
| 17CFP4      | Yes                  | 6.3/600            | <b>=</b> (   |                                                    |                                 | E                  | 10                                  | 15.38                                   | 12L     | 17500                                | No                                   |
| 17CP4       | No                   | 6.3/600            | <b>III</b> 1 |                                                    |                                 | M                  | 10                                  | 19                                      | 12D     | 17500                                | Yes                                  |
| 17CSP4      | Yes                  | 6.3/600            | <b>=</b> (   |                                                    | 3                               | Ε                  | 10                                  | 12.62                                   | 7FA     | 17500                                | No                                   |
| 17CYP4      | Yes                  | 6.3/600            | <b>I</b>     |                                                    |                                 | E                  | 10                                  | 14.38                                   | 12L     | 17500                                | No                                   |
| 17DAP4      | Yes                  | 2.68/450           | ■ (          |                                                    |                                 | E                  | 10                                  | 10.875                                  | 8JK     | 17500                                | No                                   |
| 17DKP4      | Yes                  | 6.3/600            | ■ (          |                                                    |                                 | E                  | 10                                  | 10.94                                   | 8JR     | 23000                                | No                                   |
| 17DQP4      | Yes                  | 6.3/450            | <b>=</b> (   |                                                    | 0                               | E                  | 10                                  | 12.38                                   | 7FA     | 17500                                | No                                   |
| 17DRP4*     | Yes                  | 2.68/450           |              |                                                    |                                 | Ε                  | 10                                  | 11                                      | 8JK     | 17500                                | No                                   |
| 17DSP4      | Yes                  | 6.3/600            |              |                                                    |                                 | E                  | 10                                  | 11.44                                   | 8HR     | 20000                                | No                                   |
| 17DXP4      | Yes                  | 6.3/450            | <b>•</b> (   |                                                    | -                               | E                  | 10                                  | 10.94                                   | 8JR     | 17500                                | No                                   |
| 17EFP4      | Yes                  | 6.3/450            |              |                                                    | <u> </u>                        | <u> </u>           | 10                                  | 11.437                                  | 8HR     | 20000                                | No                                   |
| 17GP4       | No                   | 6.3/600            |              |                                                    |                                 | E                  | 10                                  | 19.31                                   | 12M     | 17500                                | Yes                                  |
| 17HP4C      | Yes                  | 6.3/600            | <b>=</b> (   |                                                    |                                 | Ē                  | 18                                  | 19.56                                   | 12L     | 17500                                | No                                   |
| 17LP4B      | Yes                  | 6.3/600            |              | i* 70                                              |                                 | E                  | 19                                  | 19.56                                   | 12L     | 17500                                | No                                   |
| 17QP4B      | Yes                  | 6.3/600            | -            | 3ª 70                                              |                                 | M                  | 19                                  | 19.56                                   | 12N     | 20000                                | No                                   |
| 17TP4       | No                   | 6.3/600            |              |                                                    |                                 | Ε                  | 10                                  | 19.31                                   | 12M     | 17500                                | Yes                                  |
| 19ABP4      | Yes                  | 2.68/450           |              |                                                    |                                 | Ε                  | 14                                  | 11.125                                  | 8JK     | 20000                                | No                                   |
| 19AHP4      | Yes                  | 6.3/450            | ■ (          |                                                    |                                 | E                  | 13.5                                | 11.625                                  | 8HR     | 17500                                | No                                   |
| 19AJP4'     | Yes                  | 6.3/450            | <b>=</b> (   |                                                    | 4                               | E                  | 14                                  | 11.62                                   | 7FA     | 20000                                | No                                   |
| 19AP4B      | No                   | 6.3/600            | • 1          |                                                    |                                 | M                  | 14                                  | 22                                      | 12D     | 17500                                | Yes                                  |
| 19AUP4      | Yes                  | 6.3/600            |              | <sup>jk</sup> 11                                   |                                 | Ē                  | 18.5                                | 11.94                                   | 8HR     | 20000                                | No                                   |
| 19AVP4      | Yes                  | 6.3/600            |              | 3 11                                               | 4                               | Ε                  | 14                                  | 11.62                                   | 8HR     | 23000                                | No                                   |

### RCA PICTURE TUBE CHARACTERISTICS CHART (Cont'd)

| 19AYP4 Yes 19BDP4' Yes 19BTP4 Yes 19CHP4' Yes 19CMP4' Yes 19CMP4' Yes 19CMP4' Yes 19DAP4 Yes 19DAP4 Yes 19DAP4 Yes 6 19DAP4 Yes 6 19DAP4 Yes 6 19DAP4 Yes 6 21DAP4 Yes 6 21AWP4B Yes 21AWP4A Yes 21CBP4A Yes 21DBP4Y Yes 21DBP4Y Yes 21DBP4Y Yes 21DBP4Y Yes 21CBP4A Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Heater<br>Velts/mA Es | D)                                    | ireatest<br>effection<br>Angle <sup>2</sup><br>Approx.)<br>Jegrees | Focusing<br>Method | Tube     | Maximum<br>Over-all<br>Length<br>Inches | Basing*    | Design<br>Maximum<br>Anode o<br>Volts | PM<br>Ion-Trap<br>Magnet<br>Required |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------|--------------------------------------------------------------------|--------------------|----------|-----------------------------------------|------------|---------------------------------------|--------------------------------------|
| 19BDP4' Yes 19BTP4 Yes 19BTP4 Yes 19CMP4' Yes 6 19DCMP4' Yes 6 19DCMP4' Yes 6 19DCMP4' Yes 6 19DCMP4 Yes 6 12DCMP4 Yes 6 12TAP4 Yes 7 12TAP4 Yes | Silveran              | па Тур                                | es fo                                                              | r Blac             | k-and    | -White                                  | TV         |                                       |                                      |
| 19BTP4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.3/450               | ■ G                                   | 114                                                                | E                  | 14       | 11.62                                   | 8HR        | 23000                                 | No                                   |
| 19CHP4' Yes 6 19CXP4' Yes 6 19DXP4 Yes 6 12DXP4 Yes 6 12D | 6.3/600               | <b>■</b> G                            | 92                                                                 | £                  | 15       | 15.625                                  | 12L        | 20000                                 | No                                   |
| 19CMP4' Yes 6 19CXP4' Yes 6 19DAP4 Yes 6 19DAP4 Yes 6 19DRP4 Yes 6 19DRP4 Yes 6 19DRP4 Yes 6 19DRP4 Yes 6 20DP4D Yes 6 20DP4D Yes 6 21AMP4B Yes 6 21AMP4B Yes 6 21AVP4C Yes 6 21CBP4A Yes 6 21CBP4A Yes 6 21CBP4A Yes 6 21CBP4A Yes 6 21DFP4 Yes 6 21DFP4 Yes 6 21DFP4 Yes 6 21EP4C Yes 6 23BEP4C Yes 6 23BEP4 | 6.3/600               | ■ G                                   | 114                                                                | E                  | 14       | 11.06                                   | 8JR        | 23000                                 | No                                   |
| 19CXP4/ Yes 6 19DAP4 Yes 6 19DAP4 Yes 6 19DAP4 Yes 6 19DSP4/ Yes 6 20DP4D Yes 6 20DP4D Yes 6 20DP4D Yes 6 21AMP4B Yes 6 21AMP4B Yes 6 21AWP4C Yes 6 21AWP4A Yes 6 21CQP4 Yes 6 21CQP4 Yes 6 21DEP4A Yes 6 21DEP4A Yes 6 21DEP4A Yes 6 21DEP4A Yes 6 21DEP4C Yes 6 21EP4C Yes 6 23ABP4 Yes 6 23ABP4 Yes 6 23BP4' Yes 6                                                                                                                                                                                                                                                                             | 6.3/600               | ■G                                    | 114                                                                | E                  | 14       | 11.88                                   | 8HR        | 20000                                 | No                                   |
| 190AP4   Yes   60     190BP4   Yes   60     210BP4B   Yes   60     21AP4   No   60     21AP4   Yes   60     21AP4A   Yes   60     21CBP4A   Yes   60     21CBP4A   Yes   60     21DBP4   Yes   60     21BP4   Yes   60     21BBP4   Yes   60     21   | 6.3/450               | ■ G                                   | 114                                                                | E                  | 14       | 11.88                                   | 8HR        | 20000                                 | No                                   |
| 19DQP4 Yes 6 19DRP4 Yes 6 12DRP4 Yes 6 12DRP | 6.3/600               | ■ G                                   | 114                                                                | E                  | 14       | 11.875                                  | 7FA        | 20000                                 | No                                   |
| 1908P4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.3/450               | ■ Ğ¢×                                 | 114                                                                | Ē                  | 14       | 11.87                                   | 8HR        | 23000                                 | No                                   |
| 1905P4'   Yes   60     200P4D   Yes   60     201P4E   Yes   60     21AP4B   Yes   60     21AP4A   Yes   60     21AP4A   Yes   60     21AP4A   Yes   60     21C0P4A   Yes   60     21DFP4   Yes   60     21EP4C   Yes   60     21FP4D   Yes   60     23AP4   Yes   70     23BP4'   Yes   70     23BP4'   Yes     23BP4'   Yes   70     24BP4'   Yes   70     24   | 6.3/450               | <b>■</b> G <sup>m</sup>               | 114                                                                | Ē                  | 15       | 11.875<br>11.875                        | 8HR        | 23000                                 | No                                   |
| 20DP4D Yes 20HP4E Yes 6 21AMP4B Yes 6 21AP4 No 6 21AVP4C Yes 6 21AWP4A Yes 6 21CBP4A Yes 6 21DFP4 Yes 6 21EP4C Yes 6 21EP4C Yes 6 21EP4C Yes 6 21EP7P4 Yes 6 21EP7P4 Yes 6 21EVP4 Yes 6 21E | 6.3/600<br>6.3/600    | <b>—</b> G <sup>∞</sup>               | 114<br>114                                                         | E<br>E             | 14<br>14 | 11.875                                  | 8HR<br>8HR | 23000<br>20000                        | No<br>No                             |
| 20HP4E Yes 6 21AMP4B Yes 6 21AP4 No 6 21AVP4C Yes 6 21AVP4A Yes 6 21CBP4A Yes 6 21CBP4A Yes 6 21DFP4 Yes 6 21DFP4 Yes 6 21DFP4 Yes 6 21DSP4' Yes 6 21DSP4' Yes 6 21EP4C Yes 6 21EP4C Yes 6 21EP4C Yes 6 21EVP4' Yes 6 21EVP4' Yes 6 21EVP4 Yes  | 6.3/600               | <u> </u>                              | 70                                                                 | M                  | 30       | 20.375                                  | 12N        | 20000                                 | No                                   |
| 21AMP4B Yes 6 21AP4 No 6 21AVP4C Yes 6 21AVP4A Yes 6 21CBP4A Yes 6 21DEP4A Yes 6 21DEP4A Yes 6 21DEP4A Yes 6 21DEP4 Yes 6 21DEP4 Yes 6 21DEP4 Yes 6 21EP4C Yes 6 21EP4C Yes 6 21EVP4 Yes 7 23BEVP4 YES 7 23BE | 6.3/600               | = G                                   | 70<br>70                                                           | rvi<br>E           | 30       | 20.373                                  | 12L        | 17500                                 | No                                   |
| 21AP4 No 21AVP4C Yes 6 21AVP4A Yes 6 21CBP4A Yes 6 21CBP4A Yes 6 21CBP4A Yes 6 21DFP4 Yes 6 21CBP4C Yes 6 21EP4C Yes 6 21EVP4 Yes 6 21EVP4 Yes 6 21FP4D Yes 7 23BFP4 Yes 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6.3/600               | ■ G                                   | 90                                                                 | M                  | 24       | 23.41                                   | 12N        | 20000                                 | No                                   |
| 21AVP4C Yes 6 21AWP4A Yes 6 21CBP4A Yes 6 21CGP4 Yes 6 21CGP4 Yes 6 21DFP4 Yes 6 21DHP4 Yes 6 21DHP4 Yes 6 21DHP4 Yes 6 21EP4C Yes 6 21EVP4 Yes 6 21EVP4 Yes 6 21FAP4 Yes 7 21FP4D Yes 7 23BHP4 Yes 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 6.3/600               | ■ M                                   | 70                                                                 | M                  | 18       | 22.12                                   | 12D        | 20000                                 | Yes                                  |
| 21AWP4A Yes 6 21CBP4A Yes 6 21CQP4 Yes 6 21DEP4A Yes 6 21DFP4 Yes 6 21DHP4 Yes 6 21DHP4 Yes 6 21DLP4 Yes 6 21DLP4 Yes 6 21EQP4 Yes 6 21EQP4 Yes 6 21EQP4 Yes 6 21FAP4 Yes 7 21AP4B Yes 7 21 | 6.3/600               | ■ G                                   | 72.                                                                | Ë                  | 24       | 22.12                                   | 12L        | 22000                                 | No                                   |
| 21CBP4A Yes 21CBP4A Yes 21CBP4A Yes 62 21DFP4 Yes 62 21DFP4 Yes 62 21DFP4 Yes 62 21DFP4 Yes 62 21EVP4 Yes 62 23EVP4 Yes 62 23EVP | 6.3/600               | <b>■</b> G                            | 72                                                                 | M                  | 24       | 23.41                                   | 12N        | 20000                                 | No                                   |
| 21CQP4 Yes 6 21DEP4A Yes 6 21DFP4 Yes 6 21DHP4 Yes 6 21DLP4 Yes 6 21DLP4 Yes 6 21DLP4 Yes 6 21DLP4 Yes 6 21EQP4 Yes 6 21EQP4 Yes 6 21FAP4 Yes 7 21FAP4 Yes 7 21FAP4 Yes 7 21FAP4 Yes 7 21FYP4 Yes 7 23APP4 Yes 7 23APP4 Yes 7 23APP4 Yes 7 23BPP4 Yes 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6.3/600               | ■ G                                   | 90                                                                 | Ë                  | 24       | 18.375                                  | 12L        | 22000                                 | No                                   |
| 21DEP4A Yes 6 21DFP4 Yes 6 21DFP4 Yes 6 21DLP4 Yes 6 21DLP4 Yes 6 21DSP4' Yes 6 21EQP4 Yes 6 21EQP4 Yes 6 21EQP4 Yes 6 21FAP4 Yes 7 23APP4 Yes 7 23APP4 Yes 7 23APP4 Yes 7 23ASP4 Yes 7 23BLP4' Yes 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 6.3/600               | ■ G                                   | 110                                                                | Ē                  | 20       | 14.81                                   | 7FA        | 20000                                 | No                                   |
| 21DFP4 Yes 6 21DHP4 Yes 6 21DLP4 Yes 6 21DLP4 Yes 6 21DSP4' Yes 6 21EP4C Yes 6 21EVP4' Yes 6 21FAP4 Yes 2 23AP4 Yes 2 23AP4 Yes 2 23BP4' Yes 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6.3/600               | ≖ G                                   | 110                                                                | Ē                  | 20       | 15                                      | 8HR        | 22000                                 | No                                   |
| 21DHP4 Yes 6 21DLP4 Yes 6 21DSP4' Yes 6 21EP4C Yes 6 21EQP4 Yes 6 21EQP4 Yes 6 21FAP4 Yes 7 21FAP4 Yes 7 21FAP4 Yes 7 21FYP4 Yes 7 21MP4 No 7 21MP4B Yes 7 23MP4 Yes 7 23MP4 Yes 7 23MP4 Yes 7 23MP4' Yes 7                                                                                                                                                                                                 | 6.3/600               | ≖ G                                   | 110                                                                | Ē                  | 24       | 14,750                                  | 8HR        | 20000                                 | No                                   |
| 21DLP4 Yes 6 21DSP4' Yes 6 21EP4C Yes 6 21EQP4 Yes 6 21EVP4' Yes 6 21FVP4 Yes 7 21FP4D Yes 7 21FP4D Yes 7 21FP4D Yes 7 21FP4D Yes 7 21FP4B Yes 7 21YP4B Yes 7 21YP4B Yes 7 21YP4B Yes 7 23APP4 Yes 7 23APP4 Yes 7 23APP4 Yes 7 23APP4 Yes 7 23BPP4' Yes 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6.3/450               | ■ G                                   | 110                                                                | - <u>Ē</u>         | 20       | 15                                      | 8HR        | 20000                                 | No                                   |
| 21DSP4' Yes 6 21EP4C Yes 6 21EQP4 Yes 6 21EVP4' Yes 6 21FAP4 Yes 7 21MP4 No 7 21MP4B Yes 7 23APP4 Yes 7 23BP4' Yes 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6.3/600               |                                       | 90                                                                 | Ē                  | 24       | 17.375                                  | 12L        | 22000                                 | No                                   |
| 21EP4C Yes 6 21EVP4" Yes 6 21EVP4" Yes 6 21FAP4 Yes 2 21FAP4 Yes 2 21FP4D Yes 2 21FP4D Yes 2 21FP4P Yes 2 21MP4 Yes 2 21MP4 Yes 2 21MP4B Yes 2 23AHP4 Yes 2 23AHP4 Yes 2 23ABP4 Yes 2 23BP4" Yes 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6.3/600               | <b>≡</b> G                            | 90                                                                 | Ē                  | 24       | 18.375                                  | 12L        | 22000                                 | No                                   |
| 21EQP4 Yes 6 21EVP4" Yes 2 21FAP4 Yes 2 21FP4D Yes 2 21FP4D Yes 2 21FP4D Yes 2 21FP4D Yes 2 21MP4 No (2 21MP4B Yes 2 21XP4B Yes 2 21XP4B Yes 2 21XP4B Yes 2 21XP4C Yes 2 23AHP4 Yes 2 23ASP4 Yes 2 23BGP4 Yes 2 23BIP4" Yes 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6.3/600               | ■ GA                                  | 70                                                                 | M                  | 29       | 23.41                                   | 12N        | 20000                                 | No                                   |
| 21FAP4 Yes 21FDP4 Yes 21FP4D Yes 21FVP4 Yes 21FVP4 Yes 21WPP4 Yes 21WPP4 Yes 21WPP4B Yes 21ZYPP4B Yes 21ZPP4C Yes 23ARP4 Yes 23ARP4 Yes 23BCPP4 Yes 24BCPP4 Yes 24BCP4 Ye | 6.3/600               | <b>≡</b> G                            | 110                                                                | Ë                  | 24       | 12.88                                   | 8JR        | 20000                                 | No                                   |
| 21FAP4 Yes 21FDP4 Yes 21FP4D Yes 21FVP4 Yes 21FVP4 Yes 21WPP4 Yes 21WPP4 Yes 21WPP4B Yes 21ZYPP4B Yes 21ZPP4C Yes 23ARP4 Yes 23ARP4 Yes 23BCPP4 Yes 24BCPP4 Yes 24BCP4 Ye | 2.68/450              | <b>■</b> G                            | 110                                                                | E                  | 20       | 13.19                                   | 8JK        | 20000                                 | No                                   |
| 21F0P4 Yes 21FP4D Yes 21FP4D Yes 21FP4D Yes 21FP4D Yes 21WP4B Yes 21XP4B Yes 21ZP4C Yes 23ARP4 Yes 23ASP4 Yes 23BIP4' Yes 23BI | 6.3/600               | <b>■</b> G                            | 110                                                                | Ē                  | 20       | 13.12                                   | 8JR        | 22000                                 | No                                   |
| 21FP4D Yes<br>21FVP4 Yes<br>21MP4 No<br>21WP4B Yes<br>21XP4B Yes<br>21XP4B Yes<br>21YP4B Yes<br>21ZP4C Yes<br>23ARP4 Yes<br>23ARP4 Yes<br>23BP4' Yes<br>23BP4' Yes<br>23BP4' Yes<br>23BP4' Yes<br>23BP4' Yes<br>23BP4' Yes<br>23BP4' Yes<br>23BP4' Yes<br>23BP4' Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 6.3/600               | <b>≡</b> G                            | 110                                                                | Ē                  | 20       | 13.38                                   | 8KW        | 20000                                 | No                                   |
| 21FVP4 Yes 21MP4 No 21WP4B Yes 21XP4B Yes 21XP4B Yes 21XP4C Yes 23APP4 Yes 23ARP4 Yes 23ASP4 Yes 23BSP4' Yes 23BLP4' Yes 23BLP4' Yes 23BQP4 Yes 23CBP4 Yes 23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 6.3/600               | ■ G <sup>a</sup>                      | 70                                                                 | Ē                  | 29       | 23.41                                   | 12L        | 20000                                 | No                                   |
| 21WP4B Yes 21XP4B Yes 21YP4B Yes 21ZP4C Yes 23ARP4 Yes 23ASP4 Yes 23BSP4' Yes 23BLP4' Yes 23BCP4' Yes 23BCP4' Yes 23BCP4' Yes 23BCP4' Yes 23BCP4 Yes 23CBP4 Yes 23CBP4 Yes 23CBP4 Yes 23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6.3/450               | ■ G <sup>m</sup>                      | 114                                                                | Ε                  | 19       | 12.937                                  | 8HR        | 23000                                 | No                                   |
| 21WP4B Yes 21XP4B Yes 21YP4B Yes 21ZP4C Yes 23ARP4 Yes 23ASP4 Yes 23BSP4' Yes 23BLP4' Yes 23BCP4' Yes 23BCP4' Yes 23BCP4' Yes 23BCP4' Yes 23BCP4 Yes 23CBP4 Yes 23CBP4 Yes 23CBP4 Yes 23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6.3/600               | <b>■</b> M                            | 70                                                                 | E                  | 18       | 22.62                                   | 12M        | 17500                                 | Yes                                  |
| 21XP4B Yes<br>21YP4B Yes<br>21ZP4C Yes<br>23APP4 Yes<br>23ARP4 Yes<br>23ASP4 Yes<br>23BSP4' Yes<br>23BLP4' Yes<br>23BLP4' Yes<br>23BQP4 Yes<br>23CBP4 Yes<br>23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6.3/600               | ■ G                                   | 70                                                                 | M                  | 18       | 22.812                                  | 12N        | 20000                                 | No                                   |
| 21ZP4C Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6.3/600               | <b>≡</b> G                            | 70                                                                 | Ē                  | 18       | 22.812                                  | 12L        | 20000                                 | No                                   |
| 23AHP4 Yes<br>23ARP4 Yes<br>23ASP4 Yes<br>23BGP4' Yes<br>23BJP4' Yes<br>23BLP4' Yes<br>23BQP4 Yes<br>23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 6.3/600               | <b>≡</b> G                            | 70                                                                 | E                  | 24       | 23.41                                   | 12L        | 20000                                 | No                                   |
| 23ARP4 Yes<br>23ASP4 Yes<br>23BGP4' Yes<br>23BJP4' Yes<br>23BLP4' Yes<br>23BQP4 Yes<br>23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 6.3/600               | <b>■</b> G                            | 70                                                                 | M                  | 24       | 23.41                                   | 12N        | 20000                                 | No                                   |
| 23ASP4 Yes<br>23BGP4' Yes<br>23BJP4' Yes<br>23BLP4' Yes<br>23BLP4' Yes<br>23BQP4 Yes<br>23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 6.3/600               | <b>■</b> G                            | 92                                                                 | Ē                  | 25       | 18.38                                   | 12L        | 22000                                 | No                                   |
| 23BGP4' Yes<br>23BJP4' Yes<br>23BLP4' Yes<br>23BLP4' Yes<br>23BGP4 Yes<br>23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 6.3/600               | <b>≖</b> G                            | 110                                                                | Ē                  | 25       | 15.156                                  | 8HR        | 22000                                 | No                                   |
| 23BJP4' Yes<br>23BLP4' Yes<br>23BQP4 Yes<br>23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6.3/600               | <b>≡</b> G                            | 92                                                                 | E                  | 25       | 17.38                                   | 12L        | 22000                                 | No<br>No                             |
| 23BLP4' Yes<br>23BQP4 Yes<br>23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6.3/600               | ■ G <sup>3</sup>                      | 110                                                                | E<br>E             | 25       | 15.562                                  | 8HR        | 22000<br>25000                        | No<br>No                             |
| 23BQP4 Yes<br>23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6.3/600               | ■ G                                   | 92                                                                 |                    | 33       | 18.50                                   | 12L        |                                       |                                      |
| 23CBP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6.3/600               | <b>■</b> G <sup>jk</sup>              | 92                                                                 | Ē                  | 35       | 18.88                                   | 12L        | 25000                                 | No                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 6.3/450               | ■ G <sup>j</sup>                      | 110                                                                | Ē                  | 33       | 15.562                                  | 8HR        | 23000                                 | No<br>No                             |
| Z3CGP4 Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6.3/450               | <b>■</b> G <sup>jk</sup>              | 110                                                                | Ē                  | 33       | 15.56                                   | 8HR        | 23000                                 | No<br>No                             |
| 000B/ V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6.3/450               | ■ G                                   | 92                                                                 | E                  | 25<br>33 | 18.375<br>15.56                         | 12L<br>8HR | 22000<br>22000                        | No<br>No                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 6.3/600<br>6.3/450    | <b>≢</b> G <sup>≠</sup><br><b>≢</b> G | 110<br>114                                                         | E<br>E             | 33<br>25 | 13.36                                   | 8HR        | 23500                                 | No                                   |

<sup>\*</sup> Basing diagrams for RCA picture tubes are shown on page 493.

### RCA PICTURE TUBE CHARACTERISTICS CHART (Cont'd)

| RCA<br>Type | Aluminized<br>Screen |          | Envelopeª               | Greatest<br>Deflection<br>Angle <sup>b</sup><br>(Approx.)<br>Degrees | Focusing<br>Method | Approx.<br>Tube<br>Weight<br>Pounds | Maximum<br>Over-all<br>Length<br>Inches | Basing* | Design<br>Maximum<br>Anode<br>Volts | PM<br>Ion-Trap<br>Magnet<br>Required |
|-------------|----------------------|----------|-------------------------|----------------------------------------------------------------------|--------------------|-------------------------------------|-----------------------------------------|---------|-------------------------------------|--------------------------------------|
|             |                      | Silvera  | ıma Ty                  | pes fo                                                               | Blac               | k-and                               | -White                                  | TV      |                                     |                                      |
| 23DAP47     | 'Yes                 | 6.3/600  | ■ G                     | 94                                                                   | E                  | 27                                  | 17.39                                   | 8HR     | 23000                               | No                                   |
| 23DBP41     | Yes                  | 6.3/600  | <b>≡</b> G              | 110                                                                  | Ε                  | 25                                  | 15.156                                  | 8HR     | 22000                               | No                                   |
| 23ENP4      | Yes                  | 6.3/600  | <b>≡</b> G <sup>m</sup> | 92                                                                   | E                  | 29                                  | 18.500                                  | 12L     | 25000                               | No                                   |
| 23EP47      | Yes                  | 6.3/600  | <b>≡</b> G <sup>j</sup> | 110                                                                  | E                  | 33                                  | 15.562                                  | 8KP     | 22000                               | No                                   |
| 23EQP4      | Yes                  | 6.3/450  | ■ G <sup>m</sup>        | 114                                                                  | Ε                  | 25                                  | 14.812                                  | 8HR     | 23000                               | No                                   |
| 23ETP4      | Yes                  | 6.3/600  | <b>■</b> G <sup>m</sup> | 110                                                                  | E                  | 25                                  | 15.156                                  | 8HR     | 23000                               | No                                   |
| 23FBP4      | Yes                  | 6.3/600  | ■ G*m                   | 92                                                                   | E                  | 29                                  | 18.500                                  | 12L     | 25000                               | No                                   |
| 23FP4A      | Yes                  | 6.3/600  | <b>≡</b> G              | 114                                                                  | Ε                  | 25                                  | 14.062                                  | 8HR     | 23500                               | No                                   |
| 23JP41      | Yes                  | 6.3/450  | ■ G'                    | 110                                                                  | E                  | 33                                  | 15.88                                   | 7FA     | 22000                               | No                                   |
| 23NP41      | Yes                  | 6.3/600  | <b>≖</b> G              | 114                                                                  | Ε                  | 25                                  | 14.812                                  | 8HR     | 22000                               | No                                   |
| 23YP4       | Yes                  | 6.3/600  | ■ G <sup>3</sup>        | 92                                                                   | E-                 | 35                                  | 18.75                                   | 12L     | 22000                               | No                                   |
| 24AEP4      | Yes                  | 6.3/600  | <b>≖</b> G              | 90                                                                   | Ε                  | 35                                  | 19.500                                  | 12L     | 22000                               | No                                   |
| 24AHP4      | Yes                  | 6.3/600  | ■ G                     | 110                                                                  | E                  | 28                                  | 16.188                                  | 8HR     | 22000                               | No                                   |
| 24ATP4*     | Yes                  | 6.3/600  | <b>≡</b> G              | 90                                                                   | E                  | 35                                  | 19.500                                  | 12L     | 22000                               | No                                   |
| 24AUP4      | Yes                  | 6.3/600  | ■ G                     | 90                                                                   | E                  | 35                                  | 18.50                                   | 12L     | 22000                               | No                                   |
| 24BAP47     | Yes                  | 6.3/600  | ■ G                     | 110                                                                  | E                  | 28                                  | 16.188                                  | 8HR     | 22000                               | No                                   |
| 24BEP4      | Yes                  | 6.3/600  | ■ G                     | 110                                                                  | E                  | 28                                  | 15.12                                   | 8KW     | 20000                               | No                                   |
| 24CP4B      | Yes                  | 6.3/600  | ■ G                     | 90                                                                   | М                  | 35                                  | 21.50                                   | 12N     | 22000                               | No                                   |
| 27MP4       | Yes                  | 6.3/600  | ■ M                     | 90                                                                   | M                  | 30                                  | 22.19                                   | 12D     | 20000                               | Yes                                  |
| 27RP4A      | Yes                  | 6.3/600  | <b>■</b> G              | 90                                                                   | M                  | 44                                  | 23.44                                   | 12N     | 22000                               | No                                   |
|             |                      |          | Co                      | lor Pic                                                              | ture T             | ubes                                | •                                       |         |                                     |                                      |
| 15GP22"     | Yes                  | 6.3/1800 |                         | 45                                                                   | E                  | 25                                  | 26.12                                   | 20A     | 22000                               | No                                   |
| 21AXP22A    | Yes                  | 6.3/1800 |                         | 70                                                                   | £                  | 28                                  | 25.31                                   | 14AH    | 27500                               | No                                   |
| 21CYP22A    | Yes                  | 6.3/1800 |                         | 70                                                                   | E                  | 36.5                                | 25.406                                  | 14AL    | 27500                               | No                                   |
| 21FBP22     | Yes                  | 6.3/1800 | " ● G                   | 70                                                                   | E                  | 36.5                                | 25.406                                  | 14AU    | 27500                               | No                                   |
| 21FBP22A    | Yes                  | 6.3/1800 | • G                     | 70                                                                   | E                  | 36.5                                | 25.406                                  | 14AU    | 27500                               | No                                   |
| 21FJP22     | Yes                  | 6.3/1800 | p                       | 70                                                                   | Ε                  | 41                                  | 25.594                                  | 14AU    | 27500                               | No                                   |
| 21FJP22A    | Yes                  | 6.3/1800 |                         |                                                                      | E                  | 41                                  | 25.594                                  | 14AU    | 27500                               | No                                   |
| 25AP22A     | Yes                  | 6.3/800° | ■ G*                    | <sup>2</sup> 90                                                      | <u>E</u>           | 42                                  | 20.375                                  | 14BE    | 27500                               | No                                   |
|             |                      |          | Te                      | st Pict                                                              | ure T              | ubes                                |                                         |         |                                     |                                      |
| 5AXP4       | No                   | 6.3/600  | • G                     | 53                                                                   | E.                 | 1.5                                 | 11.00                                   | 12S     | 20000                               | No                                   |
| 8XP4        | Yes                  | 6.3/600  | <b>■</b> G              | 90                                                                   | E*                 | 3                                   | 11.75                                   | 128     | 22000                               | No                                   |
| 8YP4        | Yes                  | 6.3/600  | <b>■</b> G              | 110                                                                  | £•                 | 2                                   | 9                                       | 7FG     | 22000                               | No                                   |

- \* Basing diagrams for RCA picture tubes are shown on page 493.
  - G Glass round.
  - M Metal round.
    G Glass rectangular.

  - M Metal rectangular. E Electrostatic.

  - M Magnetic.

    a Faceplate is spherical, unless otherwise specified. b All types utilize magnetic deflection except for type 7JP4 which employs elec-
  - trostatic deflection. c The anode is defined as the electrode, or the electrode in combination with one or more additional electrodes connected within the tube
- to it, to which is applied the highest dc voltage for accelerating the electrons in the beam.
- d Projection type.

  e Typical deflection factors
  (volts dc/in.) for anode
  voltage of 6000 volts:

  DJ1 & DJ2 (nearer screen)
  - 186 to 246 DJ3 & DJ4 (nearer base)
- 150 to 204 f Has low grid-No.2 voltage
- rating: for Cathode-Drive Service.
- g This type has an internal magnetic shield.

- h Cylindrical faceplate.
- j Bipanel type.
  k Treated to reduce specular reflection.
- m PAN-O-PLY-integral implosion protection.
- n This type has a flat, aluminized, filterglass phosphordot screen plate.
- p Three heaters paralleled internally.
- q This type has an integral protective window.
- rThree heaters series connected internally.
- s Automatic.

# RCA VOLTAGE-REGULATOR AND VOLTAGE-REFERENCE TUBES

These tubes are designed for voltage-regulation requiring a relatively constant dc output voltage across a load independent of load and line-voltage variations,

| RCA<br>Type                                        | DC Oper-<br>ating<br>Volts         | DC<br>Operating<br>Current<br>Range<br>mA            | Anode<br>Starting<br>Volts      | Anode<br>Starting<br>(mA)        | Regu-<br>lation<br>Volts    | Ambient<br>Operating<br>Temperature<br>Range (°C)                  | Max<br>Length<br>(in)                     | Max<br>Diam-<br>eter<br>(in)        | Diagram<br>Terminal                    |  |
|----------------------------------------------------|------------------------------------|------------------------------------------------------|---------------------------------|----------------------------------|-----------------------------|--------------------------------------------------------------------|-------------------------------------------|-------------------------------------|----------------------------------------|--|
| VOLTAGE-REGULATOR TUBES †                          |                                    |                                                      |                                 |                                  |                             |                                                                    |                                           |                                     |                                        |  |
| OA2<br>OA3<br>OA3A<br>OB2<br>OC2                   | 150<br>75<br>75<br>75<br>105<br>75 | 5 to 30<br>5 to 40<br>5 to 40<br>5 to 30<br>5 to 30  | 185<br>105<br>105<br>133<br>115 | 75<br>100<br>100<br>75<br>75     | 6<br>6.5<br>6.5<br>4<br>4.5 | -55 to +90<br>-55 to +90<br>-55 to +90<br>-55 to +90<br>-55 to +90 | 4-1/8 1<br>3-1/16 1<br>2-5/8              | 3/4<br>-9/16<br>-9/32<br>3/4<br>3/4 | 5B0<br>4AJ<br>4AJ<br>5B0<br>5B0        |  |
| OC3<br>OC3A<br>OD3<br>OD3A<br>991                  | 105<br>105<br>150<br>150<br>59     | 5 to 40<br>5 to 40<br>5 to 40<br>5 to 40<br>0.4 to 2 | 133<br>127<br>185<br>180<br>87  | 100<br>100<br>100<br>100         | 4<br>4<br>5.5<br>5.5<br>8   | -55 to +90<br>-55 to +90<br>-55 to +90<br>-55 to +90               | 3-1/16 1                                  | -9/32<br>-9/16                      | 4AJ<br>4AJ<br>4AJ<br>4AJ               |  |
| 6073<br>6073/0A2<br>6074<br>6074/0B2<br>6626/0A2WA | 150<br>150<br>105<br>105<br>150    | 5 to 30<br>5 to 30<br>5 to 30<br>5 to 30<br>5 to 30  | 185<br>185<br>133<br>133<br>165 | 75<br>75<br>75<br>75<br>75<br>75 | 6<br>6<br>4<br>4<br>5       | -55 to +90<br>-55 to +90<br>-55 to +90<br>-55 to +90<br>-55 to +90 | 2-5/8<br>2-5/8<br>2-5/8<br>2-5/8<br>2-5/8 | 3/4<br>3/4<br>3/4<br>3/4<br>3/4     | 5B0<br>5B0<br>5B0<br>5B0<br>5B0<br>5B0 |  |

# VOLTAGE-REFERENCE TUBES \*

(for exceptional voltage stability)

| 5651  | 87   | 1.5 to 3.5 | 115 |   | 3 | -55 to +90 | 2-1/8 | 3/4 | 5B0 |
|-------|------|------------|-----|---|---|------------|-------|-----|-----|
| 5651A | 85.5 | 1.5 to 3.5 | 115 | _ | 3 | -55 to +90 | 2-1/8 | 3/4 | 5B0 |

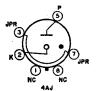
## SERIES-VOLTAGE-REGULATOR TUBES \*\*

(for high-current applications)

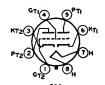
| RCA<br>Type | Heater<br>Volts | Heater<br>Amperes | DC<br>Plate<br>Volts | DC<br>Plate<br>Amperes | Plate Dis-<br>sipation<br>(watts) | Ampli-<br>fication<br>Factor | Plate Re-<br>sistance<br>(ohms) | Max<br>Length<br>(in) | Max<br>Diameter<br>(in) | Terminal<br>Diagram |
|-------------|-----------------|-------------------|----------------------|------------------------|-----------------------------------|------------------------------|---------------------------------|-----------------------|-------------------------|---------------------|
| 6336A       | 6.3             | 2.5               | 250                  | 0.125                  | 13                                | 2                            | 280                             | 4-5/8                 | 1-9/16                  | 8BD                 |
| 6AS7G       | 6.3             | 2.5               | 250                  | 0.125                  | 13                                | 2                            | 280                             | 4-1/6                 | 1-23/32                 | 8BD                 |
| 6080        | 26.5            | 0.6               | 250                  | 0.125                  | 13                                | 2                            | 280                             | 4-1/6                 | 1-23/32                 | 8BD                 |
| 6082        | 6.3             | 5                 | 400                  | 0.4                    | 30                                | 2.7                          | 280                             | 4-3/4                 | 2.07                    | 8BD                 |

<sup>\*\*</sup> Indirectly-heated-cathode, vacuum, low-mu twin triodes.

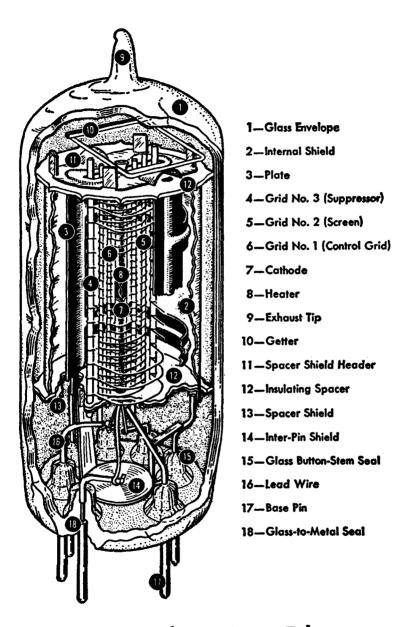
<sup>†</sup> Cold-cathode, glow-discharge types.







\* Candelabra two-contact socket.



Structure of a Miniature Tube

# Electron Tube Testing

HE electron-tube user-service man. experimenter. or non-technical radio listener—is interested in knowing the condition of his tubes, since they govern the performance of the device in which they are used. In order to determine the condition of a tube, some method of test is necessary. Because the operating capabilities and design features of a tube are indicated and described by its electrical characteristics. a tube is tested by measuring its characteristics and comparing them with values established as standard for that type. Tubes which read abnormally high with respect to the standard for the type are subject to criticism just the same as tubes which are too low.

Certain practical limitations are placed on the accuracy with which a tube test can be correlated with actual tube performance. These limitations make it impractical for the service man and dealer to employ complex and costly testing equipment having laboratory accuracy. Because the accuracy of the tube-testing device need be no greater than the accuracy of the correlation between test results and receiver performance, and since certain fundamental characteristics are virtually fixed by the manufacturing technique of leading tube manufacturers, it is possible to employ a relatively simple test in order to determine the serviceability of a tube.

In view of these factors, dealers and service men will find it economically expedient to obtain adequate accuracy and simplicity of operation by employing a device which indicates the status of a single characteristic. Whether the tube is satisfactory or unsatisfactory is judged from the test result of this single characteristic. Consequently, it is

very desirable that the characteristic selected for the test be one which is truly representative of the tube's over-all condition.

The following information and circuits are given to describe and illustrate general theoretical and practical tubetester considerations and not to provide information on the construction of a home-made tube tester. In addition to the problem of determining what tube characteristic is most representative of performance capabilities in all types of receivers, the designer of a home-made tester faces the difficult problem of determining satisfactory limits for his particular tester. Getting information of this nature, if it is to be accurate and useful, is a big job. It requires the testing of many tubes of each type, testing of many types, and correlation of the data with performance in many kinds of equipment.

#### **Short-Circuit Test**

The fundamental circuit of a shortcircuit tester is shown in Fig. 106. Although this circuit is suitable for tet-

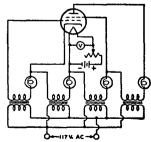


Fig. 106—Fundamental circuit of a shortcircuit tester.

rodes and types having less than four electrodes, tubes of more electrodes may be tested by adding more indicator lamps to the circuit. Voltages are applied between the various electrodes with lamps in series with the electrode leads. The value of the voltages applied will depend on the type of tube being tested and its maximum ratings. Any two shorted electrodes complete a circuit and light one or more lamps. Since two electrodes may be just touching to give a high-resistance short, it is desirable that the indicating lamps operate on very low current. It is also desirable to maintain the filament or heater of the tube at its operating temperature during the short-circuit test, because shortcircuits in a tube may sometimes occur only when the electrodes are heated. However, a short-circuit tester having too high a sensitivity may indicate veryhigh-resistance shorts that do not adversely affect tube operation.

### Selection of a Suitable Characteristic for Test

Some characteristics of a tube are far more important in determining its operating worth than are others. The cost of building a device to measure any one of the more important characteristics may be considerably higher than that of a device which measures a less representative characteristic. Consequently, three methods of test will be discussed, ranging from relatively simple and inexpensive equipment to more elaborate, more accurate, and more costly devices.

An emission test is perhaps the simplest method of indicating a tube's condition. (Refer to Diodes, in Electrons, Electrodes, and Electron Tubes section, for a discussion of electron emission.) Since emission falls off as the tube wears out, low emission is indicative of the end of tube serviceability. However, the emission test is subject to limitations because it tests the tube under static conditions and does not take into account the actual operation of the tube. On the one hand, coated filaments, or cathodes.

often develop active spots from which the emission is so great that the relatively small grid area adjacent to these spots cannot control the electron stream. Under these conditions, the total emission may indicate the tube to be normal although the tube is unsatisfactory. On the other hand, coated types of filaments are capable of such large emission that the tube will often operate satisfactorily after the emission has fallen far below the original value.

Fig. 107 shows the fundamental circuit diagram for an emission test. All of the electrodes of the tube, except the cathode, are connected to the plate. The filament, or heater, is operated at rated voltage; after the tube has reached con-

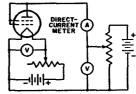


Fig. 107—Fundamental circuit of an emission tester

stant temperature, a low positive voltage is applied to the plate and the electron emission is read on the meter. Readings which are well below the average for a particular tube type indicate that the total number of available electrons has been so reduced that the tube is no longer able to function properly.

A transconductance test takes into account a fundamental operating principle of the tube. (This fact will be seen from the definition of transconductance in the Section on Electron Tube Characteristics.) It follows that transconductance tests, when properly made, permit better correlation between test results and actual performance than does a straight emission test.

There are two forms of transconductance test which can be utilized in a tube tester. In the first form (illustrated by Fig. 108 giving a fundamental circuit with a tetrode under test), appropriate operating voltages are applied to the electrodes of the tube. A plate current

depending upon the electrode voltages will then be indicated by the meter. If the bias on the grid is then shifted by the application of a different grid voltage, a new plate-current reading is obtained. The difference between the two plate-current readings is indicative of the transconductance of the tube. This

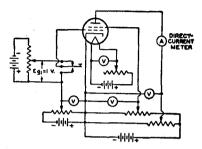


Fig. 108—Fundamental circuit of a transconductance tester using the "grid-shift" method.

method of transconductance testing is commonly called the "grid-shift" method, and depends on readings under static conditions. The fact that this form of test is made under static conditions imposes limitations not encountered in the second form of test made under dynamic conditions.

The dynamic transconductance test illustrated in Fig. 109 gives a fundamental circuit with a tetrode under test. This method is superior to the static transconductance test in that ac voltage

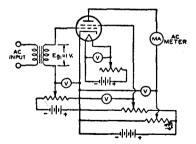


Fig. 109—Fundamental circuit of a dynamic transconductance tester.

is applied to the grid. Thus, the tube is tested under conditions which approximate actual operating conditions. The alternating component of the plate current is read by means of an ac ammeter of the dynamometer type. The transconductance of the tube is equal to the ac plate current divided by the input-signal voltage. If a one-volt rms signal is applied to the grid, the plate-current-meter reading in milliamperes multiplied by one thousand is the value of transconductance in micromhos.

The power-output test probably gives the best correlation between test results and actual operating performance of a tube. In the case of voltage amplifiers, the power output is indicative of the amplification and output voltages obtainable from the tube. In the case of power-output tubes, the performance of the tube is closely checked. Consequently, although more complicated to set up, the power-output test will give closer correlation with actual performance than any other single test.

Fig. 110 shows the fundamental circuit of a power-output test for class A operation of tubes. The diagram illustrates the method for a pentode. The ac output voltage developed across the

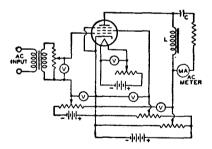


Fig. 110—Fundamental circuit of a poweroutput tester for class A operation of tubes.

plate-load impedance (L) is indicated by the current meter. The current meter is isolated as far as the dc plate current is concerned by the capacitor (C). The power output can be calculated from the current reading and known load resistance. In this way, it is possible to determine the operating condition of the tube quite accurately.

Fig. 111 shows the fundamental circuit of a power-output test for class B operation of tubes. With ac voltage

applied to the grid of the tube, the current in the plate circuit is read on a dc milliammeter. The power output of the tube is approximately equal to:

$$(I_{b^2} \times R_L)/0.405$$
,

where  $P_o$  is the power output in watts,  $I_b$  is the dc current in amperes, and  $R_L$  is the load resistance in ohms.

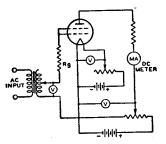


Fig. 111—Fundamental circuit of a poweroutput tester for class B operation of tubes.

### Essential Tube-Tester Requirements

- 1. The tester should provide for making a short-circuit test before measurement of the tube's characteristics.
- It is important that some means of controlling the voltages applied to the electrodes of the tube be provided. If

the tester is ac operated, a line-voltage control permits the supply of proper electrode voltages.

- 3. It is essential that the rated voltage applied to the filament or heater be maintained accurately.
- 4. It is suggested that the characteristics test follow one of the methods described. The method selected and the quality of the parts used in the test will depend upon the user's requirements.

### **Tube-Tester Limitations**

A tube-testing device can only indicate the difference between a given tube's characteristics and those which are standard for that particular type. Since the operating conditions imposed upon a tube of a given type may vary within wide limits, it is impossible for a tube-testing device to evaluate tubes in terms of performance capabilities for all applications. The tube tester, therefore, cannot be looked upon as a final authority in determining whether or not a tube is always satisfactory. Actual operating test in the equipment in which the tube is to be used will give the best possible indication of a tube's worth.

### Resistance-Coupled Amplifiers

RESISTANCE-COUPLED, audiofrequency voltage amplifiers utilize simple components and are capable of providing essentially uniform amplification over a relatively wide frequency range.

### Suitable Tubes

In this section, data are given for over 45 types of tubes suitable for use in resistance-coupled circuits. These types include low- and high-mu triodes, twin triodes, triode-connected pentodes, and pentodes. The accompanying key to tube types will assist in locating the appropriate data chart.

### Circuit Advantages

For most of the types shown, the data pertain to operation with cathode bias; for all of the pentodes, the data pertain to operation with series screengrid resistor. The use of a cathode-bias resistor where feasible and a series screen-grid resistor where applicable offers several advantages over fixed-voltage operation.

The advantages are: (1) effects of possible tube differences are minimized; (2) operation over a wide range of plate-supply voltages without appreciable change in gain is feasible; (3) the low frequency at which the amplifier cuts off is easily changed; and (4) tendency toward motorboating is minimized.

### **Number of Stages**

These advantages can be enhanced by the addition of suitable decoupling filters in the plate supply of each stage of a multi-stage amplifier. With proper filters, three or more amplifier stages can be operated from a single powersupply unit of conventional design with-

| Type Cha                                | rt No.                    | Type Chart                                     | No.                   |
|-----------------------------------------|---------------------------|------------------------------------------------|-----------------------|
| 3AU6<br>3AV6<br>3BC5<br>3CB6<br>3CF6    | 2<br>9<br>11<br>10<br>11  | 6CG7<br>6CN7<br>6EU7<br>6FQ7<br>6SL7GT         | 8<br>5<br>9<br>8<br>5 |
| 4AU6<br>4BQ7A<br>4BZ7<br>4CB6<br>5BK7A  | 2<br>10<br>10<br>11<br>10 | 6SN7GTB<br>6T8A<br>7AU7<br>8CG7<br>12AT6       | 8<br>5<br>3<br>8<br>5 |
| 5BQ7A<br>5T8<br>6AB4<br>6AG5<br>6AT6    | 10<br>5<br>4<br>11<br>5   | 12AT7<br>12AU6<br>12AU7A<br>12AV6<br>12AX7A    | 4<br>2<br>3<br>9      |
| 6AU6A<br>6AV6<br>6BC5<br>6BK7B<br>6BQ7A | 2<br>9<br>11<br>10<br>10  | 12AY7<br>12SL7GT<br>12SN7GTA<br>20EZ7<br>5879P | 1<br>5<br>8<br>9<br>6 |
| 6BZ7<br>6C4<br>6CB6<br>6CB6A<br>6CF6    | 10<br>3<br>11<br>11<br>11 | 5879T<br>7025<br>7199P<br>7199T                | 7<br>9<br>12<br>13    |
|                                         |                           |                                                |                       |

T = Triode Unit or Triode Connection
P = Pentode Unit or Pentode Connection

**KEY TO CHARTS** 

out encountering any difficulties due to coupling through the power unit. When decoupling filters are not used, not more than two stages should be operated from a single power-supply unit.

### Symbols Used in Resistance-Coupled Amplifier Charts

 $C = Blocking Capacitor (\mu f).$ 

 $C_k$  = Cathode Bypass Capacitor ( $\mu$ f).  $C_{ga}$  = Screen-Grid Bypass Capacitor

E<sub>bb</sub> = Plate-Supply Voltage (volts). Voltage at plate equals platesupply voltage minus drop in R<sub>p</sub> and R<sub>k</sub>.

 $R_k$  = Cathode Resistor (ohms).

R<sub>g2</sub> = Screen-Grid Resistor

(megohms).

R<sub>g</sub> = Grid Resistor (megohms) for following stage.

 $R_n$  = Plate Resistor (megohms).

V.G. = Voltage Gain.

E<sub>o</sub> = Output Voltage (peak volts).

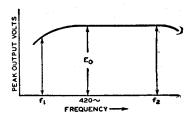
This voltage is obtained across R<sub>s</sub> (for following stage) at any frequency within the flat region of the output vs. frequency curve, and is for the condition where the signal level is adequate to swing the grid of the resistance-coupled amplifier tube to the point where its grid starts to draw current.

Note: The listed values for E<sub>0</sub> are the peak output voltages available when the grid is driven from a low-impedance source. The listed values for the cathode resistors are optimum for any signal source. With a high-impedance source, protection against severe distortion and loss of gain due to input loading may be obtained by the use of a coupling capacitor connected directly to the input grid and a high-value resistor connected between the grid and ground.

### **General Circuit Considerations**

In the discussions which follow, the frequency (f<sub>2</sub>) is that value at which the high-frequency response begins to fall off. The frequency (f<sub>1</sub>) is that value at which the low-frequency response drops below a satisfactory value, as discussed below. A variation of 10 per cent in values of resistors and capacitors has only slight effect on perform

ance. One-half-watt resistors are usually suitable for  $R_{g2}$ ,  $R_g$ ,  $R_p$ , and  $R_k$  resistors. Capacitors C and  $C_{g2}$  should have a working voltage equal to or greater than  $E_{bb}$ . Capacitor  $C_k$  may have a low working voltage in the order of 10 to 25 volts.



### Triode Amplifier Heater-Cathode Type

Capacitors C and  $C_k$  have been chosen to give an output voltage equal to  $0.8 E_0$  for a frequency  $(f_1)$  of 100 cycles. For any other value of  $f_1$ , multiply values of C and  $C_k$  by  $100/f_1$ . In

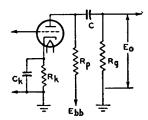


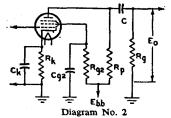
Diagram No. 1

the case of capacitor Ck, the values shown in the charts are for an amplifier with dc heater excitation; when ac is used, depending on the character of the associated circuit, the gain, and the value of f<sub>1</sub>, it may be necessary to increase the value of C<sub>k</sub> to minimize hum disturbances. It may be desirable to operate the heater at a positive voltage of from 15 to 40 volts with respect to the cathode. The voltage output at  $f_1$  of "n" like stages equals  $(0.8)^n \times E_0$ , where E<sub>0</sub> is the peak output voltage of final stage. For an amplifier of typical construction, the value of f2 is well above the audio-frequency range for any value of R<sub>p</sub>.

### **Pentode Amplifier**

Heater-Cathode Type

Capacitors C,  $C_k$ , and  $C_{g2}$  have been chosen to give an output voltage equal to  $0.7 \times E_o$  for a frequency  $(f_1)$  of 100 cycles. For any other value of  $f_1$ , multiply values of C,  $C_k$ , and  $C_{g2}$  by  $100/f_1$ . In the case of capacitor  $C_k$ , the values shown in the charts are for



an amplifier with dc heater excitation; when ac is used, depending on the character of the associated circuits, the voltage gain, and the value of f1, it may be necessary to increase the value of Ck to minimize hum disturbances. It may be desirable to operate the heater at a positive voltage of from 15 to 40 volts with respect to the cathode. The voltage output at f1 for "n" like stages equals  $(0.7)^n \times E_0$  where E<sub>0</sub> is peak output voltage of final stage. For an amplifier of typical construction, and for  $R_p$  values of 0.1, 0.25, and 0.5 megohm, approximate values of f2 are 20000, 10000, and 5000 cycles per second, respectively.

|--|

### 12AY7° See Circuit Diagram 1

| E <sub>bb</sub> | R <sub>p</sub> | Rg   | R <sub>g2</sub> | Rk   | C <sub>22</sub> | C, | C    | E.* | V.G.     |
|-----------------|----------------|------|-----------------|------|-----------------|----|------|-----|----------|
|                 | 0.1            | 0.24 |                 | 1800 |                 |    | _    | 13  | 24<br>26 |
| 90              | 0.24           | 0.51 | _               | 3700 | _               |    |      | 14  | 26       |
|                 | 0.51           | 1.0  | -               | 7800 | -               | _  |      | 16  | 27       |
|                 | 0.1            | 0.24 |                 | 1300 |                 |    |      | 31  | 27       |
| 180             | 0.24           | 0.51 |                 | 2800 |                 |    | _    | 33  | 29       |
|                 | 0.51           | 1.0  |                 | 5700 |                 |    | **** | 33  | 30       |
|                 | 0.1            | 0.24 |                 | 1200 |                 |    | _    | 58  | 28       |
| 300             | 0.24           | 0.51 |                 | 2300 | _               |    |      | 30  | 30       |
|                 | 0.51           | 1.0  |                 | 4800 |                 |    | _    | 56  | 31       |

One triode unit.

<sup>\*</sup> Peak volts.

<sup>&</sup>lt;sup>▲</sup> Coupling capacitors should be selected to give desired frequency response. Cathode resistors should be adequately bypassed.

| Ebb | R <sub>p</sub>                                                       | Rg                                                                  | R <sub>g2</sub>                                                 | Rk                                                                    | C <sub>g2</sub>                                                      | Cx                                                            | C                                                                               | E,*                                                | V.G.                                                 |                          |
|-----|----------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------|--------------------------|
|     | 0.22<br>0.22<br>0.22<br>0.47                                         | 0.22<br>0.47<br>1.0                                                 | 0.340<br>0.370<br>0.380<br>1.00                                 | 2700<br>2900<br>3100                                                  | 0.057<br>0.050<br>0.050<br>0.027                                     | 5.8<br>5.4<br>5.3<br>2.8                                      | 0.0081<br>0.0055<br>0.0034<br>0.0042                                            | 16<br>22<br>25<br>13                               | 79<br>104<br>125<br>105                              | (2)                      |
| 90  | 0.47<br>0.47<br>0.47<br>1.0<br>1.0                                   | 0.47<br>1.0<br>2.2<br>1.0<br>2.2                                    | 1.00<br>1.00<br>1.00<br>1.90<br>2.40                            | 6000<br>6200<br>6300<br>10800<br>13100                                | 0.027<br>0.023<br>0.027<br>0.017<br>0.017                            | 2.7<br>2.8<br>1.7<br>1.7                                      | 0.0042<br>0.0027<br>0.0019<br>0.0025<br>0.0017                                  | 17<br>25<br>10<br>19                               | 137<br>161<br>139<br>184                             | 3AU6<br>4AU6<br>6AU6A    |
| 180 | 0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47<br>1.0                  | 0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2<br>1.0<br>2.2             | 0.520<br>0.520<br>0.520<br>1.05<br>1.15<br>1.20<br>2.40<br>2.70 | 1340<br>1390<br>1420<br>2700<br>2880<br>2960<br>5500<br>6000          | 0.059<br>0.059<br>0.059<br>0.039<br>0.037<br>0.036<br>0.028<br>0.022 | 8.8<br>8.7<br>8.6<br>5.5<br>5.4<br>5.4<br>3.2<br>2.8          | 0.0081<br>0.0053<br>0.0032<br>0.0041<br>0.0027<br>0.0019<br>0.0023<br>0.0015    | 31<br>43<br>48<br>34<br>43<br>50<br>33<br>40       | 143<br>192<br>223<br>189<br>249<br>294<br>230<br>323 | See Circuit<br>Diagram 2 |
| 300 | 0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47<br>1.0                  | 0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2<br>1.0<br>2.2             | 0.530<br>0.540<br>0.540<br>1.15<br>1.22<br>1.31<br>2.50<br>2.80 | 780<br>783<br>800<br>1590<br>1650<br>1720<br>3300<br>3500             | 0.077<br>0.077<br>0.077<br>0.057<br>0.049<br>0.045<br>0.036<br>0.031 | 13.2<br>13.2<br>13.1<br>8.4<br>7.4<br>7.2<br>5.3<br>4.2       | 0.0082<br>0.0053<br>0.0033<br>0.0045<br>0.0027<br>0.0017<br>0.0022<br>0.0015    | 53<br>65<br>74<br>56<br>72<br>82<br>57<br>72       | 200<br>270<br>316<br>275<br>357<br>418<br>352<br>466 |                          |
| 90  | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22 | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0  |                                                                 | 1600<br>1800<br>2000<br>3000<br>3800<br>4500<br>6800<br>9500<br>11500 | = = = = = = = = = = = = = = = = = = = =                              | 3.2<br>2.5<br>2.0<br>1.6<br>1.1<br>1.0<br>0.7<br>0.5<br>0.43  | 0.061<br>0.033<br>0.015<br>0.032<br>0.015<br>0.007<br>0.015<br>0.0065<br>0.0035 | 9<br>11<br>14<br>10<br>15<br>18<br>14<br>20<br>24  | 10<br>11<br>11<br>11<br>11<br>11<br>11<br>11         | 3<br>6C4                 |
| 180 | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22 | 0.047<br>0.1<br>0.22<br>0.1<br>0.22.<br>0.47<br>0.22<br>0.47<br>1.0 |                                                                 | 920<br>1200<br>1400<br>2000<br>2800<br>3600<br>5300<br>8300<br>10000  |                                                                      | 3.9<br>2.9<br>2.5<br>1.9<br>1.4<br>1.1<br>0.8<br>0.56<br>0.48 | 0.062<br>0.037<br>0.016<br>0.032<br>0.016<br>0.007<br>0.015<br>0.007<br>0.0035  | 20<br>26<br>29<br>24<br>33<br>40<br>31<br>44<br>54 | 11<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12   | 7AU7* 9AU7* 12AU7A*      |
| 300 | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22        | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0  | = = = = = = = = = = = = = = = = = = = =                         | 870<br>1200<br>1500<br>1900<br>3000<br>4000<br>5300<br>8800<br>11000  |                                                                      | 4.1<br>3.0<br>2.4<br>1.9<br>1.3<br>1.1<br>0.9<br>0.52<br>0.46 | 0.065<br>0.034<br>0.016<br>0.032<br>0.016<br>0.007<br>0.015<br>0.007<br>0.0035  | 38<br>52<br>68<br>44<br>68<br>80<br>57<br>82<br>92 | 12<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12   | Diagram 1                |

<sup>•</sup> One triode unit.

<sup>\*</sup> Peak volts.

|                                                        | Еьь            | Rp                                                                 | Rg                                                               | Rgo | R <sub>k</sub>                                                                   | C <sub>g2</sub>                         | Ck                                                                  | C                                                                                    | E.*                                                    | V.G.                                                     |
|--------------------------------------------------------|----------------|--------------------------------------------------------------------|------------------------------------------------------------------|-----|----------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------|
| 6AB4<br>12AT7                                          | 90             | 0.1<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47          | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2 |     | 2680<br>3060<br>3390<br>5500<br>6300<br>6930<br>10900<br>12500<br>13500          |                                         | 2.4<br>2.00<br>1.84<br>1.33<br>1.01<br>0.92<br>0.63<br>0.52<br>0.47 | 0.026<br>0.014<br>0.0074<br>0.0136<br>0.0067<br>0.0038<br>0.007<br>0.0043<br>0.0031  | 8<br>11<br>13<br>10<br>14<br>15<br>13<br>14<br>18      | 24<br>25<br>28<br>25<br>28<br>28<br>26<br>28<br>28       |
| See Circuit :<br>Diagram 1                             | 180            | 0.1<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47  | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2 |     | 1407<br>1674<br>1786<br>2890<br>3860<br>4660<br>6960<br>8450<br>9600             |                                         | 3.6<br>3.0<br>2.6<br>1.75<br>1.34<br>1.14<br>0.83<br>0.67<br>0.55   | 0.029<br>0.016<br>0.0083<br>0.0140<br>0.0077<br>0.0047<br>0.0075<br>0.0046<br>0.0032 | 20<br>28<br>31<br>24<br>35<br>42<br>31<br>39<br>45     | 31<br>33<br>34<br>33<br>33<br>33<br>31<br>32             |
|                                                        | 300            | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47 | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2 |     | 974<br>1404<br>2169<br>2510<br>4200<br>4950<br>5700<br>8720<br>9700              |                                         | 4.0<br>3.1<br>2.5<br>1.9<br>1.3<br>1.1<br>0.90<br>0.62<br>0.57      | 0.028<br>0.015<br>0.0083<br>0.015<br>0.0074<br>0.0046<br>0.0076<br>0.0041<br>0.0030  | 37<br>57<br>78<br>50<br>78<br>85<br>57<br>81<br>88     | 34<br>34<br>33<br>33<br>33<br>32<br>33<br>32<br>32<br>32 |
| 5                                                      | 90             | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47                 | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2 | -   | 4200<br>4600<br>4800<br>7000<br>7800<br>8100<br>12000<br>14000<br>15000          |                                         | 2.5<br>2.2<br>2.0<br>1.5<br>1.3<br>1.1<br>0.83<br>0.7<br>0.6        | 0.025<br>0.014<br>0.0065<br>0.013<br>0.007<br>0.0035<br>0.006<br>0.0035              | 5.4<br>7.5<br>9.1<br>7.3<br>10<br>12<br>10<br>14<br>16 | 22<br>27<br>30<br>30<br>34<br>37<br>36<br>39<br>41       |
| 5T8<br>6AT6<br>6CN7<br>8CN7<br>6SL7GT<br>6T8A<br>12AT6 | 180            | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47         | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2 |     | 1900<br>2200<br>2500<br>3400<br>4100<br>4600<br>6600<br>8100<br>9100             | = = = = = = = = = = = = = = = = = = = = | 3.6<br>3.1<br>2.8<br>2.2<br>1.7<br>1.5<br>1.1<br>0.9                | 0.027<br>0.014<br>0.0065<br>0.014<br>0,0065<br>0.0035<br>0.0035<br>0.0035            | 19<br>25<br>32<br>24<br>34<br>38<br>29<br>38<br>43     | 30<br>35<br>37<br>38<br>42<br>44<br>44<br>46<br>47       |
| 12SL7GT*<br>19T8<br>See Circuit<br>Diagram 1           | 300<br>• One 1 | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47         | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>0.1<br>0.47<br>1.0<br>2.2 |     | 1500<br>1800<br>2100<br>2600<br>3200<br>3700<br>5200<br>6300<br>7200<br>k volts. |                                         | 4.4<br>3.6<br>3.0<br>2.5<br>1.9<br>1.6<br>1.2<br>1.0                | 0.027<br>0.014<br>0.0065<br>0.013<br>0.0065<br>0.0035<br>0.006<br>0.0035<br>0.002    | 40<br>54<br>63<br>51<br>65<br>77<br>61<br>74<br>85     | 34<br>38<br>41<br>42<br>46<br>48<br>48<br>50<br>51       |

|     |                                                                      |                                                                     |                                                            |                                                                      |                                                                               |                                                                 |                                                                               |                                                    |                                                         | •                                      |
|-----|----------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------|----------------------------------------|
| Ebb | R <sub>p</sub>                                                       | Rg                                                                  | $R_{\rm g2}$                                               | Rk                                                                   | C <sub>g2</sub>                                                               | C <sub>k</sub>                                                  | C                                                                             | E <sub>o</sub> *                                   | V.G.                                                    |                                        |
| 90  | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47                   | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2    | 0.35<br>0.35<br>0.35<br>0.80<br>0.80<br>0.80<br>1.9<br>1.9 | 1700<br>1700<br>1700<br>3000<br>3000<br>3000<br>7000<br>7000         | 0.044<br>0.046<br>0.047<br>0.034<br>0.035<br>0.036<br>0.021<br>0.022<br>0.023 | 4.6<br>4.5<br>4.4<br>3.2<br>3.1<br>3.0<br>1.8<br>1.7            | 0.020<br>0.012<br>0.006<br>0.010<br>0.005<br>0.003<br>0.005<br>0.003          | 13<br>17<br>20<br>15<br>21<br>24<br>21<br>25<br>28 | 29<br>39<br>47<br>43<br>59<br>67<br>59<br>75<br>87      | As Pentode 5879                        |
| 180 | 0.1<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47            | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2    | 0.35<br>0.35<br>0.35<br>0.80<br>0.80<br>0.80<br>1.9<br>1.9 | 700<br>700<br>700<br>1200<br>1200<br>1200<br>2500<br>2500<br>2500    | 0.060<br>0.062<br>0.064<br>0.045<br>0.046<br>0.048<br>0.033<br>0.034<br>0.035 | 7.4<br>7.3<br>7.2<br>5.5<br>5.3<br>5.2<br>3.5<br>3.4<br>3.3     | 0.020<br>0.012<br>0.006<br>0.010<br>0.005<br>0.003<br>0.005<br>0.003          | 24<br>28<br>33<br>24<br>31<br>34<br>27<br>32<br>37 | 39<br>56<br>65<br>65<br>87<br>101<br>98<br>122<br>140   | See Circuit<br>Diagram 2               |
| 300 | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47           | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2    | 0.35<br>0.35<br>0.35<br>0.80<br>0.80<br>0.80<br>1.3<br>1.3 | 300<br>300<br>300<br>600<br>600<br>600<br>1200<br>1200               | 0.075<br>0.077<br>0.080<br>0.056<br>0.057<br>0.058<br>0.044<br>0.046<br>0.047 | 10.8<br>10.6<br>10.5<br>7.9<br>7.5<br>7.4<br>5.3<br>5.2<br>5.1  | 0.020<br>0.012<br>0.006<br>0.010<br>0.005<br>0.003<br>0.005<br>0.003<br>0.002 | 25<br>32<br>35<br>28<br>37<br>41<br>34<br>42<br>48 | 51<br>68<br>83<br>81<br>109<br>123<br>125<br>152<br>174 |                                        |
| 90  | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22 | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.00 |                                                            | 1800<br>2100<br>2200<br>3200<br>3900<br>4300<br>6200<br>8100<br>9000 |                                                                               | 2.9<br>2.4<br>2.3<br>1.8<br>1.3<br>1.0<br>0.87<br>0.53<br>0.49  | 0.060<br>0.033<br>0.016<br>0.027<br>0.015<br>0.007<br>0.015<br>0.006<br>0.003 | 9<br>12<br>14<br>10<br>13<br>16<br>12<br>16<br>19  | 10<br>11<br>21<br>12<br>13<br>13<br>13<br>13            | 7                                      |
| 180 | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.22<br>0.22                | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.00 |                                                            | 1200<br>1600<br>1800<br>2200<br>2900<br>3400<br>4500<br>6400<br>8200 |                                                                               | 3.5<br>2.6<br>2.4<br>1.9<br>1.35<br>1.1<br>0.92<br>0.61<br>0.52 | 0.063<br>0.033<br>0.016<br>0.031<br>0.015<br>0.007<br>0.015<br>0.006<br>0.003 | 21<br>29<br>35<br>26<br>33<br>40<br>28<br>39<br>47 | 12<br>13<br>13<br>13<br>14<br>14<br>14<br>14            | As Triode: 5879  See Circuit Diagram 1 |
| 300 | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.1<br>0.1<br>0.22          | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.00 |                                                            | 1100<br>1500<br>1700<br>2000<br>3400<br>3700<br>4300<br>7200<br>7400 |                                                                               | 3.9<br>2.8<br>2.5<br>2.1<br>1.4<br>1.1<br>0.97<br>0.63<br>0.63  | 0.063<br>0.033<br>0.016<br>0.032<br>0.015<br>0.007<br>0.015<br>0.007<br>0.003 | 42<br>65<br>71<br>45<br>74<br>83<br>50<br>88<br>94 | 13<br>14<br>15<br>15<br>15<br>15<br>15                  |                                        |

|                                                         | Еьь | Rp                                                                   | Rg                                                                  | R <sub>g2</sub>                 | R <sub>k</sub>                                                          | C <sub>g2</sub> | C <sub>k</sub>                                                 | C                                                                                | E <sub>o</sub> *                                   | V.G.                                               |
|---------------------------------------------------------|-----|----------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------|-----------------|----------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------|
| 8                                                       | 90  | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22        | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.00 | -                               | 1870<br>2230<br>2500<br>3370<br>4100<br>4800<br>7000<br>9100<br>10500   |                 | 3.1<br>2.5<br>2.1<br>1.8<br>1.3<br>1.1<br>0.80<br>0.65<br>0.60 | 0.063<br>0.031<br>0.016<br>0.034<br>0.015<br>0.006<br>0.013<br>0.007             | 14<br>18<br>20<br>15<br>20<br>23<br>16<br>22<br>25 | 13<br>14<br>14<br>14<br>14<br>15<br>14<br>14<br>15 |
| 6CG7*<br>6FQ7<br>6SN7GTB*<br>8CG7<br>8FQ7*<br>12SN7GTA* | 180 | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22 | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.00 | -<br>-<br>-<br>-<br>-<br>-<br>- | 1500<br>1860<br>2160<br>2750<br>3550<br>4140<br>5150<br>7000<br>7800    |                 | 3.6<br>2.9<br>2.2<br>1.8<br>1.4<br>1.3<br>1.0<br>0.71<br>0.61  | 0.066<br>0.055<br>0.015<br>0.028<br>0.015<br>0.007<br>0.016<br>0.007<br>0.004    | 33<br>41<br>47<br>35<br>45<br>51<br>36<br>45<br>51 | 14<br>14<br>15<br>15<br>15<br>16<br>16<br>16       |
| See Circuit<br>Diagram 1                                | 300 | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.1<br>0.22<br>0.22<br>0.22 | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.00 | -                               | 1300<br>1580<br>1800<br>2500<br>3130<br>3900<br>4800<br>6500<br>7800    |                 | 3.6<br>3.0<br>2.5<br>1.9<br>1.4<br>1.2<br>0.95<br>0.69<br>0.58 | 0.061<br>0.032<br>0.015<br>0.031<br>0.014<br>0.0065<br>0.015<br>0.0065<br>0.0035 | 59<br>73<br>83<br>68<br>82<br>96<br>68<br>85<br>96 | 14<br>15<br>16<br>16<br>16<br>16<br>16<br>16       |
| 9                                                       | 90  | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47           | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2    |                                 | 4400<br>4700<br>4800<br>7000<br>7400<br>7600<br>12000<br>13000<br>14000 | . =             | 2.7<br>2.4<br>2.3<br>1.6<br>1.4<br>1.3<br>0.9<br>0.8<br>0.7    | 0.023<br>0.013<br>0.007<br>0.012<br>0.006<br>0.003<br>0.006<br>0.003<br>0.002    | 5<br>6<br>8<br>6<br>9<br>11<br>9<br>11             | 29<br>35<br>41<br>39<br>45<br>48<br>48<br>52<br>55 |
| 3AV6<br>4AV6<br>6AV6<br>6EU7<br>12AV6                   | 180 | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47   | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2    |                                 | 1800<br>2000<br>2200<br>3000<br>3500<br>3900<br>5800<br>6700<br>7400    |                 | 4.0<br>3.5<br>3.1<br>2.4<br>2.1<br>1.8<br>1.3<br>1.1           | 0.025<br>0.013<br>0.006<br>0.012<br>0.006<br>0.003<br>0.006<br>0.003<br>0.002    | 18<br>25<br>32<br>24<br>34<br>39<br>30<br>39<br>45 | 40<br>47<br>52<br>53<br>59<br>63<br>62<br>66<br>68 |
| 12AX7A° 20EZ7° 7025° See Circuit Diagram 1              | 300 | 0.1<br>0.1<br>0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47           | 0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2    |                                 | 1300<br>1500<br>1700<br>2200<br>2800<br>3100<br>4300<br>5200<br>5900    |                 | 4.6<br>4.0<br>3.6<br>3.0<br>2.3<br>2.1<br>1.6<br>1.3<br>1.1    | 0.027<br>0.013<br>0.006<br>0.013<br>0.006<br>0.003<br>0.006<br>0.003<br>0.002    | <b>43 57 66 54 69 79 62 77 92</b>                  | 45<br>52<br>57<br>59<br>65<br>68<br>69<br>73<br>75 |

<sup>•</sup> One triode unit. • Peak volts.

| Ebb | Rp                                                              | Rg                                                                  | $R_{\rm g2}$                                                    | Rk                                                                   | C <sub>g2</sub>                                                      | Ck                                                                | C                                                                                   | E <sub>o</sub> *                                   | V.G.                                                 |
|-----|-----------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------|
| 90  | 0.047<br>0.047<br>0.047<br>0.1<br>0.1<br>0.1<br>0.22<br>0.22    | 0.047<br>0.10<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0 | -                                                               | 1580<br>1760<br>1820<br>2920<br>3570<br>4020<br>6040<br>7500<br>8800 |                                                                      | 4.0<br>3.5<br>3.0<br>2.1<br>1.7<br>1.4<br>0.98<br>0.78<br>0.63    | 0.058<br>0.032<br>0.015<br>0.029<br>0.015<br>0.0075<br>0.0135<br>0.0075<br>0.0036   | 9<br>13<br>16<br>12<br>17<br>20<br>16<br>21<br>25  | 18<br>19<br>20<br>19<br>20<br>20<br>19<br>20<br>20   |
| 180 | 0.047<br>0.047<br>0.047<br>0.10<br>0.10<br>0.10<br>0.22<br>0.22 | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0  |                                                                 | 694<br>817<br>905<br>1596<br>1630<br>1860<br>3950<br>4500<br>5530    |                                                                      | 6.0<br>4.4<br>4.0<br>2.80<br>2.30<br>2.00<br>1.24<br>0.96<br>0.79 | 0.062<br>0.032<br>0.0155<br>0.030<br>0.0152<br>0.0073<br>0.0150<br>0.0072<br>0.0038 | 25<br>32<br>35<br>30<br>32<br>38<br>35<br>41<br>49 | 23<br>24<br>25<br>23<br>24<br>24<br>22<br>23<br>23   |
| 300 | 0.047<br>0.047<br>0.047<br>0.10<br>0.10<br>0.22<br>0.22<br>0.22 | 0.047<br>0.1<br>0.22<br>0.10<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0 |                                                                 | 438<br>542<br>644<br>1009<br>1332<br>1609<br>2623<br>3900<br>4920    |                                                                      | 6.70<br>5.50<br>4.30<br>3.5<br>2.5<br>2.1<br>1.5<br>1.1<br>0.88   | 0.062<br>0.032<br>0.016<br>0.031<br>0.015<br>0.0074<br>0.015<br>0.0073<br>0.0039    | 38<br>48<br>57<br>42<br>56<br>64<br>50<br>70<br>84 | 26<br>27<br>27<br>25<br>26<br>25<br>24<br>24<br>24   |
| 90  | 0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47<br>1.0             | 0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2<br>1.0<br>2.2             | 0.480<br>0.480<br>0.500<br>1.04<br>1.10<br>2.50<br>2.50         | 3800<br>3800<br>4400<br>7200<br>7700<br>8400<br>16000<br>18600       | 0.046<br>0.049<br>0.045<br>0.033<br>0.033<br>0.031<br>0.018<br>0.016 | 5.5<br>5.5<br>5.3<br>2.9<br>2.8<br>2.6<br>1.4<br>1.2              | 0.0084<br>0.0054<br>0.0034<br>0.0044<br>0.0029<br>0.0020<br>0.0023<br>0.0017        | 10<br>16<br>23<br>10<br>15<br>18<br>10             | 89<br>114<br>128<br>111<br>133<br>152<br>118<br>139  |
| 180 | 0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>1.0                     | 0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2<br>1.0<br>2.2             | 0.550<br>0.620<br>0.650<br>1.00<br>1.00<br>1.00<br>2.60         | 1600<br>1800<br>1900<br>3400<br>3500<br>3800<br>7300<br>7400         | 0.072<br>0.062<br>0.062<br>0.059<br>0.059<br>0.059<br>0.029          | 9.5<br>8.5<br>8.5<br>6.0<br>6.0<br>5.8<br>2.7<br>2.7              | 0.0090<br>0.0053<br>0.0034<br>0.0048<br>0.0031<br>0.0020<br>0.0022<br>0.0016        | 30<br>36<br>43<br>34<br>41<br>46<br>33<br>38       | 161<br>208<br>239<br>183<br>229<br>262<br>227<br>281 |
| 300 | 0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>1.0<br>1.0              | 0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2<br>1.0<br>2.2             | 0.600<br>0.680<br>0.700<br>1.25<br>1.34<br>1.53<br>2.60<br>3.00 | 980<br>1090<br>1150<br>2000<br>2150<br>2350<br>4000<br>4700          | 0.085<br>0.084<br>0.081<br>0.064<br>0.061<br>0.057<br>0.044<br>0.038 | 13.0<br>12.0<br>11.0<br>7.9<br>7.6<br>7.1<br>5.2<br>4.3           | 0.0085<br>0.0055<br>0.0033<br>0.0045<br>0.0029<br>0.0019<br>0.0023<br>0.0015        | 51<br>64<br>74<br>52<br>67<br>79<br>51<br>69       | 223<br>288<br>334<br>285<br>363<br>416<br>334<br>427 |

<sup>(10)</sup> 

4BQ7A\* 4BZ7\* 5BK7A\* 5BQ7A\* 6BK7B\* 6BQ7A\* 6BZ7\*

See Circuit Diagram 1



3BC5 3CB6 3CF6 4CB6 6AG5 6BC5 6CB6 6CB6A 6CF6

See Circuit Diagram 2

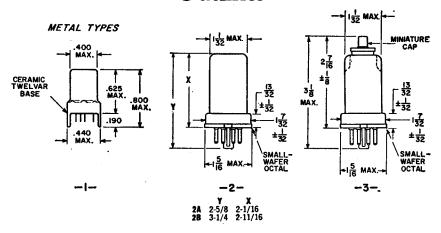
<sup>•</sup> One triode unit.

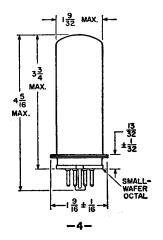
<sup>•</sup> Peak volts.

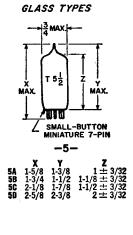
|                          | Ebb | R,                                                                      | Rg                                                                  | R <sub>g2</sub>                                                 | Rx                                                                   | C <sub>g2</sub>                                                      | C*                                                                | C                                                                                 | E <sub>o</sub> *                                   | V.G.                                                 |
|--------------------------|-----|-------------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------|
| 12                       | 90  | 0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>0.47<br>1.0                     | 0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2<br>1.0                    | 0.560<br>0.600<br>0.640<br>0.870<br>0.980<br>1.00<br>2.00       | 3700<br>3900<br>4200<br>6000<br>6700<br>6700<br>12200                | 0.046<br>0.043<br>0.039<br>0.036<br>0.044<br>0.043<br>0.021          | 4.50<br>4.30<br>4.00<br>2.70<br>3.00<br>2.80<br>1.44              | 0.0090<br>0.0055<br>0.0033<br>0.0046<br>0.0030<br>0.0020<br>0.0028                | 12<br>17<br>19<br>16<br>22<br>25<br>15             | 73<br>95<br>109<br>95<br>113<br>131<br>119           |
| 7199                     |     | 1.0                                                                     | 2.2                                                                 | 2.20                                                            | 12800                                                                | 0.024                                                                | 1.74                                                              | 0.0016                                                                            | 21                                                 | 167                                                  |
| Pentode<br>Unit          | 180 | 0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>1.0<br>1.0                      | 0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2<br>1.0<br>2.2             | 0.530<br>0.600<br>0.650<br>1.12<br>1.40<br>1.57<br>2.50<br>3.40 | 1570<br>1730<br>1820<br>3200<br>3500<br>3740<br>6500<br>7500         | 0.069<br>0.064<br>0.061<br>0.053<br>0.042<br>0.040<br>0.039<br>0.026 | 7.50<br>7.40<br>7.30<br>5.30<br>5.10<br>5.40<br>2.80<br>2.30      | 0.0088<br>0.0064<br>0.0034<br>0.0046<br>0.0028<br>0.0019<br>0.0024<br>0.0015      | 32<br>38<br>45<br>35<br>40<br>45<br>34<br>39       | 82<br>164<br>190<br>147<br>209<br>250<br>179<br>277  |
| See Circuit<br>Diagram 2 | 300 | 0.22<br>0.22<br>0.22<br>0.47<br>0.47<br>1.0<br>1.0                      | 0.22<br>0.47<br>1.0<br>0.47<br>1.0<br>2.2<br>1.0<br>2.2             | 0.600<br>0.670<br>0.720<br>1.25<br>1.43<br>1.45<br>3.00<br>3.30 | 9200<br>1010<br>1100<br>1950<br>3210<br>2200<br>4100<br>4340         | 0.086<br>0.076<br>0.076<br>0.060<br>0.053<br>0.055<br>0.040<br>0.037 | 11.2<br>10.5<br>10.0<br>7.0<br>6.4<br>6.3<br>4.2<br>3.6           | 0.0085<br>0.0052<br>0.0033<br>0.0044<br>0.0027<br>0.0019<br>0.0022<br>0.0016      | 52<br>66<br>77<br>41<br>72<br>82<br>57<br>74       | 182<br>236<br>257<br>221<br>296<br>345<br>295<br>378 |
| 13                       | 90  | 0.047<br>0.047<br>0.047<br>0.10<br>0.10<br>0.10<br>0.22<br>0.22         | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0  | -                                                               | 1292<br>1401<br>1470<br>2630<br>3090<br>3440<br>6550<br>8270<br>9130 |                                                                      | 3.3<br>2.8<br>2.4<br>1.60<br>1.24<br>1.10<br>0.70<br>0.51<br>0.44 | 0.060<br>0.032<br>0.016<br>0.029<br>0.015<br>0.008<br>0.015<br>0.0077<br>0.0045   | 8<br>10<br>11<br>9<br>12<br>14<br>12<br>16<br>18   | 12<br>13<br>13<br>13<br>13<br>14<br>12<br>12<br>12   |
| 7199<br>Triode<br>Unit   | 180 | 0.047<br>0.047<br>0.047<br>0.10<br>0.10<br>0.10<br>0.22<br>0.22         | 0.047<br>0.1<br>0.22<br>0.1<br>0.22<br>0.47<br>0.22<br>0.47<br>1.0  |                                                                 | 723<br>836<br>948<br>1543<br>2002<br>2522<br>4390<br>6122<br>8060    |                                                                      | 4.0<br>3.5<br>2.9<br>2.0<br>1.6<br>1.2<br>0.79<br>0.57<br>0.47    | 0.061<br>0.032<br>0.016<br>0.031<br>0.016<br>0.0082<br>0.015<br>0.0078<br>0.0046  | 16<br>20<br>24<br>17<br>24<br>30<br>24<br>33<br>41 | 14<br>14<br>15<br>14<br>14<br>13<br>13<br>12<br>12   |
| See Circuit<br>Diagram 1 | 300 | 0.047<br>0.047<br>0.047<br>0.10<br>0.10<br>0.10<br>0.22<br>0.22<br>0.22 | 0.047<br>0.1<br>0.22<br>0.1<br>0.22-<br>0.47<br>0.22<br>0.47<br>1.0 |                                                                 | 534<br>726<br>840<br>1117<br>1613<br>2043<br>3133<br>4480<br>4930    | = = = = = = = = = = = = = = = = = = = =                              | 4.0<br>3.6<br>3.0<br>2.3<br>1.7<br>1.31<br>0.93<br>0.69<br>0.56   | 0.061<br>0.031<br>0.015<br>0.031<br>0.0155<br>0.0078<br>0.015<br>0,0079<br>0.0045 | 27<br>38<br>44<br>26<br>41<br>51<br>36<br>51<br>55 | 15<br>15<br>15<br>15<br>14<br>14<br>13<br>13<br>13   |

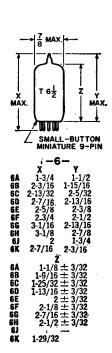
<sup>•</sup> Peak volts.

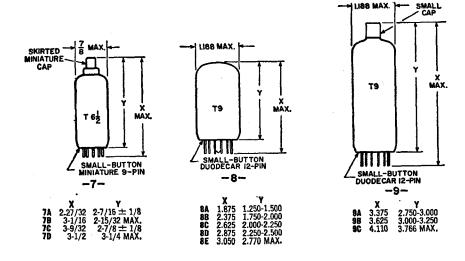
### Outlines

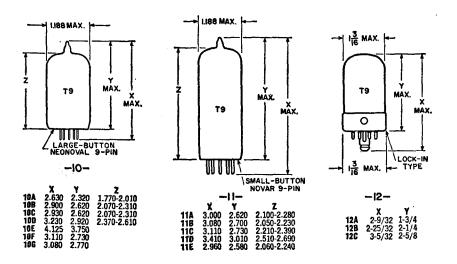




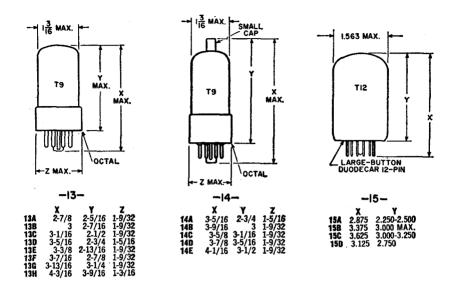


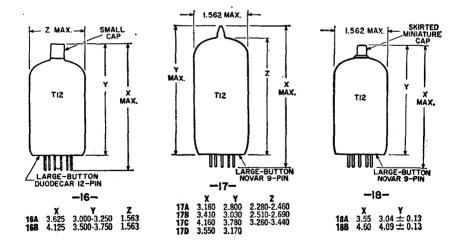




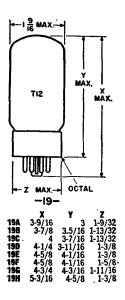


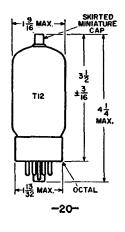
All measurements in inches.

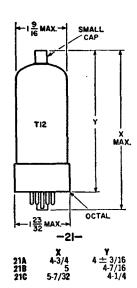


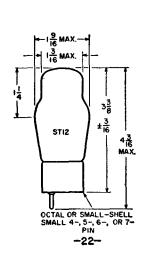


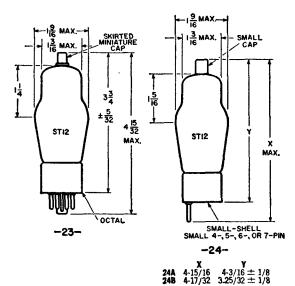
All measurements in inches.



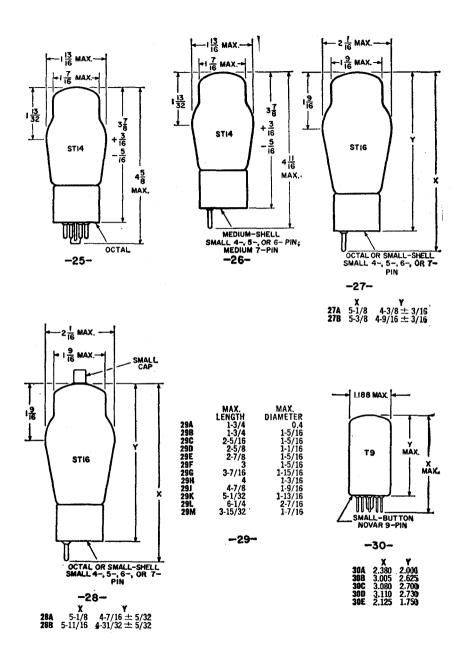




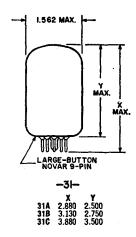


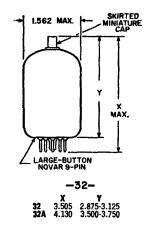


All measurements in inches.



All measurements in inches.





All measurements in inches.

### Circuits

THE circuits included in this Manual illustrate some of the more important applications of RCA receiving tubes; they are not necessarily examples of commercial practice. These circuits have been conservatively designed and are capable of excellent performance. Electrical specifications are given for circuit components to assist those interested in home construction. Layouts and mechanical details are omitted because they vary widely with the requirements of individual set builders and with the sizes and shapes of the components employed.

Circuits designed for operation from both ac and dc voltage supplies should be installed in non-metallic cabinets or properly insulated from metallic cabinets. Potentiometer shafts and switches should make use of insulated (plastic) knobs. In practical use, no metallic part of an "ac/dc" chassis should be exposed to touch, accidental or otherwise. When such circuits are tested outside of their cabinets, a line isolation transformer such as the RCA WP-25A Isotap should be used.

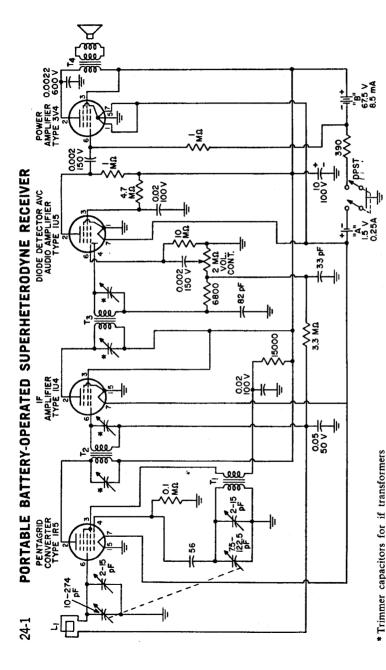
Performance of these circuits depends as much on the quality of the components selected and the care employed in layout and construction as on the circuits themselves. Good signal reproduction from receivers and amplifiers requires the use of good-quality speakers, transformers, chokes, and input sources (microphones, phonograph pickups, etc).

Coils for the receiver circuits may be purchased at local parts dealers by specifying the characteristics required: for rf coils, the circuit position (antenna or interstage), tuning range desired, and tuning capacitances employed; for if coils or transformers, the intermediate frequency, circuit position (1st if, 2nd if, etc.), and, in some cases, the associated tube types; for oscillator coils, the receiver tuning range, the intermediate frequency, the type of converter tube, and the type of winding used (tapped or transformer-coupled).

The voltage ratings specified for capacitors are the minimum dc working voltages required. Paper, mica, or ceramic capacitors having higher voltage ratings than those specified may be used except insofar as the physical sizes of such capacitors may affect equipment layout. However, if electrolytic capacitors having substantially higher voltage ratings than those specified are used. they may not "form" completely at the operating voltage, with the result that the effective capacitances of such units may be below their rated value. The wattage ratings specified for resistors assume methods of construction that provide adequate ventilation; compact installations having poor ventilation may require resistors of higher wattage ratings.

Circuits which work at very high frequencies or which are required to handle very wide bandwidths demand more than ordinary skill and experience in construction. Placement of component parts is quite critical and may require considerable experimentation. All rf leads to components including bypass capacitors must be kept short and must be properly dressed to minimize undesirable coupling and capacitance effects. Correct circuit alignment and oscillator tracking may require the use of a cathode-ray oscilloscope, a high-impedance vacuum-tube voltmeter, and a signal generator capable of supplying a properly modulated signal at the appropriate frequencies. Unless the builder has had considerable experience with broadband, high-frequency circuits, he should not undertake the construction of such circuits.

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Notes: 1. Resistance in ohms and capacitance in microfarads unless specified.

2. All resistors 0.5 watt unless otherwise specified.

122.5-pF tuning capacitor and 455- $T_1 = Oscillator$  coil for use with 7.5- to L2T3 = Intermediate-frequency transformkc/s if transformer

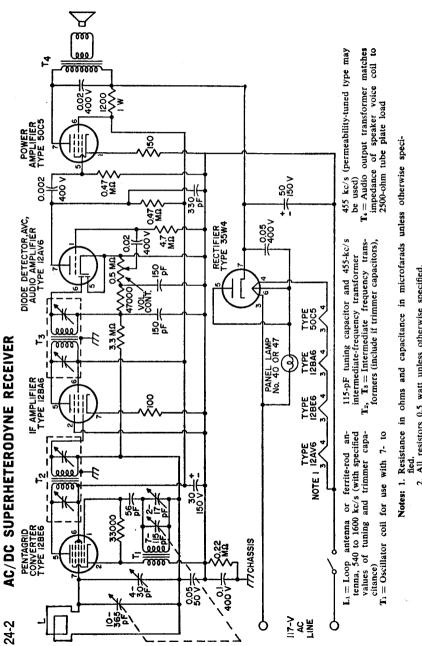
L<sub>1</sub> = Loop antenna or ferrite-rod antenna, 540 to 1600 kc/s (with specified values of tuning and trimmer

capacitance)

T<sub>1</sub> = Audio output transformer, matches impedance of speaker voice coil to 10000-ohm tube plate load

ers, 455 kc/s (permeability-tuned types

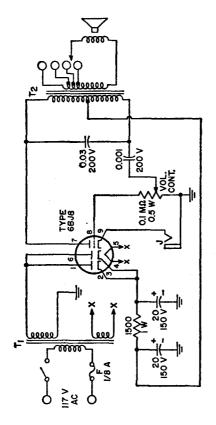
may be used)



All resistors 0.5 watt unless otherwise specified.

3. The following tube types may be used for a 100-mA heater complement: 18FX6A converter, 18FW6A if amplifier, 18FY6A detector and audio ampliffer, 34GD5A power amplifier, and 36AM3B rectifier.

## CODE-PRACTICE OSCILLATOR



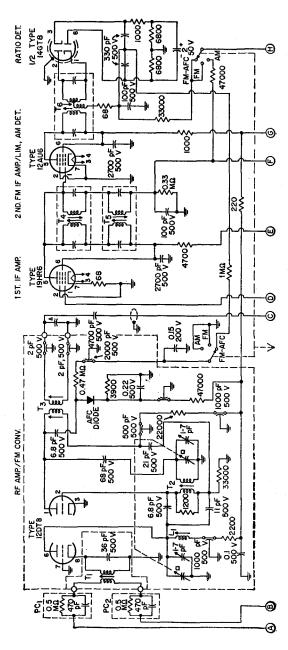
T<sub>1</sub> = Power transformer, 125 volts rms, 15 mA; 6.3 volts, 0.6 ampere T<sub>2</sub> = Universal output transformer

Notes: 1. Any two terminals of the secondary of T<sub>2</sub> that give the desired tone may be selected. Adjustment of volume control may cause a slight change in tone.

2. Resistance in ohms and capacitance in microfarads unless otherwise specified.

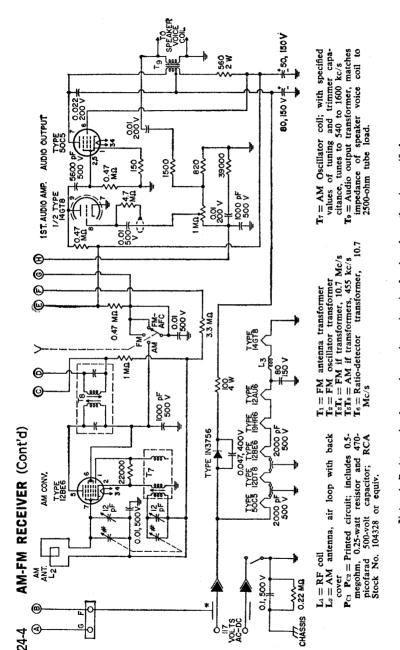
AM/FM RECEIVER

24-4



# Ganged tuning capacitors; tune AM antenna (L2) and T<sub>7</sub> to 540 to 1650 kc/s A IF transformer tuning capacitor; value, with cable capacitance, tunes T<sub>2</sub> to Ganged tuning capacitors; tune L, and T2 to 80 to 108 Mc/s 10.7 Mc/s.

\*On FM, the ac line serves as an FM antenna by means of a special line cord having a third wire which is not physically connected to the line. Alternatively, an external FM antenna may be connected to terminals G and F with the connection to the third wire of the power cord omitted.



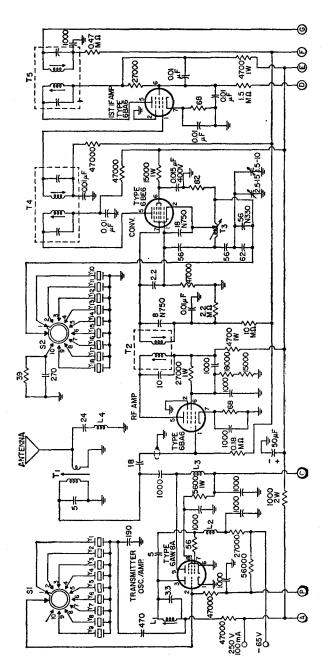
Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt, ±10% unless otherwise specified.

3. See general considerations for construction of high-frequency and broadband

circuits on page 519.

24-5



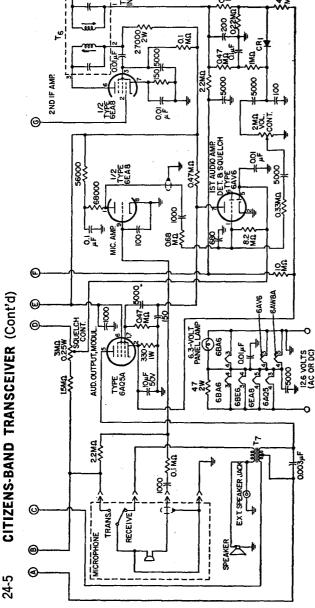
Notes: 1. Resistance in ohms and capacitance in picofarads unless otherwise specified.

2. All fixed resistors are 0.5 watt and all capacitors 500 voits unless otherwise

specified. 6

See general considerations for construction of high-frequency and broadband circuits on page 519.

FCC regulations require that the transmitting crystals are installed and the operating frequency checked by or under the supervision of a person who holds a second-class (or higher) commercial radio operator's license. 4



CITIZENS-BAND TRANSCEIVER (Cont'd)

S2 == Rotary switch, receiver channel selector, RCA stock No. 226189 or output transformer, T2 = RF interstage transformer, 26.965 to 27.255 Mc/s, RCA stock No. 226191 RCA stock No. 226184 or equiv. T<sub>1</sub> = Transmitter equiv.

RCA

L<sub>1</sub> = Transmitter oscillator coil, CR1 =Crystal diode, type 1N34

stock No. 226183 or equiv.

 $L_2L_3=RF$  choke, 500  $\mu H$ No. 226187 or equiv.

mary and secondary capacitors), 1650 Ye = Transmitting crystals. T<sub>1</sub> = Audio output transformer, centertapped primary, matches impedance of speaker voice coil to 5000-ohm tube oad, RCA stock No. 226224 or equiv. Yn through Y18 = Receiving crystals. kc/s, RCA stock 226193 or equiv. T.T.F. = IF transformer (includes Y<sub>1</sub> through T3 = Receiver oscillator coil, RCA stock

No. 226192 or equiv.

This transceiver is similar to the RCA "mark nine" Citizens-Band 2-Way Radio,

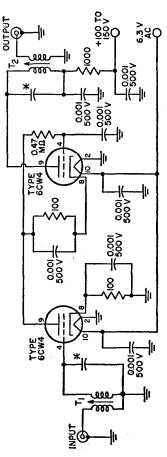
or equiv.

S1 = Rotary switch, transmitter channel L<sub>i</sub> = Second-harmonic trap, RCA stock

selector, RCA stock No. 226189 or

# PREAMPLIFIER FOR AMATEUR RECEIVER

10- and 6-Meter (30- and 50-Mc/s) Amateur Bands and 27-Mc/s Citizens Band



ondary of each transformer; for operation at 50 Mc/s, use 5-pF 500-volt capacitor across secondary of T<sub>1</sub> and 6.8-pF 500-volt capacitor across secondary of T<sub>2</sub>. \* For operation at 27 Mc/s, use 6.8-pF 500-volt capacitors across secondaries of T<sub>1</sub> and T<sub>2</sub>, for operation at 30 Mc/s, use 5-pF 500-volt capacitor across sec-

to across second natches preamplifier to 52-ohn input ine (for 300-ohm input line (for 300-ohm input line, double number of turns in primary); wound from #32 copper enamel wire on slugtuned form having ¼-inch outer diameter; primary, ½ turns, secondary, 18

turns for operation at 27 or 30 Mc/s or 10 turns for operation at 27 or 30 Mc/s or 10 turns for operation at 50 Mc/s matches preamplifier to 72-ohm output line (use of other than a 72-ohm line between preamplifier output and receiver input is not recommended);

wound from #32 copper enamel wire on slug-tuned form having ¼-inch outer diameter; primary, 18 turns for operation at 27 or 30 Mc/s or 10 turns for operation at 50 Mc/s; secondary, 1½ turns

mmended); totales otherwise specified.

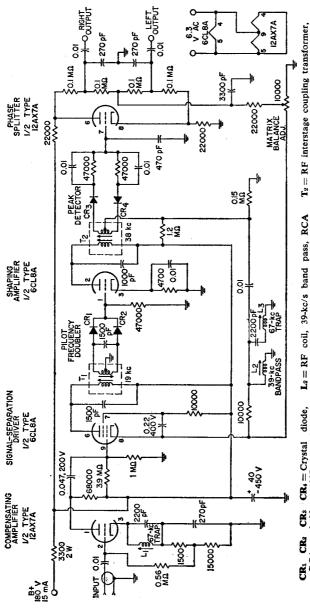
Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt unless otherwise specified.

 See general considerations for construction of high-frequency and broadband circuits on page 519.

|                     | ALIGNMENT DATA |             |
|---------------------|----------------|-------------|
| Operating Frequency | Tune T, to:    | Tune T2 to: |
| 27 Mc/s             | 30 Mc/s        | 27 Mc/s     |
| 30 Mc/s             | 32 Mc/s        | 29.5 Mc/s   |
| 50 Mc/s             | 51 Mc/s        | 50 Mc/s     |

24-7



L<sub>2</sub> = RF coil, 39-kc/s band pass, RCA stock No. 111048 or equiv. T<sub>1</sub>=RF interstage coupling transformer, 19-kc/s, RCA stock No. 111045 or t La = RF coil, 67-kc/s trap, RCA stock No. 111047 or equiv. RCA stock No. 111207 or equiv. L. L. RF

38-kc/s, RCA stock No. 111046 or equiv.

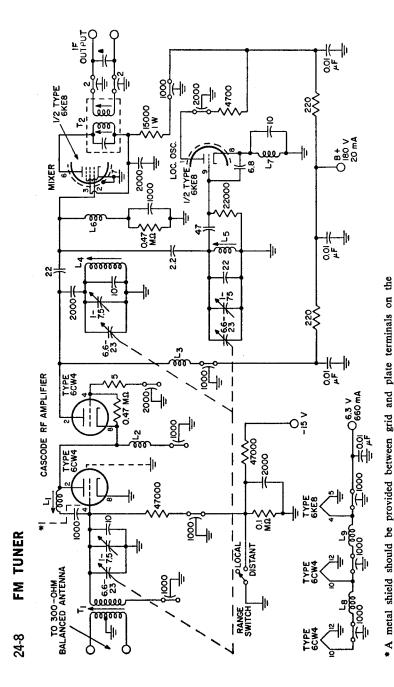
Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt and all capacitors 500 volts unless otherwise specified.

3. See general considerations for construction of high-frequency and broadband

equiv.

circuits on page 519.



A Capacitor inserted in place of tuning capacitor in secondary winding of T2. Value with cable capacitance tunes output circuit of tuner to 10.7 Mc/s. 6CW4 socket.

### FM TUNER (Cont'd)

slug-tuned coil form; tuning slug ==  $L_1 = RF$  coil, 12 turns of No. 22 enamel wire close-wound on 1/4-inch-diameter 38-inch-long Moldite No. 5101 ferrite

L<sub>2</sub> = RF coil, 5 turns of No. 22 enamel wire close-wound on 1/4-inch-diameter or equiv. coil form

 $L_8 = RF$  choke, 4  $\mu$ H, J. W. Miller No. 70F396A1 or equiv.

L<sub>4</sub> = RF coil, 3 turns of No. 16 enamel wire wound double-spaced on 1/4-inchdiameter slug-tuned coil form; tuning slug = 3/8-inch-long Moldite No. 5101

ferrite or equiv. L<sub>0</sub> = RF choke, 2  $\mu$ H, Ohmite No. Z144  $L_1 = RF$  coil; 0.4  $\mu$ H; 20 turns of No. 26 enamel wire close-wound on a Lo = RF coil, 11/2 turns of No. 16 enamel wire close-wound on 1/4-inchdiameter slug-tuned coil form; tuning 0.47 megohm, 0.5w Allen-Bradley reslug = 38-inch-long Moldite No. 5101 or equiv.

Ls Lo = RF chokes; 1  $\mu$ H; 25 turns of No. 24 enamel wire close-wound on sistor or resistor of equivalent physical a 0.47-megohm, 1-watt Allen-Bradley

turns of No. 32 wire with type B nylon insulation, Alpha No. 1860 or double-spaced on 14-inch-diameter slug-tuned coil form; tuning slug = or equiv.  $T_2 = FM$  if transformer, 10.7 Mc/s, J. W. Miller 1451 or equiv.; capacitor in secondary should be replaced by one shown connected across tuner equivalent, center-tapped; secondary: 3 turns of No. 16 enamel wire; wound %-inch-long Moldite No. 5101 ferrite resistor or resistor of equivalent phys- $T_1 = Antenna$  transformer; primary: output terminals (see footnote ^)

Notes: 1. Resistances in ohms and capacitance in picofarads unless otherwise specified.

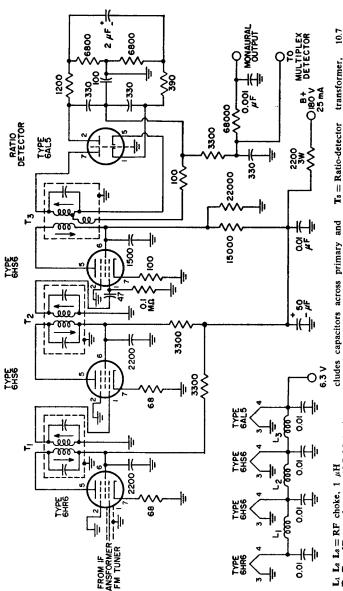
2. All resistors 0.5 watt and all capacitors 400 volts unless otherwise specified.

3. See general considerations for construction of high-frequency and broadband

# THREE-STAGE IF AMPLIFIER/LIMITER AND DETECTOR

24-9

For Monaural or Stereo Tuner



cludes capacitors across primary and secondary windings L<sub>1</sub> L<sub>2</sub> L<sub>3</sub> = RF choke, 1  $\mu$ H T<sub>1</sub> T<sub>2</sub> = IF transformers, 10.7 Mc/s, in-

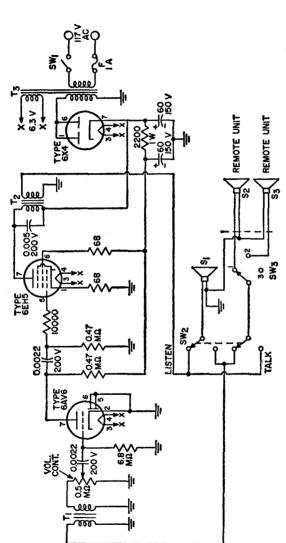
Mc/s, includes capacitor across secondary winding.

Notes: 1. Resistances in ohms and capacitance in picofarads unless otherwise specified.

2. All resistors 0.5 watt and all capacitors 400 volts unless otherwise specified. 3. Tube shields may be required if regeneration is encountered. See general considerations for construction of high-frequency and broadband circuits on

INTERCOMMUNICATION SET

With Master Unit and Two or More Remote Units



S1 S2 S3 == Speaker; permanent-magnet; SW1 = On-off switch, single-pole singlethrow, attached to volume control voice-coil impedance, 3 to 4 ohms potentiometer

SW2 = Talk-listen switch, double-pole  $T_1 = Input$  transformer, 4-ohm primary, SWs = Station Selector, rotary switch 25000-ohm secondary double-throw

T<sub>2</sub> = Output transformer, 3000-ohm pri-Ts = Power transformer; 125 volts rms, 50 mA; 6.3 volts, 2 amperes. mary, 4-ohm secondary

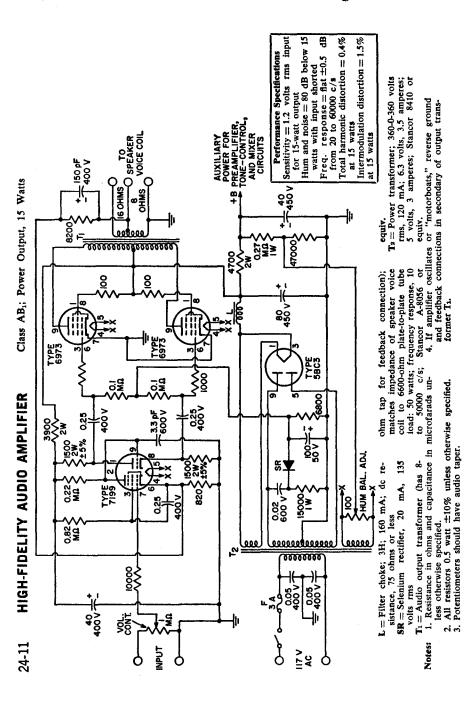
Notes: 1. The leads from the LISTEN-TALK switch to T1 and T2 should be kept as ar apart as possible to prevent undesirable regenerative effects.

Connections to the remote speaker units should be made with low-resistance wire, preferably with shielded "intercom" cable.

Resistance in ohms and capacitance in microfarads unless otherwise specified.

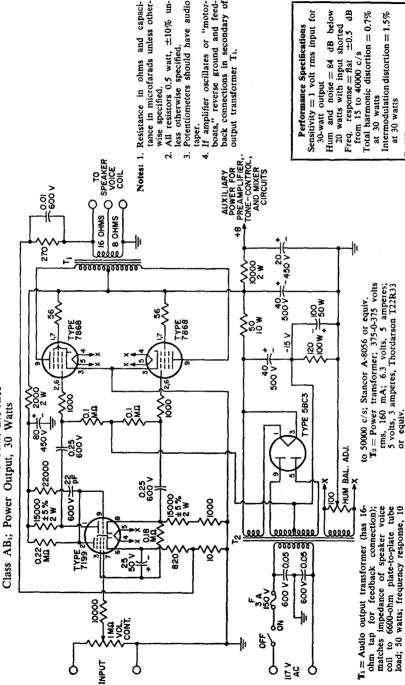
All resistors 0.5 watt unless otherwise specified.

5. Potentiometer should have audio taper.





24-12

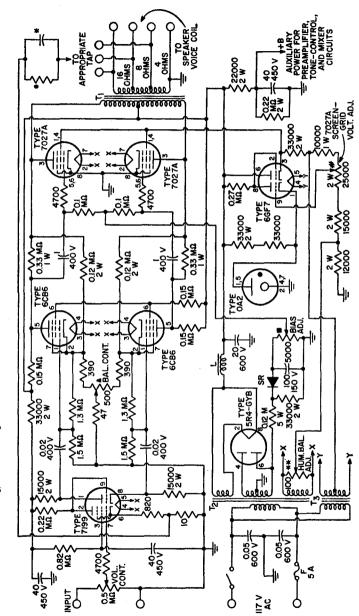


Sensitivity = 1 volt rms input for Hum and noise = 84 dB below ±0.5 dB fotal harmonic distortion = 0.7% 20 watts with input shorted

ntermodulation distortion = 1.5%

## HIGH-FIDELITY AUDIO AMPLIFIER

Class AB<sub>1</sub>; Power Output, 50 watts



Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified. All resistors 0.5 watt, ±10% unless otherwise specified.

3. Potentiometers should have audio taper.

Townstances: a sixtual tasts around tasts.
 If amplifier oscillates or "motorboats," reverse ground and feedback connections in secondary of output transformer T<sub>1</sub>.

## HIGH-FIDELITY AUDIO AMPLIFIER (Cont'd)

- Capacitor = 0.002  $\mu F$  when connected to 4-ohm transformer tap, 0.0015  $\mu F$ when connected to 8-ohm tap, or 0.001  $\mu F$  when connected to 16-ohm tap, 400
- resistor = 600 ohms when connected to 4-ohm transformer tap, 820 ohms when connected to 8-ohm tap, or 1200 ohms when connected to 16-ohm tap, 0.5 watt.

L = Filter choke; 8H; 250 mA; dc resistance, 60 ohms or less

SR = Selenium rectifier, 20 mA, 135 volts rms

T<sub>1</sub> = Audio output transformer; matches impedance of speaker voice coil to 5000-ohm plate-to-plate tube load; 50 watts; frequency response, 10 to 50000

c/s; Acrosecond T0340 or equiv.

T<sub>2</sub> = Power transformer; 600-0-600 volts rms, 200 mA; 6.3 volts, 3 amperes; 5 volts, 3 amperes; Thordarson 22R36 or equiv.

or equiv.

Ts = Filament transformer; 6.3 volts, center-tapped, 1 ampere; Thordarson 21F08 or equiv.

### Preliminary Adjustments

The following adjustments should be made before operation:

(\*) With rectifier out of socket, adjust Bias Adj. for --40 volts between the

wiper arm and ground bus.) With speaker connected, adjust Screen-Grid Voltage Adj. for 400 volts between pin 2 of 6GF7 and ground bus.

(\*\*) With input shorted, adjust Hum Bal. Adj. for minimum hum from speaker.

(\*) With input open and Vol. Cont. set for maximum volume, adjust Bal. Cont. for minimum hum from speaker.

**Performance Specifications** 10 to 50000 c/s **Sensitivity** = 0.4 volt rms input Total harmonic distortion = 0.1% for 50 watts output

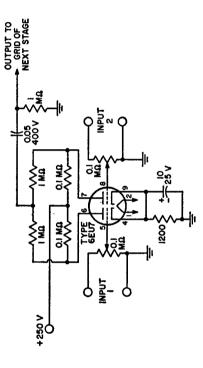
Hum and noise = 70 dB below Intermodulation distortion = 1%

So watts with input shorted

at 50 watts

The control of the con

24-14 TWO-CHANNEL AUDIO MIXER
Voltage Gain from Each Grid of 6EU7 to Output is Approximately 20



Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

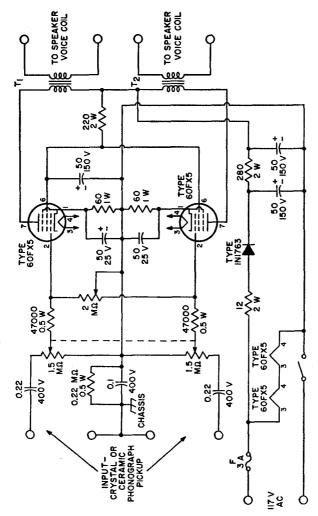
2. All resistors 0.5 watt unless otherwise specified.

3. Potentiometers should have audio taper.

# TWO-CHANNEL STEREOPHONIC AMPLIFIER

24-15

Power Output, 1 Watt Each Channel

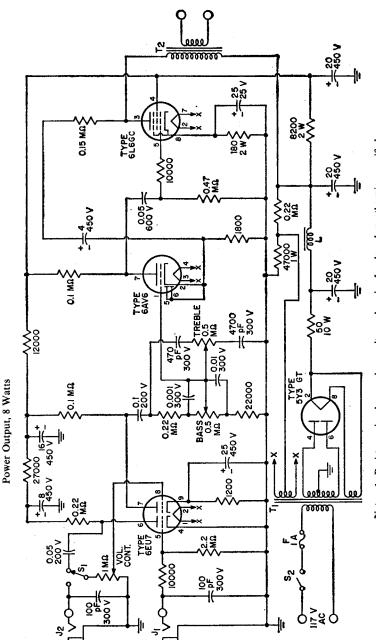


T: T: = Audio output transformer, matches impedance of speaker voice coil to 3000-ohm tube plate load, Triad S-16X or equiv.

Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. Potentiometers should have audio taper.

MICROPHONE AND PHONOGRAPH AMPLIFIER



Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt, ±10% unless otherwise specified.

3. Potentiometers should have audio taper.

# MICROPHONE AND PHONOGRAPH AMPLIFIER (Cont'd)

24-16

J1 = Jack for high-impedance crystal microphone input

L = Filter choke, 5 henries, 200 mA, Universal Transformer Corp. R20 or J<sub>2</sub> = Jack for crystal phono-pickup in-

S<sub>1</sub> = Microphone-phonograph selector; wafer switch; single-pole, double-throw  $S_2 = On-off$  switch; single-pole, singleT<sub>1</sub> = Power transformer; 300-0-300 volts rms, 90 mA; 6.3 volts, 3.5 amperes, 2 amperes; volts, center-tapped;

matches impedance of speaker voice coil to 4000-ohm tube plate load, 10 Transformer Corp.  $\Gamma_2 = \text{Universal audio output transformer,}$ Thordarson 22RO4 or equiv. Universal S14 or equiv. watts,

= 6.8 millivolts rms microphone input (at  $J_1$ ) for 8-watt output Sensitivity = 200 millivolts rms phono input (at J2) for 8-watt output

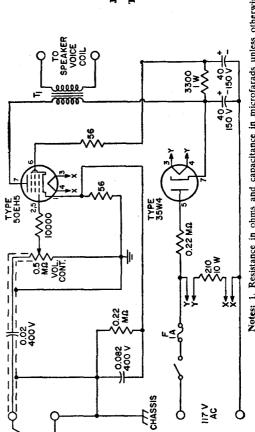
PHONOGRAPH AMPLIFIER

24-17

Power Output, 1 Watt

SPEAKER VOICE COIL

T = Audio output transformer, matches impedance of speaker voice coil to J = Input connector, shielded, for crystal phonograph pickup 3000-ohm tube load

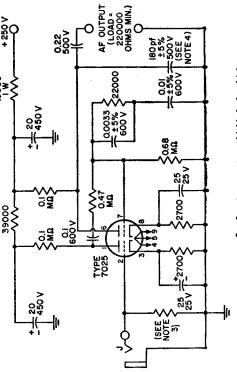


Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified. 2. All resistors 0.5 watt unless otherwise specified.

Potentiometers should have audio taper.

# AMPLIFIER FOR MAGNETIC PHONOGRAPH PICKUP

With RIAA Equilization



J = Input connector, shielded, for highimpedance magnetic phono pickup (10 mV output approx.)

Sensitivity = 3 millivolts rms input for output of 0.55 volt at frequency of 1000 c/s Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

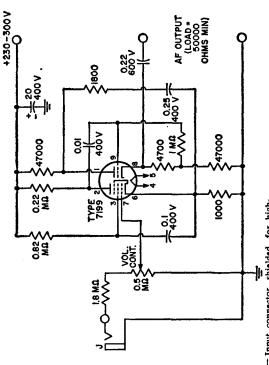
- 2. All resistors 0.5 watt, ±10% unless otherwise specified.

  3. Value of input resistor depends on type of magnetic pickup used. Follow
  - Value of input resistor depends on type of magnetic picl pickup manufacturer's recommendations.
- 4. Value shown for capacitor connected between pin 6 of 7025 and ground includes capacitance of amplifier output cable.

PREAMPLIFIER FOR CERAMIC PHONOGRAPH PICKUP

24-19

Cathode Follower (Low-Impedance) Output



J = Input connector, shielded, for high-impedance ceramic phono pickup (0.5 volt output)

Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt unless otherwise specified.

3. Potentiometer should have audio taper.

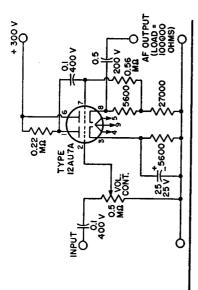
## TWO-STAGE INPUT AMPLIFIER

Cathode-Follower (Low-Impedance) Output

Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt unless otherwise specified.

3. Potentiometer should have audio taper.



### For Low-Output, High-Impedance Microphones **LOW-DISTORTION PREAMPLIFIER** 24-21

+250-300V

450 个十

0.47 MD ^

0.047

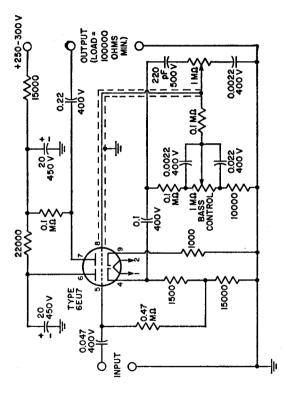
Sensitivity = 3 millivolts rms input for output of 220 millivolts.

Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt unless otherwise specified.

220000 OHMS MIN.) (LOAD = OUTPUT 0.22 400 V +<del>| 25</del> -<del>| 25</del> -<del>|</del> 25 v **4**00 **v** 8 **TYPE** 5879 INPUT

# BASS AND TREBLE TONE-CONTROL AMPLIFIER



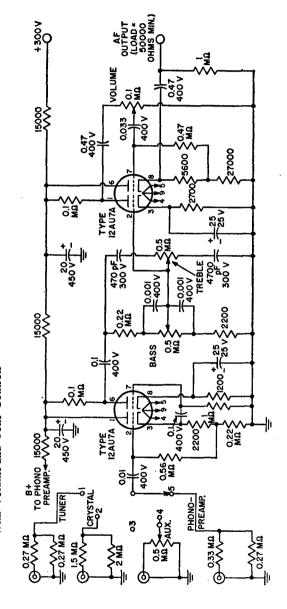
**Sensitivity** = 0.5 volt rms input for output of 1.25 volts with controls set for flat

Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt unless otherwise specified.

3. Potentiometers should have audio taper.

24-23 AUDIO CONTROL UNIT
With Volume and Tone Controls



Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt unless otherwise specified.

3. Potentiometers should have audio taper.

### TELEVISION CIRCUITS 24-24 to 24-28

Circuits 24-24 through 24-28 are essentially identical to the corresponding circuits in the RCA-KCS-152 Television Receiver. These circuits comprise a complete television receiver with the exception of the deflection coils and the picture tube. Portions of any television receiver, however, are required to operate over an extremely wide range of very high frequencies. The construction of such circuits requires more than ordinary skill and experience and the use of sophisticated test equipment (see general consideration for the construction of high-frequency and broadband circuits on page 519). Home construction of such circuits is not recommended unless the builder has had considerable experience in this type of work.

The chassis of circuits 24-24 through 24-28 are connected to one side of the ac line during operation. Servicing of these circuits should not be attempted by persons not familiar with the precautions necessary when working on this type of equipment.

- An isolation transformer should be inserted between the receiver and the ac line before any servicing is attempted.
- 2. If the receiver must be operated directly from the ac supply, the power plug should be inserted in the proper direction to connect the chassis to the ground side of the ac line. Use an ac voltmeter to measure the voltage between the chassis and the power-source ground; no voltage reading should be obtained. If a reading is obtained, reverse the power plug, and recheck for a zero reading.

For further information on television circuits, the reader should consult the text sections in this manual

75 OHM LEAD ≹ຮູ້| | TO MONOPOLE ANTENNA (75 OHMS) |<del>\</del>20 <u>8</u> Šō 十.22 /F L31 1000 Loc. osc. IF OUTPUT +140 V

24-24 VHF TUNER
For Black-and-White Television Receiver

## VHF TUNER (Cont'd)

24-24

arad capacitors, forms high-pass filter pliffer and mixer, part of S2 assembly L<sub>30</sub> = Variable rf coil; mixer plate tuning adjustment; RCA stock No. 112909 or L1 L2 L2 = RF coils; with two 82-pico-(antenna input network), RCA Stock L<sub>1</sub> = RF amplifier grid coil, part of S3 through L17 = RF-amplifier tuning Lis through Lie Mixer tuning coils, part L<sub>5</sub> = Mixer grid coil, part of S<sub>2</sub> assembly Le = Interstage coupling coil for rf am-GIMMICK = Trimmer-capacitor plate coils, part of S<sub>8</sub> assembly No. 114458 or equiv. of S2 assembly La = RF choke assembly

Las = Variable rf coil; local-oscillator Las through Les = Local-oscillator tuning coils (variable coil Las is tuning adjustment for channel 6), part of S1 tuning adjustment for channel 13 assembly

L44 = Variable rf coil; fine-tuning control; RCA Stock No. 113323, or equiv. S<sub>1</sub> = Local-oscillator section of channelselector switch; stator assembly, RCA Stock No. 114462 or equiv., includes local-oscillator tuning coils Las through

S<sub>2</sub> = Mixer section of channel-selector switch; stator assembly, RCA Stock No. 114461 or equiv., includes mixer tuning coils Ls, Ls, and L18 through

selector switch; stator assembly, RCA Stock No. 114460 or equiv., includes rf-amplifier tuning coils L, and L7 S<sub>s</sub> = RF amplifier section of channelthrough Li7

selectors S<sub>1</sub>, S<sub>2</sub>, and S<sub>3</sub>; RCA Stock No. 114185 or equiv. 300-ohm balanced antenna-lead line S. = VHF-UHF function selector; twosection switch ganged with channel T<sub>1</sub> = Antenna-matching balun; matches to 75-ohm unbalanced receiver-input line; RCA Stock No. 111973 or equiv.  $T_2 = Antenna$  transformer; RCA Stock

Z<sub>1</sub> Z<sub>2</sub> = Resistance-capacitance network (capristor), RCA stock No. 109956 or No. 113195 or equiv.

Notes: 1. All switches are ganged together on same shaft and are shown with shaft in channel 13 position.

Resistance values in ohms and capacitance values in picofarads, unless otherwise specified.

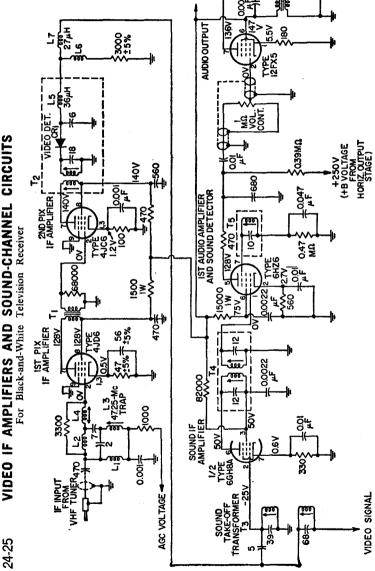
All resistors 0.5 watt ±10% and all capacitors 500 volt unless otherwise

specified.

For de voltage and heater supply, see circuit 24-28, page 553. See additional notes on page 547. Voltages shown are obtained with no signal input.

SPEAKER

**VIDEO IF AMPLIFIERS AND SOUND-CHANNEL CIRCUITS** 



+150 V

Notes: 1. Resistance in ohms and capacitance in picofarads unless otherwise specified. All resistors 0.5 watt unless otherwise specified.

Voltages shown are obtained with no signal input. For de voltage and heater supply, see circuit 24-28, page 553. See additional notes on page 547.

# VIDEO IF AMPLIFIERS AND SOUND-CHANNEL CIRCUITS (Cont'd)

24-25

CR<sub>1</sub> = Video detector, crystal diode, RCA Stock No. 11224 or equiv.

L<sub>1</sub> = RF coil, RCA Stock No. 114315 or equiv.

L<sub>2</sub> = RF coil, RCA Stock No. 114314 or equiv.

L<sub>3</sub> = RF coil, RCA Stock No. 114314

L<sub>4</sub> = RF coil, RCA Stock No. 113097 or equiv.

L<sub>4</sub> = RF coil, RCA Stock No. 113097 or equiv.

L<sub>5</sub> = Video-detector peaking coil, 36  $\mu$ H,

RCA Stock No. 109758 or equiv. La = Video-detector peaking coil, 560  $\mu$ H, RCA Stock No. 114488 or equiv. Lr = Filter choke (reactor), 2.7  $\mu$ H, RCA Stock No. 107463 or equiv. Ti = First pix if transformer, RCA Stock No. 109158 or equiv.

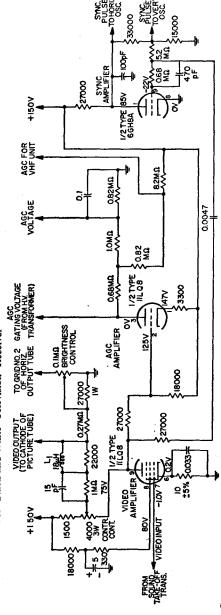
T2=Second pix if transformer, RCA Stock No. 114317 or equiv.
T3=Sound take-off transformer, 4.5-Mcfs, RCA Stock No. 114489 or

T<sub>4</sub> = Sound if transformer (includes primary and secondary capacitors), RCA Stock No. 104137 or equiv.

To E Sound detector resonant circuit (includes 10-pF capacitor), RCA Stock No. 109948 or equiv.

To Audio output transformer, matches speaker voice-coil impedance to tube plate load, RCA Stock No. 114490 or equiv

## VIDEO, AGC, AND SYNC AMPLIFIERS For Black-and-White Television Receiver



 $L_1 = \text{Video-amplifier peaking coil, 18}$  $\mu H$ , RCA Stock No. 109946 or equiv.

Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

2. All resistors 0.5 watt unless otherwise specified.

Voltages shown are obtained with no signal input,

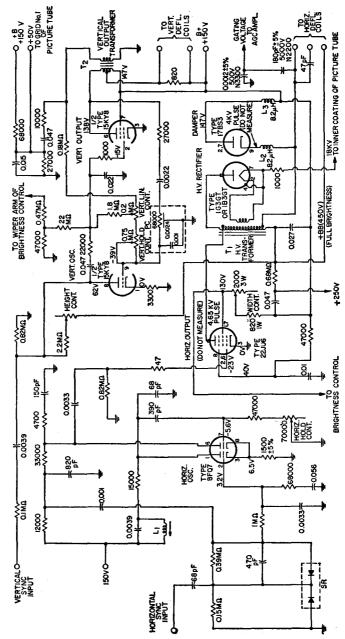
. For dc voltage and heater supply, see circuit 24-28, page 553.

. See additional notes on page 547.

VERTICAL AND HORIZONTAL DEFLECTION CIRCUITS AND HIGH-VOLTAGE RECTIFIER

24-27

For Black-and-White Television Receiver



## VERTICAL AND HORIZONTAL DEFLECTION CIRCUITS AND HIGH-VOLTAGE RECTIFIER (Cont'd)

RCA Stock No. PC = Printed circuit (includes 0.001- $\mu F$ L2 L3 = RF chokes (reactors), 8.2 μH, RCA Stock No. 107385 or equiv.  $\mathbf{L}_1 = \mathbf{Oscillator}$  coil, 114486 or equiv.

and 0.0024-µF capacitors and 68000-ohm resistor), RCA Stock No. 114506 SR = Selenium rectifier, RCA Stock No. or equiv.

T<sub>1</sub> = High-voltage and horizontal-output transformer, RCA Stock No. 114498

or equiv. T<sub>2</sub> = Vertical-output transformer, Stock No. 114502 or equiv.

Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified.

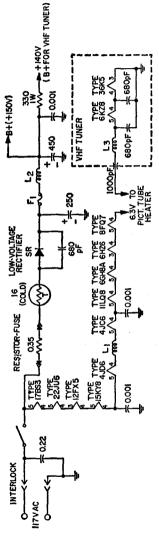
109474 or equiv.

3. Voltages shown are obtained with no signal input. 4. For dc voltage and heater supply, see circuit below. See additional notes on page 547.

2. All resistors 0.5 watt unless otherwise specified.

## BLACK-AND-WHITE TELEVISION RECEIVER LOW-VOLTAGE AND HEATER SUPPLY FOR

24-28



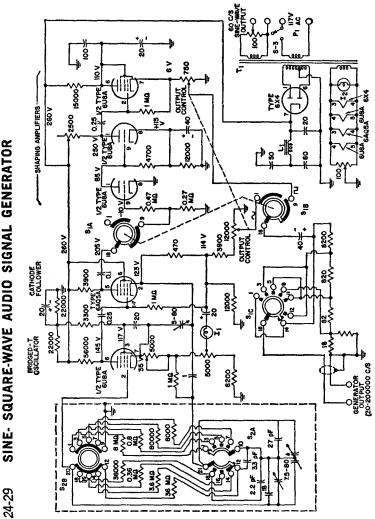
L<sub>1</sub> = RF choke, part of heater printed-circuit bond, RCA Stock No. 114499 or equiv. (includes two 0.001-µF capa-L2 = Filter choke (reactor), RCA Stock

L<sub>3</sub> = RF choke for VHF tuner filament Resistor-fuse = 0.35-ohm, No. 114501 or equiv. No. 114481 or equiv. circuit

Thermistor (T) = Surge-protection resistor, 16 ohms (cold), RCA Stock No. SR = Silicon rectifier, Type 1N3194

Notes: 1. Resistance in ohms and capacitance in microfarads unless otherwise specified. 2. See additional notes on page 547.





## SINE- SQUARE-WAVE AUDIO SIGNAL GENERATOR (Cont'd) 24-29

◆ On each range, the frequency of the generator is adjusted by means of variable two-gang capacitor, RCA stock No. 220226 or equiv.

L<sub>1</sub> = Filter choke (reactor), RCA stock  $I_1 = Lamp$ , 3 watts, 120 volts  $I_2 = Pilot lamp$ , No. 47

S<sub>1</sub> = Rotary switch; sine-square attenuation selector; 8 positions, 3 wafers; RCA stock No. 220216 or equiv. No. 220215 or equiv.

S<sub>2</sub> = Rotary switch; frequency range selector; 4 positions, 2 wafers; RCA

stock No. 220217 or equiv. S<sub>8</sub> = On-Off switch.

60 c/s; RCA stock No. 220214 or T<sub>1</sub> = Power transformer; 117 volts rms,

### SWITCH POSITIONS

| S1 Frequency Range S2 Sin                    | S2 Sine/Square    |                                                                |
|----------------------------------------------|-------------------|----------------------------------------------------------------|
| 1—X1<br>2—X10<br>3—X100<br>4—X1000<br>4—Sine | X10<br>X1<br>X0.1 | 5—Square X0.01<br>6—Square X0.1<br>7—Square X1<br>8—Square X10 |

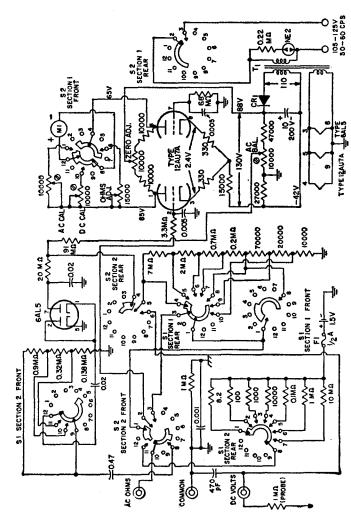
Frequency Ranges: 20 to c/s; 200 to 2000 c/s; 2000 to 200000 c/s; 20000 to 200000 c/s. Sine-Wave Output: 0 to 8 volts rms. Square-Wave Output: 0 to 10 volts, peak.

Notes: 1. "Sine-Square Attenuator" St, shown in "X10" position.
2. "Freq. Range" selector, Sz, shown in "X1" position.
3. Resistance in ohms and capacitance in microfarads unless otherwise specified.
4. DC voltages shown are measured between points indicated and ground with a

vacuum-tube voltmeter.

This audio generator is similar to the RCA type WA-44C.





## ELECTRONIC VOLT-OHM METER (Cont'd)

CRa = Selenium rectifier, Radio Receptor Co. No. 8Y1B or equiv.

Mi = Meter, dc, 0-200 microamperes
Si = Range selector, 7-position rotary
switch, RCA stock No. 217924 or equiv.

S<sub>2</sub> = Function selector, 5-position rotary switch, RCA stock No. 217923 or equiv.

T<sub>1</sub> = Power transformer, 105 to 125

equiv.

T<sub>1</sub> = Power transformer, 105 to 125 volts rms, 50 to 60 cycles per second, RCA stock No. 217921 or equiv.

Notes: 1. Switches are shown in their maximum counterclock-wise positions ( $S_1 = 1.5$  V, R X 1;  $S_2 = \text{``OFF''}$ ).

2. Resistance in ohms and capacitance in microfarad unless otherwise specified.

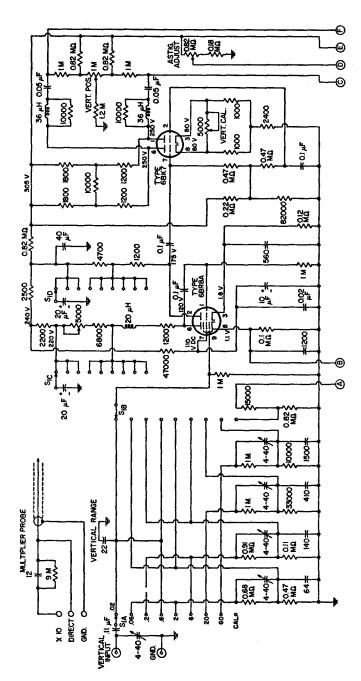
3. All resistors 0.5-watt and all capacitor 400-volt unless otherwise specified.

For home construction of this or a similar circuit, the complete Kit-WV-77E(K) or RCA-WV-96C(K) is recommended because of the large number of special components used.

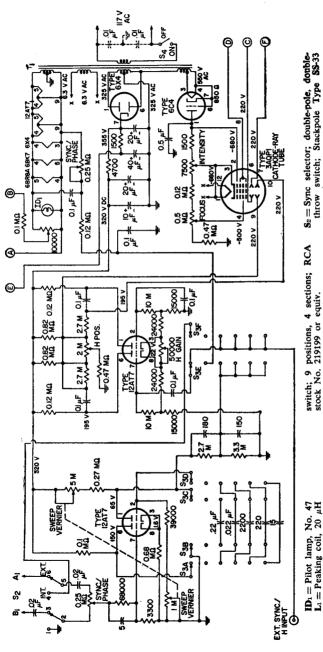
Special components used.

4. DC voltages shown are measured with respect to circuit ground unless otherwise indicated, under following conditions; ac line voltage, 117 volts; Function selector S<sub>2</sub> at "+ DC"; Range Switch S<sub>1</sub> at "1500 V."





24-31



rotary S<sub>3</sub> = Horizontal sweep selector;

 $T_1 = Power$  transformer 117 volts, 60 c/s; RCA stock No. 218122 or equiv. or equiv.  $S_4 = \text{On-off switch}$ 

switch; 6 positions, 5 sections; RCA

Le Le = Peaking coil, 36  $\mu$ H (wound on

10,000-ohm, 0.5-watt resistor)

stock No. 219200 or equiv.

rotary

selector;

range

S<sub>1</sub> = Vertical

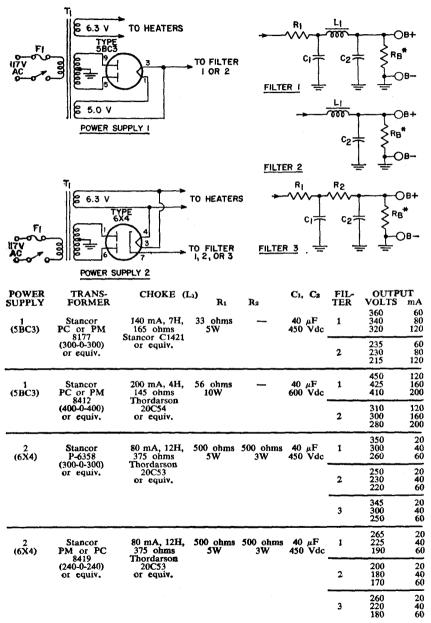
circuit is also available in wired form as the RCA-WO-33A. the large number of special components used. The For home construction of this circuit, the complete kit RCA-WO-33A (K) is recommended because of

> 2. For trimmer capacitors, 4 to 40 picofarads, use Arco No. 422 or equiv. 3. DC voltages shown are measured from points indicated to chassis ground with Notes: 1. Resistance in ohms and capacitance in picofarads unless otherwise specified.

a vacuum-tube voltmeter.

### 24-32

### ALL-PURPOSE POWER SUPPLY



<sup>\*</sup> Bleeder RB can be omitted if an external load is permanently connected across the output terminals. Bleeder current should be approximately 10 per cent of the load current.

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| 7AF7<br>7AG7<br>7AH7<br>7AU7<br>7B4            | 470<br>470<br>390               | 9GV8<br>9KZ8<br>9U8A<br>10<br>10AL11      | 372<br>472                      | 12AX7A       391         12AX7A/ECC83       391         12AY3       143         12AY3A       143         12AY7       392 |
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- RCA SILICON POWER RECTIFIERS—62S10—8 pages. Contains technical data on RCA's line of diffused-junction silicon power rectifiers. Includes quick-selection guide for stud-type and high-voltage "stack" and "stick" type rectifiers. Single copy free on request.
- RCA DIFFUSED-JUNCTION SILICON RECTIFIER STACKS AND BRIDGES—SRS-300—10 pages. Contains technical data on RCA's diffused-junction silicon rectifier stacks and bridges. Characteristics of basic rectifier circuits are also given to assist in selection of proper RCA rectifier device. Price 20 cents.\*
- RCA SMALL-SIGNAL SILICON N-P-N TRANSISTORS—SST-210—8 pages. Contains technical data on 2N2102 family of silicon transistors including high-voltage types, very-high voltage types, linear-beta types, and general types. Also includes quick-reference guide. Price 20 cents.\*

### **Batteries**

• RCA BATTERY MANUAL—BDG-111 (10%" x 834")—64 pages. Contains information on dry cells and batteries [carbon zinc (Leclanché), mercury, and alkaline types]. Includes battery theory and applications, detailed electrical and mechanical characteristics, a classification chart, dimensional out-

| lines, and terminal connections on each battery type. Price 50 cents.*†            | WR-99A (Marker Calibrator)1.00*                    |
|------------------------------------------------------------------------------------|----------------------------------------------------|
| • RCA BATTERIES—BAT-134G (10%"                                                     | WT-100A (Electron-Tube Micro<br>Mho Meter)1.75*    |
| x 83/8"—32 pages. Technical data on                                                | WT-100A (Electron-Tube Micro                       |
| 142 Leclanché, alkaline, and mercury-<br>type dry batteries for radios, industrial | Mho Meter, Ser. No.                                |
| applications, flashlights, lanterns, and                                           | 1001 and over)2.00*                                |
| for photoflash service. Price 35 cents.*†                                          | WT-100A (Tube Chart                                |
| Test and Measuring                                                                 | 1CE-163)3.00*                                      |
| Equipment                                                                          | WT-110A (Automatic Electron-                       |
| Equipment                                                                          | Tube Tester)0.75* WT-110A (1CE-174 Card Punch      |
| • INSTRUCTION BOOKLETS — Illus-                                                    | Data)0.25*                                         |
| trated instruction booklets are available<br>for all RCA test instruments at the   | WT-110A (1CE-234 Card Punch                        |
| prices indicated below.                                                            | Data)1.00*                                         |
| •                                                                                  | WT-115A (Color Picture Tube                        |
| WA-44A (Audio Signal Generator)\$0.50*                                             | Tester)0.50*                                       |
| WA-44C (Audio Signal                                                               | WV-37A (Radio Battery                              |
| Generator)1.00*                                                                    | Tester)0.25*                                       |
| WO-33A (Super Portable                                                             | WV-37B (Radio Battery                              |
| Oscilloscope)1.00*                                                                 | Tester)0.25*                                       |
| WO-88A (5-in. Oscilloscope)0.75*                                                   | WV-38A (Volt-Ohm-                                  |
| WO-91A (5-in. Oscilloscope)1.00*                                                   | Milliammeter)0.50*                                 |
| WO-91B (5-in. Oscilloscope)1.00*                                                   | WV-65A (VoltOhmyst†)0.25*                          |
| WR-36A (Dot-Bar Generator) .0.50*                                                  | WV-74A (High Sensitivity                           |
| WR-46A (Video Dot/Crosshatch                                                       | AC VTVM)0.75*                                      |
| Generator)1.00*                                                                    | WV-75A (VoltOhmyst†)0.25* WV-76A (High Sensitivity |
| WR-49A (RF Signal Generator)0.50*                                                  | AC VTVM)0.75*                                      |
| WR-49B (RF Signal                                                                  | WV-77A (VoltOhmyst†)0.25*                          |
| Generator)1.00*                                                                    | WV-77B (VoltOhmyst†)0.25*                          |
| WR-50A (RF Signal                                                                  | WV-77E (VoltOhmyst†)1.00*                          |
| Generator)1.00*                                                                    | WV-84C (Ultra-Sensitive DC                         |
| WR-51A (Stereo FM Signal                                                           | Microammeter)0.75*                                 |
| Simulator)1.00* WR-52A (Stereo FM Signal                                           | WV-95A (Master                                     |
| Simulator)1.00*                                                                    | VoltOhmyst†)0.25*                                  |
| WR-61B (Color-Bar                                                                  | WV-97A (Senior<br>VoltOhmyst†)0.75*                |
| Generator)1.00*                                                                    | WV-98A (Senior                                     |
| WR-64A (Color Bar/Dot/Cross-                                                       | VoltOhmyst†)1.00*                                  |
| hatch Generator)1.00*                                                              | WV-98B (Senior                                     |
| WR-64B (Color/Bar/Dot/Cross-                                                       | VoltOhmyst†)1.00*                                  |
| hatch Generator)1.00*                                                              | WV-98C (Senior                                     |
| WR-67A (Test-Oscillator)0.25* WR-69A (Television/FM Sweep                          | VoltOhmyst†)0.50*                                  |
| Generator)1.00*                                                                    | 195-A (VoltOhmyst†)0.25*                           |
| WR-70A (RF-IF-VF Marker                                                            | ° Trade Mark Reg. U.S. Pat. Off.                   |
| Adder)0.75*                                                                        | * Prices shown apply in U.S.A. and are             |
| WR-86A (UHF Sween                                                                  | subject to change without notice.                  |
| Generator)0.50*                                                                    | † Suggested price.                                 |

### Reading List

This list includes references of both elementary and advanced character. Obviously, the list is not inclusive, but it will guide the reader to other references.

ALBERT, A. L. Electrons and Electron Devices. The Macmillan Co.

BECK, A. H. W. Thermionic Valves. Cambridge University Press

CHUTE, G. M. Electronics in Industry. McGraw-Hill Book Co., Inc.

DOME, R. B. Television Principles. McGraw-Hill Book Co., Inc.

Dow, W. G. Fundamentals of Engineering Electronics. John Wiley and Sons, Inc.

EASTMAN, A. V. Fundamentals of Vacuum Tubes. McGraw-Hill Book Co., Inc.

EDSON, W. A. Vacuum Tube Oscillators. John Wiley and Sons, Inc.

FINK, D. G. Television Engineering. McGraw-Hill Book Co., Inc.

GHIRARDI, A. A. Radio and Television Receiver Circuitry and Operation. Rinehart and Co., Inc.

GRAY, T. S. Applied Electronics. John Wiley and Sons, Inc.

GROB, B. Basic Television. McGraw-Hill Book Co., Inc.

HENNEY, KEITH. Radio Engineering Handbook. McGraw-Hill Book Co., Inc.

HOAG, J. B. Basic Radio. D. Van Nostrand Co., Inc.

KOLLER, L. R. Physics of Electron Tubes. McGraw-Hill Book Co., Inc.

MAEDEL, G. F. Basic Mathematics for Television and Radio. Prentice-Hall, Inc.

MARCUS, A. Elements of Radio. Prentice-Hall, Inc.

MARKUS AND ZELUFF. Handbook of Industrial Electronic Circuits. McGraw-Hill Book Co., Inc.

MILLMAN AND SEELY. Electronics. McGraw-Hill Book Co., Inc.

MOYER AND WOSTREL. Radio Receiving and Television Tubes. McGraw-Hill Book Co., Inc.

PENDER, DELMAR, AND McILWAIN. Handbook for Electrical Engineers—Communications and Electronics. John Wiley and Sons, Inc.

PREISMAN, A. Graphical Constructions for Vacuum Tube Circuits. McGraw-Hill Book Co., Inc.

HICKEY, H. V., and VILLINES, JR., W. M. Elements of Electronics. McGraw-Hill Book Co., Inc.

RCA TECHNICAL BOOK SERIES. Electron Tubes, Vol. 1 and Vol. 11. RCA Review.
REICH. H. J. Theory and Applications of Electron Tubes. McGraw-Hill Book

REICH, H. J. Theory and Applications of Electron Tubes. McGraw-Hill Book Co., Inc.

RICHTER, WALTHER. Fundamentals of Industrial Electronic Ciruits. Mc-Graw-Hill Book Co., Inc.

SEELY, S. Electron Tube Circuits, McGraw-Hill Book Co., Inc.

SPANGENBERG, K. R. Vacuum Tubes. McGraw-Hill Book Co., Inc.

STURLEY, K. R. Radio Receiver Design. Chapman and Hall, Ltd.

TERMAN, F. E. Fundamentals of Radio. McGraw-Hill Book Co., Inc.

TERMAN, F. E. Radio Engineers Handbook. McGraw-Hill Book Co., Inc.

The Radio Amateurs Handbook. American Radio Relay League.

ZWORYKIN AND MORTON. Television: The Electronics of Image Transmission. John Wiley and Sons, Inc.

### KEY: BASING DIAGRAMS (Bottom Views)

| BC BS C CL DJ ES | Gas-Type Tube Base Sleeve Base Shell External Conductive Coating Collector Deflecting Electrode External Shield | F—  FM  G  H  HL | Filament (negative only) Filament Tap Grid Heater Heater Tap for Panel Lamp Heater Tap | NC PRC        | Do Not Use, Except As Specified in Data No Internal Connection— May Be Used As Tie Point Plate (Anode) Ray-Control |
|------------------|-----------------------------------------------------------------------------------------------------------------|------------------|----------------------------------------------------------------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------|
| ES<br>F<br>F+    | External Shield Filament Filament (positive only)                                                               | IC<br>IS<br>K    | Do Not Use<br>Internal Shield<br>Cathode                                               | RC<br>S<br>TA | Ray-Control<br>Electrode<br>Shell<br>Target                                                                        |

Subscripts for multi-unit types: B, beam unit; D, diode unit; HP, heptode unit; HX, hexode unit; P, pentode unit; T, triode unit; TR, tetrode unit.

Many tube types are available in addition to the home-entertainment types described in this manual. For industrial and specialized applications, other small receiving-type tubes are available, such as nuvistor tubes, "premium" tubes, thyratrons, cold-cathode (glow-discharge) tubes, computer tubes, tubes for mobile communications applications, and Special Red tubes. Other lines of RCA electron devices include:

### **POWER TUBES**

Transmitting and Industrial Types

### TELEVISION CAMERA TUBES

Image Orthicons, Vidicons, and Monoscopes

### **PHOTOTUBES**

Single-Unit, Twin-Unit, and Multiplier Types

### **PHOTOCELLS**

Photoconductive and Photojunction Types

### THYRATRONS and IGNITRONS

### MICROWAVE TUBES

Magnetrons, Traveling-Wave
Tubes, Pencil Tubes

### **CATHODE-RAY TUBES**

Special-Purpose Kinescopes, Storage Tubes, and Oscillograph Types

### SPECIAL TYPES

Vacuum Gauge Tubes, Image Converters

### SEMICONDUCTOR DEVICES

Germanium and Silicon Transistors, Silicon Rectifiers, Tunnel Diodes, Silicon Controlled Rectifiers, Memory Devices

### RADIO CORPORATION, OF AMERICA

ELECTRONIC COMPONENTS AND DEVICES

HARRISON, N. J.



RCA RECEIVING TUBE MANUAL