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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.

The material in this edition has been augmented and revised to include the recent technological advances in the electronics field. Many tube types widely used in the design of new electronic equipment only a few years ago are now chiefly of interest for renewal purposes. Consequently, in the Tube Types Section, information on many older types is limited to basic essential data; information on newer and more important types is given in greater detail.

Radio Corporation of America
Electronic Components and Devices
Harrison, N. J.
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.

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 heater-cathode, 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
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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.

The heater-cathode construction is well adapted for use in electron tubes intended for operation from a.c. 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 a.c. 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 heater-cathode 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 a.c. 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 potential 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 flow from the cathode to the plate and return through the external plate-battery circuit to the cathode, thus completing the circuit. The 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.

Rectifier tubes are used in a.c. receivers to convert the a.c. supply voltage to d.c. voltage for the electrodes of 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 cycle. The 6X4, 6Y5GT, and 6U4G 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 impede 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. 6, 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.

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's 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 heater-cathodes, 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 space-charge effect is utilized in mercury-vapor 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

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 wires (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 positive, there will be less negative, the plate is less able to attract electrons to it and plate current decreases. When the

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.
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**Electrons, Electrodes, and Electron Tubes**

Therefore, attracts electrons from the cathode. However, because of the comparatively large space between wires of the screen grid, most of the electrons are drawn to the screen grid and 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 grid screen shields the electrons between cathode and screen grid from the plate so that the plate extracts 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 screen-grid 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 the secondary electrons and particularly so if the plate voltage swings lower than the screen-grid voltage. This effect lowers 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.8) 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.

![Electron Flow](image)

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 3V4 and 6K6GT; representative pentodes used for voltage amplification are the 1U4, 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 wound so that each turn of the screen grid is shielded from the cathode by a grid turn. This alignment of the screen grid Ar 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 space-charge suppression and illustrates how 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 space-charge effect may also be obtained by use of an actual suppressor grid. Examples of beam power tubes are 6AQ5A, 6L6GB, 6V6GT, and 50C5.

**Multi-Electrode and Multi-Unit Tubes**

Early in the history of tube development and application, tubes were designed for 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 designs 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 6C66 and 6B6. Types of this class generally require more than three electrodes to obtain the desired special characteristics and may be broadly classified as multi-electrode types. The 6B6 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 multi-unit tubes such as the twin-diode triodes 6G6F and 6A6V, as well as triode-pentodes such as the 6USA and 6X5. This class also includes class A twin triodes such as the 6GT and 12AX7, and types such as the 6CM7 containing dissimilar triodes which are 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 1R6, 6BE6, and 6SQ7. 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 6A8C and the 6A9C. 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 neonval types, and the twelve-pin nundecar types. Examples of the seven-pin miniature types are the 6A8A and 6B8. Examples of the nine-pin miniature types are the 12A7A and 6EA8. Examples of the novar types are the 6B6S and 7668. 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 cylindrical electrode structure housed in a ceramic-metal envelope (see page 2 for cutaway view). These tubes combine new materials, processes, and fabrication techniques. Examples of the nuvistor are the 2CW4 and the 6CW4.

**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 yoke 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-trap-magnet 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 dots. 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.

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 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 consisting of four electromagnetic coils similar to the deflecting yoke used for black-and-white picture tubes.
Eletron 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 illustrated by Fig. 11. Fig. 12 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.

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 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 ($r_p$) 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 millampere (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 ($g_m$), 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 millampere (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 microhm (amho), is used to express transconductance. Thus, in the example, 0.002 mho is 2000 microhms.

Conversion transconductance ($g_c$) 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; or 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 ($E_o$) and dc plate current ($I_o$) at full signal, or

$$\text{Plate efficiency (}%) = \frac{P_o \text{ watts}}{E_o \text{ volts } \times I_o \text{ amperes}} \times 100$$

The power sensitivity of a tube is the ratio of the power output to the square of the input signal voltage ($E_{in}$) and is expressed in mhos as follows:

$$\text{Power sensitivity (mhos)} = \frac{P_o \text{ watts}}{(E_{in}, \text{rms})^2}$$
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 amplying 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. 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 for 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 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 conditions 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 grid-voltage 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. 13 gives a graphical illustration of this method of amplification 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) is the resulting amplified plate-current variation.

The plate current flowing through the load resistance (R) of Fig. 14 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 the voltage amplification, or gain, provided by the tube. The voltage amplification due to the tube is expressed by the following convenient formula:

\[ \text{Voltage amplification} = \frac{\mu \times R_L}{R_L + r_p} \]

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 \( \mu_r \) is the transconductance in microamps.

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. 15 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 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 reactive component resulting from the 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 the tube is operated with its grid biased negative. In a class A or AB, 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, or class AB, 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 appreciably the gain and selectivity of a preceding stage. Tubes such as the "acorn" and "pencil" types and the high-frequency miniature types 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 ultra-high 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. Cross-modulation 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. 16 illustrates the construction of the grid No.1 (control grid) in a remote-cutoff tube. The remote-cutoff 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. 17 shows a typical plate-current vs. grid-voltage curve for a remote-cutoff type compared with the curve 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 following 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. 18) provides twice the output of a single tube with the same value of grid-signal voltage. With this connection, 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. 19), although it requires twice the grid-signal
It should be noted that in the case of filament types of tubes, the calculations are given on the basis of a deoperated filament. When the filament is re-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, \( I_P \), 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 \( E_P \) and the zero-signal dc plate current \( I_P \). If it is found that the plate-dissipation rating of the tube is exceeded with the zero-signal bias \( E_C \) 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 \( E_C \) to zero (\( E_g = 0 \)) 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 \( E_{max} \) and \( I_{max} \); during the positive swing, they reach values of \( E_{min} \) and \( I_{min} \). Because power is the product of voltage and current, the power output \( P_o \), as shown by a wattmeter is given by

\[
P_o = \frac{(E_{max} - E_{min}) \times (E_{max} - E_{min})}{8}
\]

where \( E \) is in volts, \( I \) is in amperes, and \( P_o \) 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:

\[
\% \text{ distortion} = \frac{2}{2 + \frac{I_{max} + I_{min}}{I_{max} - I_{min}}} \times \frac{1}{100}
\]

where \( I_L \) 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. 20. 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, \( E_C = -0.68 \times 250 / 4.2 = -40.5 \) volts. From the curve for this voltage, it is found that the zero-signal plate current \( I_P \), at a plate voltage of 250 volts is 0.08 amperes; and, therefore, the plate-dissipation rating is exceeded (0.08 \times 250 = 20 watts). Consequently, it is necessary to reduce zero-signal plate current to 0.06 amperes at 250 volts. The grid bias is now seen to be -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 one-half the filament voltage, or to -46 volts, and the circuit returned to the mid-point of the filament circuit.

Point X can now be determined. Point X is at the intersection of the dc bias curve at zero volts with \( I_{max} \). Point X is drawn through points P and X. \( E_{max} \), \( E_{min} \), and \( I_{min} \) are then found from the curves. Substituting these values in the power-output formula, we obtain:

\[
P_o = \frac{(355 - 105) \times (355 - 105)}{8} = 3.52 \text{ watts}
\]

where \( E \) is in volts, \( I \) is in amperes, and \( P_o \) is in watts.

The resistance represented by load line XY is

\[
\frac{(355 - 105)}{8} = 4210 \text{ ohms}
\]

When the values from the curves are substituted in the distortion formula, we obtain

\[
\% \text{ distortion} = \frac{2}{2 + \frac{I_{max} + I_{min}}{I_{max} - I_{min}}} \times 100 = 5.5\%
\]

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 give 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 1.4 × 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 × 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, therefore, 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 maximum power output for triodes in push-pull class A operation as follows:

E, is the operating plate voltage. Higher bias than this value requires higher grid-signal voltage and results in class AB operation which is discussed later.

The point for calculating maximum power output for triodes in push-pull class A operation is as follows: Erect a vertical line at 0.6 E, (see Fig. 21), intersecting the E, curve at the point I, then I, is determined from the curve for use in the formula

\[ P_o = \left( I_{\text{max}} \times E_o \right) / 6 \]

If I, is expressed in amperes and E, 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, on the zero-bias curve and through the E, point on the zero-current axis. Four times the resistance represented by this load line is the plate-to-plate load (R,pp) for two triodes in a class A push-pull amplifier. Expressed as a formula,

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

where E, is expressed in volts, I, in amperes, and R,pp in ohms.

Example: Assume that the plate voltage (E,) is to be 300 volts, and the method for calculating power output, erect a vertical line at 0.6 E, = 180 volts. The intersection of the line with the curve E, = 0 is I, or 0.2 ampere. When this value is substituted in the power formula, the power output is (0.2 × 250) / 6 = 10 watts. The load resistance is determined from the load formula: Plate-to-plate load (R,pp) = 4 × (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. 22.

From a point A at or just below the knee of the zero-bias curve, draw arbitrarily selected load lines to intercept the zero-grid-current axis. These lines should be on both sides of the operating point P whose position is determined by the desired operating plate voltage, E,, and one-half the maximum signal plate current. Along any load line, say AA, measure the distance AO. On the same line, lay off an equal distance, O'A. For optimum operation, the change in bias from A to O should be nearly equal to the change in bias from O to A. If this condition can not be met with one line, the chart provides a means of reducing the distortion and the conversion factors for voltage changes other than those shown in the published data can be obtained by the use of the nomograph shown in Fig. 23 when all electrode voltages are changed simultaneously in the same ratio. The nomograph includes conversion factors for current (F), power output (P,), plate resistance or load resistance (R), and transconductance (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,) and the published or original value of that voltage (E,). 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, and E, 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, P,, or Gm scale.

For example, suppose it is desired to operate two 6LS6's in class A push-pull, fixed bias, with a plate voltage of 250 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:

\[ F_p = \frac{I_{\text{max}} - I_{\text{min}} + 1.44 (I_1 - I_2)}{0.5} \]

\[ F_p = \frac{I_{\text{max}} - I_{\text{min}} + 1.44 (I_1 - I_2)}{0.5} \]

\[ F_p = \frac{I_{\text{max}} - I_{\text{min}} + 1.44 (I_1 - I_2)}{0.5} \]
Because contact-potential effects become noticeable only at very small dc grid-No.1 (bias) voltages, they are generally negligible in power tubes. 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 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 AB1 and class AB2. In class AB1, 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 AB2, 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 AB1 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 AB1 amplifier usually has a step-down turns ratio.

Because of the large fluctuations of plate current in a class AB2 stage, it is important that the plate power supply should have good regulation. Otherwise, the fluctuations in plate current cause 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 AB2 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 than in class A service.

In general, for any load line through point D, Fig. 24, the plate-to-plate load
resistance in ohms of a push-pull amplifier is \( R_{op} = 4E_0/Y_1 \), where \( Y_1 \) is the plate current value in amperes at which the load line as projected intersects the plate current axis, and \( E_0 \) is in volts. This formula is another form of the one given under push-pull class A amplifiers, \( R_{op} = (I_{max}/\sqrt{2}) \times Y_{op}/4 \), where \( I_{max} \) is the peak plate current at zero grid voltage for the load chosen. This formula is simplified as \( (I_{max}/\sqrt{2}) \times R_{pp}/8 \). The maximum-signal average plate current is \( 2I_{max}/\pi \) or 0.636 \( I_{max} \); the maximum-signal average power input is 0.636 \( I_{max} \times E_0 \).

It is desirable to simplify these formulas for a first approximation. A simplification can be made if it is assumed that the peak plate current, \( I_{max} \) occurs at the point of the zero-bias curve corresponding approximately to 0.6 \( E_0 \); the condition for maximum power output. The simplified formulas are:

\[
P_0 = (I_{max} \times E_0)/5 \]
\[
R_{pp} = 1.66E_0/I_{max}
\]

where \( E_0 \) is in volts, \( I_{max} \) is in amperes, \( E_0 \) 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. 24 illustrates the application of this method to a pair of 2A3’s operated at \( E_0 = 300 \) volts. Each tube has a plate-dissipation rating of 15 watts. The method is to erect a vertical line at 0.6 \( E_0 \), or at 180 volts, which intersects the \( E_0 = 0 \) curve at the point \( I_{max} = 0.26 \) ampere. Using the simplified formulas, we obtain:

\[
R_{pp} = 1.66(300)/0.26 = 1845 \text{ ohms}
\]
\[
P_0 = (0.26 \times 300)/5 = 16.6 \text{ watts}
\]

At this point, it is well to determine the plate dissipation to compare it with the maximum rated value. From the average plate current formula \( 0.636 I_{max} \) 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 load of 3000 ohms. From the formula for \( e_0 \), the value of \( Y_1 \) is found to be 0.4 amperes. The load line for the 3000-ohm load resistance is then represented by a straight line from the point \( Y_1 = 0.4 \) amperes on the plate-current ordinate to the point \( E_0 = 800 \) volts on the plate-voltage abscissa. At the intersection of the load line with the zero-bias curve, the peak plate current, \( I_{max} \), can be read at 0.2 amperes. Then:

\[
P_0 = (I_{max}/\sqrt{2}) \times R_{pp}/4 = 0.2(41.4)/3000/4 = 16 \text{ watts}
\]

Proceeding as in the first approximation, we find that the maximum-signal average plate current, 0.636 \( I_{max} \), is 0.127 ampere, and the maximum-signal average power input is 38.1 watts. This input minus the power output is 38.1 - 18.1 = 21.6 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 zero-signal plate current may now be found by use of a curve which is derived from the plate family and the load line. Fig. 25 is a curve of instantaneous values of plate current and dc grid-bias voltages taken from Fig. 24. Values of grid bias are read from each of the grid-bias curves of Fig. 24 along the load line and are transferred to Fig. 25 to produce the curve from A to C. A tangent to this curve, starting at A, is drawn to intersect the grid-voltage abscissa. The point of intersection of this tangent and the zero-bias curve 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 voltage 300 and grid bias -60 volts; 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 ac signal voltage per tube is 60 volts, and the grid-to-grid value is 120 volts.

As in the case of the push-pull class A amplifier, the second-harmonic distortion in a class AB amplifier using triodes for the load is 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. 24). 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, we have assumed a deviation of 30 volts from the operating grid voltage of -60 volts. 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) = -30-volt bias curve and read the plate current at this intersection, which is 0.165 ampere; likewise, at the intersection of a vertical line at 300 + 40 = 340 volts and the (-60) + (-30) = -90-volt bias curve, read the plate current. In this example, the plate current is estimated to be 0.023 ampere. The difference of 0.165 ampere between these two currents determines the point on the 300 - 40 = 260-volt vertical. Similarly, another point on the same composite curve is found by assuming the same grid-bias deviation but a larger plate-voltage deviation, say, 100 volts. We now have 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-dashed line in Fig. 24. 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 \( I_{nom} \) and the peak plate current, \( I_{max} \), are used in the following formula to find peak value of the third-harmonic component of the plate current.

\[
I_{hm} = (2I_{nom} - I_{max})/3
\]

In the example, where \( I_{nom} = 0.097 \) amperes and \( I_{max} = 0.2 \) ampere, \( I_{hm} = (2 \times 0.097 - 0.2)/3 = 0.184 \) ampere. The fact that \( I_{hm} \) is negative indicates that the phase relationship of the fundamental (first-harmonic) and third-harmonic components of the plate current is such as to result in a slightly peaked wave form. \( I_{hm} \) 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:

\[
I_{hm} = 2/3 \times (I_{nom} + I_{hm})
\]

In the example, \( I_{hm} = 2/3 \times (0.2 + 0.097) = 0.185 \) ampere. Thus, the percentage of third-harmonic distortion is \( I_{hm}/I_{nom} \times 100 = 0.097/0.185 \times 100 = 51 \) per cent approx.

**Class AB, Power Amplifiers**

A class AB amplifier employs two tubes connected in push-pull as in the case of class AB 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, it is assumed 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 is 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 stage usually has a step-down 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, i.e., large power output can be obtained without excessive plate dissipation. Class B operation differs from class AB, 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 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 half-cycle 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 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 dissipation 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 stage.

Power amplifier tubes designed for class A operation can be used in class AB, and class B service under suitable operating conditions. There are several type tubes designed especially for class B service. One 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. An example of a twin triode used in class B service is the 6N7.

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 1db 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 7886 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 generation of signals at frequencies equal to the sum and difference of the interacting frequencies. Intermodulation distortion should be less than 0.2 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 frequency-divider 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 7886 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. 26. The load is placed in 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 cathode-drive circuit is approximately equal to 1/Re, when the load resistance is small compared to the rA of the tube. A certain
amount of power is required, therefore, to drive such a circuit. However, in the type of service in which cathode-drive 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 by Fig. 27. In this circuit, R₁, R₂, and C are connected as a voltage divider across the output of the tube. The secondary of the grid-input transformer is returned to a point on this voltage divider. Capacitor C blocks the d-c plate voltage from the grid. However, a portion of the tube’s a-f output voltage, approximately equal to the output voltage multiplied by the fraction R₁/(R₁ + R₂), is applied to the grid. This voltage lowers the source impedance of the circuit and a decrease in distortion results which is explained in the curves of Fig. 28.

Consider first the amplifier without the use of inverse feedback. Suppose that when a signal voltage e₂ is applied to the grid the a-f plate current iₚ 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 a-f plate voltage has a waveform shown by eₚ. 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 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 feedback voltage feedback to the grid has the same waveform and phase as the plate voltage, but is smaller in magnitude. Hence, with a plate voltage waveform shown by eₚ, the feedback voltage appearing on the grid is as shown by eₚ′. This voltage applied to the grid produces a component of plate current iₚ′. It is evident that the irregularity in the waveform of 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 iₚ. The dotted curve shown by iₚ′ is the component of plate current due to the feedback voltage on the grid. The dotted curve shown by iₚ 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 iₚ 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 iₚ, 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 the 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. 20. The circuit is conventional except that a feedback resistor, R₁, is connected between the plates of tubes T₁ and T₂. The output signal voltage of T₁ and a portion of the output signal voltage of T₂ appears across R₁. Because the distortion generated in the plate circuit of T₁ is applied to its grid out of phase with the input signal, the distortion in the output of T₂ is comparatively low. With sufficient inverse feedback of the constant-voltage type 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 amplifiers.

Constant-current inverse feedback is usually obtained by omitting the bypass capacitor across a cathode resistor.

**Fig. 27**

**Fig. 28**

**Fig. 29**

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 give 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 given in Fig. 30. In this application, the load has been transferred from the plate circuit to the cathode circuit of the tube.

![Fig. 30](image)

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 formula.

For a triode:

\[ V.A. = \frac{\mu}{1 + \mu} \]

For a pentode:

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

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 \( 1 + \frac{1}{2} \) 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 cathode-follower 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 lower 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 \( (Z_o) \) can be made, in most practical cases, by the use of the following formula to determine the approximate value of the required cathode transconductance.

\[ g_m (\text{mhos}) = \frac{1000}{Z_o (\text{ohms})} \]

Once the required transconductance is obtained, a suitable tube and its operating conditions may be determined from the technical data given in the TUBE TYPES SECTION. The tube selected should have a value of transconductance slightly lower than that obtained from the above expression to allow for the shunting effect of the cathode load resistance. The conversion nomograph given in Fig. 28 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 triode:

\[ R_L = \frac{Z_o \times r_p}{r_p + Z_o (1 + a)} \]

For pentode:

\[ R_L = \frac{Z_o}{1 - \frac{g_m \times Z_o}{R_L}} \]

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

If the value of the cathode load resistance calculated to give the required output impedance does not give the required operating bias, the basic cathode-follower circuit can be modified in a number of ways. Two of the more common modifications are given in Figs. 31 and 32.

In Fig. 31 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. 32 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 dc voltage drop across the added resistance. The size of 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 microhms, the plate resistance is 62500 ohms, the amplification factor is 100, and the plate current is 0.0012 amper. When these values are used in the expression for determining the cathode load resistance, we obtain

\[ R_L = \frac{g_m \times Z_o}{1 - \frac{g_m \times Z_o}{R_L}} = 500 \times 62500 = 2600 \text{ ohms} \]

The voltage across this resistor for a plate current of 0.0012 ampere is 2600 = 0.0012 = 3.12 volts. Because the required bias voltage is only -2 volts, the circuit arrangement given in Fig. 32 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 B-supply, of course, is increased by the voltage drop across the cathode resistance which, in this exam-
The bias voltage obtained across this resistance is 1460 x 0.0008 = 1.17 volts. Since this value is for all practical purposes close enough to the required bias, no additional 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 6A7G is

\[ V.A. = \frac{4500}{5400 + 1460 (70 + 1)} = 0.05 \]

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. 32 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 and the voice-coil 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 transformer 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 only for 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. 33.

In a volume compressor, the variable-gain amplifier V1 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. 33, the signal to be amplified is applied to V1, and a portion of the signal is also applied to V2. The amplified output from V1 is then rectified by V3, and applied as a negative (or compresses) to positive (for expanders) bias voltage to V4. As this bias voltage varies with variations in signal amplitude, the gain of V1 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 tubes are the 6BQ5 and 6BQ6. 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.
of a phase-inverter circuit to a single-stage triode \( T_1 \). Phase inversion in this circuit is provided by triode \( T_1 \). The output voltage of \( T_1 \) is applied to the grid of triode \( T_2 \). A portion of the output voltage of \( T_1 \) is also applied through the resistors \( R_3 \) and \( R_4 \) to the grid of \( T_1 \). The output voltage of \( T_1 \) is applied to the grid of triode \( T_2 \).

When the output voltage of \( T_1 \) swings in the positive direction, the plate current of \( T_2 \) increases. This action increases the voltage drop across the plate resistor \( R_3 \) and sways the plate of \( T_1 \) 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° out of phase with the output voltage of \( T_1 \).

In order to obtain equal voltages at \( E_1 \) and \( E_2 \), \((R_3 + R_4)/R_5 \) should equal the voltage gain of \( T_2 \). Under the conditions where a twin-type tube or two tubes having the same characteristics are used at \( T_1 \) and \( T_2 \), \( R_3 \) should be equal to the sum of \( R_3 \) and \( R_4 \). The ratio of \( R_3 + R_4 \) to \( R_3 \) should be the same as the voltage gain ratio of \( T_2 \), in order to apply the correct value of signal voltage to \( T_2 \). The value of \( R_3 \) is, therefore, equal to \( R_5 \) divided by the voltage gain of \( T_2 \). \( R_3 \) is equal to \( R_5 \) minus \( R_4 \). Values of \( R_3 \), \( R_4 \), \( R_5 \) plus \( R_4 \), and \( R_5 \) may be taken from the chart in the RESISTANCE-COUPLED AMPLIFIER SECTION. In the practical application of this circuit, it is convenient to use a twin-triode tube combining \( T_1 \) and \( T_2 \).

**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. 35. 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-microfarad capacitor serves as a bypass for the 5-megohm resistor, and the combined impedance of the resistor-capacitor network is lowered. Thus, more values for the components, it may be made to respond to changes in the \( R_5 \) potentiometer setting for only low frequencies (below 1000 cycles).

**Fig. 39** 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. 35. In the treble “cut” circuit, the parallel RC elements serve to attenuate the signal voltage further because the capacitor bypasses the resistance across the output.

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 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 resistance-capacitance 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 over-all gain of a well-designed tone-control network should be approximately unity.

**Fig. 39** 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. 35. In the treble “cut” circuit, the parallel RC elements serve to attenuate the signal voltage further because the capacitor bypasses the resistance across the output.

**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 non-uniform 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 CIRCUIT 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 phono graph pickup, on the other hand, usually has an essentially flat frequency-response 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 recorders 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 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 gridNo.1 resistor and capacitor bias with plate and grid-No.2 voltages which are low compared with customary if-amplifier operating conditions. 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 system, 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 RF Amplifiers

In a radio or television receiver, noise generated in the first amplifier stage is often the controlling factor in determining the overall sensitivity of the receiver. The "front end" of a receiver, therefore, 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 circuit. 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 is a factor in 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 inevitably 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/No) divided by the ratio of signal power to noise power at the output (S/No), as follows:

$$\text{NF} = \frac{S/\text{No}}{S/\text{No}_0}$$

The noise figure in decibels is equal to ten times the logarithm of this power ratio. For example, an amplifier having a one-db noise figure 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 100.

Tuner input circuits of vhf television receivers may use either a triode or a pentode in the rf amplifier stage. Such stages are required to amplify signals ranging from 55 to 216 Mc, although the tuner is usually adjusted for a bandwidth of 6 Mc to assure complete coverage of the band. In the early rf tuners, pentodes rather than triodes were used because the grid-plate capacitance of triodes created stability problems. 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 sensitivity of triodes because of the "parasitic noise" introduced by the screen grid. The direct-coupled cathode-drive circuit offers good gain and the stability capabilities of the pentode and a low-noise triode input stage. Because the cathode-drive stage provides a low-impedance load to the grounded-cathode stage, its gain 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 has made possible the design of a neutralized triode rf circuit. The 6BN4 has been used commercially in neutralized triode circuits. Tubes such as the 6K8 and 5CW4, now in common usage, were specially designed to minimize grid-plate capacitance to permit easier neutralization of a grounded-cathode circuit over the wide frequency band. The bridge-neutralized rf amplifier circuit has become 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 arrangement provides excellent gain and noise performance with stable operation across the band.

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, 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, \( g_m \), to the sum of its input and output capacitances, \( C_{in} \) and \( C_{out} \), as follows:

\[
\text{Figure of Merit} = \frac{g_m}{C_{in} + C_{out}}
\]

Typical values for this figure are in the order of \( 500 \times 10^6 \) or greater.

A typical video amplifier stage, such as that shown in Fig. 40, is connected between the second detector of the television receiver and the picture tube. The contrast control, \( R_c \), in this circuit controls the gain of the video amplifier tube. The inductance, \( L_n \), in series with the load resistor, \( R_p \), maintains the plate load impedance at a relatively constant value with increasing frequency. The inductance \( L_t \) 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, \( C_{lp} \), is used to improve the low-frequency response. Tubes used as video amplifiers include types 6CL6 and 12BY7A, or the pentode sections of types 6AW8 and 6AN8.

The luminance amplifier in a color-television receiver is a conventional video amplifier having a bandwidth of approximately 3.5 Mc. 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 Mc is fed to a bandpass amplifier, as shown in the block diagram in Fig. 41. The color synchronizing signal, or "burst," contained in the 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 keyer tube is applied to the burst amplifier tube and the signal is then fed to the 3.5-Mc 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-and-white broadcasts. A threshold control varies the bias and controls the burst level at which the killer stage operates.

The output of the 3.5-Mc oscillator and the output of the bandpass amplifier are fed into phase and amplitude modulator circuits. The output of each modulator 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. 42. In this circuit, the time constant of the network is long with respect to the interval between pulses. During each pulse, the grid is driven positive and draws current, thereby charging capacitor \( C_t \). Consequently, the grid develops a bias which is slightly greater 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.

**Electron Tube Applications**

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 age circuits by gating or by a combination of gating, inversion, and cancellation. An example of the latter method is shown in Fig. 43. In this circuit the 6GY6, which has two independent control grids, serves the dual function of age 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 extending above the tip level will appear inverted across the grid-No.2 load resistor \( R \). This inverted noise signal is recombined with the video signal and
A half-wave rectifier and a full-wave rectifier circuit are shown in Fig. 45. 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 CIRCUIT 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 allowable 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 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.
With the full-wave voltage-doubler circuit in Fig. 47, 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 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. 47 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 full-wave 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. 48. 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 half-cycles 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. 49. The action of this circuit when a modulated rf wave is applied is illustrated by Fig. 50. 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 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 voltage and reproduces the af modulation.

The curve for voltage across the capacitor, as drawn in Fig. 50, 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 give 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 ac 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. 51. Both diodes are connected together. R, 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. In a typical circuit, resistor R may be tapped so that five-sixths of the total af voltage across R 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 and the audio bypass resistor C. The function of capacitor C is to block the dc bias of the cathode from the grid. The function of capacitor C is to bypass and 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. 52. In this circuit, the triode grid 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. 52 over the self-bias arrangement shown in Fig. 51 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 for different signal strengths and the triode will produce distortion. Because there is no bias applied to the diode-biased 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 zero-bias 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 6B6 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. 53. 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 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 lower the selectivity of the input circuit.

The grid - resistor - and - capacitor method, illustrated by Fig. 54, 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 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 lowers the selectivity of the input circuit.

**FM Detection**

The effect of frequency modulation on the waveform of the rf wave is shown in Fig. 55. 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 rf 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 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. 56. 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.

The faults of the simple circuit are overcome in a push-pull arrangement, sometimes called a discriminator circuit, such as that shown in Fig. 57. Because of the phase relationships between 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 C1), the rf voltages applied to the diodes become unequal as the rf signal swings from the resonant frequency in each direction.

Since the swing occurs at audio frequencies (determined by the af modulation), the voltage developed across the diode load resistors, R1 and R2, connected in series, varies at audio frequencies. The output voltage depends on the difference in amplitude of the voltages developed across R1 and R2. 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 indicated in Fig. 58.

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.)

The rectified voltage across $C_4$ is proportional to the voltage across diode 1, and the rectified voltage across $C_6$ is proportional to the voltage across diode 2. Since the voltages across the two diodes differ according to the instantaneous frequency of the carrier, the voltages across $C_4$ and $C_6$ differ proportionately, the voltage across $C_4$ being the larger of the two voltages at carrier frequencies below the intermediate frequency and the smaller at frequencies above the intermediate frequency.

These voltages across $C_4$ and $C_6$ are additive and their sum is fixed by the constant voltage across $C_4$. Therefore, while the ratio of these voltages varies at an audio rate, their sum is always constant. The voltage across $C_4$ 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 CIRCUIT SECTION.

Automatic Volume or Gain Control

The chief purposes of automatic volume control (avc) or automatic gain control (agc) in a radio or television receiver are 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.

Because of the flow of diode current through $R_n$, there is a voltage drop across $R_n$ which makes the left end of $R_n$ negative with respect to ground. This voltage drop across $R_n$ is applied, through the filter $R_a$ and $C_a$ 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 $R_n$ 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 decreases, 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, $C_a$ and $R_n$, prevents the avc voltage from varying at audio frequency. The filter is necessary because the voltage drop across $R_n$ varies with the modulation of the carrier being received. If avc voltage were taken directly from $R_n$ 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 $C_a$. Because of the resistance $R_n$ in series with $C_a$, the capacitor $C_a$ can change 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 CIRCUIT SECTION.

In the circuit shown in Fig. 60, a certain amount of ave negative bias is applied to the preceding stages on a weak signal. Since 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 dave circuits.

A dave circuit is shown in Fig. 61. In this circuit, the diode section $D_i$ of the 616 acts as detector and avc diode.

$R_1$ is the diode load resistor and $R_2$ and $C_1$ are the dave filter. Because the cathode of diode $D_1$ is returned through a fixed supply of 3 volts to the cathode of $D_1$, a dc current flows through $R_1$ and $R_2$ in series with $D_1$. The voltage drop caused by this current places the avc lead at approximately 3 volts (less the negligible drop through $D_1$). When the average
amplitude of the rectified signal developed across R, does not exceed 3 volts, the a.v.c. lead remains at 3 volts. Hence, for signals not strong enough to develop 3 volts across R, the bias applied to the controlled tubes is constant at a value giving high sensitivity.

However, when the average amplitude of rectified signal voltage across R exceeds 3 volts, the plate of diode D, becomes more negative than the cathode of D and current flow in diode D causes the potential of the a.v.c. lead to be more negative. Therefore, with increase in signal strength, the a.v.c. circuit applies an increasing a.v.c. 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. 61 that a portion of the –3 volt delay voltage is applied to the plate of the detector diode D, this portion being approximately equal to R/V (R + R) 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 r.f. picture carrier amplitude. The peak carrier level rather than the average carrier level is controlled by the age 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. 62, consists of a diode 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 circuit receives the incoming signal from the last if stage of the television receiver through the capacitor C, The resistor R, 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, where the negative charge is stored. Because of the low impedance offered by the diode during conduction, C, charges up to the value of the peak applied voltage.

During the negative excursion of the signal, the diode does not conduct, and C, discharges through resistor R, Because of the large time constant of the C, however, only a small percentage of the voltage across C, is lost during the interval between horizontal sync pulses. During succeeding positive cycles, the incoming signal must overcome the negative charge stored in C, before the diode conducts, and plate current flows only at the peak of each positive cycle. The voltage across C, therefore, is determined by the level of the peaks of the positive cycles, or the sync pulses. The negative voltage developed across resistor R, by the sync pulses is filtered by resistor R, and capacitor C, 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 age system may be expanded to include amplification of the age 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" age system such as that shown in Fig. 63 is used to eliminate flutter and to improve noise immunity in weak signal areas. This system provides more rapid action than the conventional age circuits because the filter circuit can employ lower capacitance and resistance values.

In the keyed age 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 age amplifier. The video stage increases the gain of the age channel and, in addition, 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 than that of the cathode, 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° to 0° as the control electrode is raised or lowered.

In the application of the electron-ray 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. 65. The flow of the triode plate current through resistor R, produces a voltage drop which determines the potential of the control electrode. When the voltage of the triode grid changes in the positive direction, plate current increases, and 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 6A6FG. This tube contains only an indicator unit but employs two ray-cont...
may be obtained by connecting the two ray-control electrodes together, or, two unlike patterns may be obtained by individual connection of each ray-control electrode to its respective amplifier.

In radio receivers, a-c voltage is applied to the grid of the dc amplifier. Because a-c 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.

The choice between electron-ray tubes depends on the a-c characteristic of the receiver. The 6E5 contains a sharp-cutoff triode which closes the shadow angle on a comparatively low value of a-c voltage. The 6AS5/6N5 and 6U5 each have a remote-cutoff triode which closes the shadow on a larger value of a-c voltage than the 6E5. The 6AP6G 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 present-day radio broadcast receivers, this application is limited practically to superheterodyne receivers for supplying the heterodyning frequency. Several circuits (represented in Figs. 67 and 68) 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.

**Multivibrators**

Relaxation oscillators, which are widely used in present-day electronic equipment, are used to produce nonsinusoidal waveforms 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. 69 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 $V_1$, then decreases, causing $V_2$ to conduct less and less. At the same time, the plate voltage of $V_1$ begins to rise, causing $V_1$ to conduct more heavily. Because of the amplification, this cumulative effect builds up extremely fast, and conduction switches from $V_2$ to $V_1$ within a few microseconds, depending on the circuit components.

In this circuit, therefore, conduction switches from $V_2$ to $V_1$ 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 $V_2$ through a similar process to complete the cycle. The plate waveform is essentially rectangular in shape, and may be adjusted as to symmetry and 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 pulses of a given amplitude and frequency to provide a frequency-stabilized output. Multivibrator circuits may also be designed so that they are not free-running, but must be triggered externally to start conduction from one tube to the other. Depending on the type of circuit, conduction may shift from 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. 70. 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 that properly locked-in horizontal scanning results.

The triode $V_3$ in Fig. 70 is a conventional blocking oscillator which enables a sawtooth voltage to be developed across the capacitor $C_3$. A portion of this sawtooth is fed back to the grid of the control tube $V_1$. The positive pulse in $V_3$ are also applied to the grid of $V_1$. The waveforms shown in Fig. 71 illustrate the sawtooth and sync pulses $A$ and $B$ and their proper "in-sync" combination $C$. The sync pulse occurs partly during the period of the sawtooth voltage in which the triode $V_1$ 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 oscillator-tube grid by changing the voltage to which the capacitor $C_3$ in the cathode circuit may charge. An increase in the positive bias increases the frequency of oscillation.

For example, waveform $D$ in Fig. 71 illustrates a condition in which the sawtooth voltage is advanced in phase 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 $C_3$ to charge to a higher voltage. This increased reference voltage also appears in the grid circuit of $V_3$, 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 \( V_{10} \) is brought out of cutoff very sharply. This effect is obtained by sine-wave stabilization. The tuned circuit \( L_{1}C_{1} \) in the plate circuit of Fig. 70 superimposes a shock-excited sine wave on the plate and grid waveforms, as shown in Fig. 72.

**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-oscillator-output stage is shown in Fig. 73. Waveforms 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 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 \( R_{2} \) and the RC combination \( R_{3}C_{1} \), as explained previously in the section on multivibrators. The desired trapezoidal waveshape at the grid of \( V_{1} \) is created by capacitor \( C_{1} \) and resistor \( R_{2} \) if \( R_{2} \) were equal to zero, \( C_{1} \) would cause the grid-voltage waveshape to take the form shown in Fig. 74(a). When \( R_{2} \) is sufficiently large, \( C_{1} \) does not discharge completely when \( V_{1} \) conducts. When \( V_{1} \) is cut off, therefore, the voltage on the grid of \( V_{1} \) immediately rises to the voltage across \( C_{1} \). The resulting waveshape is shown in Fig. 74(b). The negative-going pulse of the grid-voltage waveshape prevents the high plate pulse from causing excessive conduction, and thereby prevents over damping.

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. 75 shows a typical horizontal-output-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 the ultor 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 6DQ6B, 5C6GA, or 6G6W.

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 autotransformer 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 Kc in the output circuit, which may be considered as an 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 yoke 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 winding 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. 76. In this...
circuit, the cathode is held at a fixed positive potential with respect to ground. Because thegrid potential is kept slightly less positive by the valve, the grid voltage across resistor $R_g$, the tube operates in the negative grid region and no grid current is drawn.

When the output voltage, $v_o$, 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 $R_2$ and $R_3$. This increases the grid voltage, causing 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, $R_3$, 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 control of the output-voltage level.

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 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 schematically in Fig. 77, 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.

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 $f_i$. 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 frequency 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 fixed frequency and the oscillator frequency. These variations in plate current produce across the tuned plate circuit a voltage at the desired intermediate frequency. The methods differ in the types of tubes employed and in the means of input voltage to the mixer tube.

A method widely used before the availability of tubes especially designed for frequency-conversion service and grid voltage in many P.M. television, and standard broadcast receivers, employs a mixer tube either a triode, a tetrode, or a pentode, in which oscillator voltage and signal voltage are applied to the control grid. In this method, coupling 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 complete cathode which supplies to the rest of the tube an electron stream that varies with the oscillator frequency.**

This varying electron stream is further controlled by the rf voltage on grid No. 4. Thus, the plate current and signal frequency 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 grid. 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 net effect of the rf signal on the signal grid produces little effect on the cathode current. There is, therefore, little detuning of the oscillator by ac bias because changes in ac 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 paragraphs are the single-ended types 1R5 and 6BE6. A schematic diagram illustrating the use of the 6BE6 with self-excitation is given in Fig. 78; the 6BE6 may also be used with separate excitation. A complete circuit is shown in the CIRCUIT SECTION.

Another method of frequency conversion utilizes a separate oscillator having its grid connected to the No. 1 grid of a mixer tube. The cathode, hexode mixer grid (grid No. 1), hexode screen 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 currently used hexode grid No. 2. The tube is not critical to changes in oscillator plate 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 9 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 ac voltage. The oscillator voltage is applied to grid No. 3. This grid has a sharp-cutoff characteristic and produces a comparatively large change in 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. 79. In such circuits, the oscillator voltage is applied to the mixer grid by inductive coupling, capacitive coupling, or a combination of the two.

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° 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 effective reactance and, consequently, the 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 afg circuit is shown in Fig. 81. 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 afg circuit at a given moment.

The horizontal sync pulses obtained from the separate circuits 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 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 horizontal sync pulses from affecting 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 Circuit 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 lower temperature 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 supply may be a direct-current source (a battery or a dc 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 voltage-dropping 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 subminatures are operated from a single 1.5-volt flashlight-type dry-cell, when the 2.0-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, the ac-cells-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 arrangement, 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. Whenever this is done, the excess input voltage will cause proportionate 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 series-resistor or booster-transformer method of controlling line voltage is seldom required.

In the case of the series arrangement 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, the tubes will operate at their rated heater or filament current. The method for calculating the resistance 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 string filament it is necessary to add all filament current sections in series for sufficient resistance across each filament section to bypass that 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 (in ohms) =

\[
\text{supply voltage} - \text{total rated volts of tubes} / \text{rated amperes of tubes}
\]

Thus, if a receiver having one 6BE6, one 6BQ6, one 6AT6, one 256GT, and one 2528GT 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 the 6.3 volts x 25 volts) divided by 0.3 amperes (rating of these tubes), or approximately 160 ohms. The wattage dissipation in the resistor will be 117 volts minus 68.9 volts x 0.3 amperes, 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
The balanced arrangement described above also minimizes heater-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 de 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 receiving-tube practice as "zero-bias operation."

In any case, the object is to make the grid voltage equal to the negative end of the resistance. The value of the resistance for a cathode-biasing single tube can be determined from the following formula:

\[
\text{Resistance (ohms)} = \frac{\text{desired grid-bias voltage} \times 1000}{\text{rated cathode current in milliamperes}}
\]

Thus, the resistance required to produce 9 volt bias for a triode which operates at 3 milliamperes plate current is 9 X 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 rfc circuits the cathode resistor usually is bypassed. In af circuits the use of an un bypassed resistor will reduce distortion by introducing degeneration into the circuit. However, the use of an un bypassed 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 the beam power tubes, it may be necessary to shunt the bias resistor with a small micro capacitor (approximately 0.001 µf) in order to prevent oscillations. The usual 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 6B6G, 6CD6, and 6AC7, input capacitance and input conductance change appreciably with plate current.

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**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 midpoint of the heater supply winding, to the mid-tap 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 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.
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 22-1 and 22-4 in the CIRCUIT 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 22-1 and 22-4 in the CIRCUIT 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. 84 and 85; (2) from a bleeder circuit by means of a potentiometer as shown in Fig. 86; or (3) from a bleeder circuit in which the bleeder current is varied by a tube used for automatic volume control. The latter circuit is shown in Fig. 60.

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 resistor, or by connecting a fixed cathode resistance in series with the variable resistance used for regulation.

When receiver gain is controlled by grid-bias variation, it is advisable to have the control voltage extend over a wide range in order to minimize cross-modulation and modulation-distortion.

The grid is made more positive, as shown in Fig. 87. The value of grid voltage at which the grid-current curve intersects 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 1 ½ 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 sufficient 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.

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. 88 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 screen-grid currents does not take place with the application of the signal, the screen-grid voltage may be obtained through a series resistor from a high-voltage 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. 89 shows a pentode with its screen-
grid voltage supplied through a series resistor.

When 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 series-resistor method of obtaining screen-grid voltage should not be used. A change in screen-grid current appears as a change in the voltage drop across the series resistor, and it 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 lowers 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. 88.) 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 superhetronyed 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 cathode 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 high-frequency stages, it is necessary to shield separately each tube in high-frequency 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 voltage-supply circuit. Fig. 90 illustrates several forms of filter circuits. Capacitor C 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 power-supply 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. 91.

The CIRCUIT 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 instance...
taneous 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 input-choke method is used, the available dc output voltage will be somewhat lower than with the input-choke 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 60-cycle supply line, etc.). It is usually caused by the formation of a static 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. 92.) 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.

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 dc 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-and-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. 93. Examples of transformers for push-pull stages are shown in several of the circuits given in the CIRCUIT SECTION.

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 connected 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 1 1/4 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 power-supply 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 heater-supply transformer on or near the amplifier unit. If such a transformer is installed on or near a preamplifier for a magnetic-tape pick-
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 ultraviolet cavity of all-glass picture tubes. This film may prevent sparking to take place over the glass surface to the external conducting coating or to the metal shield. Since sparking may introduce noise into the receiver, sparking should be prevented. In some cases, 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 ultraviolet cavity of all-glass 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 Drift, then rinsed with clean water, and immediately dried.

Corona Considerations. A high-voltage 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 high-voltage 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 prevent 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 yoke 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 ultraviolet cavity 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.

The tube data given in the following TUBE TYPES SECTION include ratings, typical operation values, characteristics, and characteristic curves.

The values for grid-bias voltages, other electrode voltages, and electrode supplies 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 unipolar 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 electronics industry. The oldest is now the Absolute Maximum system, the next as the Design Center system, and the latest and newest is the Design Maximum system. Definitions of these systems have been formulated by the Joint Electron Tube Engineering Council (JETEC)* 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. Unless specified otherwise, ratings given in the TUBE TYPES SECTION are based on the Design Center System.

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 voltages 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. 94. The heater is placed in series with a

*Now Identified as the Joint Electron Device Engineering Council (JEDEC).
resistance having a value 3 times the nominal heater operating resistance \((R = 3 \, E_t/L)\), and a voltage having a value 4 times the rated heater voltage \((V = 4 \, E_t)\) is then applied. The warm-up time is determined when \(E = 0.8 \, E_t\).

**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 tetodes and pentodes, the power dissipated in the screen-grid 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. 95. (This curve cannot be assumed to apply to types other than those for which it is specified in the data section.) Full rated screen-grid input is permissible at 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 voltage-dropping 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:

\[ R_{d} \geq \frac{E_{m} (E_{g} + E_{C})}{E_{C}} \]

where \(R_{d}\) is the minimum value for the voltage-dropping resistor in ohms, \(E_{m}\) is the selected screen-grid voltage in volts, \(E_{g}\) is the screen-grid supply voltage in volts, and \(E_{C}\) is the screen-grid input in watts corresponding to \(E_{m}\).

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. 96 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 \((G = I_{0}/E)\) of several diodes. Pervance can be considered a figure of merit for diodes; high-pervance units have lower voltage drop at a fixed current level.

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 pervance 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 6U4GB has a tube voltage drop (per plate) of 44 volts at a plate current of 225 milliamperes.
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 gas-filled tubes, it is the safe top value to prevent arc-back in the tube operating within the specified temperature range. Referring to Fig. 97, 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 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 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 peak-indicating electronic voltmeter is useful in determining the actual peak inverse voltage.

In single-phase, half-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 voltage 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 dc 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 a 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 lines 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 TUBE TYPES 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.

**Inter-electrode 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 shown in Fig. 98. 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 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 screen-grid 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 S1. The circuit can also be made more or less sensitive to heater-grid hum by increasing or decreasing the grid resistance Rg. 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 38 principal types of application, as listed below.

Tube types are grouped by structure under each classification; they are also keyed to indicate miniature, octal, nuvisor, and novar types. Triodes are designated as low-, medium-, or high-μ 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 88.

### APPLICATIONS:

1. Audio-Frequency Amplifiers
2. Automatic Gain Control (AGC and AVC) Circuits
3. Burst Amplifiers
4. Cathode-Drive RF Amplifiers (Grounded-Grid)
5. Color Killers
6. Color Matrixing Circuits
7. Complex-Wave Generators
8. Converters
9. Dampers
10. Demodulators (Color TV)
11. Detectors
12. DC Restorers
13. Discriminators
14. Frequency Dividers
15. FM Detectors
16. Gated Noise, AGC, and Sync Amplifiers
17. Harmonic Generators
18. Horizontal-Deflection Circuits
19. Intermediate-Frequency Amplifiers
20. Limiters
21. Mixers—RF
22. Mixer-Oscillators—RF
23. Multivibrators
24. Noise Inverters
25. Oscillators
26. Phase Inverters
27. Phase Splitters
28. Radio-Frequency Amplifiers
29. Reactance Circuits
30. Rectifiers
31. Regulators
32. Relay Control Circuits
33. Sync Amplifiers
34. Sync Clippers
35. Sync Separators
36. Tuning Indicators
37. Vertical-Deflection Circuits
38. Video Amplifiers

### 1. AUDIO-FREQUENCY AMPLIFIERS

**Voltage Amplifiers**

<table>
<thead>
<tr>
<th>High-Mu Triode</th>
<th>High-Mu Triode with Twin Diode</th>
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<tbody>
<tr>
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<td>6AV6 *6CT7 *12SQ7</td>
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<th>High-Mu Triode with Triple Diode</th>
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<tr>
<td>7199 †</td>
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<tr>
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<th>High-Mu Twin Triode</th>
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<tr>
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<td>6EU7 † *12AZ7</td>
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<tr>
<td>560 *7AU7 *12SN7GA</td>
<td>6EU7 † *12AZ7</td>
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*Miniature*  *Octal*  *Nuvisor*  *Novar*  For high-fidelity equipment.
15. FM DETECTORS  
(See 13. DISCRIMINATORS)

16. GATED NOISE, AGC, AND  
SYNC AMPLIFIERS

High-Mu Triode—Sharp-Cutoff Pentode  
* 6KA8  * 6KAB  
* 5858A  * 8ABWA  * 10HFB  
* 6984  89G68  11KUB  
* 6JY8

Sharp-Cutoff Pentode  
* 5A6U  5EF6  6D6  
* 3C85  6AK7  6D6  
* 3C8B  6AC7  6D6  
* 3C8F  6AG3  6D7  
* 3DB6  6AH6  6E6  
* 3J6  6AK5  6H6  
* 3J6D*  6AH6  6J6  
* 4A6U  6A6A  6J6  
* 4A6B  6B6  12A6U  
* 4E6W  6B6  12A6W  
* 4J6D*  6C8F  19H6

Sharp-Cutoff Pentode with Diode  
* 5AM8  6A6BA  6KL8  
* 5AS8  6AS8  12K18

Semiremote-Cutoff Pentode  
* 3BZ6  6EH7  6H6  
* 4B26  6GM6  12B26  
* 5GM6  6HR6  19H6  
* 6BZ6

Remote-Cutoff Pentode  
* 6B6  12A6U  12B6U  12FW6  
* 6K7  12SK7  18FW6A

Remote-Cutoff Pentode with Diode  
* 6Q7  12EQ7  20EQ7

20. LIMITERS

Beam Tube  
* 3BN6  * 4BN6  * 6BN6

Sharp-Cutoff Pentode  
* 3A6U  6C6X6  6C6X6  12A6U  
* 4A8*  6AS6  6B7t  
* 5G6  6BST6  19H6

Sharp-Cutoff Pentode with Diode  
* 6K18  12K18

21. MIXERS—RF

Medium-Mu Triode Twin  
* 5J6  * 12A7  * 19J6

High-Mu Triode  
* 2CW4  * 6AB4  6CW4

22. MIXER-Oscillators—RF

Medium-Mu Triode—Sharp-Cutoff Tetrode  
* 3CL8A  * 6CL8A  * 6CQ8

17. HARMONIC GENERATORS  
(See 7. COMPLEX-WAVE GENERATORS)

18. HORIZONTAL-DEFLECTION  
CIRCUITS

Oscillators  
Medium-Mu Triode—Sharp-Cutoff Pentode  
* 5C14*  6CHB  6CHR8

Medium-Mu Twin Triode  
* 6LC7  6HC7  12A7  
* 6Q7  12BHTA  
* 6S77CTB  9A7U  12S7N  
* 7A7U  GTA

Amplifiers  
Beam Power Tube  
* 6AUSGT  6C6  17B6  
* 6A5G6  6GB6  17B6  
* 6B6GA  17B6  17C6  
* 6B6G6/7  17C6  17C6  
* 6CBGA  12C6U  17C7  
* 6CD6S  12DQ6A  17B6  
* 6DN6  12DQ6B  22J6  
* 6DQ5  25AS95  
* 6DQ5A  12CT  25R6  
* 6EX6  12GW6  12GUC  
* 6CJS  12J6B  25C6DB  
* 6CT8  25D6N

19. INTERMEDIATE-FREQUENCY  
AMPLIFIERS

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

Medium-Mu Triode—Sharp-Cutoff Pentode  
* 5AN  6A28  6C6U  
* 6AAN4  6BB8  6C8X  
* 6AAM4  6CHB  6C8X

26. PHASE INVERTERS

Medium-Mu Triode—High-Mu Triode  
* 12A7  * 12A7A

Medium-Mu Triode  
* 6M7  7A7U  12S7N  
* 6C6U  9A7U  GTA  
* 6S77CTB  12A7A

High Mu Triode—Sharp-Cutoff Pentode  
* 6A6B  6AB8  6G8N  
* 6G8N  6H8A  10HFB

High-Mu Triode Twin  
* 6J7  12A7A  12DT8

23. MULTIVIBRATORS

Medium-Mu Triode—Sharp-Cutoff Pentode  
* 5CHB  6CHR8  6CBB4

Medium-Mu Twin Triode  
* 6GC7  7A7U  12S7N  
* 6G7U  9A7U  GTA  
* 6S77CTB  12A7A

24. NOISE INVERTERS

High-Mu Triode—Sharp-Cutoff Pentode  
* 6K8  6K8  

Sharp-Cutoff Pentode  
* 6LY6*  6LY6*  

Radio Oscillators—UHF  
Medium-Mu Triode  
* 2AF4  3AF4A  6AF4  
* 2DV4  3DV4  6DV4

25. OSCILLATORS  
Radio Frequency—VHF

Medium-Mu Triode  
* 5J6  * 12A7  * 19J6

High-Mu Triode  
* 6AB4

Power Triode  
* 6C6 (Class C)

Low Frequency, Sweep Type  
Medium-Mu Triode—Sharp-Cutoff Pentode  
* 5AB4  5AB4A  6AB4A  
* 6AB4  6B7B  6CB8  
* 6F8  6FB7A  12A7  
* 6FB7  6F8  19J6

28. RADIO-FREQUENCY  
AMPLIFIERS

Medium-Mu Triode  
* 2BN4  6BC4  6BN4  

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

Medium-Mu Triode  
* 3BB8  5J6  6B7Z  
* 3BB7  6B8  6C6U  
* 3BB8  6BB8  6C6U  
* 3BB8  6BB8  12A7  

Medium-Mu Triode Twin  
* 6A6B  6AB4  6F95  
* 2CW4  6AB4  6F95A

High Mu Triode Twin  
* 6B7B  12A7A  12DT8

High Mu Triode Twin  
* 6B7B  12A7A  12DT8

* Miniature  * Octal  * Navigator  * Noval  
* Dual-control grids  * Approaches semiremote-cutoff characteristics used in first of amplifier applications.
30. RECTIFIERS

Power-Supply Types—Vacuum

High-Voltage Types (For rf-rectifier or pulsed low-current applications)—Vacuum

Half-Wave (Diode)

- 6M2
- 6G3
- 6BQ5
- 6BQ6
- 6BQ7
- 6BQ8
- 6548
- 6548B
- 6548C
- 6548D
- 6548A
- 6548B

31. REGULATORS

High-Voltage, Low Current

Sharp-Cutoff Beam Triode
- 6J9

32. RELAY CONTROL CIRCUITS

Medium-Mu Twin Triode
- 12GFV
- 12GFP

High-Mu Twin Triode
- 6GFY

33. SYNC AMPLIFIERS

Medium-Mu Triode—Sharp-Cutoff Pentode
- 6AQ8A
- 6CX8
- 8CX8

Medium-Mu Triode—Sharp-Cutoff Pentode
- 6AQ8A
- 6CX8
- 8CX8

34. SYNC CLIPPERS

Medium-Mu Triode—Sharp-Cutoff Tetrode
- 5C86
- 6CQ6

Medium-Mu Triode—Sharp-Cutoff Pentode
- 6AQ8A
- 6CX8
- 8CX8

5. VERTICAL-DEFLECTION CIRCUITS

Oscillators and Amplifiers (Combined)

Medium-Mu Triode—Low-Mu Triode
- 6DE7
- 7DE7
- 6E9

Beam Power Tube
- 6BQ5

Power Tube
- 6BQ5

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 data on current types, as well as information on those RCA discontinued types in which there may still be some interest. Unless otherwise specified, the ratings given are based on the Design Center system. Information on picture tubes is shown at the end of this section.

In choosing tube types for the design of new electronic equipment, the designer should refer to the APPLICATION GUIDE FOR RCA RECEIVING TUBES on pages 75 to 81.

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

**DIODE**

Miniature type used as detector tube in portable FM receivers and in portable high-frequency measuring equipment. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater volts (ac/ dc), 1.4; amperes, 0.15. Maximum ratings for half-wave rectifier service: peak inverse plate volts, 330 max; peak plate ma, 5 max; dc output ma, 0.5 max; peak heater-cathode volts, 140 max. This type is used principally for renewal purposes.

**REMOTE-CUTOFF PENTODE**

Glass type used in battery-operated receivers as rf or if amplifier. This type is similar electrically to type 1D6-GP. Outline 24B, OUTLINES SECTION. Tube requires four-contact socket. Filament volts (dc), 2.0; amperes, 0.06. Type 1A4-P is a DISCONTINUED type listed for reference only.

**POWER PENTODE**

Glass octal type used in output stage of battery-operated receivers. Outline 14C, OUTLINES SECTION. This type may be supplied with pin No.1 omitted. Tube requires octal socket and may be mounted in any position. For filament considerations, refer to type 1U4. Filament volts (dc), 1.4; amperes, 0.05. Typical operation as class A; amplifier: plate and grid-No.2 volts, 90 (110 max); grid-No.1 volts, 4.5; peak if grid-

No.1 volts, 4.5; plate ma, 4.0; grid-No.2 ma, 1.1; plate resistance (approx.), 0.2 megohm; transconductance, 450 microamp; load resistance, 25000 ohms; power output, 116 milliwatts. Type 1A5-GT is used principally for renewal purposes.

Structure of a Miniature Tube
**PENTAGRID CONVERTER**

Glass type used in battery-operated receivers. This type is identical electrically with type 1D6-G, except for interelectrode capacitances. Outline 248, OUTLINES SECTION. Tube requires six-contact socket. Filament volts (dc), 240; anode volts, 0.06. Type 1A6 is a DISCONTINUED type listed for reference only.

**PENTAGRID CONVERTER**

Glass octal type used in superheterodyne circuits having battery power supplies. Outline 16A, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Filament volts (dc), 1.4; anodes, 0.06. Typical operation as converter; plate and grid-No.2 volts, 90 (110 max); grids No.1 and No.3 supply volts, 110 volts grid-No.3 and No.6 volts, 48 (60 max); grid-No.4 volts, 0; grid-No.1 resistor, 0.2 megohm; plate resistance (approx.) 0.6 megohm; plate ma., 16; grids No.3 and No.5 ma., 0.7; grid-No.2 ma. 12; grid-No.1 ma., 0.63; total cathode ma., 2.5 (4 max); conversion transconductance, 250 amhos. This type is used principally for replacement purposes.

**POWER PENTODE**

Subminiature type used in output stage of small, compact, battery-operated receivers for the standard AM broadcast band. Maximum dimensions: over-all height, 1.75 inches; seated height, 1.5 inches; diameter, 0.4 inch. Tube requires subminiature eight-contact socket. Filament volts (dc), 1.25; anodes, 0.04. Filament voltage should never exceed 1.6 volts. Typical operation as Class A amplifier; plate and grid-No.2 volts, 67.5 volts; grid-No.1 volts, 46; peak inverse grid-No.1 volts, 14 volts; zero signal grid-No.2 ma., 0.4; cathode ma., 4 ma.; plate resistance, 16.15 megohms; transconductance, 570 ohms; load resistance, 25000 ohms; total harmonic distortion, 10 per cent; maximum power output, 50 milliwatts. This is a DISCONTINUED type listed for reference only.

**HALF-WAVE VACUUM RECTIFIER**

Duodec type used to supply power to the anode of the picture tube in television receivers. Outline 16A, OUTLINES SECTION. Tube requires duodec twelve-contact socket and may be mounted in any position. Socket terminals 4 and 10 may be used as tie points for components at or near filament potential. Filament volts (ac/dc), 1.25; anodes, 0.2.

**PULSED RECTIFIER**

For operation in a 625-line, 50-frame system

**SHARP-CUTOFF PENTODE**

Subminiature type used as rf or if amplifier in stages not controlled by ac in small, compact, battery-operated receivers for the standard AM broadcast band. Maximum dimensions: over-all length, 1.75 inches; seated height, 1.5 inches; diameter, 0.4 inch. Tube requires subminiature eight-contact socket. Filament volts (dc), 1.25; anodes, 0.04. Filament voltage should never exceed 1.6 volts. Characteristics as class A; amplifier plate and grid-No.2 volts, 67.5 volts; grid-No.1 volts, 0; plate resistance, 0.7 megohms; transconductance, 750 ohms; total cathode ma., 4 ma.; plate ma., 1.6; grid-No.2 ma., 0.7. This is a DISCONTINUED type listed for reference only.

**HALF-WAVE VACUUM RECTIFIER**

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

**FILAMENT VOLTAGE (AC/DC)……………………………………1.25 volts**

**FILAMENT CURRENT……………………………………0.2 amperes**

**DIRECT INTERELECTRODE CAPACITANCE (Approx.)……………………………………1.3 pf**

* 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 625-line, 50-frame system

**Maximum Ratings, (Design-Maximum Values):**

**PEAK INVERSE PLATE VOLTAGE**……………………………………26000 volts**

**PEAK PLATE CURRENT**……………………………………50 ma.**

**AVERAGE PLATE CURRENT**……………………………………0.6 ma.**

**Characteristics, Instantaneous Value:**

<table>
<thead>
<tr>
<th>Tube Voltage Drop for plate current of 1 ma.</th>
<th>100 volts</th>
<th>100 volts</th>
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<tbody>
<tr>
<td>RADIO-FREQUENCY RECTIFIER</td>
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</table>

**Maximum Ratings, (Design-Maximum Values):**

**PEAK INVERSE PLATE VOLTAGE**……………………………………33000 volts**

**PEAK PLATE CURRENT**……………………………………50 ma.**

**AVERAGE PLATE CURRENT**……………………………………0.6 ma.**

**FREQUENCY RANGE OF SUPPLY VOLTAGE**……………………………………1.5 to 100 Ke**

* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 625-line, 50-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

* The dc component must not exceed 2200 volts.

**INSTALLATION AND APPLICATION**

Type 1B3-GT requires an octal socket and may be mounted in any position. Plate connection is 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 16D, OUTLINES SECTION.
The high voltages at which the 1B3-GT 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, whether 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 1B3-GT 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.

**SHARP-CUTOFF PENTODE**

1B4P

Glass octal type used as rf amplifier or detector in battery-operated receivers. Outline 24B, OUTLINES SECTION. This tube requires four-contact socket. For typical operating conditions and maximum ratings as a class A amplifier, refer to type 1B5-GT. Filament volts (dc), 2.0; amperes, 0.06. Type 1B4-P is a DISCONTINUED type listed for reference only.

**TWIN DIODE—MEDIUM-MU TRIODE**

1B5/2SS

Glass tube used as combined detector, amplifier, and grid tube in battery-operated receivers. Maximum dimensions: overall length, 4.2/16 inches; seated height, 3-9/16 inches; diameter, 1-9/16 inches. Tube requires six-contact socket. Filament volts (dc), 2.0; amperes, 0.06. Typical operation as class A amplifier: plate volts, 150 ma; grid volts, -3 ma; plate ma, 0.8; plate resistance, 35,000 ohms; amplification factor, 20; transconductance, 675 µmhos. This is a DISCONTINUED type listed for reference only.

**PENTAGRID CONVERTER**

1B7GT

Glass octal type used in superheterodyne circuits having battery power supply. Outline 15A, OUTLINES SECTION. Filament volts (dc), 1.4; amperes, 0.1. This is a DISCONTINUED type listed for reference only. The 1B7-GT may be replaced by the 1A7-GT if circuit adjustment is made for lower filament current of type 1A7-GT.

**POWER PENTODE**

1C5GT

Glass octal type used in output stage of battery-operated receivers. Outline 14C, OUTLINES SECTION. This type may be supplied with pin No.1 omitted. Tube requires octal socket. Filament volts (dc), 1.4; amperes, 0.1. Typical operation as class A amplifier: plate and grid-No.2 volts, 90 (110 ma); grid-No.1 volts, -7.8; peak of grid-No.1 volts, 7.8; plate ma, 20; plate resistance (approx.), 15,000 ohms; transconductance, 1550 µmhos; load resistance, 8000 ohms; power output, 240 milliwatts. Type 1C5-GT is used principally for renewal purposes.

**PENTAGRID CONVERTER**

1C6

Glass type used in battery-operated receivers. Similar electrically to type 1C7-G except for interelectrode capacitances. Outline 24B, OUTLINES SECTION. Tube requires six-contact socket. Filament volts (dc), 2.0; amperes, 0.12. Type 1C6 is a DISCONTINUED type listed for reference only.

**PENTAGRID CONVERTER**

1C7G

Glass octal type used in battery-operated receivers. Outline 23, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.12. Typical operation as converter: plate volts, 150 ma; grid-No.3 and No.6 (screen-grid) volts, 67.0 ma; grid-No.2 (anode-grid) supply volts, 180 (applied through 20,000-ohm dropping resistor bypassed by 0.01 µf capacitor); grid-No.4 (control-grid) volts, -3; grid-No.1 (oscillator-grid) resistance, 60,000 ohms; plate ma, 1.5; grid-No.3 and No.6, 2; grid-No.2, 4; grid-No.1, 0.2. This is a DISCONTINUED type listed for reference only.

**REMOTE-CUTOFF PENTODE**

1D5GP

Glass octal type used in battery-operated receivers as rf or if amplifier. Outline 22, OUTLINES SECTION. Tube requires six-contact socket. Filament volts (dc), 2.0; amperes, 0.06. Typical operation as class A amplifier: plate volts, 150 ma; grid-No.2 (screen-grid) volts, 67.0 ma; grid-No.1 volts, -3 ma; plate ma, 2.5; grid-No.2, 0.8; plate resistance (approx.), 1.0 megohm; transconductance, 765 µmhos; transconductance at bias of -15 volts, 15.0 µmhos. This is a DISCONTINUED type listed for reference only.

**REMOTE-CUTOFF TETRODE**

1D5GT

Glass octal type used in battery-operated receivers as rf or if amplifier. Outline 23, OUTLINES SECTION. Filament volts (dc), 2.0; amperes, 0.06. This is a DISCONTINUED type listed for reference only. It is similar electrically to type 1D6-CP.

**PENTAGRID CONVERTER**

1D7G

Glass octal type used in battery-operated receivers. Outline 15A, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.06. Typical operation as converter: plate volts, grid-No.3 and No.6 volts, grid-No.2 supply volts, grid-No.4 volts, and grid-No.1 resistor are same as for type 1C7-G; plate ma, 1.3; grid-No.3 and No.6, 2; grid-No.2, 2.8; grid-No.1, 0.2. This is a DISCONTINUED type listed for reference only.

**DIODE—TRIODE—POWER PENTODE**

1D8GT

Glass octal type used in compact battery-operated receivers. Diode unit is used as detector or s-c tube, triode as first audio amplifier, and pentode as power output tube. Outline 15A, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 1.4; amperes, 0.1. Typical operation of pentode unit as class A amplifier: plate and grid-No.2 volts, 90 (110 ma); grid-No.1 volts, -9; plate ma, 5; grid-No.2 ma, 8; plate resistance (approx.), 45,000 ohms; transconductance, 575 µmhos; plate ma, 1.1. This is a DISCONTINUED type listed for reference only.
DIODE—
SEMIREMOTE-CUTOFF PENTODE

1DN5

Miniature type used in battery-operated portable radio receivers as combined A.M. detector and of voltage amplifier. Outline 78, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Filament volts (dc), 1.4; amperes, 0.05. Characteristics of pentode unit as class A; amplifier: plate grid-No.2 (screen-grid) volts, 67.5 (60 ma); grid-No.1 volts, 0; plate resistance (approx.), 0.6 megohm; transconductance, 690 amhos; plate ma., 2.1; grid-No.2 ma., 0.55. Maximum diode rating: plate ma., 0.25 ma. This type is used principally for renewal purposes.

SHARP-CUTOFF PENTODE

1E5GP

Gloss octal type used as rf amplifier or detector in battery-operated receivers. Outline 73, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.06. Characteristics as class A; amplifier: plate volts, 180 ma; grid-No.2 volts, 67.5 ma; grid-No.1 volts, -3; plate ma., 1.7; grid-No.2 ma, 0.6; plate resistance, 0.4 megohm; transconductance, 690 amhos. This is a DISCONTINUED type listed for reference only.

TWIN POWER PENTODE

1E7GT

Gloss octal type used in push-pull output stage of battery-operated receivers. Outline 14C, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.24. Typical operation as push-pull class A; amplifier: plate and grid-No.2 volts, 185 ma; grid-No.1 volts, -5.5; plate ma., 10.6; grid-No.2 ma., 2.6; output watts, 0.976. This is a DISCONTINUED type listed for reference only.

PENTAGRID CONVERTER

1E8

Subminiature type used in small, battery-operated receivers for the standard A.M. broadcast band. Maximum dimensions: over-all length, 1.76 inches; seated height, 1.5 inches; diameter, 0.4 inch. Tube requires subminiature eight-contact socket. Filament volts (dc), 1.25; amperes, 0.04. Typical operation as converter: plate volts and grid-No.2 grid-No.4 supply volts, 67.5 ma; grids-No.2 and-No.4 resistors, 2000 ohms; grid-No.3 volts, 0; grid-No.1 resistor, 0.1 megohm; plate resistance (approx.), 0.4 megohm; conversion transconductance, 150 amhos; total cathode ma., 2.6 (4 ma); plate ma., 1; grid-No.3 and-No.4 ma., 1.8; grid-No.1 ma., 70. This is a DISCONTINUED type listed for reference only.

POWER PENTODE

1F4

Gloss type used in output stage of battery-operated receivers. Outline 27, OUTLINES SECTION. Tube requires five-contact socket. Filament volts (dc), 2.0; amperes, 0.12. Type 1F4 is similar electrically to type 1F6-G. Type 1F4 is a DISCONTINUED type listed for reference only.

POWER PENTODE

1F5G

Gloss octal type used in output stage of battery-operated receivers. Outline 26, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.12. Typical operation as class A; amplifier: plate and grid-No.2 (screen-grid) volts, 185 (180 ma); grid-No.1 volts, -4.5; plate ma., 8; grid-No.2 ma., 2.4; cathode resistor, 425 ohms; output watts, 0.31. This is a DISCONTINUED type listed for reference only.

TWIN DIODE—
SHARP-CUTOFF PENTODE

1F6

Gloss octal type used as combined detector, amplifier, and arc tube in battery-operated receivers. Outline 23, OUTLINES SECTION. Tube requires six-contact socket. Filament volts (dc), 2.0; amperes, 0.06. Typical operation of pentode unit as class A; amplifier: plate volts, 150; grid-No.2 (screen-grid) volts, 67.5 ma; grid-No.1 volts, -1.5; plate ma., 2.2; grid-No.2 ma., 0.7. This is a DISCONTINUED type listed for reference only.

TWIN DIODE—
SHARP-CUTOFF PENTODE

1F7G

Gloss octal type used as combined detector, amplifier, and arc tube in battery-operated receivers. Outline 23, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.06. Similar electrically to type 1F8 except for interelectrode capacitances. Type 1F7G is a DISCONTINUED type listed for reference only.

HALF-WAVE VACUUM RECTIFIER

1G3GT / 1B3GT

Gloss octal type used in high-voltage, low-current applications such as the rectifier in a high-voltage, r-f operated power supply or as a rectifier of high-voltage pulses produced in television scanning systems. Outline 15B, OUTLINES SECTION. This type may be supplied with pins 1, 4, and/or 6 omitted. Tube requires octal socket and may be mounted in any position. Except for physical dimensions, this type is identical with gloss octal type 1B3-GT.

MEDIUM-MU TRIODE

1G4GT

Gloss octal type used in battery-operated receivers as detector or voltage amplifier. Outline 14C, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 1.4; amperes, 0.06. Typical operation and characteristics as class A; amplifier: plate volts, 90 (100 ma); grid volts, -6; plate ma., 2.3; plate resistance, 1070 ohms; amplification factor, 25; transconductance, 825 amhos. This is a DISCONTINUED type listed for reference only.

POWER PENTODE

1G5G

Gloss octal type used in output stage of battery-operated receivers. Outline 26, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.12. Typical operation as class A; amplifier: plate and grid-No.2 (screen-grid) volts, 155 ma; grid-No.1 volts, -15.5; plate ma., 9.7; output watts, 0.55. This is a DISCONTINUED type listed for reference only.
HIGH-MU TWIN POWER TRIODE

Glass octal type used in output stage of battery-operated receivers. Outline 14C, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 1.4; amperes, 0.1. Typical operation as class B amplifier; plate volts, 90 (110 max); dc grid volts, 0; peak af grid-to-grid volts, 48; effective grid-circuit impedance per unit, 2500 ohms; plate ma., (zero signal), 2, (maximum signal), 11; peak grid ma., per unit, 6; output watts (approx.), 0.35. This is a DISCONTINUED type listed for reference only.

1G6GT

MEDIUM-MU TRIODE

Glass octal type used as detector or voltage amplifier in battery-operated receivers. Outline 22, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.06. Typical operation as class A amplifier; plate volts, 180 ma.; grid volts, -33.5; amplification factor, 3.8; plate resistance, 11000 ohms; transconductance, 900 micros; plate ma., 3.1. This is a DISCONTINUED type listed for reference only.

1H4G

DIODE—HIGH-MU TRIODE

Glass octal type used as combined detector and amplifier in battery-operated receivers. Outline 18A, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 1.4; amperes, 0.05. Characteristics of triode unit as class A1 amplifier; plate volts, 90 (110 max); grid volts, 0; plate ma., 0.15; plate resistance (approx.), 240000 ohms; amplification factor, 65; transconductance, 270 micros. Diode is located at negative end of filament. This type is used principally for renewal purposes.

1H5GT

TWIN DIODE—MEDIUM-MU TRIODE

Glass octal type used as combined detector, amplifier, and ac line in battery-operated receivers. Outline 22, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.06. Type 1H6-G is similar electrically to type 1H6-25S. Type 1H6-G is a DISCONTINUED type listed for reference only.

1H6G

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. Outline 15D, OUTLINES SECTION. Except for physical dimensions, this type is identical with glass octal type 1K3.

1J3

POWER PENTODE

Glass octal type used in output stage of battery-operated receivers. Outline 26, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 2.0; amperes, 0.12. Typical operation as class A1 amplifier; plate and grid-No.2 zero grid) volts, 150 ma. grid-No.1 volts, -16.5; plate ma., 7.6; plate resistance, 105000 ohms; load resistance, 13500 ohms; output watts, 0.45. This is a DISCONTINUED type listed for reference only.

1J5G

Technical Data

HIGH-MU TWIN POWER TRIODE

Glass octal types used in output stage of battery-operated receivers. Type 1J6-G, Outline 22, type 1J6G-T, Outline 14G, OUTLINES SECTION. Tubes require octal socket. Filament volts (dc), 2.0; amperes, 0.24. Typical operation as class B power amplifier; plate volts, 135 ma.; peak plate ma., per plate, 50 ma.; grid volts, 0; zero signal plate ma., per plate, 11; effective plate-to-plate load resistance, 16000 ohms; average input watts, 0.17; output watts, 2.1. These are DISCONTINUED types listed for reference only.

1J6G

1J6GT

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. Type 1K3 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 common 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 15B, OUTLINES SECTION. For high-voltage considerations, see type 1B3-GT.

1K3

PULSED RECTIFIER

For operation in a 255-line, 50-frame system

Maximum Ratings, (Design-Maximum Values):

| Filament Voltage (AC/DC) | 1.25 volts |
| Filament Current | 0.2 ampere |
| Direct Inter-electrode Capacitance (Approx.) | 1.6 pf |

- Under no circumstances should the filament voltage be less than 1.05 volts or greater than 1.65 volts.

Tube Voltage Drop for plate current of 7 ma | 225 volts |

- The duration of the voltage pulse must not exceed 15 percent of one horizontal scanning cycle. In a 525-line, 50-frame system, 15 percent of one horizontal scanning cycle is 10 microseconds.

- The dc component must not exceed 22000 volts.

PENTAGRID CONVERTER

Miniature type used in low-drain battery-operated receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Filament volts (dc), 1.4; amperes, 0.05. Typical operation as converter: plate and grid-No.2 volts, 90 (110 max); grid-No.3 and No.6 supply volts, 110 ma.; grid-No.3 and No.5 volts, 45 (65 max); grid-No.4 volts, 0; grid-No.1 resistor, 0.2 megohm; plate resistance (approx.), 0.65 megohm; plate ma., 0.5; grid-No.3 and No.5 ma., 0.6; grid-No.2 ma., 1.2; grid-No.1 ma., 0.085; total cathode ma., 0.85; conversion transconductance, 300 microhs. This type is used principally for renewal purposes.

1L6

POWER PENTODE

Glass lock-in type used in output stage of battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament volts (dc), 1.4; amperes, 0.05. For electrical characteristics and typical operation, refer to glass octal type 1A5-GT. Type 1LA4 is a DISCONTINUED type listed for reference only.
**PENTAGRID CONVERTER**
Glass lock-in type used in battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.4; amperes, 0.05. Typical operation as converter is the same as for type 1A7GT except that grid-No.2 volts is 0.10 volts, total plate dissipation is 0.05 watts, and conversion transconductance is 150 µhos. This type is used principally for renewal purposes.

**POWER PENTODE**
Glass lock-in type used in output stage of battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.14; amperes, 0.06. For electrical characteristics, refer to pentode unit of glass-octal type 1D6-GT. Type 1LB4 is used principally for renewal purposes.

**SHARP-CUTOFF PENTODE**
Glass lock-in type used as r.f. or if amplifier in battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.14; amperes, 0.06. Typical operation as class A amplifier: plate voltage, 90 (110 ma); grid-No.2 voltage, 45 volts; grid-No.1 voltage, 55 volts; plate resistance (approx.), 10 megohms; transconductance, 125 µhos; plate ma, 1.5; grid-No.2 ma, 0.5. This is a DISCONTINUED type listed for reference only.

**PENTAGRID CONVERTER**
Glass lock-in type used in battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.14; amperes, 0.06. Typical operation as converter: plate voltage, 90 (110 ma); grid-No.2 voltage, 45 volts; grid-No.1 voltage, 55 volts; plate resistance (approx.), 10 megohms; transconductance, 125 µhos; plate ma, 1.5; grid-No.2 ma, 0.5. This is a DISCONTINUED type listed for reference only.

**DIODE—SHARP-CUTOFF PENTODE**
Glass lock-in type used as combined detector and af voltage amplifier in battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.14; amperes, 0.06. Characteristics of pentode unit: plate voltage, 90 (110 ma); grid-No.2 voltage, 45 volts; grid-No.1 voltage, 55 volts; plate ma, 0.6; grid-No.2 ma, 0.1; plate resistance, 10 megohms; transconductance, 125 µhos. This is a DISCONTINUED type listed for reference only.

**MEDIUM-MU TRIODE**
Glass lock-in type used as detector or voltage amplifier in battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.14; amperes, 0.06. Typical operation as class A amplifier: plate voltage, 90 (110 ma); grid voltage, -3 volts; plate ma, 1.4; plate resistance, 19000 ohms; transconductance, 760 µhos; amplification factor, 14.5. This type is used principally for renewal purposes.

**REMOTE-CUTOFF PENTODE**
Lock-in type used as r.f. or if amplifier in battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.14; amperes, 0.06. Typical operation as class A amplifier: plate voltage, 90 (110 ma); grid-No.2 voltage, 45 (110 ma); grid-No.1 voltage, 55 volts; plate resistance (approx.), 10 megohms; transconductance, 800 µhos; plate ma, 1.7; grid-No.2 ma, 0.4. This type is used principally for renewal purposes.

**DIODE—HIGH-MU TRIODE**
Glass lock-in type used as combined detector and amplifier in battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.14; amperes, 0.06. For electrical characteristics, refer to glass-octal type 1B3G.T. Type 1LH4 is used principally for renewal purposes.

**SHARP-CUTOFF PENTODE**
Glass lock-in type used as r.f. or if amplifier in battery-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament voltage (dc), 1.14; amperes, 0.06. Typical operation as class A amplifier: plate and grid-No.2 voltage, 90 (110 ma); grid-No.1 voltage, 55 volts; plate ma, 1.5; grid-No.2 ma, 0.5. Plate resistance (approx.), 10 megohms; transconductance, 800 µhos. This type is used principally for renewal purposes.

**HALF-WAVE VACUUM RECTIFIER**
Glass octal type used as high-voltage rectifier in television receivers. Maximum over-all length, 2.9/16 inches; maximum seated length, 3 inches; maximum diameter, 1-9/16 inches. Tube requires octal socket and may be operated in any position. For installation and application considerations, refer to type 1B3G.T.

**1LA6**

**1LB4**

**1LC5**

**1LC6**

**1LD5**

**1LE3**

**1LG5**

**1LH4**

**1LN5**

**1N2A**

**Technical Data**

**FILAMENT VOLTAGE (AC)**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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<td>volts</td>
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</tbody>
</table>

**DIRECT INTERELECTRODE CAPACITANCE**

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</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>amperes</td>
</tr>
</tbody>
</table>

**PULSED RECTIFIER**

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

**Maximum Ratings: (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>50</td>
<td>ma</td>
</tr>
<tr>
<td>0.6</td>
<td>ma</td>
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</table>

**Characteristics, Instantaneous Value:**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>volts</td>
</tr>
</tbody>
</table>

*Under no circumstances should the filament voltage be less than 1.05 volts or greater than 1.45 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 2400 volts.**
**Technical Data**

**POWER PENTODE**

Miniature type used in output stage of lightweight, compact, battery-operated equipment. Types 154 and 354 are identical except for filament arrangement. Outline 75, OUTLINES SECTION. Type 154 requires miniature seven-contact socket and may be mounted in any position. For ratings and typical operation, refer to type 354 with parallel filament arrangement. Filament volts (dc), 1.4; amperes, 0.1. This type is used principally for renewal purposes.

**DIODE—SHARP-CUTOFF PENTODE**

Miniature type used in lightweight, portable, compact, battery-operated receivers as combined detector and rf voltage amplifier. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Filament volts (dc), 1.4; amperes, 0.06. For electrical characteristics, refer to type 1.5. Type 155 is used principally for renewal purposes.

**REMOTE-CUTTOFF PENTODE**

Miniature type used in lightweight, portable, compact, battery-operated receivers as rf or if amplifier. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Filament volts (dc), 1.4; amperes, 0.06. Characteristics as class A1 amplifier: plate volts, 300 (110 ma); plate resistance (approx.), 0.1 megohm; transconductance, 600 µmhos; plate resistance, 3500 ohms; output watt, 0.1. This type is used principally for renewal purposes.

**BEAM POWER TUBE**

Glass octal type used in output stage of battery-operated receivers. Outline 14C, OUTLINES SECTION. Tube requires octal socket. Filament volts (dc), 1.4; amperes, 0.1. For electrical characteristics and ratings, refer to type 15GT. This type is used principally for renewal purposes.

**DIODE—SHARP-CUTOFF PENTODE**

Miniature type used as combined detector and audio amplifier in small, compact, battery-operated receivers for the standard AM broadcast band. Maximum dimensions: over-all length, 1.75 inches; seated height, 1.0 inches; dia.-w. 0.4 inch. Tube requires miniature eight-contact socket. Filament volts (dc), 1.25; amperes, 0.04. Filament voltage should never exceed 1.6 volts. Typical operation of pentode unit as class A1 amplifier: plate and grid-No.2 volts, 67.5 ma; grid-No.1 volts, 6.5; plate resistance (approx.), 0.4 megohm; transconductance, 600 µmhos; plate ma., 1.6; grid-No.2 ma., 6.4; total cathode ma., 2.0 ma. Maximum diode plate ma., 0.26. This is a DISCONTINUED type listed for reference only.

**PENTAGRID CONVERTER**

Miniature type used in lightweight, portable, compact, battery-operated receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Characteristics as a converter with separate excitation: plate volts, 67.5 ma; grid-No.2 and No.4 volts, 67.5 ma; grid-No.3 volts, 6; rms grid-No.1 volts, 25; grid-No.1 resistor, 0.1 megohm; plate resistance (approx.), 0.4 megohm; conversion transconductance, 280 µmhos; plate ma., 1.4; grid-No.2 and No.4 ma., 3.5; grid-No.1 ma., 250; total cathode ma., 5.2. This type is used principally for renewal purposes.
SHARP-CUTOFF PENTODE

Miniature type used as rf or if amplifier if stages not controlled by ave in lightweight, compact, portable, battery-operated equipment. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Filament volts (dc), 1.4; amperes, 0.05. Characteristics as class A amplifier: plate and grid-No. 2 volts, 20 (320 ma); grid-No.1 volts, 0; plate resistance (approx.), 1 megohm; transconductance, 900 microns; plate ma., 1.6; grid-No.2 ma., 0.5. This type is used principally for renewal purposes.

DIODE-SHARP-CUTOFF PENTODE

Miniature type used in lightweight, compact, portable, battery-operated receivers as combined detector and rf voltage amplifier. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Filament volts (dc), 1.4; amperes, 0.05. Characteristics of pentode unit as class A amplifier: plate and grid-No.2 volts, 67.5 (100 ma); grid-No.1 volts, 0; plate resistance (approx.), 0.6 megohm; transconductance, 625 microns; plate ma., 1.6; grid-No.2 ma., 0.4. Maximum diode plate ma., 0.25 ma. This type is used principally for renewal purposes.

HALF-WAVE VACUUM RECTIFIER

Glass type used in ac/dc or automobile receivers. Maximum dimensions: over-all length, 4-3/16 inches; seat height, 3-3/16 inches; diameter, 1-9/16 inches. Tube requires four-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.3. Maximum ratings as half-wave rectifier: peak inverse plate volts, 1960; peak plate ma., 270; peak heater-cathode volts, 500; dc output ma., 45. This type is used principally for renewal purposes.

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 use of a rectifier transformer having small size and light weight.

Filament Voltage (ac) = 0.625 volts
Filament Current = 0.3 amperes
Direct Interelectrode Capacitance = Plate to Filament (Approx.) = 0.8 pf

Under no circumstances should the filament voltage be less than 0.525 volt or greater than 0.725 volt.

PULSED RECTIFIER

For operation in a 555-line, 30-frame system

Maximum Ratings: (Design-Maximum Values):
Peak Inverse Plate Voltage = 2000 volts
Peak Plate Current = 50 ma
Average Plate Current = 0.6 ma

* The duration of the plate voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 555-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

The dc component must not exceed 7000 volts.

POWER TRIODE

Glass type used in output stage of radio receivers and amplifiers. Outline 28, OUTLINES SECTION. Tube requires four-contact socket. Filament volts (ac/dc), 5.5; amperes, 2.5; Typical operation as class A amplifier: plate volts, 500 (300 ma); grid volts, -45; plate ma., 60; amplification factor, 4.5; load resistance, 800 ohms; transconductance, 5250 microns; plate dissipation, 15 ma watts; load resistance, 2500 ohms.
POWER PENTODE
Glass type used in output stage of ac-operated receivers. Outline 27, OUTLINES SECTION. Tube requires six-contact socket. Except for its heater rating (2.5 volts ac/dc; 1.75 amperes), the 2A5 has electrical characteristics identical with type 6F6. Type 2A5 is a DISCONTINUED type listed for reference only.

TWIN DIODE—HIGH-MU TRIODE
Glass type used in ac-operated receivers chiefly as a combined detector, amplifier, and a.c. tube. Outline 2A4B, OUTLINES SECTION. Tube requires six-contact socket. Except for its heater rating (2.5 volts ac/dc; 0.8 amperes), and within its 250-volt maximum plate rating, the 2A6 has electrical characteristics identical with type 6GQ7. Type 2A6 is a DISCONTINUED type listed for reference only.

PENTAGRID CONVERTER
Glass type used in ac-operated receivers. Outline 2A4F, OUTLINES SECTION. Tube requires small seven-contact (0.76-inch, pin-circle diameter) socket. Except for its heater rating (2.5 volts ac/dc; 0.6 amperes) and its inter electrode capacitances, the 2A7 has electrical characteristics identical with type 6A8. Complete shielding of this tube is generally necessary. Type 2A7 is a DISCONTINUED type listed for reference only.

MEDIUM-MU TRIODE
Miniature types used as local oscillator in u.h.f. television receivers employing series-connected heater strings. Outline 7A, OUTLINES SECTION. Heater volts (ac/dc), 2.35; amperes, 0.6; warm-up time (average), 11 seconds. Type 2AF4-B only, maximum rating (design maximum), peak heater-cathode volts, 180 max. When the heater is positive with respect to the cathode, the d.c. component of the heater-cathode voltage must not exceed 100 volts. Typical operation of 2AF4-B as oscillator at 1000 Mc: plate ma., 17.5; grid ma. (approx.), 700. Except for heater ratings noted, these types are identical with miniature type 6AF4-A. Type 2AF4-A is a DISCONTINUED type listed for reference only.

HALF-WAVE VACUUM RECTIFIER
Duodecator type used to supply high voltage to the anode of picture tubes in television receivers. Outline 16B, OUTLINES SECTION. Tube requires twelve-contact socket and may be mounted in any position. Socket terminals 2, 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 1B3-GT. Heater volts (ac/dc), 2.5; amperes, 0.3.

Technical Data

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

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK INVERSE PLATE VOLTAGE*................</td>
</tr>
<tr>
<td>PEAK PLATE CURRENT..........................</td>
</tr>
<tr>
<td>AVERAGE PLATE CURRENT........................</td>
</tr>
<tr>
<td>Characteristics, Instantaneous Value:</td>
</tr>
<tr>
<td>Tube Voltage Drop for plate current of 7 ma.</td>
</tr>
<tr>
<td>*The duration of the voltage pulse must not exceed 16 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.</td>
</tr>
</tbody>
</table>

HALF-WAVE VACUUM RECTIFIER
Duodecator type used to supply high voltage to the anode of picture tubes in television receivers. Outline 16B, OUTLINES SECTION. Tube requires twelve-contact socket and may be mounted in any position. Socket terminals 2, 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 1B3-GT. Heater volts (ac/dc), 2.5; amperes, 0.3.

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

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK INVERSE PLATE VOLTAGE*................</td>
</tr>
<tr>
<td>PEAK PLATE CURRENT..........................</td>
</tr>
<tr>
<td>AVERAGE PLATE CURRENT........................</td>
</tr>
<tr>
<td>Characteristics, Instantaneous Value:</td>
</tr>
<tr>
<td>Tube Voltage Drop for plate current of 7 ma.</td>
</tr>
<tr>
<td>*The duration of the voltage pulse must not exceed 16 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.</td>
</tr>
</tbody>
</table>

TWIN DIODE—REMOTE-CUTOFF PENTODE
Glass type used as combined detector, a.c. tube, and amplifier. Outline 2B7, OUTLINES SECTION. Tube requires small seven-contact (0.76-inch, pin-circle diameter) socket. Except for its heater rating (2.5 volts ac/dc; 0.8 amperes) and its inter electrode capacitances, the 2B7 has electrical characteristics identical with type 6B8-G. Type 2B7 is a DISCONTINUED type listed for reference only.

MEDIUM-MU TRIODE
Miniature types used as i.f. amplifier in v.h.f. television tuners employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 2BN1; 23, 2BN1-A; 2.35; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings noted, these types are identical with miniature types 2BN4 and 2BN4A, respectively. Type 2BN4 is a DISCONTINUED type listed for reference only. Type 2BN4-A is used principally for renewal purposes.

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HIGH-MU TRIODE
Nuvistor type used as a grounded-cathode, neutralized rf amplifier in vhf tuners of television and FM receivers employing series-connected heater strings. Outline 1, OUTLINES SECTION. Heater volts (ac/dc), 2.1; amperes, 0.45; warm-up time (average), 8 seconds. Except for heater ratings, this type is identical with nuvistor type 6CW4.

SHARP-CUTOFF TETRODE
Miniature type used as rf amplifier in vhf tuners of television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 2.4; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CY5.

HIGH-MU TRIODE
Nuvistor type used as grounded cathode, neutralized rf amplifier in vhf tuners of television and FM receivers employing series-connected heater strings. Because of its cutoff characteristics, the 2DS4 is used in circuits to reduce cross-modulation distortion. Outline 1, OUTLINES SECTION. Heater volts (ac/dc), 2.1; amperes, 0.45; warm-up time (average), 8 seconds. Except for heater ratings, this type is identical with nuvistor type 6DS4.

MEDIUM-MU TRIODE
Nuvistor type used at frequencies up to 1,000 megacycles in uhf oscillator stages of television receivers employing series-connected heater strings. Outline 1, OUTLINES SECTION. Heater volts (ac/dc), 2.1; amperes, 0.6; warm-up time (average), 8 seconds. Except for heater ratings, this type is identical with nuvistor type 6DV4.

HIGH-MU TRIODE
Miniature type used as a local-oscillator tube in uhf television receivers covering the frequency range from 470 to 890 megacycles and employing series-connected heater strings. Outline 7A, OUTLINES SECTION. Heater volts (ac/dc), 2.35; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts, 150 max (the dc component must not exceed 100 volts when heater is positive with respect to cathode). Except for heater and heater-cathode ratings, this type is identical with miniature type 6DZ4.

Technical Data

ELECTRON-RAY TUBE
Glass type with triode unit 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. Maximum dimensions: overall length, 4.3/16 inches; seated height, 3.9/16 inches; diameter, 1.9/16 inches. Tube requires six-contact socket. Except for its heater rating (2.5 volts ac/dc; 0.8 amperes), the 2E5 has electrical characteristics identical with type 6E5. Type 2E5 is a DISCONTINUED type listed for reference only.

TWIN DIODE
Miniature type used as a horizontal phase detector in television receivers. Outline 7B, OUTLINES SECTION. Tube requires a six-contact socket and may be mounted in any position. Heater volts (ac/dc), 2.1; amperes, 0.45; warm-up time (average), 11 seconds. Maximum ratings: dc output max. per plate, 5 mm; peak heater-cathode volts, 200 mm. When the heater is positive with respect to cathode, the dc component of the heater-cathode voltage must not exceed 100 volts. Type 2EN5 is used principally for renewal purposes.

SHARP-CUTOFF TRIODE
Miniature type with frame grid used in vhf tuners of television receivers. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 2.3; amperes, 0.6. Except for heater ratings, this type is identical with miniature type 6ER5.

SHARP-CUTOFF TRIODE
Miniature type used as an rf amplifier in vhf tuners of television receivers employing series-connected heater strings. Outline 1, OUTLINES SECTION. Heater volts (ac/dc), 2.35; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6FH5.

BEAM HEXODE
Miniature type used as an rf amplifier in vhf television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 2.4; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6FS5.

HIGH-MU TRIODE
Miniature type with frame grid used as grounded-cathode rf amplifier tube in vhf tuners of television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 2.3; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6GK5.
HALF-WAVE VACUUM RECTIFIER

Miniature type used as rectifier of high-voltage pulses produced in scanning systems of color television receivers. Outline 9A, OUTLINES SECTION. Tube requires miniature 3-contact socket and may be mounted in any position. Socket terminals 3 and 7 may be connected to the heater. Heater volts (ac), 3.15; amperes, 0.22. Maximum ratings as pulsed rectifier in 525-line, 30-frame system: peak inverse plate volts, 18000 max; peak plate ma., 80 ma; average plate ma., 1.6 ma. For high-voltage considerations, see type 1B3-GT. Type 3A2 is used principally for renewal purposes.

3A2

HALF-WAVE VACUUM RECTIFIER

Glass octal type used as rectifier of high-voltage pulses produced in the scanning systems of color television receivers. Outline 15D, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. 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 1B3-GT.

Heater Voltage (ac) .................................................. 3.15 volts
Heater Current .......................................................... 0.22 amperes
Direct Intercathode Capacitance (Approx.): Plate to heater, Cathode, and Internal Shield: 1.6 pf
* Under no circumstances should the heater voltage be less than 2.65 volts or greater than 3.65 volts.

PULSED RECTIFIER

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

Maximum Ratings, (Design-Maximum Values):

Peak Inverse Plate Voltage* ........................................ 90000 ma volts
Peak Plate Current .................................................. 88 ma
Average Plate Current ............................................. 1.7 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 microseconds.

DIODE—TRIODE—PENTODE

Glass octal type used as combined detector, af amplifier, and rf amplifier in battery-operated receivers. Maximum over-all length, 3-7/16 inches; maximum diameter, 1-5/16 inches. Filament volts, 1.4 (parallel), 2.8 (series); amperes, 0.1 (parallel), 0.05 (series). Typical operation as class A: amplifier: triode unit—plate volts, 90 (110 ma); grid volts, 0; amplification factor, 65; plate resistance, 0.2 megohm; transconductance, 825 μmhos; plate ma., 0.2; pentode unit—plate and grid-No.2 volts, 90 (110 ma); grid-No.1 volts, 0; plate resistance, 0.8 megohm; transconductance, 750 μmhos; plate ma., 1.5; grid-No.2 ma., 0.5. This is a DISCONTINUED type listed for reference only.

3A8GT

MEDIUM-MU TRIODE

Miniature type used as local oscillator in uhf television receivers covering the frequency range of 470 to 890 megacycles per second and employing series-connected heater strings. Outline 7A, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AF4-A.

3AF4A

TWIN DIODE—HIGH-MU TRIODE

Miniature type used as combined detector, amplifier, and ave tube in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts, 200 max. When the heater is positive with respect to the cathode, the dc component of the heater-cathode voltage must not exceed 100 volts. Except for heater and heater-cathode ratings, this type is identical with miniature type 6AV6.

3AV6

TWIN DIODE

Miniature type having high-perveance used as detector in television receivers employing series-connected heater strings. Outline 7A, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AL5.

3AL5

SHARP-CUTOFF PENTODE

Miniature type used as rf amplifier in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts, 200 max. When the heater is positive with respect to the cathode, the dc component of the heater-cathode voltage must not exceed 100 volts. Except for heater and heater-cathode ratings, this type is identical with miniature type 6AU6.

3AU6

PULSED RECTIFIER

For operation in a 125-line, 30-frame system

Maximum Ratings, (Design-Maximum Values):

Peak Inverse Plate Voltage* ........................................ 80000 max volts
Peak Plate Current .................................................. 88 ma
Average Plate Current ............................................. 1.7 ma

* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 125-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 15B, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 3.15; amperes, 0.22.

**PULSED RECTIFIER**

For operation in a 52-line, 30-frame system

*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 52-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 systems of television receivers. Outline 3B4, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Low-potential circuits should not be connected to any of the socket terminals. Any or all of the following socket-terminal connections are permissible and may aid in corona reduction: socket terminals 1, 3, 6, and 7 may be connected together; socket terminals 2, 6, and 8 may be connected together; socket terminal 4 may be connected to socket terminals 2 or 7, or may be used as a tie point for a heater-voltage dropping resistor. Heater volts (ac/dc), 3.15; amperes, 0.23. Maximum ratings as pulsed rectifier in 52-line, 30-frame system: peak inverse plate volts (absolute maximum), 39000 max (dc 26000 max); peak plate ma., 80 max; average plate ma., 1.1 max. For high-voltage considerations, see type 153-GT. Type 3B4 is used principally for renewal purposes.

REMOTE-CUTOFF PENTODE

Miniature type used as rf amplifier in standard broadcast and FM receivers, as well as in wide-band, high-frequency applications, for use in equipment employing series-connected heater strings. Outline 17B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BA6.

SHARP-CUTOFF PENTODE

Miniature type used as rf or if amplifier in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts, 200 max. When the heater is positive with respect to the cathode, the dc component of the heater-cathode voltage must not exceed 100 volts. Except for heater and heater-cathode ratings, this type is identical with miniature type 6BC5.

PENTAGRID CONVERTER

Miniature type used as converter in superheterodyne circuits in both the standard broadcast and FM bands in equipment employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BY6.

MEDIUM-MU TRIODE

Miniature types used as rf amplifier 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 reduction in input conductance. In addition, the housing arrangement facilitates isolation of input and output circuits and permits short, direct connections to base-pin terminals. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, the 3BN4 and 3BN4-A are identical with miniature types 6BN4 and 6BN4-A, respectively. Type 3BN4 is a DISCONTINUED type listed for reference only.

BEAM TUBE

Miniature type used as combined limiter, discriminator, and af voltage amplifier in intercarrier television and FM receivers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BN6.

SHARP-CUTOFF TWIN PENTODE

Miniature type used as combined sync separator, sync clipper, and af amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BU8.

PENTAGRID AMPLIFIER

Miniature type used as gated amplifier in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BY6.
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**SEMIREMOTE-CUTOFF PENTODE**

Miniature type used in gain-controlled video if stages of television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts when heater is negative with respect to cathode, 500 max (the dc component must not exceed 200 volts). Excl. for heater and heater-cathode ratings, this type is identical with miniature type 6BZ6.

**SHARP-CUTOFF PENTODE**

Miniature type used as rf or if amplifier in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts: heater negative with respect to cathode, 300 max; heater positive with respect to cathode, 200 max (the dc component must not exceed 100 volts). Excl. for heater and heater-cathode ratings, this type is identical with miniature types 6CB6 and 6CB6-A.

**SHARP-CUTOFF PENTODE**

Miniature type used as rf and if amplifier in vhf television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts, 3.15; amperes, 0.6; heater warm-up time (average), 11 seconds. Excl. for heater ratings, this type is identical with miniature type 6CE5.

**SHARP-CUTOFF PENTODE**

Miniature type used as rf or if amplifier in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts: heater negative with respect to cathode, 300 max; heater positive with respect to cathode, 200 max (the dc component must not exceed 100 volts). Excl. for heater and heater-cathode ratings, this type is identical with miniature type 6CF6.

**PENTAGRID AMPLIFIER**

Miniature type used as gated amplifier in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Excl. for heater ratings, this type is identical with miniature type 6CS6.

**SHARP-CUTOFF TETRODE**

Miniature type used as rf amplifier in vhf tuners of television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 2.8; amperes, 0.45; warm-up time (average), 11 seconds. Excl. for heater ratings, this type is identical with miniature type 6CY5.

**FULL-WAVE VACUUM RECTIFIER**

Glass octal type used as power supply in television receivers and other equipment, having high dc requirements. Outline 19D, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. 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), 3.8; amperes, 3.8.

**3CY5**

Related types: 2CY5, 4CY5, 6CY5

**3DG4**

**FULL-WAVE RECTIFIER**

Maximum Ratings, (Design-Maximum Values):
- Peak Inverse Plate Voltage: 1650 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

**RATING CHART**

![RATING CHART](chart.png)

**Typical Operation with Capacitor Input to Filter**
- AC Plate-to-Plate Supply Voltage (rms): 350 volts
- Filter-Input Capacitor: 40 pF
- Effective Plate-Supply Impedance per Plate: 32 ohms
- DC Output Voltage at Input to Filter (Approx.): 800 volts

**Characteristics**
- Tube Voltage Drop for plate current of 850 ma (per plate): 25 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 peak plate current.*

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**SHARP-CUTOFF PENTODE**

Miniature types used as intermediate-frequency amplifier in television receivers. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts: heater negative with respect to cathode, 300 max; heater positive with respect to cathode, 200 max (the dc component must not exceed 100 volts). Except for heater and heater-cathode ratings, this type is identical with miniature type 6DK6.

**3DK6**

**3DT6**

**3DT6A**

Related types: 4DT6A, 6DT6A

Miniature types used as FM detector in television receivers employing series-connected heaterstrings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, these types are identical with miniature types 6DT6 and 6DT6-A, respectively. Type 3DT6 is a DISCONTINUED type listed for reference only.

**MEDIUM-MU TRIODE**

Miniature type used as a local oscillator tube in uhf television receivers covering the frequency range from 470 to 890 megacycles and employing series-connected heaterstrings. Outline 7A, OUTLINES SECTION. Heater volts (ac/dc), 3.2; amperes, 0.45; warm-up time (average), 11 seconds. Peak heater-cathode volts, 180 max (the dc component must not exceed 100 volts when heater is positive with respect to cathode). Except for heater and heater-cathode ratings, this type is identical with miniature type 6DZ4.

**3DZ4**

**3EA5**

Related types: 6EA5

Miniature type used as rf amplifier in uhf tuners of television receivers having series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc) 2.9; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6EA5.

**SHARP-CUTOFF PENTODE**

Miniature type used as if-amplifier tube in television receivers. Outline 8C, OUTLINES SECTION. Heater volts (ac/dc), 3.4; amperes, 0.6; Except for heater ratings, this type is identical with miniature type 6EH7.

**3EH7**

**3EJ7**

Related types: 4EJ7, 6EJ7

Miniature type used as if-amplifier tube in television receivers. Outline 8C, OUTLINES SECTION. Heater volts (ac/dc), 3.4; amperes, 0.6; Except for heater ratings, this type is identical with miniature type 6EJ7.

**SEMIREMOTE-CUTOFF PENTODE**

**3EJ7**

**3HA5**

Related types: 6HA5

Miniature type used as if-amplifier tube in television receivers. Outline 8C, OUTLINES SECTION. Heater volts (ac/dc), 3.4; amperes, 0.6; Except for heater ratings, this type is identical with miniature type 6EJ7.

**SHARP-CUTOFF PENTODE**

**3ER5**

Related types: 2ER5, 6ER5

Miniature type used as if-amplifier tube in uhf tuners of television receivers employing series-connected heaterstrings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 3; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6ER5.

**HIGH-MU TRIODE**

**3FH5**

Related types: 2FH5, 6FH5

Miniature type used as rf-amplifier tube in uhf tuners of television receivers employing series-connected heaterstrings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 2.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6FH5.

**HIGH-MU TRIODE**

**3GK5**

Related types: 2GK5, 6GK5

Miniature type used as grounded-cathode rf-amplifier tube in uhf tuners of television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 2.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6GK5.

**SHARP-CUTOFF TWIN PENTODE**

**3GS8/3BU8**

Related type: 4GS8/4BU8

Miniature type used as combined sync separator, sync clipper, and age amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6. Except for heater ratings, this type is identical with miniature type 4GS8/4BU8.

**HIGH-MU TRIODE**

**3HA5**

Related types: 6HA5

Miniature type used as rf-amplifier tube in uhf tuners of television receivers. Outline 7A, OUTLINES SECTION. Heater volts (ac/dc), 2.7; amperes, 0.45. Except for heater ratings, this type is identical with miniature type 6HA5.

**SHARP-CUTOFF TWIN PENTODE**

**3HS8**

Related types: 4HS8, 6HS8

Miniature type used in age amplifier, sync, and noise-limiting circuits of television receivers employing series-connected heater strings. One pентode unit is used as a combined sync separator and sync clipper; the other pentode unit is used as the age amplifier.
Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 3.15; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this tube is identical with miniature type 6HS8.

**SHARP-CUTOFF PENTODE**

**3JC6**

Miniature type with frame grid used in if-amplifier stages of television receivers utilizing intermediate frequencies in the order of 40 megacycles and employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 3.5; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6JC6.

**SHARP-CUTOFF PENTODE**

**3JD6**

Miniature type used as if-amplifier tube in television receivers utilizing intermediate frequencies in the order of 40 megacycles and employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 3.5; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6JD6.

**BEAM POWER TUBE**

**3LF4**

Glass octal type used in output stage of ac/dc battery portable receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Filament volts (dc), 1.4 (parallel), 2.8 (series); amperes, .06 (series). For electrical characteristics, refer to glass-octal type 3Q4-GT. Type 3LF4 is used principally for renewal purposes.

**POWER PENTODE**

**3Q4**

Miniature type used in output stage of lightweight, compact, portable, battery-operated equipment. Outline 7B, OUTLINES SECTION. Except for terminal connections, types 3Q4 and 5V4 are identical. Refer to type 5V4 for ratings and typical operation. Type 3Q4 is used principally for renewal purposes.

**BEAM POWER TUBE**

**3Q5GT**

Glass octal type used in output stage of ac/dc battery portable receivers. Outline 14C, OUTLINES SECTION. This type may be supplied with grid-11 omitted. Filament volts (dc), 2.8 in series: filament arrangement and 1.4 in parallel arrangement; amperes, .06 (series). Typical operation as Class A amplifier: plate and grid-No.2 volts, 110 ma.; grid-No.1 volts, -6.6; peak a grid-No.1 volts, -6.6; peak at grid-No.1 volts, -6.6; total cathode ma., 6 ma. for each 1.4-volt filament section; plate resistance (approx.), 0.1 megohm; transconductance, 2000 mhms (series), 2200 mhms (parallel); load resistance, 5000 ohms; total harmonic distortion, 0.5 per cent (series), 0 per cent (parallel); max. signal power output, 260 mw (series), 460 mw (parallel). This type is used principally for renewal purposes.

**POWER PENTODE**

**3S4**

Miniature type used in output stage of lightweight, compact, portable, battery-operated equipment. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Filament volts (dc), 2.8 (series), 1.4 (parallel); amperes, .06 (series). Typical operation as Class A amplifier: plate and grid-No.2 volts, 65.6 (40 ma.); grid-No.4 volts, -7; peak a grid-No.1 volts, 7; zero-signal plate ma., 6 (series), 7.2 (parallel); zero-signal grid-No.2 ma., 1.2 (series), 1.5 (parallel); plate resistance (approx.), 0.1 megohm; transconductance, 1400 mhms (series), 1500 mhms (parallel); load resistance, 5000 ohms; maximum-signal power output, 160 milliwatts (series), 180 milliwatts (parallel). This type is used principally for renewal purposes.

**POWER PENTODE**

**3V4**

Miniature type used in output stage of lightweight, compact, portable, battery-operated equipment. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Filament volts (dc), 2.8 (series), 1.4 (parallel); amperes, .06 (series). Typical operation as Class A amplifier: plate and grid-No.2 volts, 90 (100 ma.); grid-No.4 volts, -4.5; peak a grid-No.1 volts, 4.5; zero-signal plate ma., 7.7 (series), 9.6 (parallel); grid-No.2 ma., zero-signal, 1.7 (series), 2.1 (parallel); plate resistance (approx.), 0.12 megohm (series), 1.1 megohm (parallel); transconductance, 2000 mhms (series), 2500 mhms (parallel); load resistance, 1000 ohms; maximum-signal power output, 240 milliwatts (series), 270 milliwatts (parallel). This type is used principally for renewal purposes.

**SHARP-CUTOFF PENTODE**

**4AU6**

Miniature type used as rf amplifier in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Peak heater-cathode volts: heater negative with respect to cathode, 200 ma.; heater positive with respect to cathode, 200 ma. (the dc component must not exceed 100 volts). Except for heater and heater-cathode ratings, this type is identical with miniature type 6AU6.

**TWIN DIODE—HIGH-MU TRIODE**

**4AV6**

Miniature type used as combined detector, amplifier, and avc tube in automobile and ac-operated radio receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AV6.

**SHARP-CUTOFF PENTODE**

**4BC5**

Miniature type used in compact radio equipment as an rf or if amplifier at frequencies up to 400 megacycles per second. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2;
amperes, 0.45; warm-up time (average), 11 seconds. Peak heater-cathode volts: heater negative with respect to cathode, 200 ma; heater positive with respect to cathode, 200 ma (the dc component must not exceed 100 volts). Except for heater and heater-cathode ratings, this type is identical with miniature type 6BC5.

**MEDIUM-MU TWIN TRIODE**

4BC8

**Related type:**
6BC8

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BC8.

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

4BL8

**Related type:**
6BL8

Miniature type used in frequency-changer service in television receivers. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.6; amperes, 0.6. Except for heater ratings, this type is identical with miniature type 6BL8.

**BEAM TUBE**

4BN6

**Related types:**
3BN6, 6BN6

Miniature type used as combined limiter, discriminator, and audio-voltage amplifier in intercarrier television and FM receivers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Peak heater-cathode volts, 200 ma. When the heater is positive with respect to the cathode, the dc component of the heater-cathode voltage must not exceed 100 volts. Except for heater and heater-cathode ratings, this type is identical with miniature type 6BN6.

**MEDIUM-MU TWIN TRIODE**

4BQ7A

**Related types:**
5BQ7A, 6BQ7A

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.5; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BQ7-A.

**MEDIUM-MU TWIN TRIODE**

4BS8

**Related type:**
6BS8

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.5; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BS8.

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**SHARP-CUTOFF TWIN PENTODE**

4BU8

**Related types:**
3BU8, 6BU8

Miniature type used as combined sync separator, sync clipper, and age amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BU8.

**SEMIREMOTE-CUTOFF PENTODE**

4BZ6

**Related types:**
3BZ6, 6BZ6, 12BZ6

Miniature type used in gain-controlled video if stages of television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BZ6.

**MEDIUM-MU TWIN TRIODE**

4BZ7

**Related type:**
6BZ7

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.2 amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BZ7.

**SHARP-CUTOFF PENTODE**

4CB6

**Related types:**
3CB6, 6CB6, 6CB6A

Miniature type used as if and as rf amplifier in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Peak heater-cathode volts; heater negative with respect to cathode, 200 ma (the dc component must not exceed 200 volts); heater positive with respect to cathode, 200 ma (the dc component must not exceed 100 volts). Except for heater and heater-cathode ratings, this type is identical with miniature types 6CB6 and 6CB6-A.

**PENTAGRID AMPLIFIER**

4CS6

**Related types:**
3CS6, 6CS6

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 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CS6.

**SHARP-CUTOFF TETRODE**

4CY5

**Related types:**
2CY5, 3CY5, 6CY5

Miniature type used as rf amplifier in vhf tuners of television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.5; amperes, 0.3; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CY5.
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. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this tube is identical with miniature type 6D6.

SHARP-CUTOFF PENTODE

Miniature types used as fm detector in television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, these types are identical with miniature types 6DT6 and 6D76-A, respectively. Type 4DT6 is a DISCONTINUED type listed for reference only.

SEMI REMOTE-CUTOFF PENTODE

Miniature type used as if-amplifier tube in television receivers. Outline 8C, OUTLINES SECTION. Heater volts (ac/dc), 4.4; amperes, 0.45; Except for heater ratings, this type is identical with miniature type 6EH7.

SHARP-CUTOFF PENTODE

Miniature type used as if-amplifier tube in television receivers. Outline 8C, OUTLINES SECTION. Heater volts (ac/dc), 4.4; amperes, 0.45; Except for heater ratings, this type is identical with miniature type 6EJ7.

VARIABLE-MU TWIN TRIODE

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6ES8.

SHARP-CUTOFF PENTODE

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. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6EW6.

SHARP-CUTOFF PENTODE

Miniature type used as combined sync separator, sync clipper, and age amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

Heater Voltage (ac/dc)................. 6.45 volts
Heater Current......................... 11.4 amperes
Heater Warm-Up Time (Average)......... 11 seconds
Direct Inter-electrode Capacitance:
Grid No.3 to Plate (Each Unit)........ 2 pf
Grid No.1 to All Other Electrodes...... 2 pf
Grid No.3 to All Other Electrodes (Each Unit)......... 3.8 pf
Plate to All Other Electrodes (Each Unit)......... 3.2 pf
Plate No.3 of Unit No.1 to Grid No.3 of Unit No.2........ 0.015 max pf

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
Plate Voltage (Each Unit)............... 500 max volts
Grid-No.3 (Screen-Grid) Voltage (Each Unit): 50 max volts
DC positive value....................... 50 max volts
DC negative value...................... 50 max volts
Grid-No.3 (Screen-Grid) Voltage........ 150 max volts
Grid-No.1 (Control-Grid) Voltage, Negative bias value........ 50 max volts
Cathode Current......................... 12 ma
Grid-No.3 Input.............. 0.75 max watts
Plate Dissipation (Each Unit)........ 1.1 max watts
Peak Heats-Cathode Voltage:
Heater negative with respect to cathode........ 200 max volts
Heater positive with respect to cathode........ 200 max volts

Characteristics:
With Both Units Operating:
Plate Voltage (Each Unit)................ 100 volts
Grid-No.3 Voltage (Each Unit)........... 67.5 volts
Grid-No.2 Voltage....................... 67.5 volts
Grid-No.1 Voltage....................... 2 ma
Grid Current (Each Unit)................. 8 ma
Grid-No.2 Current....................... 6 ma
Cathode Current......................... 7.7 ma

With One Unit Operating:
Plate Voltage......................... 100 volts
Grid-No.3 Voltage........................ 67.5 volts
Grid-No.2 Voltage....................... 67.5 volts
Grid-No.1 Voltage....................... 2 ma
Grid-No.3 Transconductance.............. 270 ambles
Grid-No.1 Transconductance.............. 2 ma
Plate Current.......................... 2 ma
Grid-No.3 Voltage (Approx.) for plate current of 100 ma........ 3.7 volts
Grid-No.1 Voltage (Approx.) for plate current of 100 ma........ 3 volts

Maximum Circuit Values:
Grid-No.3 Circuit Resistance (Each Unit)............... 0.5 ma megohm
Grid-No.3 Circuit Resistance (Each Unit)............... 0.6 ma megohm
*The dc component must not exceed 100 volts.
*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.

POWER PENTODE

Miniature type used in audio output stages of radio and television receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 4; amperes, 0.6; warm-up time (average), 11 seconds.
**RCA Receiving Tube Manual**

**CLASS A: AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

- **PLATE VOLTAGE:**
  - 300 max volts

- **GRID-No.1 (CONTROL-GRID) VOLTAGE, Positive-bias value:**
  - 200 volts

- **AVERAGE CATHODE CURRENT:**
  - 30 max ma

- **PLATE DISSIPATION:**
  - 4.8 max watts

- **GRID-No.2 INPUT:**
  - 1.1 max watts

**PEAK HEATER-CATHODE VOLTAGE:**

- Heater negative with respect to cathode...
  - 200 max volts

- Heater positive with respect to cathode...
  - 200 max volts

**BULB TEMPERATURE (At hottest point):**

- 500 max °C

**Typical Operation:**

- **Plate Supply Voltage:**
  - 250 volts

- **Grid-No.2 Supply Voltage:**
  - 250 volts

- **Cathode-Bias Resistor:**
  - 270 ohms

- **Peak AF Grid-No.1 Voltage:**
  - 5.8 volts

- **Zero-Signal Plate Current:**
  - 16 ma

- **Maximum-Signal Plate Current:**
  - 16 ma

- **Zero-Signal Grid-No.2 Current:**
  - 5 ma

- **Maximum-Signal Grid-No.2 Current:**
  - 5 ma

- **Plate Resistance (Approx.)**
  - 0.15 megohms

- **Transconductance:**
  - 16000 amhos

- **Loudness Resistance:**
  - 10000 ohms

- **Total Harmonic Distortion:**
  - 10 per cent

- **Maximum-Signal Power Output:**
  - 1.8 watts

**Maximum Circuit Values:**

- **Grid-No.1-Circuit Resistance:**
  - For fixed-bias operation...
    - 0.5 max megohms

- **For cathode-bias operation:**
  - 1 max megohm

*The dc component must not exceed 100 volts.

**SHARP-CUTOFF PENTODE 4HS8**

Miniature type used in age amplifier, sync, and noise-limiting circuits of television receivers employing series-connected heater strings. One pentode unit is used as a combined sync separator and sync clipper; the other pentode unit is used as the age amplifier. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 4HS8.

**SEMIREMOTE-CUTOFF PENTODE 4HT6**

Miniature type with frame grid used in the if-amplifier stages of television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds.

**4HM6**

Miniature type with frame grid used in the if-amplifier stages of television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 4.2; amperes, 0.45; warm-up time (average), 11 seconds.

**CLASS A: AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

- **PLATE VOLTAGE:**
  - 300 max volts

- **GRID-No.2 (SCREEN-GRID) SUPPLY VOLTAGE:**
  - 250 volts

- **GRID-No.1 (CONTROL-GRID) VOLTAGE, Negative-bias value:**
  - 250 volts

- **CATHODE CURRENT:**
  - 50 max ma

- **PLATE DISSIPATION:**
  - 2.5 max watts

- **GRID-No.2 INPUT:**
  - For grid-No.2 voltages up to 125 volts...
    - 6.6 max watts

- **For grid-No.2 voltages between 125 and 250 volts...**
  - See current page 70

**PEAK HEATER-CATHODE VOLTAGE:**

- Heater negative with respect to cathode...
  - 200 max volts

- Heater positive with respect to cathode...
  - 200 max volts

**Characteristics:**

- **Plate Supply Voltage:**
  - 125 volts

- **Grid-No.2 (Suppressor Grid):**
  - Connected to cathode at socket

- **Cathode-Bias Resistor:**
  - 56 ohms

- **Plate Resistance (Approx.)**
  - 0.166 megohms

- **Transconductance:**
  - 16000 amhos

- **Plate Current:**
  - 13 ma

- **Grid-No.2 Current:**
  - 13 ma

- **Grid-No.1 Voltage (Approx.) for transconductance of 100 amhos:**
  - 8.2 volts

*The dc component must not exceed 100 volts.

**SHARP-CUTOFF PENTODE 4JC6**

Miniature type with grid used in if-amplifier stages of television receivers utilizing intermediate frequencies in the order of 40 megacycles and employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.5; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6JC6.
**RCA Receiving Tube Manual**

**SHARP-CUTOFF PENTODE**

4JD6

- Related types: 2JD6, 6JD6
- Miniature type used as if-amplifier tube in television receivers utilizing intermediate frequencies in the order of 40 megacycles and employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 6.5; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6J16.

**5AM8**

- Related type: 6AM8A
- Miniature type used in diversified applications in television receivers employing series-connected heater strings. The pentode unit is used as an amplifier and the high-perveance diode as a detector or dc restorer. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AM8-A.

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

5AN8

- Related type: 6AN8A
- Miniature type used in a wide variety of applications in television receivers employing series-connected heater strings. The pentode unit is used as an amplifier and the triode unit is used in oscillator or sync circuits. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AN8.

**BEAM POWER TUBE**

5AQ5

- Related types: 6AQ5A, 12AQ5
- Miniature type used as audio amplifier in television receivers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AQ5-A.

**FULL-WAVE VACUUM RECTIFIER**

5AS4

- Related type: 5AS4A
- Glass octal types used in power supply of television receivers having high dc requirements. Type 5AS4-A, Outline 10C, OUTLINES SECTION. Type 5AS4 maximum dimensions: over-all length, 5-1/8 inches; seated height, 4-9/16 inches; diameter, 2-1/16 inches. Type 5AS4-A may be supplied with pins 3, 5, and 7 omitted. Tubes require octal socket. Vertical mounting is preferred, but horizontal mounting is permissible if pins 1 and 4 are in vertical plane. It is especially important that these tubes, 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 5U4-GB. Type 5AS4 is a DISCONTINUED type listed for reference only.

**DIODE—SHARP-CUTOFF PENTODE**

5AS8

- Related type: 6AS8
- Miniature type used in diversified applications in television receivers employing series-connected heater strings. The pentode unit is used as an amplifier and the high-perveance diode as a detector or dc restorer. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AS8.

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

5AT8

- Related type: 6AT8A
- Miniature type used as combined oscillator and mixer tube in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AT8-A.

**FULL-WAVE VACUUM RECTIFIER**

5AU4

- Full-wave rectifier
- Glass octal type used as power supply in television receivers and other equipment having high dc requirements. Maximum dimensions: over-all length, 4-3/4 inches; seated height, 4-3/16 inches; diameter, 1-11/16 inches. Tube requires octal socket and must be used in vertical position; horizontal operation is permissible only 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, 3.75. For discussion of Rating Chart, refer to INTERPRETATION OF TUBE DATA.

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**Technical Data**

**Diode—Sharp-Cutoff Pentode**

- Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AS8.

**Medium-Mu Triode—Sharp-Cutoff Pentode**

- Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AT8-A.

**Full-Wave Vacuum Rectifier**

- Glass octal types used in power supply of television receivers having high dc requirements. Type 5AS4-A, Outline 10C, OUTLINES SECTION. Type 5AS4 maximum dimensions: over-all length, 5-1/8 inches; seated height, 4-9/16 inches; diameter, 2-1/16 inches. Type 5AS4-A may be supplied with pins 3, 5, and 7 omitted. Tubes require octal socket. Vertical mounting is preferred, but horizontal mounting is permissible if pins 1 and 4 are in vertical plane. It is especially important that these tubes, 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 5U4-GB. Type 5AS4 is a DISCONTINUED type listed for reference only.
RCA Receiving Tube Manual

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

Miniature type used in a wide variety of applications in television receivers. Employing series-connected heater strings, Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

**5AV8**

**HEATER VOLTAGE (AC/DC)**

| Grid to Plate | 1.5 | pf |
| Grid to Cathode and Heater | 2 | pf |
| Plate to Cathode and Heater | 0.34 | pf |

**Penode Unit:**

| Grid No. 1 to Plate | 0.08 | pf |
| 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 |
| Penode Grid No. 1 to Triode Plate | 0.005 | pf |
| Penode Plate to Triode Plate | 0.045 | pf |

**CLASS A AMPLIFIER**

**Maximum Ratings (Design-Center Values):**

| Plate Voltage | 300 mA | 300 mA | volts |
| Grid No. 2 Supply Voltage | 300 mA | volts |
| Grid No. 2 (Screen-Grid) Voltage | See curve page 70 |
| Grid No. 1 (Control-Grid) Voltage, Positive-bias Value | 0 mA | 0 mA | volts |
| Plate Dissipation | 2.5 mA | 2 mA | watts |
| Grid No. 2 Input | 50 mA | watt |
| For grid-No. 2 voltages up to 150 volts | See curve page 70 |
| For grid-No. 2 voltages between 150 and 300 volts | |

**Peak Heater-Cathode Voltage:**

- Heater negative with respect to cathode: 200 mA
- Heater positive with respect to cathode: 200 mA

**Characteristics:**

- Plate Supply Voltage: 200 volts
- Grid-No. 2 Supply Voltage: 200 volts
- Grid-No. 1 Voltage: 200 volts
- Cathode-Bias Resistor: 19 ohms
- Amplification Factor: 0.0018
- Plate Resistance (Approx): 1800 ohms
- Plate-No. 1 Voltage (Approx.) for plate current of 19 mA: 19.6 mA
- Plate Current | 19 | mA |

**Full-Wave Vacuum Rectifier**

Glass octal type used in power supplies of radio and television receivers, having high-frequency capabilities. Maximum ratings: over-all length 5-3/16 inches; seated length 4-5/8 inches; diameter 1-9/16 inches. Tube requires octal socket and may be operated in any position. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Filament volts (ac/dc) 5, amperes, 3.7. For discussion of Rating Chart, refer to INTERPRETATION OF TUBE DATA.

**5AW4**

**Full-Wave Rectifier**

- Maximum Ratings (Design-Center Values): 1550 mA, 750 mA
- Peak Plate Current (Per Plate): 1000 mA
- Hot-plate current (Per Plate) maximum duration 0.2 second: 4 mA, amperes
- AC Plate Supply Voltage (Per Plate, rms): See Rating Chart
- DC Output Current: See Rating Chart

**Typical Operation:**

| Plate to-plate Supply Voltage (rms) | 900 | volts |
| Grid-No. 2 Input Capacitor | 10 | μF |
| Effective Plate Supply Impedance per Plate | 150 | ohms |
| Grid-No. 1 Input Choke | 10 | henries |
| DC Output Voltage at Input to Filter (Approx.) | 250 | volts |
| DC Output Voltage at Input to Filter (Approx.) | 422 | volts |

**Characteristics, Instantaneous Value:**

- Tube Voltage Drop for plate current of 250 mA (per plate): 50 volts

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**5AZ4**

**Full-Wave Vacuum Rectifier**

Lock-in type used in power supply of radio equipment, having moderate de requirements. Outline 13B, OUTLINES SECTION. Tube requires lock-in socket. Filament volts (ac) 6.3, amperes, 2.5. Maximum ratings as full-wave rectifiers: peak plate voltage, 2400 volts; peak plate ma. (per plate), 375 mA; dc plate ma. 125 mA. This type is used principally for renewal purposes.

**Typical Operation:**

- Plate to-plate Supply Voltage (rms): 700, 1000 volts
- Grid-No. 1 Input Capacitor: 4, μF
- Total Effective Plate-Supply Impedance Per Plate: 10 ohms
- Grid-No. 1 Input Choke: 10 henries

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120
MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

5B8

Miniature type used as combined vhf oscillator and mixer in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater voltages (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds.

**CLASS A1, AMPLIFIER**

<table>
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<th>Maximum Ratings, (Design-Maximum Values):</th>
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<td><strong>Triode</strong> Unit</td>
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<td>----------------</td>
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<tr>
<td><strong>PLATE VOLTAGE</strong></td>
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<tr>
<td><strong>Grid-No.2 (Screen-Grid) Supply Voltage</strong></td>
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<td><strong>Grid-No.3 Voltage</strong></td>
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<td><strong>Grid-No.1 (Control-Grid) Voltage</strong></td>
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<tr>
<td><strong>Plate Dissipation</strong></td>
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<td><strong>Grid-No.2 Input:</strong></td>
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<tr>
<td>For grid-No.2 voltages up to 150 volts.</td>
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<tr>
<td>For grid-No.2 voltages between 150 and 300 volts.</td>
</tr>
<tr>
<td><strong>PEAK HEATER/CATHODE VOLTAGE:</strong></td>
</tr>
<tr>
<td>Heater negative with respect to cathode:</td>
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<tr>
<td>Heater positive with respect to cathode:</td>
</tr>
<tr>
<td><strong>Characteristics:</strong></td>
</tr>
<tr>
<td>Plate Supply Voltage</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
</tr>
<tr>
<td>Grid Voltage</td>
</tr>
<tr>
<td>Cathode Bias Resistor</td>
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<tr>
<td>Amplification Factor</td>
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<tr>
<td>Plate Resistance (Approx.)</td>
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<tr>
<td>Transconductance</td>
</tr>
<tr>
<td>Plate Current</td>
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<tr>
<td>Grid-No.2 Current</td>
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<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 10 ma</td>
</tr>
<tr>
<td>Maximum Circuit Voltages:</td>
</tr>
<tr>
<td>Grid-No.1-Circuit Resistance:</td>
</tr>
<tr>
<td>For fixed bias operation</td>
</tr>
<tr>
<td>For cathode bias operation</td>
</tr>
</tbody>
</table>

*The dc component must not exceed 100 volts.

**FULL-WAVE VACUUM RECTIFIER**

5BC3

Novar type used in power supplies of radio equipment and television receivers having high dc requirements. Outline 178, OUTLINES SECTION. Tube requires novar nine-contact socket. Vertical operation is preferred, but tube may be operated in horizontal position if pins 2 and 7 are in vertical plane. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Filament voltages (ac), 5; amperes, 3.

**Technical Data**

**FULL-WAVE RECTIFIER**

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peak Inverse Plate Voltage</strong></td>
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<tr>
<td><strong>Peak Plate Current</strong> (Per Plate)</td>
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<tr>
<td><strong>Hot-Switching Transient Plate Current (Per Plate)</strong></td>
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<tr>
<td><strong>AC Plate-Supply Voltage</strong> (Per Plate, rms)</td>
</tr>
<tr>
<td><strong>DC Output Current</strong> (Per Plate)</td>
</tr>
</tbody>
</table>

**Typical Operation with Capacitor Input to Filter:**

| AC Plate-to-Plate Supply Voltage (rms) | 600 | 900 | 1100 | volts |
| DC Output Voltage at Input to Filter: |
| At load current of: | 270 ma | 165 ma | 150 ma | 100 ma |
| 50 ma | 503 ma | 503 ma | 520 ma |

*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 6 amperes during the initial cycle of the hot-switching transient should not be exceeded.

**5BE8**

Miniature type used as combined vhf mixer and oscillator tube in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater voltages (ac), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Characteristics of triode unit as Class A1 amplifier: plate supply voltage, 120 (500 max); cathode bias resistor, 50 ohms; amplification factor, 40; plate resistance (approx.), 1000 ohms; transconductance, 8000 amhos; plate ma, 15; plate dissipation, 2.5 max watts. Pentode unit: plate supply voltage, 220 (500 max); grid-No.2 supply voltage, 110 (300 max); cathode bias resistor, 68 ohms; plate resistance (approx.), 0.4 megohm; transconductance, 3200 amhos; plate ma, 10; grid-No.2 ma, 3.5; plate dissipation, 2.5 max watts; grid-No.2 input, 0.6 max watt. This type is used principally for renewal purposes.
**RCA Receiving Tube Manual**

**MEDIUM-MU TWIN TRIODE**

5BK7A  
Related type: 6B27B  

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners utilizing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BK7-B.

5BQ7A  
Related types: 4B27A, 6BQ7A  

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 5.6; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BQ7-A.

5BR8  
Related type: 6B8A  

Miniature type used in a wide variety of applications in color and black-and-white television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BR8-A.

5BT8  

Miniature type used in a variety of applications in television receivers employing series-connected heater strings. The pentode unit is used as an rf amplifier, video amplifier, gate amplifier, or retrace tube. The diode unit is used in automatic-frequency-control and detector circuits. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Tube requires miniature nine-contact socket. Characteristics of pentode unit as class A amplifier: plate supply volts, 200 (300 max); grid-No.2 supply volts, 150 (300 max); cathode-bias resistor, 180 ohms; plate resistance (approx.), 0.3 megohm; transconductance, 6200 microhm; plate ma., 9.3; grid-No.2 ma., 2.3; plate dissipation, 2 watt watts; grid-No.2 input, 0.5 watt watts. Maximum diode plate ma. (each unit), 1 watt. This type is used principally for renewal purposes.

5BW8  
Related type: 6BW8  

Miniature type used in television receivers employing series-connected heater strings. The pentode unit is used as a sound if amplifier, sound limiter, and age keyer. The diodes are used as horizontal phase detectors. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BW8.

**Technical Data**

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

5CG8  
Related type: 6CG8  

Miniature type used as combined oscillator and mixer tube in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CG8-A.

5CL8  
Related type: 6CL8A  

Miniature type used as combined vhf oscillator and mixer in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, types 5CL8 and 6CL8-A are identical with miniature types 6CL8 and 6CL8-A, respectively. Type 5CL8 is a DISCONTINUED type listed for reference only.

5CM8  
Related type: 6CM8  

Miniature type used in television receivers employing series-connected heater strings. The pentode unit is used as an intermediate-frequency amplifier, a video amplifier, an agc amplifier, or as a retrace tube. The triode unit is used in sweep oscillator, sync separator, synchro, and phase splitter circuits. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6. Except for heater ratings, this type is identical with miniature type 6CM8.

5CQ8  
Related type: 6CQ8  

Miniature type used in a wide variety of applications in color and black-and-white television receivers employing series-connected heater strings. The tetrode unit is used as a mixer or amplifier and the triode unit is used in oscillator and rf amplifier circuits. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CQ8.

5CW5  
Related type: 6CW5  

Miniature type used as vertical deflection amplifier and as audio output tube in television and radio receivers employing series-connected heater strings. Outline 8E, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CW5.
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)**: 5 max amperes
- **Peak Plate Current, Transient Plate Current (Per Plate)**: See Rating Chart
- **AC Plate Supply Voltage** (Per Plate, rms, without load): 600 volts
- **DC Output Current** (Per Plate): See Rating Chart

* Typical Operating Conditions:*

- **Filter Input**
  - **Capacitor**: 1.0 mf
  - **Choke**: 10 henrys

- **Effective Plate-Supply Impedance**
  - **Per Plate**: 21 ohms

- **DC Output Voltage** (Approx.): 300 volts

*RATING CHART*

---

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

Miniature type used as combined oscillator and mixer in television receivers employing series-connected heater strings and operating at intermediate frequencies in the order of 40 megacycles. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6BAS.

---

**FULL-WAVE VACUUM RECTIFIER**

Glass octal type used in power supply of radio and television receivers having high dc requirements. Outline 8D, OUTLINES SECTION. Tube requires octal socket; operation in vertical position is preferred, but horizontal operation is permissible if pins 2 and 4.
SHARP-CUTOFF PENTODE

5EW6
Related types: 4EW6, 6EW6

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. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 5.6; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6EW6.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

5FG7
Related type: 6FG7

Miniature type used as combined oscillator and mixer tube in vhf television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6FG7.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

5FV8
Related type: 6FV8

Miniature type used as combined vertical deflection oscillator and general-purpose rf amplifier in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6FV8.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

5GH8
Related type: 6GH8

Miniature type used in multi-vibrator-type horizontal-deflection circuits in television receivers employing a series heater-string arrangement. Also used for age-amplifier or sync-separator applications in such receivers. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6GH8.

SEMIREMOTE-CUTOFF PENTODE

5GM6
Related type: 6GM6

Miniature type used in gain-controlled picture-if stages of television receivers employing series-connected heater strings and operating at intermediate frequencies in the order of 40 megacycles. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 5.6; amperes, 0.5; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6GM6.

Technical Data

SHARP-CUTOFF PENTODE

5GX6
Related type: 6GX6

Miniature type used for FM sound-detecting 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 controlled heater warm-up time for use in receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6GX6.

MEDIUM-MU TWIN TRIODE

5J6
Related types: 6J6, 19J6

Miniature type used as combined rf power amplifier and oscillator in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6J6.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

5KE8
Related type: 6KE8

Miniature type with frame-grid pentode unit used as combined oscillator-mixer tube in television receivers using an intermediate frequency in the order of 40 megacycles and employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 5.6; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6KE8.

FULL-WAVE VACUUM RECTIFIER

5T4

Metal type used in power supply of radio equipment having large dc requirements. Outline 6, OUTLINES SECTION. Tube requires octal socket. Vertical tube mounting is preferred if pins 2 and 4 are in vertical plane. Filament volts (ac), 6.6; amperes, 2.9. Maximum ratings as full-wave rectifier: peak inverse plate volts, 1600 max; peak plate ma. (per plate), 675 max; dc output ma., 225 max. This type is used principally for renewal purposes.

Typical Operation

<table>
<thead>
<tr>
<th>Filter Input</th>
<th>Capacitor</th>
<th>Choke</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.C. Plate-to-Plate Supply Voltage (rms)</td>
<td>900</td>
<td>1100</td>
</tr>
<tr>
<td>Filter-Input Capacitor</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Total Effective Plate-Supply (Impedance Per Plate)</td>
<td>150</td>
<td>10</td>
</tr>
<tr>
<td>Filter Input (Choke)</td>
<td>—</td>
<td>225</td>
</tr>
<tr>
<td>DC Output Current</td>
<td>225</td>
<td>225</td>
</tr>
<tr>
<td>DC Output Voltage at Input to Filter (Approx.)</td>
<td>580</td>
<td>485</td>
</tr>
<tr>
<td>At half-load current (11.5 ma.)</td>
<td>480</td>
<td>480</td>
</tr>
<tr>
<td>At full-load current (225 ma.)</td>
<td>450</td>
<td>50</td>
</tr>
<tr>
<td>Voltage Regulation (Approx.)</td>
<td>50</td>
<td>16</td>
</tr>
</tbody>
</table>

† When a filter-input capacitor larger than 40,000 uf is used, it may be necessary to use more plate-supply impedance than the value shown in order to limit the peak plate current to the rated value.
**TRIPLE DIODE—HIGH-MU TRIODE**

5T8

Miniature type used as combined AM detector, FM detector, and AF voltage amplifier in radio and television receivers employing series-connected heater strings. Outline 8B, 4.7\(\times\)amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts, 200 maz. When the heater is in positive with respect to the cathode, the dc component of the heater-cathode voltage must not exceed 100 volts. Except for heater and heater-cathode ratings, this type is identical with miniature type 6T8-A.

**FULL-WAVE VACUUM RECTIFIER**

5U4G 5U4GB

Glass octal types used in power supplies of radio and television receivers having high dc requirements. Type 5U4-GB, Outline 19D, OUTLINES SECTION. Type 5U4-G maximum dimensions: over-all length, 5-5/16 inches; seated height, 4-3/4 inches; diameter, 2-1/16 inches. Tubes require octal socket. Either type may be supplied with pins 3, 5, and 7 omitted. 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 these tubes, like other power-handling tubes, be adequately ventilated. For discussion of Rating Chart and Operation Characteristics, refer to INTERPRETATION OF TUBE DATA. Maximum ratings for type 5U4-GB as full-wave rectifier: peak inverse plate volts, 1550 maz; peak plate amperes per plate, 0.8 maz (transient, 4.0 max). Type 5U4-G is used principally for renewal purposes. Filament volts (ac), 5; amperes, 3.

**FULL-WAVE RECTIFIER**

Maximum Ratings, (Design-Center Values):

<table>
<thead>
<tr>
<th></th>
<th>Type 5U4-GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Plate Supply Voltage (rms)</td>
<td>600 maz</td>
</tr>
<tr>
<td>Peak Plate Current (Per Plate)</td>
<td>10.0 maz</td>
</tr>
<tr>
<td>Hot-Switching Transient Plate Current (Per Plate)</td>
<td>1.0 maz</td>
</tr>
<tr>
<td>AC Plate Supply Voltage (Per Plate, rms)</td>
<td>600 maz</td>
</tr>
<tr>
<td>DC Output Current (Per Plate)</td>
<td>1.0 maz</td>
</tr>
</tbody>
</table>

**RATING CHART**

![RATING CHART](chart)

Typical Operation of 5U4-GB with Capacitor Input to Filter:

- AC-Plate-to-Plate Supply Voltage (rms) 600 900 1100 volts
- Filter Input Capacitance 40 µf
- Total Effective Plate-Supply Impedance per Plate 21 67 97 ohms

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

5U8

Miniature type used as combined oscillator and mixer tube in AM/FM receivers and television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION.

Heater volts (ac/dc), 4.7\(\times\)amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6U8-A.
FULL-WAVE VACUUM RECTIFIER

5V3
5V3A

Glass octal types used as power supply in color television receivers and other equipment having high dc requirements. Outline 19D, OUTLINES SECTION. Tubes require octal socket. Vertical mounting is preferred, but horizontal mounting is permissible if pins 2 and 4 are in vertical plane. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. For discussion of Rating Chart, refer to INTERPRETATION OF TUBE DATA. Type 5V3 is a DISCONTINUED type listed for reference only. Filament volts (ac/dc), 5; amperes, 3.5 (5V3), 3(5V3-A).

FULL-WAVE RECTIFIER

<table>
<thead>
<tr>
<th>Design- Center Values</th>
<th>Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Inverse Plate Voltage</td>
<td>1400 mA</td>
</tr>
<tr>
<td>Peak Plate Current (Per Plate)</td>
<td>1.2 mA</td>
</tr>
<tr>
<td>Hot-Switching Transient Plate Current (Per Plate)</td>
<td>5.5 mA</td>
</tr>
<tr>
<td>C Plate-Supply Voltage (Per Plate, rms, without load)</td>
<td>See Rating</td>
</tr>
<tr>
<td>DC Output Current (Per Plate)</td>
<td>Chart</td>
</tr>
</tbody>
</table>

With capacitor-input filter for ac plate-supply volts (rms, per plate, without load) = 470,

typical Operation:

<table>
<thead>
<tr>
<th>5V3</th>
<th>5V3-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitor</td>
<td>Choke</td>
</tr>
<tr>
<td>AC Plate-to-Plate Supply Voltage (rms)</td>
<td>850</td>
</tr>
<tr>
<td>Filter-Input Capacitor</td>
<td>40</td>
</tr>
<tr>
<td>Effective Plate-Supply Impedance per Plate</td>
<td>56</td>
</tr>
<tr>
<td>Minimum Filter-Input Choke</td>
<td></td>
</tr>
<tr>
<td>DC Output Current</td>
<td>350</td>
</tr>
<tr>
<td>DC Output at Input to Filter (Approx.)</td>
<td>480</td>
</tr>
</tbody>
</table>

Characteristics:

5V3

Tube Voltage Drop for plate current of 350 ma (per plate) . . . . 47 | 42 | volts

When capacitor values greater than 40 μF are used, the effective plate-supply impedance should be increased so that the maximum rating for peak plate current is not exceeded.

OPERATION CHARACTERISTICS

<table>
<thead>
<tr>
<th>Filter Type</th>
<th>Type 5V3-GA 5V500-AGA 5V500-AGD 5V500-AGF 5V500-AGG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>550 V 550 V 550 V 550 V 550 V</td>
</tr>
<tr>
<td>Choke (Input)</td>
<td>400 400 400 400 400</td>
</tr>
<tr>
<td>Effective Plate-Supply Impedance</td>
<td>56 56 56 56 56</td>
</tr>
<tr>
<td>Minimum Filter-Input Choke</td>
<td>10 10 10 10 10</td>
</tr>
</tbody>
</table>

FULL-WAVE VACUUM RECTIFIER

5V4GA

Glass octal types used in full-wave power supplies having high dc requirements. Outlines 26 and 19A, respectively, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position. The heater is designed to operate from the ac line through a step-down transformer. The voltage at the heater terminals should be 5.0 volts.

BEAM POWER TUBE

5V6GT

Glass octal type used as output amplifier in television receivers employing series-connected heater strings. Outline 14C, OUTLINES SECTION.

This type may be supplied with pin No.1 omitted. Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 5V6-GT.

FULL-WAVE VACUUM RECTIFIER

5W4

Metal type 5W4 and glass-socket type 5W4-GT are used in power supply of radio equipment having low dc requirements. Outlines 5A and 14D, respectively, OUTLINES SECTION. Both types require octal socket. Filament volts (ac), 5.0; amperes, 1.5; Maximum ratings: peak inverse plate volts, 1400 ma; peak plate ma, 300 ma; dc output ma, 100 ma. These are DISCONTINUED types listed for reference only.
FULL-WAVE VACUUM RECTIFIER

Glass octal type used in power supply of radio equipment having large dc requirements. Maximum dimensions: over-all length, 5-3/16 inches; seated height, 4-3/4 inches; diameter, 2-1/16 inches. Filament volts, 5.0; amperes, 3.0. Tube requires octal socket. Maximum ratings as full-wave rectifier: peak inverse plate volts, 1550 maz; peak plate amperes per plate, 675 maz. Type 5X4-G is used principally for renewal purposes.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

5X8

Related types: 6X6, 19X6

Heater volts (ac/dc), 4.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater rating, this type is identical with miniature type 6X8.

FULL-WAVE VACUUM RECTIFIER

Glass octal types used in power supply of radio equipment having moderate dc requirements. Type 5Y3-G, Outline 26, type 5Y3-GT, Outline 14D, OUTLINES SECTION. Tubes require octal socket. Vertical tube mounting is preferred, but horizontal mounting is permissible if pins 2 and 8 are in horizontal plane. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. For discussion of Rating Chart and Operation Characteristics, refer to INTERPRETATION OF TUBE DATA. Maximum ratings for type 5Y3-G as full-wave rectifier: peak inverse plate volts, 1400 maz; peak plate ma. per plate, 375 maz. Type 5Y3-G is a DISCONTINUED type listed for reference only. Filament volts (ac), 5; amperes, 2.

FULL-WAVE RECTIFIER

Maximum Ratings, (Design-Center Values):

Peak Inverse Plate Voltage: 1400 maz volts

Peak Plate Current (Per Plate): 440 maz ma.

Hot-Switching Transient Plate Current (Per Plate): 2.5 maz amperes

AC Plate Supply Voltage (Per Plate, rms): See Rating Chart

DC Output Current (Per Plate): See Rating Chart

RATING CHART

FULL-WAVE VACUUM RECTIFIER

Glass octal types used in power supplies of radio equipment having moderate DC requirements. Outlines 26, 14D, and 19D, respectively, OUTLINES SECTION. Tubes require octal socket. Type 5Y4-GT is supplied
with pins 4 and 6 missing. Vertical tube mounting is preferred, but horizontal mounting is permissible; if pins 2 and 7 are in horizontal plane (5Y4-G); if pins 1 and 4 are in vertical plane (5Y4-GA); if pins 2 and 3 are in vertical plane (5Y4-GT). It is especially important that these tubes, like other power handling tubes, be adequately ventilated. For discussion of Rating Chart, refer to INTERPRETATION OF TUBE DATA. Maximum ratings for type 5Y4-G as full-wave rectifier: peak inverse plate volts, 1400 max.; peak plate ma. per plate, 375 max. (transient amperes, 2.2 max). Type 5Y4-G is a DISCONTINUED type listed for reference only. Filament volts (ac/dc), 5; amperes, 2.

FULL-WAVE RECTIFIER

<table>
<thead>
<tr>
<th>5Y4-GA</th>
<th>5Y4-GT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>1400 max volts</td>
</tr>
<tr>
<td>Peak Plate Current (Per Plate)</td>
<td>400 max ma</td>
</tr>
<tr>
<td>Hot-Plate Current</td>
<td>2.2 max amperes</td>
</tr>
<tr>
<td>AC Plate Supply Voltage (Per Plate, rms)</td>
<td>See Rating Chart</td>
</tr>
<tr>
<td>DC Output Current (Per Plate)</td>
<td>See Rating Chart</td>
</tr>
</tbody>
</table>

Typical Operation of 5Y4-GA & 5Y4-GT:

<table>
<thead>
<tr>
<th>Filter Input</th>
<th>Capacitor</th>
<th>Choke</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Plate-to-Plate Supply Voltage (rms)</td>
<td>700</td>
<td>1000 volts</td>
</tr>
<tr>
<td>Input Filter Capacitor</td>
<td>10</td>
<td>0.01 uf</td>
</tr>
<tr>
<td>Total Effective Plate-Supply Impedance per Plate</td>
<td>50</td>
<td>10 ohms</td>
</tr>
<tr>
<td>Filters Input Choke</td>
<td>125</td>
<td>125 ma</td>
</tr>
<tr>
<td>DC Output Current</td>
<td>125</td>
<td>125 ma</td>
</tr>
<tr>
<td>DC Output Voltage</td>
<td>350</td>
<td>390 volts</td>
</tr>
</tbody>
</table>

Characteristics, Instantaneous Values:

Tube Voltage Drop for plate current of 125 ma (per plate) | 60 volts

* Values of capacitance greater than 50 ma may be used, provided the plate-supply impedance is increased to prevent exceeding the maximum peak-plate-current rating.

FULL-WAVE VACUUM RECTIFIER

Glass type used in power supply of radio equipment having medium load requirements. Outline 28, OUTLINES SECTION. Tube requires four-contact socket. Vertical mounting is preferred but horizontal mounting is permissible if pins 1 and 4 are in horizontal plane. Plate filament volts (ac), 5.0; amperes, 5.0. Maximum ratings as full-wave rectifier: peak inverse plate volts, 1650 max.; peak plate ma. per plate, 675 ma. Type 5Z3 is used principally for radio purposes.

FULL-WAVE VACUUM RECTIFIER

Metal type used in power supply of radio equipment having moderate load requirements. Outline 5, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac), 5.0; amperes, 2.0. Maximum ratings: peak inverse plate volts, 1400 max.; peak plate ma. per plate, 375 max. Typical operation as full-wave rectifier with filament-input filter: plate to plate supply voltage (rms), 700; effective plate-supply voltage per plate, 50 ohms; dc output ma., 125. Typical operation with choke-input filter: ac plate-to-plate supply voltage, 1000; minimum filter-input choke, 5 henries; dc output ma., 125.

POWER TRIODE

Glass type used in output stage of radio receivers. Outline 28, OUTLINES SECTION. Tube requires four-contact socket. Filament volts (ac/dc), 6.5; amperes, 1.0. This tube is identical electrically with type 6B4-G. Type 6A3 is a DISCONTINUED type listed for reference only.

HIGH-MU TWIN POWER TRIODE

Glass type used in output stage of co-operated receivers as a class A power amplifier or with units in parallel as a class A amplifier to drive 6A6 as class B amplifier. Outline 27, OUTLINES SECTION. Tube requires medium seven-contact (0.056-inch, pin-circle diameter) socket. Filament volts (ac/dc), 6.5; amperes, 0.8. This type is electrically identical with type 6N7. Type 6A6 is a DISCONTINUED type listed for reference only.

PENTAGRID CONVERTER

Glass types used in superheterodyne circuits. Outline 24B, OUTLINES SECTION. These types require the small seven-contact (0.12-inch, pin-circle diameter) socket. Except for interelectrode capacitances, the 6A7 is identical electrically with type 6A8. Type 6A7S, now DISCONTINUED, has the external shield connected to cathode. In general, its electrical characteristics are similar to those of the 6A7, but the two types are usually not directly interchangeable. Type 6A7S is used principally for renewal purposes.

PENTAGRID CONVERTER

Metal type 6A8 and glass octal types 6A8-G and 6A8-GT used in superheterodyne circuits. 6A8 Outline 3, 6A8-G Outline 23, 6A8-GT Outline 15A, OUTLINES SECTION. Tube requires octal socket. Heater volts (ac/dc), 6.3; amperes, 0.3; characteristics as converter: plate and grid-No.2-supply volts, 250 (300 max); grid-No.3 and No.5 (screen-grid) supply volts, 100 max; grid-No.4 (control-grid) volts, 80 max; grid-No.2 (anode-grid) resistor, 20000 ohms (by-passed by 0.1-uf capacitor); grid-No.1 (oscillator-grid) resistor, 50000 ohms; plate resistance (approx.), 0.3 megohms; conversion transconductance, 560 microhms; plate ma., 3.5; grid-No.3 and No.5 ma., 2.7; grid-No.2 ma., 4; grid-No.1 ma., 0.4; total cathode ma., 10.6. 14 ma.; plate dissipation, 1 max watt; grid-No.3 and No.5 input, 0.3 max watt; grid-No.2 input, 0.75 max watt; peak heater-cathode volts, 90 max. These types are used principally for renewal purposes.

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 7B, OUTLINES SECTION. Tube requires 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.
RCA Receiving Tube Manual

**ELECTRON-RAY TUBE**

Glass octal type used to indicate visually by means of a fluorescent target the effects of changes in the controlling voltages. It is a twin-indicator type and is used as a conventional means of indicating accurate radio-receiver tuning. Maximum over-all length, 2-7/8 inches; maximum diameter, 1-6/16 inches. Heater voltages (ac/dc), 6.3; amperes, 0.15. Maximum ratings as class A; push-pull class A, plate dissipation, 10 mwa. This type is used principally for renewal purposes.

---

**SHARP-CUTOFF PENTODE**

Metal type used in rf and if stages of picture amplifier of television receivers particularly those employing automatic gain control. Outline 2, OUTLINES SECTION. Tube requires octal socket. Heater voltages (ac/dc), 6.3; amperes, 0.45. Maximum ratings at class A, plate and grid-No.2 supply voltages, 300 mwa; grid-No.3, connected to cathode at socket; grid-No.1 voltages for transconductance of 56 mwa, 0.025; plate ma, 12.5; grid-No.2 ma, 3.2. This type is used principally for renewal purposes.

---

**HIGH-MU POWER TRIODE**

Glass octal type used in single-ended or push-pull audio-frequency power amplifiers of the direct-coupled type in which a driver tube develops positive grid bias for the 6AC5GT output stage. Outline 14C, OUTLINES SECTION. This type may be supplied with pin No. 1 omitted. Tube requires octal socket. Heater voltages (ac/dc), 6.3; amperes, 0.4. Maximum ratings at push-pull class B, power amplifier: plate voltages, 250 mwa; plate ma, 110 mwa; average plate dissipation, 10 mwa. This type is used principally for renewal purposes.

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**LOW-MU TRIODE**

Glass octal type used as an audio amplifier in ac/dc radio receivers. Outline 14C, OUTLINES SECTION. Heater voltages (ac/dc), 6.3; amperes, 0.3. Maximum ratings at class A amplifier: plate voltages, 265 mwa; plate dissipation, 2.5 mwa. This is a DISCONTINUED type listed for reference only.

---

**LOW-MU TRIODE**

Glass octal type used as a voltage amplifier or as a driver for two type 6AC5GT tubes in dynamic-coupled, push-pull amplifiers. In the latter service, type 6AE7GT replaces two tubes ordinarily required as drivers. Outline 14C, OUTLINES SECTION. Heater voltages (ac/dc), 6.3; amperes, 0.5. This is a DISCONTINUED type listed for reference only.

---

**HALF-WAVE VACUUM RECTIFIER**

Miniature type used as a damper tube in horizontal deflection circuits of television receivers. Outline 9B, OUTLINES SECTION. Tube requires miniature nine-contact 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 voltages (ac/dc), 6.3; amperes, 1.2.

---

**DAMPER SERVICE**

For operation in a 355-line, 20-frame system

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Maximum Values):</th>
<th>4500 mwa volts</th>
<th>750 mwa ma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Plate Voltage (<em>A</em>)</td>
<td>185 mwa ma</td>
<td>185 mwa ma</td>
</tr>
<tr>
<td>Peak Plate Current (<em>A</em>)</td>
<td>300 mwa ma</td>
<td>300 mwa ma</td>
</tr>
<tr>
<td>Peak Heater Cathode Voltage:</td>
<td>4500 mwa volts</td>
<td>210 mwa</td>
</tr>
<tr>
<td>Heater negative with respect to cathode:</td>
<td>210 mwa</td>
<td>210 mwa</td>
</tr>
<tr>
<td>Bulb Temperature (At hottest point)</td>
<td>4500 mwa volts</td>
<td>750 mwa ma</td>
</tr>
</tbody>
</table>

* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 355-line, 20-frame system, 10 per cent of one horizontal scanning cycle is 10 microseconds.
* The dc component must not exceed 100 volts.
* 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 590 megacycles per second. 6AF4 Outline 7B, 6AF4-A Outline 7A, OUTLINES SECTION. Tubes require miniature seven-contact socket and may be mounted in any position.

HEATER VOLTAGE (AC/DC) ........................................ 6.3 volts
HEATER CURRENT .................................................... 0.225 amperes
DIRECT INTERELECTRODE CAPACITANCES:* Grid to Plate ................................. 1.9 pf Plate to Cathode and Heater ................. 2.2 pf Plate to Cathode and Heater ................. 2.4 pf Plate to Cathode ........................................... 2.2 pf Plate to Cathode* ........................................... 2.2 pf
* With external shield connected to cathode, except as noted.
** With external shield connected to plate.

Characteristics:

CLAS A, AMPLIFIER

Plate Supply Voltage ........................................... 80 volts
Cathode-Bias Resistor ......................................... 150 ohms
Amplification Factor ........................................... 13.5
Plate Resistance (Approx.) ................................... 2100 ohms
Transconductance .............................................. 6500 micromhos
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 .................................................... 2 max ma
PLATE DISSIPATION ............................................ 2.5 max watts
CATHODE CURRENT ............................................ 24 max ma
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode .................... 50 max volts
Heater positive with respect to cathode ................... 50 max volts

Typical Operation as Oscillator at 1000 Mc:
Plate Supply Voltage ........................................... 100 volts
Plate Resistor .................................................. 220 ohms
Grid Resistor ................................................... 18000 ohms
Plate Current .................................................... 17 ma
Grid Current (Approx.) ....................................... 750 ma

Maximum Circuit Values:

Grid-Circuit Resistance: ........................................ Not recommended
For fixed-bias operation 0.5 max megohms

The dc component must not exceed 25 volts.

ELECTRON-RAY TUBE

Glass octal used to indicate visually, by means of two shadows on the fluorescent target, the effects of change in the controlling voltages. It is a twin-indicator type and is used as a control meter of indicating accurate radio-receiver tuning. Maximum over-all length, 2-5/16 inches; maximum diameter, 1-5/16 inches.

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, 220 max; peak heater-cathode volts, 95 max. Typical operation: fluorescent-target volts, 220; fluorescent-target ma., 9.7; ray-control-electrode volts (approx. for 90° shadow angle), 165; ray-control-electrode volts (approx. for 100° shadow angle), 0.

DUAL TRIODE—SHARP-CUTOFF PENTODE

Duodeca type used in a variety of applications in television receivers. The high-mu triode unit is used for aq keyer service, the medium-mu triode unit for sync separator service, and the pentode unit for video amplifier service. Outline 12C, OUTLINES SECTION. Tube requires duodeca twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.05.

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

Triode Triode Pentode

PLATE VOLTAGE ................................................. 350 max volts 330 max volts 330 max volts
GRID-NO. 2 SCREEN-GRID SUPPLY VOLTAGE .............. – – 320 max volts
GRID-NO. 2 VOLTAGE ......................................... – – See curve page 70
GRID-NO. 1 (CONTROL-GRID) VOLTAGE, Positive-
bias value ....................................................... 0 max 0 max 0 max volts
GRID-NO. 2 INPUT:
For grid-No. 2 voltages up to 165 volts .................. – – 1.25 max watts
For grid-No. 2 voltages between 185 and 330 volts .......... – – See curve page 70
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

Characteristics:

Plate Supply Voltage ........................................... 200 volts 200 volts 200 volts
GRID-NO. 2 SUPPLY VOLTAGE ................................ – – 200 volts
GRID-NO. 1 VOLTAGE ......................................... – – –
Cathode-Bias Resistor ......................................... 220 100 ohms
Amplification Factor ........................................... 68 41 –
Plate Resistance (Approx.) .................................. 12400 9400 68000 ohms
Transconductance .............................................. 8550 4400 110000 micromhos
Plate Current .................................................... 7 9.2 24 ma
GRID-NO. 2 CURRENT ........................................... – – 4.9 ma
GRID-NO. 1 VOLTAGE (Approx.) for plate current of 100 µa: – – 4.9 volts

Maximum Circuit Values:

GRID-NO. 1 CURRENT RESISTANCE: ........................................ Not recommended
For fixed-bias operation 0.5 max megohms
For cathode-bias operation 1 max megohms

The dc component must not exceed 100 volts.

SHARP-CUTOFF PENTODE

Minature type used in compact radio equipment as an rf if amplifier up to 400 megacycles per second. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Except for slightly different
characteristics, this type is similar electrically to miniature type 6BC5. Heater volts (ac/dc), 6.3; amperes, 0.3. For typical operation as a resistance-coupled amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION.

POWER PENTODE

6AG7

Metal type used in output stage of video amplifier of television receivers. Outline 5, OUTLINES SECTION. Tube requires octal socket. Heater volts (ac/dc), 6.3; amperes, 0.65. Typical operation as class A amplifier: plate volts, 300 maz; grid No.3 connected to cathode at socket; grid-No.2 volts, 150 (360 maz); grid-No.1 volts, -5 (0 maz); peak grid-No.1 volts, 3; plate ma., 30 (zero signal), 20.5 (maximum signal); grid-No.2 ma., 7 (zero signal); 9 (maximum signal); plate resistance (approx.), 0.13 megohm; transconductance, 1100 mhos; load resistance, 10000 ohms; maximum-signal power output, 3 watts; plate dissipation, 9 maz watts; grid-No.2 input, 1.5 maz watts.

LOW-MU TRIODE

6AH4GT

Glass octal type having high plate current used as vertical deflection amplifier in television receivers. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.35. Characteristics as class A amplifier: plate volts, 250; grid volts, -32; amplification factor, 6; plate resistance (approx.), 1700 ohms; transconductance, 4500 mhos; plate ma., 30.

Maximum ratings as vertical-deflection amplifier (for operation in 525-line, 30-frame system); de plate volts, 500 maz; peak negative plate voltage, 2000 maz; peak negative-grid voltage, 200 maz; peak cathode ma., 150 maz; average cathode ma., 60 maz; plate dissipation, 7.5 maz watts; peak heater-cathode volts, 200 maz (these components must not exceed 100 volts). This type is used principally for renewal purposes.

SHARP-CUTOFF PENTODE

6AH6

Miniature type used as if amplifier in video stages of television receivers. Outline 9B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.16. Characteristics as class A amplifier: plate volts, 300 maz; grid-No.3 connected to cathode at socket; grid-No.2 supply volts, 150 (300 maz); cathode-bias resistor, 160 ohms; plate resistance (approx.), 0.13 megohm; transconductance, 900 mhos; plate ma., 5; grid-No.2 ma., 2.5; plate dissipation, 3.2 maz watts; peak heater-cathode volts, 90 maz. This type is used principally for renewal purposes.

SHARP-CUTOFF PENTODE

6AK5

Miniature type used as an rf or if amplifier, especially in high-frequency wide-band applications. It is useful as an amplifier at frequencies up to 400 megacycles per second. Outline 7A, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

HEATER VOLTAGE (AC/DC) 6.3 volts
HEATER CURRENT 0.175 amperes
DIRECT INTERELECTRODE CAPACITANCES (Approx.):
Grid No.1 to Plate 0.02 maz pF
Grid No.1 to Plate 0.02 maz pF
Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield 4.0 pF

TECHNICAL DATA

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Center Values):
PLATE VOLTAGE 180 maz volts
GRID-No.2 (SCREEN-GROUND) VOLTAGE 180 maz volts
GRID-No.2 SUPPLY VOLTAGE 180 maz volts
GRID-No.1 VOLTAGE, Positive-bias value 180 maz volts
PLATE DISSIPATION 1.7 maz watts
GRID-No.2 INPUT:
For grid-No.2 voltages up to 150 maz:
For grid-No.2 voltages between 150 and 300 maz:
CATHODE CURRENT:
Heater negative with respect to cathode:
Heater positive with respect to cathode:
Characteristics:
PLATE SUPPLY VOLTAGE 120 volts
GRID-No.2 SUPPLY VOLTAGE 120 volts
CATHODE-BIAS VOLTAGE 120 volts
PLATE DISSIPATION: 90 maz watts
TRANSCONDUCTANCE:
GRID-No.1 Voltage for plate current of 20 maz:
GRID-No.2 Current:
GRID-No.2 Current:
* With external shield connected to pins 2 or 7.

HALF-WAVE VACUUM RECTIFIER

6A3L

Miniature type used as damper tube in horizontal-deflection circuits of television receivers. Outline 9C, OUTLINES SECTION. Tube requires miniature nine-contact 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 maz volts
PEAK PLATE CURRENT 550 maz ma
DC PLATE CURRENT 220 maz ma
PLATE DISSIPATION: 5 maz watts
PEAK HEATER-CATHODE VOLTAGE 6600 maz volts
* Under no circumstances should this absolute value be exceeded.
* The duration of the voltage pulse must not exceed 15 percent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 percent of one horizontal scanning cycle is 10 microseconds.

TWIN DIODE

6AL5

Miniature, high-persistence 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 sections can be combined in parallel or full-wave bridge circuits. Resonant frequency of each unit is approximately 700 megacycles per second. Outline 7A, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

HEATER VOLTAGE (AC/DC) 6.3 volts
HEATER CURRENT 0.3 amperes
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 3.4 pf
Cathode No.3 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 0.008 maz pf

6AL15
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HALF-WAVE RECTIFIER

Maximum Ratings, (Design-Maximum Values):
- PEAK INVERSE PLATE VOLTAGE: 350 max volts
- PEAK PLATE CURRENT (Per Plate): 54 max ma
- PEAK CURRENT (Per Plate): 9 max ma

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 330 max volts
- Heater positive with respect to cathode: 310 max volts

Typical Operation:
- A.C. Plate Voltage per Plate (rms): 117 volts
- D.C. Output Current per Plate: 90 ma

AVERAGE CHARACTERISTICS
MAP-WAVE RECTIFICATION SINGLE DIODE

Type 6A5S
- E= 6.3 VOLTS

ELECTRON-RAY TUBE

Glass octal type used to indicate visually on a pair of rectangular fluorescent patterns the effects of changes in voltages applied to its grid and three deflecting electrodes. It is especially useful in testing the requirements for accurate tuning in FM receivers. Maximum dimensions: over-all length, 2-1/16 inches; overall height, 2-1/2 inches; diameter, 1-9/32 inches. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.15. Maximum ratings in indicator service: fluorescent-tube volts, 365 max, 220 min; peak heater-cathode volts, 90 max. Typical operation in indicator service: fluorescent-tube volts, 365; deflecting electrodes Nos. 1, 2, and 3 volts; 6; cathode volts (approx.), 3500 ohms; deflection sensitivity (approx.), 1 mm/volt; grid volts for fluorescence cutoff, -7. This type is used principally for renewal purposes.

BEAM POWER TUBE—SHARP-CUTOFF PENTODE

Duodecaval type used as FM detector and audio-frequency output amplifier in television receivers. Outline 12B, OUTLINES SECTION. Tube requires duodecaval twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.9.

MAXIMUM RATINGS, (Design-Maximum Values):
- PLATE VOLTAGE: 330 max volts
- GRID-NO. 2 VOLTAGE: 275 max volts
- GRID-NO. 2 INPUT: 25 max volts

Technical Data

PEAK HEATER-CATHODE VOLTAGE:
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200*max volts

Typical Operation:
- Plate Voltage: 250 volts
- Grid-No. 1 (Control-Grid) Voltage: 250 volts
- Grid-No. 1 (Control-Grid) Voltage: 8 volts
- Peak AF Grid-No. 1 Voltage: 8 volts
- Zero-Signal Plate Current: 0.25 ma
- Maximum-Signal Plate Current: 35 ma
- Zero-Signal Grid-No. 2 Current: 2.6 ma
- Maximum-Signal Grid-No. 2 Current: 7 ma
- Plate Res.istance (Approx.): 0.1 megohm
- Transconductance: 5000 µmhos
- Load Resistance: 5000 ohms
- Total Harmonic Distortion: 10% per cent.
- Maximum-Signal Power Output: 4.2 watts

Maximum Circuit Values:
- Grid-No. 1-Circuit Resistance:
  - For fixed-bias operation: 0.25 max megohm
  - For cathode-bias operation: 0.5 max megohm

* The dc component must not exceed 10 volts.

PENTODE UNIT AS A. 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: 1.2 ma
- Grid-No. 2 Current: 2.1 ma
- Grid-No. 1 Voltage (Approx.) for plate current of 30 ma: -4.5 volts
- Grid-No. 3 Voltage (Approx.) for plate current of 50 ma: -4.5 volts

PENTODE UNIT AS FM DETECTOR

Characteristics:
- PLATE VOLTAGE: 330 max volts
- GRID-NO. 2 VOLTAGE: 275 max volts
- GRID-NO. 2 SUPPLY VOLTAGE: 330 max volts
- GRID-NO. 2 VOLTAGE: See curve page 70
- GRID-NO. 1 (CONTROL-GRID) VOLTAGE: Positive-bias value: 100 volts
- GRID-NO. 1 INPUT: 1.7 max watts
- GRID-NO. 2 INPUT: See curve page 70
- PEAK HEATER-CATHODE VOLTAGE:
  - Heater negative with respect to cathode: 200 max volts
  - Heater positive with respect to cathode: 200*max volts

* The dc component must not exceed 100 volts.

HIGH-MU TRIODE

Miniature type used as mixer and rf amplifier in cathode-driver circuits of u.h.f. television receivers. Outline 8A, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.225; characteristics as class A amplifier; plate-supply volts, 200 max; cathode bias, 100 ohms; amplification factor, 85; plate resistance (approx.) 8700 ohms; transconductance, 3500 µmhos; plate ma., 16; plate dissipation, 2 max watts; peak heater-cathode volts, 80 max. This type is used principally for renewal purposes.

6AM4
**DIODE—SHARP-CUTOFF PENTODE**

**6AM8**

Miniature types used in diversified applications in television receivers. Type 6AM8-A has a controlled heater warm-up time for use in receivers employing series-connected heater strings.

The pentode unit is used as an if amplifier, video amplifier, or age amplifier. The high-pervasance diode is used as an audio detector, video detector, or dc restorer.

Outline 5B, OUTLINES SECTION. Tubes require miniature nine-contact socket and may be mounted in any position. Type 6AM8 is a DISCONTINUED type listed for reference only.

**HEATER VOLTAGE (AC/DC)**

| Voltage | 6.3 volts |

**HEATER CURRENT**

| Current | 0.45 ampere |

**HEATER WARM-UP TIME (Average) for 6AM8-A**

| Time | 11 seconds |

**DIRECT INTERELECTRODE CAPACITANCES**

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode Unit</td>
<td>1.8 pf</td>
</tr>
<tr>
<td>Cathode to Plate and Heater</td>
<td>3 pf</td>
</tr>
<tr>
<td>Pentode Unit</td>
<td>6.015 max</td>
</tr>
<tr>
<td>Grid No.1 to Plate</td>
<td>6.3 pf</td>
</tr>
<tr>
<td>Grid No.1 to Cathode, Plate</td>
<td>0.006 max</td>
</tr>
<tr>
<td>Pentode Plate to Diode Cathode</td>
<td>0.15 max</td>
</tr>
<tr>
<td>Pentode Plate to Diode Plate</td>
<td>0.1 max</td>
</tr>
</tbody>
</table>

**PENTODE UNIT AS CLASS A1 AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

| Voltage | 330 max volts |
| Grid No.2 (Suppression-Grid) Voltage | 350 max volts |
| Grid No.2 Voltage | See curve page 70 |
| Grid No.2 Control-Grid Voltage | 0 max volts |
| Plate Dissipation | 3.2 max watts |
| Grid No.2 Input | 0.55 max watt |
| For grid-No.2 voltages up to 165 volts | |
| For grid-No.2 voltages between 165 and 330 volts | See curve page 70 |

**Peak Heater-Cathode Voltage:**

- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200 max volts

**Characteristics:**

- Plate Supply Voltage: 125 volts
- Grid No.2: Connected to cathode at socket
- Grid-No.2 Supply Voltage: 155 volts

---

**Technical Data**

**Cathode-Bias Resistor**

| Resistance | 58 ohms |
| Resistance (Approx.) | 3.9 megohm |
| Grid-No.1 Voltage (Approx.) for plate current of 20 ma | 6 volts |
| Grid-No.2 Voltage (Approx.) for plate current of 2 ma and cathode bias resistor of 0 ohms | 3 volts |
| Plate Current | 12.5 ma |
| Grid-No.2 Current | 3.2 ma |

**Maximum Circuit Values:**

| Value | 0.25 max megohm |
| Value | 1.0 max megohm |

**DODE UNIT**

**Maximum Ratings, (Design-Maximum Values):**

| Value | 5.0 max ma |
| Value | 200 max volts |
| Value | 200 max volts |

*The dc component must not exceed 160 volts.*

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**HIGH-MU TRIODE—SHARP-CUTOFF PENTODE**

**6AN4**

Miniature type used as mixer or if amplifier in cathode-drive circuits of uhf television tuners covering the frequency range of 370 to 850 megacycles per second. Outline 7A, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (AC/DC), 6.3; amperes, 0.225.

**CLASS A1 AMPLIFIER**

**Maximum Ratings, (Design-Center Values):**

| Voltage | 300 max volts |
| Plate Voltage | 4.0 max watts |
| Cathode-Bias Voltage | 30 max volts |
| Peak Heater-Cathode Voltage | 200 max volts |
| Heater negative with respect to cathode: 200 max volts |
| Heater positive with respect to cathode: 200 max volts |

**Characteristics:**

- Plate Supply Voltage: 200 volts
- Cathode-Bias Factor: 100 ohms
- Amplification Factor: 10000
- Plate Current | 10 ma |
| Grid No.2 Voltage (Approx.) for plate current of 20 ma | 2.7 volts |

**Maximum Circuit Values:**

| Value | 0.1 max megohm |
| Value | 0.5 max megohm |

*The dc component must not exceed 100 volts.*

---

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

**6AN8**

Miniature types used in a wide variety of applications in color television receivers. The 6AN8-A has a controlled heater warm-up time for use in receivers employing series-connected heater strings. The pentode unit is used as an intermediate-frequency amplifier, a video amplifier, an age amplifier, or as a reactance tube. The triode unit is used in low-frequency oscillator, sync-separator, sync-clipping, and phase-splitter circuits. Outline 8B, OUTLINES SECTION. Tubes require miniature nine-contact socket and may be mounted in any position. Type 6AN8 is a DISCONTINUED type listed for reference only.

**HEATER VOLTAGE (AC/DC)**

| Voltage | 6.3 volts |

**HEATER CURRENT**

| Current | 0.45 ampere |

**HEATER WARM-UP TIME (Average) 6AN8-A**

| Time | 11 seconds |
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**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 No. 3, and Grid No. 4: 2.4 pf
  - Plate to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal 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

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- **Triode Unit**
  - Plate Voltage: 320 max volts
  - Grid-No. 2 Supply Voltage: 320 max volts
  - Grid-No. 2 Screen (Grid) Voltage: See curve page 70
  - Grid-No. 1 (Control-Grid) Voltage, Positive-bias Value: 0 max volts
  - Grid-No. 2 Input: 2.9 max watts
  - For grid-No. 2 voltages up to 165 volts: 0.65 max watt
  - For grid-No. 2 voltages above 165 and 320 volts: See curve page 70
  - Peak Heater-Cathode Voltage:
    - Heater negative with respect to cathode: 200 max volts
    - Heater positive with respect to cathode: 200 max volts

**Characteristic Ratings:**
- Plate Supply Voltage: 150 volts
- Grid-No. 2 Supply Voltage: 75 volts
- Grid-No. 1 Voltage: 125 volts
- Grid-No. 2 Bias Resistor: 50 ohms
- Plate Supply Voltage: 150 volts
- Grid-No. 2 Supply Voltage: 75 volts
- Grid-No. 1 Voltage: 125 volts
- Grid-No. 2 Bias Resistor: 50 ohms
- Amplification Factor:
  - Plate Resistance (Approx.)
  - Transformer Resistance (Approx.)
  - Transformer Resistance (Approx.)
  - Transformer Resistance (Approx.)
  - Transformer Resistance (Approx.)

**Maximum Circuit Values:**
- Grid-No. 1-Circuit Resistance:
  - For fixed-bias operation: 0.6 max ohms
  - For fixed-bias operation: 0.6 max ohms
  - For fixed-bias operation: 0.6 max ohms
  - For fixed-bias operation: 0.6 max ohms

**BEAM POWER TUBE**

**6AQ5**

**6AQ5A**

Related types: 6AQ7, 12AQ5

**6AQ5-A**

- Miniature types used as output amplifiers primarily in the automobile receivers and in ac-operated receivers and, triode-connected, as vertical deflection amplifiers in television receivers.
- Type 6AQ5-A has a controlled heater-warm-up time for use in television receivers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Tubular sockets require a seven-contact socket and may be mounted in any position. Within their maximum ratings, the performance of these types is equivalent to that of larger types 6V6 and 6V6-GTA. Type 6AQ5 is a DISCONTINUED type listed for reference only.

**HEATER VOLTAGE (AC/DC):** 4.8 volts
**HEATER CURRENT:** 0.45 ampere
**HEATER WARM-UP TIME (Average) for 6AQ5-A:** 11 seconds

**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:
- 47 volts
- Grid No. 2 connected to plate: plate grid No. 2 volts, 250; grid No. 1 volts, -12.5; plate ma, 49.5.

---

**AVERAGE CHARACTERISTICS**

**PENTODE CONNECTION**

**AVERAGE CHARACTERISTICS**

**TRIODE CONNECTION**

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- Plate Voltage: 275 max volts
- Grid-No. 2 (Screen-Grid) Voltage: 275 max volts
- Plate Dissection: 1950 max watts
- Grid-No. 1 Input: 2.9 max watts
- Peak Heater-Cathode Voltage:
  - Heater negative with respect to cathode: 200 max volts
  - Heater positive with respect to cathode: 200 max volts

**BULB TEMPERATURE (At hottest point):**
- 250°C

**Typical Operation:**
- Same as for type 6V6-GTA within the limitations of the maximum ratings.

**Maximum Circuit Values:**
- Grid-No. 1-Circuit Resistance:
  - For fixed-bias operation: 0.1 max ohms
  - For fixed-bias operation: 0.5 max ohms

---

![Diagram](image-url)
### RCA Receiving Tube Manual

#### VERTICAL DEFLECTION AMPLIFIER (Triode Connection)

For operation in a 325-line, 20-frame system.

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC PLATE VOLTAGE</td>
</tr>
<tr>
<td>PEAK POSITIVE-PULSE PLATE VOLTAGE</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE GRID-NO.1 (CONTROL-GRID) VOLTAGE</td>
</tr>
<tr>
<td>PEAK cathode CURRENT</td>
</tr>
<tr>
<td>AVERAGE cathode CURRENT</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
</tr>
<tr>
<td>BUILD TEMPERATURE (At hottest point)</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

- Grid-No.1 Circuit Resistance: 2.2 max megohms
- For cathode-bias operation.

**6AQ6**

#### TWIN DIODE—HIGH-MU TRIODE

A miniature type used as a combined detector, amplifier, and sweep tube in compact radio receivers. Outline 7B, OUTLINES SECTION.

- Heaters and characteristics of triode unit as class A amplifier: plate volts, 250 (300 max); grid volts, 3; amplification factor, 70; plate resistance (approx.), 58000 ohms; transconductance, 1200 µhos; plate ma., 1 peak heater-cathode volts, 90 max. This type is used principally for renewal purposes.

**6AQ7GT**

#### TWIN DIODE—HIGH-MU TRIODE

Glass octal type used as F.M. detector and audio amplifier in circuits which require diode and triode units with separate cathodes. Outline 14C, OUTLINES SECTION.

- Heaters and characteristics of octal socket: heater volts (ac/dc), 6.3; amperes, 0.3. Ratings and characteristics of triode unit as class A amplifier: plate volts, 250 max; grid volts, 2; amplification factor, 70; plate resistance (approx.), 44000 ohms; transconductance, 1600 µhos; plate ma., 2.3. This type is used principally for renewal purposes.

**6AQ8**

#### HIGH-MU TWIN TRIODE

A miniature type used as r.f. amplifier and self-oscillating mixer in F.M./AM radio receivers. Outline 8B, OUTLINES SECTION.

- Heaters and characteristics of r.f. amplifier: plate volts, 200 max; grid volts, 2.3; class A characteristics of triode unit: plate ma, 19; plate resistance (approx.), 9700 ohms; transconductance, 5900 µhos; amplification factor, 57.

**Technical Data**

<table>
<thead>
<tr>
<th>Typical Operation, (Each Unit):</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Amplifier</td>
</tr>
<tr>
<td>Plate Supply Voltage</td>
</tr>
<tr>
<td>Plate Voltage</td>
</tr>
<tr>
<td>Plate Resistance</td>
</tr>
<tr>
<td>Grid Resistor</td>
</tr>
<tr>
<td>Grid Voltage</td>
</tr>
<tr>
<td>Cathode Resistor</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
</tr>
<tr>
<td>Transconductance</td>
</tr>
<tr>
<td>Conversion Transconductance</td>
</tr>
<tr>
<td>Input Resistance at frequency (Mc) = 100</td>
</tr>
<tr>
<td>Plate Current</td>
</tr>
<tr>
<td>Equivalent Noise Resistance</td>
</tr>
<tr>
<td>Maximum Circuit Values, (Each Unit):</td>
</tr>
<tr>
<td>Grid-Cathode Resistance</td>
</tr>
<tr>
<td>Resistance between Cathode and Grid</td>
</tr>
</tbody>
</table>

**POWER PENTODE**

A miniature type used as output tube primarily in automobile receivers and ac-operated receivers. Outline 7C, OUTLINES SECTION.

- Heaters and characteristics of r.f. amplifier: plate volts (ac/dc), 6.3; amperes, 0.4. Maximum ratings and characteristics of triode unit: plate volts, 250 max; grid volts, 5; amplification factor, 70; plate resistance (approx.), 58000 ohms; transconductance, 1200 µhos; plate ma., 1 peak heater-cathode volts, 90 max. Within its maximum ratings, type 6A5 is equivalent in performance to a similar type 6K6-GT. Type 6AR5 is used principally for renewal purposes.

**SEMIREMOTE-CUTOFF TWIN PENTODE**

Duodecane type used as rf-amplifier tube in television receivers. Outline 11A, OUTLINES SECTION.

- Heaters and characteristics of r.f. amplifier: plate volts, 250 max; grid volts, 5; amplification factor, 70; plate resistance (approx.), 9700 ohms; transconductance, 5900 µhos; amplification factor, 57.

**6AR5**

**6AR11**

Related type: 11AR11

#### CLASS A AMPLIFIER

**Value for each unit**

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
</tr>
<tr>
<td>330 max volts</td>
</tr>
<tr>
<td>GRID-NO.3 (SUPPRESSOR-GRID) Voltage, Positive value</td>
</tr>
<tr>
<td>GRID-NO.5 (SCREEN-GRID) SUPPLY VOLTAGE</td>
</tr>
<tr>
<td>GRID-NO.6 VOLTAGE</td>
</tr>
<tr>
<td>GRID-NO.1 (CONTROL-GRID) VOLTAGE, Positive-bias value</td>
</tr>
<tr>
<td>GRID-NO.2 INPUT:</td>
</tr>
<tr>
<td>For grid-No.2 voltages up to 165 volts</td>
</tr>
<tr>
<td>For grid-No.2 voltages between 165 and 330 volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
</tr>
<tr>
<td>8.1 max watts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
</tr>
<tr>
<td>2000 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
</tr>
<tr>
<td>2000 max volts</td>
</tr>
</tbody>
</table>

**Characteristics, (Each Unit):**

- Plate Supply Voltage: 125 volts
- Grid No.3: 125 volts
- Grid-No.5 Supply Voltage: 60 ohms
- Cathode-Bias Resistor: 0.9 megohms
- Plate Resistance (Approx.): 10500 ohms
- Transconductance: 11 µhos
- Plate Current: 8.4 max
- Grid-No.2 Current: 15 volts
- Grid-No.1 Voltage (Approx.) for transconductance of 90 µhos

The dc component must not exceed 100 volts.

---

1. The duration of the voltage pulse must not exceed 16 per cent of one vertical scanning cycle. In a 325-line, 20-frame system, 16 per cent of one vertical scanning cycle is 2.3 milliseconds.

2. The dc component must not exceed 100 volts.
BEAM POWER TUBE

Miniature type used as output amplifier primarily in automobile and in so-operated receivers. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. For curves of average plate characteristics, refer to type 3SC5.

HEATER VOLTAGE (AC/DC)............. 6.3 volts
HEATER CURRENT................... 0.8 amperes
DIRECT INTERELECTRODE CAPACITANCES (Approx.)
Grid No. 1 to Plate.................. 0.9 pf
Grid No. 1 to Cylinder Plate........ 7.0 pf
Plate to Grid No. 3.................. 9.0 pf
CLASS A, AMPLIFIER
Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE.......................... 150 volts
GRID-NO. 2 VOLTAGE.................. 140 volts
PLATE DISSIPATION..................... 150 watts
GRID-NO. 2 DISSIPATION.............. 150 watts
PLATE CURRENT......................... 0.5 ma
GRID-NO. 2 CURRENT................... 0.3 ma
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode............. 100 volts
Heater positive with respect to cathode............... 100 volts
BULB TEMPERATURE (At hottest point)........... 250°C

Typical Operation:
Plate Voltage.......................... 150 volts
Grid-No. 2 Voltage.................. 140 volts
GRID-NO. 1 Voltage.................. 8.5 volts
Grid-No. 1 (Control-Grid) Voltage........ 7.0 volts
Zero-Signal Plate Current............. 1.0 ma
Maximum-Signal Plate Current.............. 3.5 ma
Zero-Signal Grid-No. 2 Current (Approx.) 2.5 ma
Maximum-Signal Grid-No. 2 Current (Approx.) 6.5 ma
Transconductance..................... 8000 anhos
Load Resistance...................... 5000 ohms
Total Harmonic Distortion................ 10 per cent
Maximum-Signal Power Output........... 2.2 watts

Maximum Circuit Values:
Grid-No. 1-Circuit Resistance:
For fixed-bias operation............. 0.1 max megohm
For cathode-bias operation............ 0.5 max megohm

DIODE

SHARP-CUTOFF PENTODE

Miniature type used in diversified applications in television and radio receivers. The pentode unit is used as an if amplifier, video amplifier, or age amplifier. The high-impedance diode is used as an audio detector, video detector, or dc restorer. Outline 8B, 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 amperes
DIRECT INTERELECTRODE CAPACITANCES:
Diode Unit:
Plate to Cathode, Heater, Pentode Grid No. 3, and Internal Shield 3.0 pf
Grid No. 1 to Plate.................. 0.02 max pf
Grid No. 1 to Cylinder Plate........ 7.0 pf
Plate to Grid No. 3.................. 9.0 pf
Plate to Diode Plate................. 10.0 pf

PENTODE UNIT AS CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE.......................... 350 volts
GRID-NO. 2 VOLTAGE.................. 350 volts
GRID-NO. 3 (SCREEN-GRID) VOLTAGE........ 350 volts
GRID-NO. 2 SUPPLY VOLTAGE............ 350 volts
GRID-NO. 1 (CONTROL-GRID) VOLTAGE........ 350 volts
Positive bias value.................. 0 volts
PLATE DISSIPATION..................... 200 watts
GRID-NO. 2 DISSIPATION.............. 200 watts
For grid-No. 2 voltages up to 150 volts...
For grid-No. 2 voltages up to 300 volts...
See curve page 70
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode...
Heater positive with respect to cathode...
BULB TEMPERATURE (At hottest point)........... 250°C

Typical Operation:
Plate Voltage.......................... 350 volts
Grid-No. 2 Voltage.................. 350 volts
Grid-No. 3 and Internal Shield........ 350 volts
GRID-NO. 2 Supply Voltage............ 350 volts
Cathode-Bias Resistor............... 350 ohms
Plate Resistance (Approx.)........... 350000 ohms
Transconductance..................... 6000 umhos
Grid-No. 1 Voltage (Approx.) for plate current of 10 ma...
Plate Current......................... 9.5 ma
GRID-NO. 2 Current................... 6.5 ma

Maximum Circuit Values:
Grid-No. 1-Circuit Resistance:
For fixed-bias operation............. 0.25 max megohm
For cathode-bias operation............ 0.10 max megohm

DIODE UNIT

Maximum Ratings, (Design-Maximum Values):
PEAK INVERSE PLATE VOLTAGE........... 350 volts
PEAK GRID-NO. 2 DISSIPATION........... 50 ma
DC PLATE CURRENT..................... 35 ma
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode...
Heater positive with respect to cathode...
BULB TEMPERATURE (At hottest point)........... 250°C

Typical Operation:
Plate Voltage.......................... 350 volts
GRID-NO. 2 Voltage.................. 350 volts
GRID-NO. 3 and Internal Shield........ 350 volts
GRID-NO. 2 Supply Voltage............ 350 volts
Cathode-Bias Resistor............... 350 ohms
Plate Resistance (Approx.)........... 350000 ohms
Transconductance..................... 6000 umhos
Grid-No. 1 Voltage (Approx.) for plate current of 10 ma...
Plate Current......................... 9.5 ma
GRID-NO. 2 Current................... 6.5 ma

PENTODE UNIT AS CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE.......................... 300 volts
GRID-NO. 2 VOLTAGE.................. 300 volts
GRID-NO. 3 (SCREEN-GRID) VOLTAGE........ 300 volts
GRID-NO. 2 SUPPLY VOLTAGE............ 300 volts
GRID-NO. 1 (CONTROL-GRID) VOLTAGE........ 300 volts
Positive bias value.................. 0 volts
PLATE DISSIPATION..................... 200 watts
GRID-NO. 2 DISSIPATION.............. 200 watts
For grid-No. 2 voltages up to 150 volts...
For grid-No. 2 voltages up to 300 volts...
See curve page 70
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode...
Heater positive with respect to cathode...
BULB TEMPERATURE (At hottest point)........... 250°C

Typical Operation:
Plate Voltage.......................... 300 volts
Grid-No. 2 Voltage.................. 300 volts
Grid-No. 3 and Internal Shield........ 300 volts
GRID-NO. 2 Supply Voltage............ 300 volts
Cathode-Bias Resistor............... 300 ohms
Plate Resistance (Approx.)........... 300000 ohms
Transconductance..................... 6000 umhos
Grid-No. 1 Voltage (Approx.) for plate current of 10 ma...
Plate Current......................... 9.5 ma
GRID-NO. 2 Current................... 6.5 ma

Maximum Circuit Values:
Grid-No. 1-Circuit Resistance:
For fixed-bias operation............. 0.25 max megohm
For cathode-bias operation............ 0.10 max megohm

DIODE UNIT

Maximum Ratings, (Design-Maximum Values):
PEAK INVERSE PLATE VOLTAGE........... 350 volts
PEAK GRID-NO. 2 DISSIPATION........... 50 ma
DC PLATE CURRENT..................... 35 ma
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode...
Heater positive with respect to cathode...
BULB TEMPERATURE (At hottest point)........... 250°C

Typical Operation:
Plate Voltage.......................... 350 volts
GRID-NO. 2 Voltage.................. 350 volts
GRID-NO. 3 and Internal Shield........ 350 volts
GRID-NO. 2 Supply Voltage............ 350 volts
Cathode-Bias Resistor............... 350 ohms
Plate Resistance (Approx.)........... 350000 ohms
Transconductance..................... 6000 umhos
Grid-No. 1 Voltage (Approx.) for plate current of 10 ma...
Plate Current......................... 9.5 ma
GRID-NO. 2 Current................... 6.5 ma

DUAL TRIODE—SHARP-CUTOFF PENTODE

Duodecar type used in television receivers. High-mu triode is used in audio if-amplifier service; medium-mu triode is used in syncro-separator service; pentode is used in video amplifier service. Outline 12B, OUTLINES SECTION. Tube requires 12-contact socket and may be mounted in any position. Heater voltage (ac/dc), 6.3; amperes, 1.05.

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE.......................... 350 volts
GRID-NO. 2 VOLTAGE.................. 350 volts
GRID-NO. 3 (SCREEN-GRID) VOLTAGE........ 350 volts
GRID-NO. 2 SUPPLY VOLTAGE............ 350 volts
GRID-NO. 1 (CONTROL-GRID) VOLTAGE........ 350 volts
Positive bias value.................. 0 volts
PLATE DISSIPATION..................... 200 watts
GRID-NO. 2 DISSIPATION.............. 200 watts
For grid-No. 2 voltages up to 150 volts...
For grid-No. 2 voltages up to 300 volts...
See curve page 70
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode...
Heater positive with respect to cathode...
BULB TEMPERATURE (At hottest point)........... 250°C

Typical Operation:
Plate Voltage.......................... 350 volts
GRID-NO. 2 Voltage.................. 350 volts
GRID-NO. 3 and Internal Shield........ 350 volts
GRID-NO. 2 Supply Voltage............ 350 volts
Cathode-Bias Resistor............... 350 ohms
Plate Resistance (Approx.)........... 350000 ohms
Transconductance..................... 6000 umhos
Grid-No. 1 Voltage (Approx.) for plate current of 10 ma...
Plate Current......................... 9.5 ma
GRID-NO. 2 Current................... 6.5 ma

Related type: S58

6AS11

Related type: 6AS8

6AS11
**TWIN DIODE—HIGH-MU TRIODE**

Miniature type used as a combined detector, amplifier, and a.c. tube in automobile and a.c.-operated radio receivers. Outline 7B, 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.

Heater Voltage (ac/dc)........... 6.3 volts
Heater Current................ 0.3 amperes
Direct Inter-electrode Capacitances:
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 pf
Plate of Diode Unit No.2 to Triode Grid........ 0.04 max pf

TRIODE UNIT AS CLASS A, AMPLIFIER

Maximum Ratings, (Design-Center Values):
Plate Voltage............ 300 max volts
Plate Dissipation........ 0.6 max watts
Grid Voltage, Positive-bias Value........ 0 max volts
Peak Heater-Cathode Voltage:
Heater negative with respect to cathode........ 90 max volts
Heater positive with respect to cathode........ 90 max volts

Characteristics:
Plate Voltage............ 100-250 volts
Grid Voltage............ 70-200 volts
Amplification Factor........ 5000
Plate Resistance........ 5000 ohms
Transconductance........ 1500 amhos
Plate Current............ 0.8 max

DIODE UNITS

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 6A6V6.

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

Miniature types used as combined oscillator and mixer tubes in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. Type 6AT8-A has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Except for interelectrode capacitances and biasing arrangement, these types are identical with miniature type 6X8. The biasing arrangement of the 6AT8 and 6AT8-A is particularly suitable for connection to the coils of certain designs of tetrode tuners. Type 6AT8 is a DISCONTINUED type listed for reference only.

Heater Voltage (ac/dc)........... 6.3 volts
Heater Current................ 0.45 amperes
Heater Warm-Up Time (Average) for 6AT8-A........ 11 seconds

**DIRECT INTER-ELECTRODE CAPACITANCES (Approx.):**

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>6AT8-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Current</td>
<td>0.5 pf</td>
</tr>
<tr>
<td>Plate to Cathode and Heater</td>
<td>4.0 pf</td>
</tr>
<tr>
<td>Plate of Diode Unit No.2 to Triode Grid</td>
<td>0.04 max pf</td>
</tr>
</tbody>
</table>

**HFAWAVE VACUUM RECTIFIER**

Glass octal types used as damper tubes in horizontal-deflection circuits of color television receivers and of television receivers utilizing picture tubes having wide-angle deflection. Outline 14F, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position. These types 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 these tubes, like other power-handling tubes, be adequately ventilated. Type 6A4-GT is a DISCONTINUED type listed for reference only.

Heater Voltage (ac/dc)........... 6.3 volts
Heater Current................ 1.8 amperes
Direct Inter-electrode Capacitances (Approx.):
Plate to Plate:............ 0.0 max
Plate to Grid No.2 to Cathode, Heater, Grid No.2, and Grid No.3: 4.0 pf
Plate to Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3: 4.0 pf
Plate to Triode Plate:........ 0.05 max pf
Plate to Triode Plate:........ 0.05 max pf
Heater to Cathode............ 6.0 pf

**DIAPOR SERVICE**

For operation in a 25-line, 50-frame system

**BEAM POWER TUBE**

Glass octal type used as horizontal-deflection amplifier in low-cost, high-efficiency deflection circuits of television receivers employing either transformer coupling or direct coupling to the deflecting yoke. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position.

Heater Voltage (ac/dc)........... 6.3 volts
Heater Current................ 1.25 amperes
Direct Inter-electrode Capacitances (Approx.):
Grid No.1 to Plate:............ 0.5 pf
Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3: 4.0 pf
Plate to Cathode, Heater, Grid No.2, and Grid No.3: 4.0 pf
Transmission Capacitance:........ 5000 amhos
Mu-Factor, Grid No.2 to Grid No.1:........ 5.9

For plate volts, 115; grid-No.2 volts, 25; grid-No.1 volts, 263.
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) ......... 5500/965 volts
Peak Negative-Pulse Plate Voltage ................................ -1250 max volts
DC Grid-No.2 (Screen-Grid) Voltage* ................................ 250 max volts
Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage* ............. -800 max volts
Peak Cathode CURRENT............................................ 400 max ma
AVG. Cathode CURRENT ........................................... 110 max ma
Grid-No.2 INPUT.................................................. 2.5 max watts
Plate Dissipation................................................... 10 max watts
Peak Heater-Cathode Voltage:
Heater negative with respect to cathode............................ 200 max volts
Heater positive with respect to cathode............................ 200 max volts
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 5 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.
* 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.
* The dc component must not exceed 100 volts.

6AU6
6AU6A
Miniature types used in compact radio equipment as rf amplifier especially in high-frequency, wide-band applications; also used as limiter tube in FM equipment. Type 6AU6-A has a controlled heater warm-up time for use in applications employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Tubes require minimum 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. Type 6AU6 is a DISCONTINUED type listed for reference only.

Heater Voltage (AC/DC)........................................ 6.3 volts
Heater Current.................................................. 0.3 ampere
Heater Warm-Up Time (Average) for 6AU6-A..................... 11 seconds

DIRECT INTERELECTRODE CAPACITANCES:

Without With
External External Shield Shield

Penode Connection:
Grid No.1 to Plate 0.0035 max 0.0035 max pf
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield 5.5 5.5 pf
Plate to Cathode, Heater, Grid No.1, and Internal Shield 5.0 5.0 pf
Internal Shield 5.0 5.0 pf

Triode Connection:
Grid No.1 to Plate, Grid No.2, Grid No.3, and Internal Shield 2.6 2.6 pf
Grid No.1 to Cathode and Heater 3.2 3.2 pf
Plate, Grid No.2, Grid No.3, and Internal Shield to Cathode and Heater 1.2 8.5 pf
* With external shield connected to cathode.
† Grid No.2, grid No.3, and internal shield connected to plate.

CLASS A AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

PLATE VOLTAGE.................................................. 275 max volts
Grid-No.3 (Suppressor-Grid) Voltage, Positive value............. - See curve page 70
Grid-No.2 (Screen-Grid) Voltage................................ 330 max volts
Grid-No.2 Supply Voltage....................................... - 330 max volts
Plate Dissipation................................................ 3.5 max watts

Technical Data

GRID-No.2 INPUT:
For grid-No.2 voltages up to 165 volts........... 0.75 max watt
For grid-No.2 voltages between 165 and 300 volts......... See curve page 70
GRID-No.1 (CONTROL-GRID) VOLTAGE:
Positive bias value ........................................ 0 max 0 max volts
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode........... 200 max 200 max volts
Heater positive with respect to cathode......... 200* 200* max volts

Characteristics:

Triode Penode
Plate Supply Voltage........................................... 250 250 volts
Grid No.3................................................ 100 150 volts
Grid-No.3 Supply Voltage.................................... 100 150 volts
Cathode-Grid Resistor........................................ 330 150 ohms
Amplification Factor.......................................... 36 68
Plate Resistance (Approx.)........................................ 0.5 1.5 1.0 megs
Transconductance............................................... 4500 4500 5200 amps
Grid-No.1 Voltage for plate current of 10 μA........... -4.2 -5.5 -6.5 volts
Plate Current.................................................. 12.2 9.9 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.
* The dc component must not exceed 100 volts.

AVERAGE CHARACTERISTICS

MEDIUM-MU TWIN TRIODE
Miniature type used as phase inverter or amplifier in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Heater voltages (AC/DC): 6.3 (series), 3.15 (parallel); amplerses, 0.3 (series), 0.6 (parallel); warms-up time (average) in parallel alignment, 11 seconds. Except for heater and heater-cathode ratings, this type is identical with miniature type 12AX7. The 6AU7 is a DISCONTINUED type listed for reference only.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE
Miniature type used in television receiver applications. Tubes have 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 sync-amplifier, sync-separator, sync-clipper, and phase-inverter circuits. Outline 8D, OUTLINES SECTION. Tubes require nine-contact socket and may be mounted in any position. Type 6AU8 is a DISCONTINUED type listed for reference only.
**BEAM POWER TUBE**

**6AV5GA**

Class octal types used as horizontal deflection amplifiers in television receivers employing either transformer coupling or direct coupling to the deflecting yoke. 6AV5-GA outline 19B, 6AV5-GT outline 14C, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position. Type 6AV5-GT is a DISCONTINUED type listed for reference only.

**6AV5GT**

**Related types:** 12AV5-GA, 25AV5-GA

---

**Technical Data**

**Peak Cathode Current:** 400 ma

**Average Cathode Current:** 110 ma

**Grid-No.2 Input:** 2.5 ma

**Plate Disipation:** 11 watts

**Peak Heater-Cathode Voltage:**
- Heater negative with respect to cathode: 200 volts
- Heater positive with respect to cathode: 200 volts

**Build Temperature (At hottest point):**
- 210 °C

**Maximum Circuit Value:**
- Grid-No.1 Circuit Resistance: 0.47 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 this is 16 per cent of one horizontal scanning cycle is 10 microseconds.

Under no circumstances should this absolute value be exceeded.

**TWIN DIODE—HIGH-MU TRIODE**

Miniature type used as combined detector, amplifier, and arc tube in automobile and ac-operated radio receivers. The 6AV6 may be substituted directly for the 6A6V6 in applications where the higher amplification of the 6AV6 is advantageous.

**Related types:** 3A6V6, 4A6V6, 12A6V6

---

**6AV6**

**Heater Voltage (ac/dc):**
- 6.3 volts

**Heater Current:**
- 0.3 amperes

**Direct Inter-electrode Capacitances:**
- Triode Grid to Triode Plate: 0.015 pF
- Plate to Cathode and Heater: 0.015 pF

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage, Positive-bias value</td>
<td>0 max volts</td>
</tr>
<tr>
<td>Plate Current</td>
<td>2.8 max 3.3 max watts</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>0.02 max.pF</td>
</tr>
<tr>
<td>Grid-No.0 Current</td>
<td>0.02 max.pF</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:***

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1 Circuit Resistance</td>
<td>0.05 max 0.25 max megohm</td>
</tr>
<tr>
<td>Grid-No.0 Circuit Resistance</td>
<td>1.0 max 1.0 max megohm</td>
</tr>
</tbody>
</table>

* The dc component must not exceed 100 volts.

---

**AVERAGE PLATE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Type</th>
<th>6AV6 TF = 4 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate</td>
<td>250 Vdc</td>
</tr>
<tr>
<td>Grid</td>
<td>-2 Vdc</td>
</tr>
</tbody>
</table>

---

**HORIZONTAL DEFLECTION AMPLIFIER**

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

---

**Maximum Ratings, (Design-Center Values):**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>550 max volts</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage (Absolute Maximum)</td>
<td>5500 max volts</td>
</tr>
<tr>
<td>DC Grid-No.2 (Screen-grid) Voltage</td>
<td>175 max volts</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid-No.1 (Control-grid) Voltage</td>
<td>-300 max volts</td>
</tr>
</tbody>
</table>
**DIODE UNITS**

**Maximum Ratings, (Design-Maximum Values):**

- **Plate Current (Each Unit):** 1.0 max ma

* The dc component must not exceed 100 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. Diode biasing of the triode unit is not recommended.

**INSTALLATION AND APPLICATION**

Type 6AV6 requires miniature seven-contact socket and may be mounted in any position. Outline B, 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.

**HIGH-MU TRIODE—SHARP-CUTOFF PENTODE**

**6AW8**

**6AW8A**

Related type: 8AW8A

Mineral types used in a wide variety of applications in television receivers. These types have a controlled heater warm-up time for use in receivers employing series-connected heater strings. The pentode unit is used as an if amplifier, video amplifier, age amplifier, or reactance tube. The triode unit is used in low-frequency oscillator, sync-separator, sync-clipper, and phase-splitter circuits. Outline 8D, OUTLINES SECTION. Tubes require miniature nine-contact socket and may be mounted in any position. Type 6AW8 is a discontinued type listed for reference only.

**Heater Voltage (AC/DC):** 6 volts

**Heater Current:** 6 ma

**Heater Warm-Up Time (Average):** 11 seconds

**DIRECT INTERELECTRODE CAPACITANCES:**

- **Without External Shield:**
  - Grid to Plate: 2.2 pf
  - Grid to Cathode, Pentode Cathode, Pentode Grid No. 3, Internal Shield, and Heater: 3.2 pf
  - Plate to Cathode, Pentode Cathode, Pentode Grid No. 3, Internal Shield, and Heater: 1.8 pf

- **With External Shield:**
  - Grid No. 1 to Plate: 0.005 max pf
  - 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: 3.6 pf

**Pentode Plate to Triode Plate:** 0.15 max pf

* With external shield connected to pins 4 and 5.

**AVERAGE CHARACTERISTICS**

**GRID CHARACTERISTICS**

- **Type 6AW8-A**
  - **Triode Unit:**
    - **Plate Voltage:** 1.3 volts
    - **Grid-No. 2 (Screen-Grid) Supply Voltage:** 0 max volts
    - **Grid-No. 3 (Control-Grid) Voltage:** 1.7 max volts
  - **Pentode Unit:**
    - **Grid-No. 2 Supply Voltage:** 1.59 max volts
    - **Grid-No. 3 Supply Voltage:** 0 max volts

**MAXIMUM RATINGS**

- **Type 6AW8-A**
  - **Triode Unit:**
    - **Plate Voltage:** 650 volts
    - **Grid-No. 2 Supply Voltage:** 0 max volts
    - **Grid-No. 3 Supply Voltage:** 0 max volts
  - **Pentode Unit:**
    - **Grid-No. 2 Supply Voltage:** 2000 volts
    - **Grid-No. 3 Supply Voltage:** 0 max volts

**PENTODE UNIT**

- **Type 6AW8-A**
  - **Triode Unit:**
    - **Plate Voltage:** 690 volts
  - **Pentode Unit:**
    - **Plate Voltage:** 690 volts

**CHARACTERISTICS**

- **Type 6AW8-A**
  - **Triode Unit:**
    - **Plate Voltage:** 690 volts
    - **Grid-No. 2 Supply Voltage:** 0 max volts
    - **Grid-No. 3 Supply Voltage:** 0 max volts
    - **Cathode-Bias Resistor:** 0 max ohms
    - **Amplification Factor:** 70
    - **Plate Resistance (Approx.)**
      - **Without External Shield:**
        - 37 ohms
  - **Pentode Unit:**
    - **Plate Voltage:** 690 volts
    - **Grid-No. 2 Supply Voltage:** 0 max volts
    - **Grid-No. 3 Supply Voltage:** 0 max volts
    - **Cathode-Bias Resistor:** 0 max ohms
    - **Amplification Factor:** 70
    - **Plate Resistance (Approx.)**
      - **Without External Shield:**
        - 37 ohms

**AVERAGE CHARACTERISTICS**

**PENTODE UNIT**

- **Type 6AW8-A**
  - **Triode Unit:**
    - **Plate Voltage:** 690 volts
    - **Grid-No. 2 Supply Voltage:** 0 max volts
    - **Grid-No. 3 Supply Voltage:** 0 max volts
    - **Cathode-Bias Resistor:** 0 max ohms
    - **Amplification Factor:** 70
    - **Plate Resistance (Approx.)**
      - **Without External Shield:**
        - 37 ohms

**AVERAGE CHARACTERISTICS**

**PENTODE UNIT**

- **Type 6AW8-A**
  - **Triode Unit:**
    - **Plate Voltage:** 690 volts
    - **Grid-No. 2 Supply Voltage:** 0 max volts
    - **Grid-No. 3 Supply Voltage:** 0 max volts
    - **Cathode-Bias Resistor:** 0 max ohms
    - **Amplification Factor:** 70
    - **Plate Resistance (Approx.)**
      - **Without External Shield:**
        - 37 ohms
**RCA Receiving Tube Manual**

**Plate Current**................... 4 ma
**Grid-No.2 Current**............. 15 ma

**Maximum Circuit Values:**

**Grid-No.1-Circuit Resistance:**
For fixed-bias operation: 0.5 max
For cathode-bias operation: 1.0 max

*The de component must not exceed 100 volts.*

---

**HALF-WAVE VACUUM RECTIFIER**

**6AX3**

**Related types:**
12AX3, 17AX3

Duo decar type used as damper tube in horizontal-deflection circuits of television receivers. Outline 12C, OUTLINES SECTION. Tube requires 12-contact socket and may be mounted in any position. Socket terminals 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/de), 6.3; amperes, 1.2.

**DAMPER SERVICE**

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

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK INVERSE PLATE VOLTAGE*</td>
<td>5000 max</td>
</tr>
<tr>
<td>DC PLATE CURRENT</td>
<td>165 ma</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>5.3 x 10^-3 watts</td>
</tr>
<tr>
<td>HEATER NEGATIVE with respect to cathode</td>
<td>5000 max</td>
</tr>
<tr>
<td>HEATER POSITIVE with respect to cathode</td>
<td>3000 max</td>
</tr>
</tbody>
</table>

*The de component must not exceed 100 volts.*

---

**6AX4GT**

**HALF-WAVE VACUUM RECTIFIER**

Glass octal type used as damper tube in horizontal deflection circuits of television receivers. Outline 14C, OUTLINES SECTION. May be supplied with pin No. 1 omitted. Tubes require a socket and may be operated in any position. Socket terminals 1, 2, 4, and 6 should not be used as tie points. 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.):**
- Cathode to Plate and Heater: 8 pf
- Plate to Cathode and Heater: 8 pf
- Heater to Cathode: 4 pf

**DAMPER SERVICE**

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

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK INVERSE PLATE VOLTAGE*</td>
<td>4400 max</td>
</tr>
<tr>
<td>DC PLATE CURRENT</td>
<td>165 max</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>5 x 10^-3</td>
</tr>
<tr>
<td>HEATER NEGATIVE with respect to cathode</td>
<td>4400 max</td>
</tr>
<tr>
<td>HEATER POSITIVE with respect to cathode</td>
<td>3000 max</td>
</tr>
</tbody>
</table>

---

**Technical Data**

**Characteristics, Instantaneous Test Condition:**

- 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 16 microseconds.
- The de component must not exceed 900 volts.

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**FULL-WAVE VACUUM RECTIFIER**

**6AX5GT**

Glass octal type used in power supply of radio equipment having moderate de requirements. Outline 14C, OUTLINES SECTION. This type may be supplied with pin No. 1 omitted.

Tubc 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 volts (ac), 6.3; amperes, 1.2.

**FULL-WAVE RECTIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK INVERSE PLATE VOLTAGE*</td>
<td>1250 max</td>
</tr>
<tr>
<td>DC PLATE CURRENT</td>
<td>950 ma</td>
</tr>
<tr>
<td>HEATER NEGATIVE with respect to cathode</td>
<td>450 max</td>
</tr>
<tr>
<td>HEATER POSITIVE with respect to cathode</td>
<td>450 max</td>
</tr>
</tbody>
</table>

**Typical Operation with Capacitor Input to Filter:**

- Tube to Plate Supply Voltage: 700 volts
- Filter Input Capacitor: 10 μf
- Effective Plate-Supply Impedance: 50 ohms
- DC Output Voltage at Input to Filter: 490 volts
- At half-load current: 10 ma
- Voltage regulation (Approx.): 50 volts

**Typical Operation with Choke Input to Filter:**

- Tube to Plate Supply Voltage: 700 volts
- Filter Input Choke: 10 μf
- DC Output Voltage at Input to Filter: 270 volts
- At half-load current: 10 ma
- Voltage regulation (Approx.): 50 volts

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**RATING CHART**

**TYPE 6AX5-GT**

- Maximum Operating Values with: 6.5 Vols
- Choke: Input Filter Capacitor: Input Filter

---

**168**
MEDIUM-MU TRIODE—SEMIREMOTE-CUTOFF PENTODE

6AX8

Miniature type used in television-receiver applications; the pentode unit is used as a video amplifier; the triode unit is used as an sync separator. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

<table>
<thead>
<tr>
<th>HEATER VOLTAGE (AC/DC)</th>
<th>6.3 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIRECT INTERELECTRODE CAPACITANCES:</td>
<td></td>
</tr>
<tr>
<td>Triode Unit:</td>
<td></td>
</tr>
<tr>
<td>Grid to Plate</td>
<td>1.8 pf</td>
</tr>
<tr>
<td>Grid to Cathode and Heater</td>
<td>2.5 pf</td>
</tr>
<tr>
<td>Plate to Cathode and Heater</td>
<td>1 pf</td>
</tr>
<tr>
<td>Pentode Unit:</td>
<td></td>
</tr>
<tr>
<td>Grid No.1 to Plate</td>
<td>0.066 max pf</td>
</tr>
<tr>
<td>Grid No.1 to Cathode, Grid No.2, Grid No.3, and Internal Shield</td>
<td>5 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater Grid No.2, Grid No.3 and Internal Shield</td>
<td>3.5 pf</td>
</tr>
<tr>
<td>Heater to Cathode (Each unit)</td>
<td>3.5 pf</td>
</tr>
</tbody>
</table>

CLASS A, AMPLIFIER

Maximum Ratings (Design-Maximum Values):

- **PLATE VOLTAGE**: 300 max volts
- **GRID NO.2 SUPPLY VOLTAGE**: 300 max volts
- **GRID NO.2 SCREEN-GRID VOLTAGE**: See curve page 70
- **GRID NO.1 CONTROL-GRID VOLTAGE**: 0 max volts
- **PLATE DISSIPATION**: 2.7 watts
- **GRID NO.2 INPUT**:
  - For grid-No.2 voltages up to 150 volts: 0.3 micro-watt
  - For grid-No.2 voltages between 150 and 300 volts: See curve page 70

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 90 max volts
- Heater positive with respect to cathode: 90 max volts

Characteristics:
- Plate Supply Voltage: 150 volts
- Grid-No.2 Supply Voltage: 110 volts
- Cathode-Bias Resistor: 5000 ohms
- Amplification Factor: 0.25
- Plate Resistance (Approx.): 0.005 megohms
- Grid-No.1 Voltage (Approx.) for plate current of 50 max: 0.480 volts
- Grid-No.2 Current: 1800 max ma

Maximum Circuit Values:
- Grid-No.1 Circuit Resistance:
  - For fixed-bias operation: 0.1 max. 0.1 max. megohms
  - For cathode-bias operation: 0.5 max. 0.5 max. megohms

* With external shield connected to cathode of unit under test except as noted.

** Technical Data **

HALF-WAVE VACUUM RECTIFIER

Novar type used as damper tube in horizontal deflection circuits of black-and-white television receivers. Outline 17B, OUTLINES SECTION. Tube requires novar socket and may be operated in any position. Socket terminals 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.

<table>
<thead>
<tr>
<th>HEATER VOLTAGE (AC/DC)</th>
<th>6.3 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER CURRENT:</td>
<td></td>
</tr>
<tr>
<td>1.2 amperes</td>
<td></td>
</tr>
<tr>
<td>DIRECT INTERELECTRODE CAPACITANCES (Approx.):</td>
<td></td>
</tr>
<tr>
<td>Plate to Cathode and Heater</td>
<td>6.5 pf</td>
</tr>
<tr>
<td>Cathode to Plate and Heater</td>
<td>9.0 pf</td>
</tr>
<tr>
<td>Heater to Cathode</td>
<td>2.8 pf</td>
</tr>
</tbody>
</table>

DAMPER SERVICE

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

Maximum Ratings, (Design-Maximum Values):
- **PEAK INVERSE PLATE VOLTAGE**:
  - 500 max volts
- **DC PLATE CURRENT**: 1100 max ma
- **PLATE DISSIPATION**: 175 max ma
- **GRID NO.1 CONTROL-GRID VOLTAGE**: 6.5 max watts
- **GRID NO.2 SUPPLY VOLTAGE**:
  - Heater negative with respect to cathode: 5900 max volts
  - Heater positive with respect to cathode: 6600 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.**

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 af amplifier, video amplifier, af amplifier, or reactance tube. The triode unit is used in low-frequency oscillator, sync separator, sweep-clipper, and phase-splitter circuit. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

<table>
<thead>
<tr>
<th>HEATER VOLTAGE (AC/DC)</th>
<th>6.3 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER CURRENT:</td>
<td></td>
</tr>
<tr>
<td>9.45 amperes</td>
<td></td>
</tr>
<tr>
<td>DIRECT INTERELECTRODE CAPACITANCES:</td>
<td></td>
</tr>
<tr>
<td>Triode Unit:</td>
<td></td>
</tr>
<tr>
<td>Grid to Plate</td>
<td>1.7 pf</td>
</tr>
<tr>
<td>Grid to Cathode, Heater, Pentode Grid No.3, and Internal Shield</td>
<td>2 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, Pentode Grid No.3, and Internal Shield</td>
<td>1.7 pf</td>
</tr>
<tr>
<td>Pentode Unit:</td>
<td></td>
</tr>
<tr>
<td>Grid No.1 to Plate</td>
<td>0.02 max pf</td>
</tr>
<tr>
<td>Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield</td>
<td>2.2 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield</td>
<td>0.027 max pf</td>
</tr>
<tr>
<td>Pentode Plate to Triode Plate</td>
<td>0.007 max pf</td>
</tr>
<tr>
<td>Pentode Plate to Plate</td>
<td>0.045 max pf</td>
</tr>
</tbody>
</table>

CLASS A, AMPLIFIER

Maximum Ratings (Design-Maximum Values):

- **PLATE VOLTAGE**: 300 max volts
- **GRID NO.2 SUPPLY VOLTAGE**: See curve page 70
- **GRID NO.2 SCREEN-GRID VOLTAGE**: 6,000 max volts
- **GRID NO.1 CONTROL-GRID VOLTAGE**: 2.5 max volts
- **PLATE DISSIPATION**: 2.6 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 70

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200 max volts.
RCA Receiving Tube Manual

Characteristics:
- Plate Supply Voltage: 200 volts
- Grid-No.2 Voltage: 180 volts
- Grid-No.1 Voltage: 180 volts
- Plate Resistance: 6Ω
- Cathode Bias Resistor: 6Ω
- Amplification Factor: 57600000 ohms
- Transconductance: 6.10 amps
- Grid-No.1 Voltage (Approx.) for plate current of 10 µm: 12.5 volts
- Transconductance: 330000 ohms
- Grid-No.2 Current: 13 µm
- Grid-No.2 Current: 13 ma

Maximum Circuit Values:
- Grid-No.1 Circuit Resistance: 0.5 max 0.55 max megohm
- For fixed-bias operation: 1.0 max 1.0 max megohm
- For cathode-bias operation: 0.5 max 0.55 max megohm

The 6B4G must operate between 0.5 and 1.0 max megohm.

POWER TRIODE
Glass octal type used in output stage of radio receivers and amplifiers. Maximum dimensions: over-all length, 5-1/2; height, 3-3/4; diameter, 2-1/2. Tube requires octal socket. For typical operation as a single-tube class A amplifier, refer to type 6B10. Amplifier grid volts (ac/dc), 63; a-mperes, 1.0. Maximum ratings: plate volts, 360; plate dissipation, 15 watts. Type 6B4G is a DISCONTINUED type listed for reference only.

DIRECT-COUPLING POWER TRIODE
Glass type used as class A amplifier. One triode, the driver, is directly connected within the tube to the second, or output, triode. Outline 27, OUTLINES SECTION. Tube requires six-contact socket. Heater volts (ac/dc), 63; a-mperes, 0.8. Characteristics of input and output triodes as class A amplifier follow. Input triode: plate volts, 300; plate ma, 45; plate resistance, 24000 ohms; load resistance, 5000 ohms; output watts, 4. This is a DISCONTINUED type listed for reference only.

TWIN-DIODE—HIGH-MU TRIODE
Glass octal type used as combined detector, amplifier, and a.c. tube. Outline 23, OUTLINES SECTION. Tube requires octal socket. Heater volts (ac/dc), 63; a-mperes, 0.4. Within its triode maximum plate-voltage rating of 250 volts, this type is similar electrically to type 6B6G and curvés under that type apply to the 6B6G. This is a DISCONTINUED type listed for reference only.

TWIN-DIODE—REMOTE-CUTOFF PENTODE
Glass type used as combined detector, amplifier, and a.c. tube. Outline 24B, OUTLINES SECTION. These types the small seven-contact (0.12-inch, pin-circle diameter) socket. Except for interelectrode capacitances, the external characteristics of the 6B7 are identical with those of type 66G. Type 667S has the external shield connected to the cathode. In general, its electrical characteristics are similar to those of the 6B7, but the two types are usually not directly interchangeable. These are DISCONTINUED types listed for reference only.

Technical Data

TWIN DIODE—SEMIREMOTE-CUTOFF PENTODE
- **6B8**
- **6B8G**
- Metal type 6B8 and glass octal type 6B8-G are used as combined detector, amplifier, and a.c. tube. Outline 23, OUTLINES SECTION. Type 6B8 is used principally for renewal purposes; 6B8G is a DISCONTINUED type listed for reference only. Tube requires octal socket. Heater volts (ac/dc), 63; a-mperes, 0.3. Maximum ratings: plate volts, 300; plate-No.2 volts, 150; plate-No.2 supply volts, 300; plate-No.1 volts, positive-bias value, 0; plate dissipation, 3.0 max watts (6B8), 2.25 max watts (6B8-G); plate-No.2 input, 0.3 max watt.

TWIN DIODE—MEDIUM-MU TWIN TRIODE
Duodeca type used in television receivers; diode units are used in horizontal-phase-detector circuits, and triode units are used in horizontal-oscillator circuits. Outline 12A, OUTLINES SECTION. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 63; a-mperes, 0.6; warm-up time (average), 11 seconds.

TRIODE UNITS AS CLASS A AMPLIFIER
Values are for each unit
- **6B10**
- Related type: 6B10

DIRECT-COUPLING POWER TRIODE
Glass type used as class A amplifier. One triode, the driver, is directly connected within the tube to the second, or output, triode. Outline 27, OUTLINES SECTION. Tube requires six-contact socket. Heater volts (ac/dc), 63; a-mperes, 0.8. Characteristics of input and output triodes as class A amplifier follow. Input triode: plate volts, 300; plate ma, 45; plate resistance, 24000 ohms; load resistance, 5000 ohms; output watts, 4. This is a DISCONTINUED type listed for reference only.

TWIN-DIODE—HIGH-MU TRIODE
Glass octal type used as combined detector, amplifier, and a.c. tube. Outline 23, OUTLINES SECTION. Tube requires octal socket. Heater volts (ac/dc), 63; a-mperes, 0.4. Within its triode maximum plate-voltage rating of 250 volts, this type is similar electrically to type 6B6G and curvés under that type apply to the 6B6G. This is a DISCONTINUED type listed for reference only.

TWIN-DIODE—REMOTE-CUTOFF PENTODE
Glass type used as combined detector, amplifier, and a.c. tube. Outline 24B, OUTLINES SECTION. These types the small seven-contact (0.12-inch, pin-circle diameter) socket. Except for interelectrode capacitances, the external characteristics of the 6B7 are identical with those of type 66G. Type 667S has the external shield connected to the cathode. In general, its electrical characteristics are similar to those of the 6B7, but the two types are usually not directly interchangeable. These are DISCONTINUED types listed for reference only.

HALF-WAVE VACUUM RECTIFIER
Novar type used as damper tube in horizontal-deflection circuits of television receivers. Outline 16B, OUTLINES SECTION. Tube requires novar nine-contact socket and may be mounted in any position. Socket terminals 1, 3, 6, and 8 should not be used as tie points.
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 Inter-electrode Capacitance (Approx.)**

- Plate to Cathode and Heater: 4.4 pf
- Cathode to Plate and Heater: 6 pf
- Heater to Cathode: 1.6 pf

**Dynamic Service**

For operation in a 335-line, 30-frame system

**Maximum Ratings, (Design-Maximum Values):**

- **Peak Inverse Plate Voltage:** 5000 volts
- **Peak Plate Current:** 1000 ma
- **DC Plate Current:** 160 ma
- **Plate Dissipation:** 5.5 watts
- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode: 5000 volts
  - Heater positive with respect to cathode: 3000 volts

- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 335-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

- **DC Component:** The dc component must not exceed 900 volts.

- **AC Component:** The ac component must not exceed 100 volts.

**Remote-Cutoff Pentode**

- **6BA6**
- **Related types:**
  - 6BA6, 12BA6

- **6SG7**
- The low value of grid-No.1-to-plate capacitance minimizes regenerative effects, while the high transconductance makes possible high signal-to-noise ratio.

**Heater Voltage (ac/dc)**

- 6.3 volts

**Heater Current**

- 0.3 amperes

**Direct Inter-electrode Capacitance**

- Grid No.1 to Plate: 0.0005 mF
- 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

- With external shield connected to cathode.

**Class A Amplifier**

**Maximum Ratings, (Design-Maximum Values):**

- **Plate Voltage:** 3300 volts
- **Grid-No.2 (Screen-Grid) Voltage:** See curve page 70
- **Grid-No.2 Supply Voltage:** 3300 volts
- **Plates Dissipation:** 5.4 watts
- **Grid-No.2 Input:**
  - For grid-No.2 voltages: 0.1 mF
  - For grid-No.2 voltages between 185 and 330 volts: 0.7 mF
  - See curve page 70
- **Grid-No.1 (Control-Grid) Voltage:**
  - Negative bias: -56 mF
  - Positive bias: 0 mF
- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode: 200 volts
  - Heater positive with respect to cathode: 200 volts

- The dc component must not exceed 100 volts.

**Characteristics:**

- Grid No.2 and Internal Shield: Connected to cathode at socket
- Grid-No.2 Supply Voltage: 100 volts
- Cathode-Bias Resistor: 60 ohms
- Plate Resistance (Approx.): 0.25 megohm
- Transconductance: 1400 mhos
- Grid-No.1 Voltage (Approx.) for transconductance of 40 mhos: 60 volts
- Plate Current: 10.8 ma
- Grid-No.2 Current: 4.4 ma

**Installation and Application**

Type 6BA6 requires miniature seven-contact socket and may be mounted in any position. Outline 7B, 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 ac system, or from a combination of these methods.

**Average Plate Characteristics**

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 (suppressor-grid) 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 ac system.
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PENTAGRID CONVERTER
Miniature type used as converter in superheterodyne circuits especially those for the FM broadcast band. Outline 8D, OUTLINES SECTION. Tube may require miniaturized nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3, amperes, 0.3.

CONVERTER SERVICE

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
<th>Plate Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>300 ma</td>
<td>300 ma</td>
</tr>
<tr>
<td>GRD NO.5 AND INTERNAL SHIELD VOLTAGE</td>
<td>0 0.5 ma</td>
<td>0 0.5 ma</td>
</tr>
<tr>
<td>GRID NO.2 AND NO.4 GRID-GRID VOLTAGE</td>
<td>100 ma</td>
<td>10 ma</td>
</tr>
<tr>
<td>GRID NO.2 AND NO.4 SUPPLY VOLTAGE</td>
<td>300 ma</td>
<td>300 ma</td>
</tr>
<tr>
<td>GRID NO.3 VOLTAGE</td>
<td>1.5 ma</td>
<td>1.5 ma</td>
</tr>
<tr>
<td>GRID NO.3 CURRENT</td>
<td>25 ma</td>
<td>25 ma</td>
</tr>
<tr>
<td>GRID NO.3 VOLTAGE</td>
<td>0 ma</td>
<td>0 ma</td>
</tr>
<tr>
<td>NEGATIVE BIAS VOLTAGE</td>
<td>-10 ma</td>
<td>-10 ma</td>
</tr>
<tr>
<td>POSITIVE BIAS VOLTAGE</td>
<td>10 ma</td>
<td>10 ma</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>90 ma</td>
<td>90 ma</td>
</tr>
<tr>
<td>HEATER negative with respect to cathode</td>
<td>90 ma</td>
<td>90 ma</td>
</tr>
</tbody>
</table>

Characteristics (Separate Excitation):*

- Plate Voltage: 100-250 volts
- Grid No.5 and Internal Shield: 100-10 volts
- Grid No.3 (Control-Grid) Voltage: -1.0 volt
- Grid No.1 (Oscillator-Grid) Resistor: 2000 ohms
- Plate Resistance: 2500 ohms
- Conversion Transconductance: 950 microamps
- Conversion Transconductance (Approx): 3.5 microamps
- Grid No.2 and No.4 Current: 0.1 mampere
- Grid No.1 Current: 0.35 mampere
- Total Cathode Current: 1.42 mampere

NOTE: The transconductance between grid No.2 and grids No.2 and No.4 connected to plate (not oscillating) is approximately 900 microamps 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.2 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 to those obtained in a self-excited oscillator circuit operating with zero bias.

** With grid-No.3 bias of -20 volts.

MEDIUM-MU TRIODE — SHARP-CUTTOFF PENTODE

6BA8A

Miniature type used in a wide variety of applications in color and black-and-white 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 a video amplifier, an age amplifier, or a reactance tube. The triode unit is used in low-frequency oscillator and phase-splitter circuits. Outline 8D, OUTLINES SECTION. Tube requires miniaturized nine-contact socket and may be mounted in any position.

<table>
<thead>
<tr>
<th>Heater Voltage (AC/DC)</th>
<th>6.3 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Current (Ave)</td>
<td>0.6 ampere</td>
</tr>
<tr>
<td>Heater Warm-Up Time (Average)</td>
<td>11 seconds</td>
</tr>
</tbody>
</table>

DIRECT INTERELECTRODE CAPACITANCES (Approx.): Triode Unit:

- Grid to Plate: 2.2 pF
- Grid to Cathode: 2.2 pF
- Plate to Cathode: 0.4 pF

TRIODE — TWIN PENTODE

6BA11

Duodec type used as vertical deflection oscillator and for combined sync-age applications in television receivers employing series-connected heater strings. Outline 12B, OUTLINES SECTION. Tube requires duodec 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. For ratings and characteristics of pentode units, refer to type 6H8S.

TRIODE UNIT AS CLASS A AMPLIFIER

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
<th>Plate Unit</th>
<th>Plate Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>300 ma</td>
<td>300 ma</td>
</tr>
<tr>
<td>GRID NO.2 SUPPLY VOLTAGE</td>
<td>150 ma</td>
<td>150 ma</td>
</tr>
<tr>
<td>GRID NO.2 VOLTAGE</td>
<td>10 ma</td>
<td>10 ma</td>
</tr>
<tr>
<td>CATHODE-BIAS RESISTOR</td>
<td>0 ma</td>
<td>0 ma</td>
</tr>
<tr>
<td>AMPLIFICATION FACTOR</td>
<td>18 ohms</td>
<td>18 ohms</td>
</tr>
<tr>
<td>PLATE CURRENT (Approx)</td>
<td>4000 ma</td>
<td>4000 ma</td>
</tr>
<tr>
<td>TRANSDUCTANCE</td>
<td>9000 microamps</td>
<td>9000 microamps</td>
</tr>
<tr>
<td>GRID NO.1 VOLTAGE (Approx) for plate current of 10 ma</td>
<td>10 microamps</td>
<td>10 microamps</td>
</tr>
<tr>
<td>PLATE CURRENT (Approx)</td>
<td>10 ma</td>
<td>10 ma</td>
</tr>
<tr>
<td>GRID NO.3 CURRENT</td>
<td>3 ma</td>
<td>3 ma</td>
</tr>
</tbody>
</table>

Characteristics:

- Plate Voltage: 250 volts
- Grid No.2 Voltage: 10 volts
- Amplification Factor: 18
- Transconductance: 4000 microamps
- Plate Current: 10 ma
- Grid Voltage (Approx) for plate current of 10 ma: -18 volts

Maximum Circuit Values:

- Grid-Circuit Resistance for fixed-bias operation: 0.25 ma, megohm
- For cathode-bias operation: 1 ma, megohm

* The decoupling must not exceed 100 volts.
MEDIUM-MU TRIODE

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 8A, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

**6BC4**

**HEATER VOLTAGE (AC/DC)**: 6.3 volts
**HEATER CURRENT**: 0.225 amperes

**DIRECT INTERELECTRODE CAPACITANCES (APPROX.):**
- Grid to Plate: 1.6 pf
- Grid to Heater and Cathode: 2.9 pf
- Plate to Heater and Cathode: 0.26 pf
- Heater to Cathode: 2.7 pf

**CLASS A1 AMPLIFIER**

**Maximum Ratings, (Design-Center Values):**
- **PLATE VOLTAGE**: 250 max volts
- **PLATE DISSIPATION**: 2.5 max watts
- **CATHODE CURRENT**: 25 max ma
- **PEAK HEATER-CATHODE VOLTAGE**: 75 max volts
- **Heater connected to cathode**: 75 max volts

**Characteristics:**
- **Plate Supply Voltage**: 150 volts
- **Cathode-Bias Resistor**: 100 ohms
- **Amplification Factor**: 48
- **Plate Resistance (Approx.)**: 4800 ohms
- **Transconductance**: 10000 amhos

**Grid Voltage (Approx.) for plate current of 10 ma**: -10 volts
**Plate Current**: 14.5 ma

**Maximum Circuit Values:**
- Grid-Circuit Resistance: Not recommended
- For fixed-bias operation: 0.5 megalohms
- For cathode-bias operation: 0.5 megalohms

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 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. For typical operation as resistance-coupled amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION.

**6BC5**

**HEATER VOLTAGE (AC/DC)**: 6.3 volts
**HEATER CURRENT**: 0.3 amperes

**DIRECT INTERELECTRODE CAPACITANCES:**
- Pentode Connection: 0.030 max pf
- Grid No. 1 to Plate: 1.2 pf
- Grid No. 1 to Cathode, Grid No. 2, Grid No. 3, and Internal Shield: 0.6 pf
- Plate to Cathode, Grid No. 2, Grid No. 3, and Internal Shield: 1.8 pf

**Triode Connection:**
- Grid No. 1 to Plate: 2.5 pf
- Grid No. 2 to Plate and Grid No. 3: 3.9 pf
- Plate and Grid No. 2 to Cathode, Grid No. 3, and Internal Shield: 3.0 pf

**6BC7**

TRIPLE DIODE

Miniature type containing three high-pervenance diode units in one envelope; used in dc restorer circuits of color television receivers. Also used in AM/FM radio receivers as a combination FM discriminator and AM detector tube. Outline 8B, OUTLINES SECTION. Tube requires nine-contact miniature socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC)**: 6.3 volts
**HEATER CURRENT**: 9.650 amperes

**DIRECT INTERELECTRODE CAPACITANCES (APPROX.):**
- Diode-No. 1 Plate to Diode-No. 1 Cathode, Heater, and Internal Shield: 8.5 pf
- Diode-No. 2 Plate to Diode-No. 2 Cathode, Heater, and Internal Shield: 5.5 pf
- Diode-No. 3 Plate to Diode-No. 3 Cathode, Heater, and Internal Shield: 3.5 pf

**Maximum Ratings, (Design-Center Values, Each Diode Unit):**
- **PEAK INVERSE PLATE VOLTAGE**: 330 max volts
- **PEAK PLATE CURRENT**: 54 ma
- **DC OUTPUT CURRENT**: 12 ma
- **PEAK HEATER-CATHODE VOLTAGE**: 200 max volts
- **Heater positive with respect to cathode**: 200 max volts

**6BC8**

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 direct-coupled grounded-cathode driver for the other unit. This type is also used in push-pull cathode-drive rf amplifiers. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC)**: 6.3 volts
**HEATER CURRENT**: 0.4 amperes

**DIRECT INTERELECTRODE CAPACITANCES:**
- Grid to Plate: 1.2 pf
- Grid to Cathode, Heater, and Internal Shield: 2.6 pf
- Plate to Cathode, Heater, and Internal Shield: 1.3 pf
- Plate to Grid, Heater, and Internal Shield: 2.4 pf
- Plate to Cathode: 2.8 pf
- Plate to Grid: 0.02 ma
- Plate of Unit No. 2 to Plate and Grid of Unit No. 1: 0.04 ma

* With external shield connected to internal shield.
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CLASS A, AMPLIFIER (Each Unit)

Maximum Ratings, (Design-Maximum Values):

- **Plate Voltage**: 250 max volts
- **Plate Dissipation**: 22 max watts
- **Cathode Current**: 22 max ma
- **Peak Heater-Cathode Voltage**:
  - Heater negative with respect to cathode: 200 max volts
  - Heater positive with respect to cathode: 200 max volts

Characteristics:

- **Plate Supply Voltage**: 150 volts
- **Cathode-Bias Resistor**: 2200 ohms
- **Plate Resistance (Approx.)**: 3000 ohms
- **Amplification Factor**: 35
- **Transconductance**: 6200 uhmhos
- **Plate Current**: 10 ma

Maximum Circuit Values:

- **Grid-Circuit Resistance**: 0.5 ma megohm

- This rating may be as high as 200 volts under cutoff conditions, when the tube is used as a cascade amplifier and the two units are connected in series.
- *The dc component must not exceed 100 volts.

**SHARP-CUT-OFF BEAM TRIODE**

Glass octal types used for the voltage regulation of high-voltage, low-current dc power supplies in color television receivers. Outline 2SB, OUTLINES SECTION. Tubecase requires octal socket. Heater voltage (ac/dc), 6.3; amperes, 0.3. Characteristics as Class A amplifier: plate voltage, 250 (300 max); grid No.3 connected to cathode at socket; grid No.2 volts, 100 (115 max); grid No.1 volts, 3; plate resistance (approx.), 0.8 megohm; transconductance, 2000 ohms; plate dissipation, 3 ma watts; grid No.2 input, 0.65 ma watts; plate ma.; grid No.2 ma.; total cathode ma., 14 ma.; peak heater-cathode volts, 90 ma. This type is used principally for renewal purposes.

**REMOTE-CUT-OFF PENTODE**

Miniature type used as rf or if amplifier in radio receivers. This type is similar in performance to metal type 6SK7. Outline 7B, OUTLINES SECTION. Tubecase requires miniature seven-contact socket and may be mounted in any position. Heater voltage (ac/dc), 6.3; amperes, 0.3. Characteristics as Class A amplifier: plate voltage, 250 (300 max); grid No.3 connected to cathode at socket; grid No.2 volts, 100 (115 max); grid No.1 volts, 3; plate resistance (approx.), 0.8 megohm; transconductance, 2000 ohms; plate dissipation, 3 ma watts; grid No.2 input, 0.65 ma watts; plate ma.; grid No.2 ma.; total cathode ma., 14 ma.; peak heater-cathode volts, 90 ma. This type is used principally for renewal purposes.

**HALF-WAVE VACUUM RECTIFIER**

Duodecator type used as damper tube in horizontal-deflection circuits of television receivers. Outline 12D, OUTLINES SECTION. Tubecase requires duodecator twelve-contact socket and may be mounted in any position. Heater voltage (ac/dc), 6.3; amperes, 1.2.

**DAMPER SERVICE**

For operation in a 555-line, 30-frame system

Maximum Ratings, (Design-Maximum Values):

- **Peak Inverse Plate Voltage**: 5000 volts
- **Peak Plate Current**: 1200 ma max
- **DC Plate Current**: 200 ma max
- **Plate Dissipation**: 6.5 max watts

**Technical Data**

<table>
<thead>
<tr>
<th>Peak Heater-Cathode Voltage:</th>
<th>5000 max volts</th>
<th>300 max volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics, Instantaneous Value:</td>
<td>Tube Voltage Drop for dc plate current of 550 ma. 25 volts</td>
<td></td>
</tr>
</tbody>
</table>

*The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 555-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.
*The dc component must not exceed 500 volts.
*The dc component must not exceed 100 volts.

**PENTAGRID CONVERTER**

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 6AT. For general discussion of pentagrid types, see Frequency Conversion in ELECTRON TUBE APPLICATION SECTION.

**HEATER VOLTAGE (AC/DC):**

- Without External Shield
- With External Shield

<table>
<thead>
<tr>
<th>Grid No.3 to Plate</th>
<th>Grid No.3 to Grid No.1</th>
<th>Grid No.1 to Plate</th>
<th>Grid No.1 to All Other Electrodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 max</td>
<td>0.5 max</td>
<td>0.1 max</td>
<td>0.05 max</td>
</tr>
</tbody>
</table>

| Grid No.1 to All Other Electrodes | 7.0 ma |
| Grid No.1 to Cathode and Grid No.4 except Grid No.1 | 6.0 ma |
| Plate to All Other Electrodes | 8.0 ma |
| Plate to Grid No.5 to All Other Electrodes | 9.0 ma |

*With external shield connected to cathode and grid No.5.

**CONVERTER**

Maximum Ratings, (Design-Maximum Values):

- **Plate Voltage**: 330 max volts
- **Grid-No.2 and No.4 (Screen-Grid) Voltage**: 110 max volts
- **Grid-No.2 and No.4 Supply Voltage**: 300 max volts
- **Plate Dissipation**: 1.1 max watts
- **Grid-No.2 and No.4 Input**: 1.1 max watts
- **Cathode Current, (Approx.)**: 15.6 ma max
- **Grid-No.3 Voltage**: 550 volts
- **Positive Bias Voltage**: 6 volts
- **Peak Heater-Cathode Voltage**: 200 max volts
- **Peak Heater Positive with respect to plate**: 200 max volts

**Typical Operation (Separate Excitation):**

- **Plate Voltage**: 100 ma 250 volts
- **Grid-No.2 and No.4 (Screen-Grid) Voltage**: 100 ma 250 volts
- **Grid-No.1 (Oscillator-Grid) Voltage (rms)**: 10 ma 25 volts
- **Grid-No.3 (Control-Grid) Voltage**: 8000 ma 20000 volts
- **Plate Resistance (Approx.)**: 100 ohms
- **Conversion Transconductance**: 4000 ma 1000000 ma
- **Grid-No.1 Voltage for conversion transconductance of 10 ma**: 100 ma 200000 ma
- **Plate Current**: 6.8 ma
- **Grid-No.2 and No.4 Current**: 6.8 ma
- **Grid-No.1 Current**: 6.8 ma
- **Cathode Current (Approx.)**: 16.3 ma

*The dc component must not exceed 100 volts.
*The characteristics shown with separate excitation correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.

**INSTALLATION AND APPLICATION**

Type 6BE6 requires miniature seven-contact socket and may be mounted in any position. Outline 7B, 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. Another important feature is that, because signal-grid voltage has so little effect on the space charge near the cathode, changes in anode 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 anode bias.

A typical self-excited oscillator circuit employing the 6B65 is given in the CIRCUIT SECTION.

In the 6B65 operation characteristics curves with self-excitation, EK is the voltage across the oscillator-coil section between cathode and ground; EK is the oscillator voltage between cathode and grid.

---

**BEAM POWER TUBE**

Minature type used in audio output stage of television and radio receivers. Triode-connected, it is used as a vertical deflection amplifier in television receivers. *Outline 7C, OUTLINES SECTION.* Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.2. Typical operation as class A amplifier: plate volts, 110 (250 volts); grid No.2 volts.

110 (117 max); grid-No.1 volts, 7.5; peak a grid-No.1 volts, 7.5; plate dissipation, 5.5 max watts; grid-No.2 input, 1.25 max; plate ma, 50 (zero-signal), 90 (maximum-signal); grid-No.2 ma, 4 (zero-signal), 10.5 (maximum-signal); plate resistance (approx.), 12,000 ohms; transconductance, 7500 microamps; plate load resistance, 2500 ohms; total harmonic distortion, 10 per cent; maximum signal power output, 1.9 watts; peak heater-cathode volts, 200 volts (dc component 100 max when heater is positive with respect to cathode). This type is used principally for renewal purposes.

**TWIN DIODE—MEDIUM-MU TRIODE**

Minature type used in compact radio equipment as combined detector, amplifier, and aove tube. The triode unit is particularly useful as a driver for impedance- or transformer-coupled

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**6B66**

Related type: 12B6.

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**Technical Data**

output stages in automobile receivers. It is equivalent in performance to metal type 6SR7. *Outline 7B, OUTLINES SECTION.* Tube requires miniature seven- contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC)**

6.3 volts

**HEATER CURRENT**

0.3 amperes

**DIRECT INTERELECTRODE CAPACITANCES:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triode Grid to Triode Plate</td>
<td>1.9 pF</td>
</tr>
<tr>
<td>Triode Grid to Cathode and Heater</td>
<td>1.3 pF</td>
</tr>
<tr>
<td>Triode Plate to Cathode and Heater</td>
<td>1.2 pF</td>
</tr>
<tr>
<td>Plate of Diode Unit No.1 to Triode Grid</td>
<td>0.07 max</td>
</tr>
<tr>
<td>Plate of Diode Unit No.2 to Triode Grid</td>
<td>0.06 max</td>
</tr>
</tbody>
</table>

* With external shield connected to cathode.

**TRIODE UNIT AS CLASS A, AMPLIFIER**

**PLATE VOLTAGE**

300 volts

**PLATE DISSIPATION**

2.5 watts

**HEATER-CATHODE VOLTAGE:**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater negative with respect to cathode</td>
<td>90 volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>90 volts</td>
</tr>
</tbody>
</table>

**Typical Operation:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>-4 volts</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>20</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>4000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>1000 microamps</td>
</tr>
<tr>
<td>Plate Current</td>
<td>9.5 ma</td>
</tr>
<tr>
<td>Load Impedance</td>
<td>10000 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>6.5 per cent</td>
</tr>
<tr>
<td>Power Output</td>
<td>500 mw</td>
</tr>
</tbody>
</table>

**Maximum Rating:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Current (Each Unit)</td>
<td>1.0 ma</td>
</tr>
<tr>
<td>The two diode plates and the triode unit have a common cathode. Diode biasing of the triode unit of the 6B66 is not suitable. For diode operation, refer to type 6A6.</td>
<td></td>
</tr>
</tbody>
</table>

---

**BEAM POWER TUBE**

Glass octal types used as output amplifier in horizontal-deflection circuits of television equipment and other applications where high pulse voltages occur during short duty cycles. Type 6B66-G, Outline 25A, OUTLINES SECTION. Type 6B66-G maximum dimensions: over-all length, 5-11/16 inches; seated height, 5-1/8 inches; diameter, 2-1/16 inches. Tubes require octal socket. They may be supplied with pins 4 and 6 or 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 6B66-G is used principally for renewal purposes.

**HEATER VOLTAGE (AC/DC)**

6.3 volts

**HEATER CURRENT**

0.9 amperes

**DIRECT INTERELECTRODE CAPACITANCES:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No.1 to Plate</td>
<td>0.34 pF</td>
</tr>
<tr>
<td>Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3</td>
<td>0.12 pF</td>
</tr>
<tr>
<td>Plate to Cathode, Heaters, Grid No.2, and Grid No.3</td>
<td>0.11 pF</td>
</tr>
</tbody>
</table>

**TRANSDUCTANCE**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum, Grid No.2 to Grid No.1</td>
<td>6000 microamps</td>
</tr>
</tbody>
</table>

*For plate and grid-No.2 volts, 250; grid-No.1 volts, -16.*

**HORIZONTAL DEFLECTION AMPLIFIER**

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

**Maximum Ratings, (Design-Center Values):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>700 volts</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage (Absolute Maximum)</td>
<td>860 volts</td>
</tr>
<tr>
<td>Peak Negative-Pulse Plate Voltage</td>
<td>1560 volts</td>
</tr>
<tr>
<td>DC Grid Voltage (Screen-Grid Voltage)</td>
<td>350 volts</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid-No.1 (Control-Grid Voltage)</td>
<td>300 volts</td>
</tr>
<tr>
<td>Peak Grid-No.2 Current</td>
<td>400 ma</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>110 ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>20 watts</td>
</tr>
<tr>
<td>Grid-No.2 Inert</td>
<td>3.2 watts</td>
</tr>
</tbody>
</table>
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**PEAK HEATER-CATHODE VOLTAGE:**
Heater negative with respect to cathode ........................................... 200 max volts
Heater positive with respect to cathode .......................................... 200 max volts

**BULB TEMPERATURE** (At highest point):
- 210 max volts

**Maximum Circuit Values:**
- Grid-No.1 Circuit Resistance ........................................ 0.47 max megohms
- Plate Resistance (Approx.) ........................................ 0.7 max megohms
- Plate Resistance (Approx.) ........................................ 1 max megohms
- Grid-No.1 Voltage (Approx.) ........................................ 3400 max volts
- Plate Current .................................................................. 5 max ma
- Grid-No.1 Current .......................................................... 1 max ma
- Grid-No.2 Current .......................................................... 2.6 max ma
- Grid-No.3 Current .......................................................... 2.1 max ma
- Grid-No.2 Current .......................................................... 2.1 max ma
- Grid-No.3 Current .......................................................... 2.1 max ma

**HALF-WAVE VACUUM RECTIFIER**
Novar type used as damper tube in horizontal deflection circuits of black-and-white television receivers. Outline 17A, OUTLINES SECTION. Tube requires noven socket and may be operated in any position. Socket terminals 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:**
- 1.6 amperes

**DIRECT INTERELECTRODE CAPACITANCES (Approx.):**
- Plate to Cathode and Heater ........................................ 9.0 pf
- Cathode to Plate and Heater ........................................ 9.0 pf
- Heater to Cathode ....................................................... 2.8 pf

**DAMPER SERVICE**
For operation in a 525-line, 30-frame system

**Maximum Ratings, (Design-Maximum Values):**
- Plate Voltage .......................................................... 5500 max volts
- Peak Plate Current .................................................... 1100 max ma
- DC Plate Current ...................................................... 150 max ma
- Plate Dissipation ....................................................... 6.5 max watts
- Peak Heater-Cathode Voltage: Heater negative with respect to cathode ........................................... 5000 max volts
- Plate to Cathode and Heater ........................................ 900 max volts
- Cathode to Plate and Heater ........................................ 900 max volts
- Heater to Cathode ....................................................... 280 max volts

**SHORT-CUTOFF PENTODE**
Miniature type used as rf amplifier in mobile equipment where low heater current drain is important. It is particularly useful in high-frequency, wide-band applications. Outline 17B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC):**
- 6.3 volts

**HEATER CURRENT:**
- 0.95 amperes

**DIRECT INTERELECTRODE CAPACITANCES (Approx.):**
- Grid-No.1 to Plate ...................................................... 0.0045 max pf
- Grid-No.1 to Cathode, Heater, Grid-No.2, Grid-No.3, and Internal Shield ........................................... 5.4 max pf
- Plate to Cathode, Heater, Grid-No.2, Grid-No.3, and Internal Shield ........................................... 4.4 max pf
- Without external shield, or with external shield connected to cathode.

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- Plate Voltage .......................................................... 300 max volts
- Grid-No.2 (Screen-Grid) Supply Voltage ........................................... See curve page 70
- Grid-No.2 Voltage ...................................................... 300 max volts
- Grid-No.1 Voltage (Approx.) Positive-bias values ............................ -9 max volts
- Grid-No.2 Input: For grid-No.2 voltages up to 150 volts ........................................... -2.5 max volts
- Plate to grid-No.2 voltages between 150 and 300 volts ............................. -2.6 max volts
- Plate Voltage (Approx.) for plate current of 100 ma .......................... -14 max volts
- Plate Current ........................................................... 9.6 max ma
- Grid-No.2 Current ....................................................... 3.4 max ma

**Characteristics:**
- Plate Supply Voltage .................................................. 150 max volts
- Grid-No.2 Supply Voltage ............................................. 125 max volts
- Grid-No.1 Voltage (Approx.) ........................................... 82 ohms
- Amplification Factor .................................................. 17
- Plate Resistance (Approx.) ........................................... 5000 ohms
- Plate Current (Approx.) for plate current of 100 ma .......................... -14 ma
- Grid-No.2 Current ....................................................... 3.4 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 an rf amplifier, a video amplifier, or an age amplifier. The triode unit is used in low-frequency oscillator circuits. Outline 17D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC):**
- 6.3 volts

**HEATER CURRENT:**
- 0.95 amperes

**DIRECT INTERELECTRODE CAPACITANCES (Approx.):**
- Grid-No.1 to Plate ...................................................... 2.4 max pf
- Grid-No.1 to Cathode, Heater, Grid-No.2, Grid-No.3, and Internal Shield ........................................... 7.4 max pf
- Plate to Cathode, Heater, Grid-No.2, Grid-No.3, and Internal Shield ........................................... 7.4 max pf
- Triode Grid to Pentode Plate ........................................ 0.116 max pf
- Pentode Grid-No.1 to Triode Plate .................................. 0.116 max pf
- Pentode Plate to Triode Plate ........................................ 0.116 max pf

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- Triode Unit .......................................................... 300 max volts
- Pentode Unit .......................................................... 300 max volts
- Grid-No.2 (Screen-Grid) Supply Voltage ........................................... See curve page 70
- Grid-No.1 Voltage ...................................................... 300 max volts
- Grid-No.2 Voltage ...................................................... 9 max volts
- Plate to grid-No.2 voltages between 150 and 300 volts ............................. -2.6 max volts
- Plate Voltage (Approx.) for plate current of 100 ma .......................... -14 max volts
- Plate Current ........................................................... 9.6 max ma
- Grid-No.2 Current ....................................................... 3.4 max ma

**Characteristics:**
- Plate Supply Voltage .................................................. 150 max volts
- Grid-No.2 Supply Voltage ............................................. 125 max volts
- Grid-No.1 Voltage (Approx.) ........................................... 82 ohms
- Plate Resistance (Approx.) ........................................... 5150 ohms
- Plate Current (Approx.) for plate current of 100 ma .......................... -14 ma
- Grid-No.2 Current ....................................................... 3.4 ma

**Maximum Circuit Values:**
- Grid-No.1 Circuit Resistance: For fixed-bias operation .......................... 0.06 max megohms
- For cathode-bias operation ............................................. 1.0 max megohms
- 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 7B, 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 amperes
- **Direct Interelectrode Capacitance**:
  - Grid No. 1 to Plate: 0.0055 pf
  - Grid No. 1 to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield: 4.5 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):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>300 max volts</td>
</tr>
<tr>
<td>Grid No. 2 (Interelectrode) Voltage</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Grid No. 2 Supply Voltage</td>
<td>300 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>3 max watts</td>
</tr>
<tr>
<td>Grid No. 2 Input:</td>
<td>6.6 max watt</td>
</tr>
<tr>
<td>Grid No. 1 (Control-Grid) Voltage</td>
<td>50 max volts</td>
</tr>
<tr>
<td>Positive bias value</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Negative bias value</td>
<td>90 max volts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE:</td>
<td>90 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>90 max volts</td>
</tr>
</tbody>
</table>

**TRIPLE DIODE**

Miniature type used as a dc-restorer tube in each of the three signal channels of color-television receivers. Each diode has a separate cathode. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts, 6.3; amperes, 0.45.

**6BJ7**

- **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
  - **Average Characteristics**:
    - Plate Voltage: 4 to 9 volts
    - Grid Voltage: 0 to 9 volts
    - Grid Current: 0 to 9 ma

**TWIN DIODE—MEDIUM-MU TRIODE**

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 a/c discriminator 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 flexibility of circuit connections. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

**6BJ8**

- **Heater Voltage (AC/DC)**: 6.3 volts
- **Heater Current**: 0.6 amperes
- **Heater Warm-Up Time (Average)**: 11 seconds
- **Direct Interelectrode Capacitances:**
  - Triode Unit: Grid to Plate 2.6 pf
  - Grid to Cathode and Heater 2.6 pf
  - Plate to Cathode and Heater 0.31 pf
  - Diode Unit: Plate to Cathode and Heater (Each Unit) 1.9 pf
  - Cathode to Plate and Heater (Each Unit) 3.0 pf
  - Plate of Unit No. 1 to Plate of Unit No. 2 0.01 max
  - Plate of Diode Unit No. 1 to Triode Grid 0.07 max
  - Plate of Diode Unit No. 1 to Triode Grid 0.11 max
  - Cathode of Either Diode Unit to All Other Electrodes 4.8 pf

**TRIODE UNIT AS CLASS A1 AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid Voltage, Positive-bias value</td>
<td>9 max volts</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>22 max ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>4 max watts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE:</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
</tbody>
</table>

**Characteristics:**

- **Plate Voltage**: 90 to 250 volts
- **Grid Voltage**: 0 to 9 volts

**AVERAGE CHARACTERISTICS, TRIODE UNIT**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>4 to 9 volts</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>0 to 9 volts</td>
</tr>
<tr>
<td>Grid Current</td>
<td>0 to 9 ma</td>
</tr>
</tbody>
</table>

---

**Diagram and Graphs:**

- Diagram of the 6BJ6 and 6BJ7 tubes showing their internal connections.
- Graph showing the characteristics of the 6BJ8 diode as a class A1 amplifier.
- Graph showing the average characteristics of the triode unit.
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- **Amplification Factor**: 22
- **Plate Resistance (Approx.)**: 4700 ohms
- **Transconductance**: 4700 μmhos
- **Grid Voltage (Approx.) for plate current of 10 ma**: 7 volts
- **Plate Current**: 13.5 ma
- **Plate Current for grid voltage of -12.5 volts**: 1.7 ma

**Maximum Circuit Values**:
- **Grid-Circuit Resistance**: 1 max megohm
- **The dc component must not exceed 100 volts.

**TrioDE UNIT AS VERTICAL DEFLECTION AMPLIFIER**

- **Maximum Ratings, (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
  - **Peak Plate Dissipation**: 4 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 Values**:
- **Grid-Circuit Resistance**: 2.2 max megohms
- **For cathode-bias operation.

**DIODE UNITS**

- **Maximum Ratings, (Design-Maximum Values):**
  - **Plate Current (Each Unit)**:
    - **Peak**: 54 max ma
    - **Average**: 9 max ma
  - **Peak Heater-Cathode Voltage**:
    - Heater negative with respect to cathode: 200 max volts
    - Heater positive with respect to cathode: 200 max volts

**SHARP-CUT-OFF BEAM TRIODE**

Glass octal type used for the voltage regulation of high-voltage, low-current dc power supplies in color television receivers. Outline 25A, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position.

- **Heater Voltage (AC/DC)**: 6.3 volts
- **Heater Current**: 0.45 amperes
- **Direct Interelectrode Capacitances (Approx.)**:
  - Grid to Plate: 6.03 pf
  - Grid to Cathode and Heater: 2.6 pf
  - Plate to Cathode and Heater: 2000 pf

**VOLTAGE-CONTROL SERVICE**

- **Maximum Ratings, (Design-Maximum Values):**
  - **DC Plate Voltage**: 27000 max volts
  - **Unregulated DC Supply Voltage**: 60000 max volts
  - **DC Grid Voltage**: -440 max volts
  - **DC Plate Current**: 1.5 max ma
  - **Plate Dissipation**: 20 max watts
  - **Peak Heater-Cathode Voltage**:
    - Heater negative with respect to cathode: 200 max volts
    - Heater positive with respect to cathode: Not recommended

**Maximum Circuit Value**:
- **Grid-Circuit Resistance**: 3 max megohms
- **For use with “Flyback Transformer” high-voltage supply.

**BEAM POWER TUBE**

Miniature type used in audio output stages of television and radio receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc): 6.8; amperes: 0.5. Typical operation as class A amplifier: plate and grid-No.2 volts, 250 ma; grid-No.1 volts, 25 ma; plate dissipation, 10 ma watts; grid-No.2 input, 0.2 ma watts; plate ma volts, 35 (zero-signal), 37 (max-signal); grid-No.2 max ma, 3.5 (zero-signal), 10 (max-signal); plate resistance (approx.), 0.1 megohm; transconductance, 3000 ohms; load resistance, 5000 ohms; total harmonic distortion, 3% per cent; power and watts; peak heater-cathode volts, 100 ma. This type is used principally for renewal purposes.

**6BK5**

Related types: 12BK5, 25BK5

**6BK7A**

Related type: 5BK8

**MEDIUM-MU TWIN TRIODE**

Miniature types used in direct-coupled cathode-driver circuits and in television tuners. In such circuits, one triode unit is used as the direct-coupled grounded-cathode driver for the other unit. These types are also used in push-pull cathode-driver amplifiers. Type 6BK7-A has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Outline 8B, 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 6BK7-A is a DISCONTINUED type listed for reference only.

- **Heater Voltage (AC/DC)**: 6.3 volts
- **Heater Warm-Up Time (Average) for 6BK7-B**: 11 seconds
- **Direct Inter-electrode Capacitances**:
  - Grid to Plate: 1.8 pf
  - Grid to Cathode, Heater, and Internal Shield: 1.8 pf
  - Plate to Cathode, Heater, and Internal Shield: 3.3 pf
  - Plate to Grid, Heater, and Internal Shield: 6.0 pf
  - Plate to Grid, Heater, and Internal Shield: 2.4 pf
RCA Receiving Tube Manual

### Plate to Cathode
0.22 pf

### Heater to Cathode
2.8 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

#### CLASS A, AMPLIFIER (Each Unit)

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>300 max volts</td>
<td></td>
</tr>
<tr>
<td>GRID VOLTAGE, Negative-bias value</td>
<td>-50 max volts</td>
<td></td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>2.7 max watts</td>
<td></td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Heater negative with respect to cathode</td>
<td>200 max volts</td>
<td></td>
</tr>
<tr>
<td>- Heater positive with respect to cathode</td>
<td>200 max volts</td>
<td></td>
</tr>
</tbody>
</table>

#### CHARACTERISTICS:
- **Plate Supply Voltage**: 150 volts
- **Cathode-Bias Resistor**: 56 ohms
- **Amplification Factor**: 46 ohms
- **Plate Resistance (Approx.)**: 4600 ohms
- **Transconductance (Approx.)**: 6800 mhos
- **Plate Current**: 0.08 ma
- **Grid Voltage (Approx.) for plate current of 10 µA**: -11 volts

#### HALF-WAVE VACUUM RECTIFIER
Glass octal type used as a damper tube in horizontal deflection circuits of color television receivers. Maximum dimensions: over-all length, 4-5/8 inches; seated height, 4-1/16 inches; diameter, 1-5/8 inches. Tube requires octal socket. Heater voltage (ac/dc), 6.3; amperes, 3. Maxi- mum ratings for damper plate: peak inverse plate voltage (absolute maximum), 4500 volts; peak plate ma., 1200 ma; dc plate ma., 200 ma; plate dissipation, 8 max watts; peak heater-cathode volts, 4500 absolute max when heater is negative with respect to cathode (de component must not exceed 900 volts): 300 ma when heater is positive with respect to cathode (de component must not exceed 100 volts). This is a DISCONTINUED type listed for reference only.

#### MEDIUM-MU TWIN TRIODE
**6B74**
Glass octal type used as combined vertical deflection amplifier and vertical deflection oscillator in television receivers. When so operated, it is recommended that unit No.1 (pins 4, 5, and 6) be used as the oscillator. Outline 14G, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position. Type 6B74-T is a DISCONTINUED type listed for reference only.

#### CHARACTERISTICS:
- **Plate Voltage**: 6.3 volts
- **Plate Current**: 0.6 amperes
- **Direct Inter electrode Capacitances (Approx.)**: Unit No. 1 Unit No. 2
  - Grid to Plate: 6 pf
  - Grid to Cathode and Heater: 6 pf
  - Plate to Cathode and Heater: 0.9 pf
  - Amplification Factor*: 15
  - Plate Resistance (Approx.)*: 2150 ohms
  - Transconductance*: 7000 mhos

#### MEDIUM-MU TRIODE
**6BN4**
Miniature type used as rf amplifier tubes in grid-drive circuits of vhf television tuners. The double base-pin connections for both cathode and grid reduce effective lead inductance and noise. Outline 8B, OUTLINES SECTION. Type 6BN4, 6BN4A
lead resistance with consequent reduction in input conductance. In addition, the busing arrangement facilitates isolation of input and output circuits and permits short, direct connections to base-pin terminals. Outline 7B, OUTLINES SECTION. Tubes require miniature seven-contact socket and may be mounted in any position. Type 6B4N is a DISCONTINUED type listed for reference only.

**HEATER VOLTAGE (AC/DC):** 6.3 volts
**HEATER CURRENT:** 6.2 amperes

**DIRECT INTERELECTRODE CAPACITANCES (APPROX.):**
- Grid to Plate: 1.2 pf
- Grid to Cathode and Heater: 3.2 pf
- Plate to Cathode and Heater: 4.4 pf

*With external shield connected to cathode.

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Center Values):**
- **PLATE VOLTAGE:** 275 max volts
- **GRID VOLTAGE, Positive-bias value:** 0 max volts
- **PLATE CURRENT:** 2.2 max watts
- **CATHODE VOLTAGE:** 22 max ma
- **PEAK HEATER-CATHODE VOLTAGE:**
  - Heater negative with respect to cathode: 100 max volts
  - Heater positive with respect to cathode: 100 max volts

**Characteristics:**
- **Plate-Supply Voltage:** 150 volts
- **Cathode-Bias Resistor:** 220 ohms
- **Amplification Factor:** 45
- **Plate Resistance (Approx.):** 5400 ohms
- **Transconductance:** 7700 mhos
- **Grid Voltage (Approx.) for plate current of 100 ma:** -6 volts
- **Plate Current:** 9 ma

**Maximum Circuit Voltage:**
- **Grid-Circuit Resistance:** 0.5 max megohm

**BEAM TUBE**

Miniature type used as combined limiter, discriminator, and audio-voltage amplifier in intercarrier television and FM receivers. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3: amperes, 0.3.

**LIMITER AND DISCRIMINATOR SERVICE**

**Maximum Ratings, (Design-Maximum Values):**
- **PLATE-SUPPLY VOLTAGE:** 330 max volts
- **GRID-VOLTAGE, Positive peak value:** 110 max volts
- **GRID-No.2 VOLTAGE:** 80 max volts
- **CATHODE CURRENT:** 15 max ma
- **PEAK HEATER-CATHODE VOLTAGE:**
  - Heater negative with respect to cathode: 200 max volts
  - Heater positive with respect to cathode: 200 max volts

*The dc component must not exceed 100 volts.

**TWIN DIODE—HIGH-MU TRIODE**

Miniature type used in a wide variety of applications in color and black-and-white television receivers. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. The triode unit is used in burst-amplifier, at amplifier, and low-frequency oscillator applications. The diode units are used in phase-detector, ratio-detector or discriminator, and horizontal AFC discriminator circuits. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC):**
- **Heater VOLTAGE (DC):** 6.3 volts
- **Heater Current:** 6.2 amperes
- **HEATER WARM-UP TIME (AVERAGE):** 11 seconds

**DIRECT INTERELECTRODE CAPACITANCES:**
- Triode Grid to Triode Plate: 2.5 pf
- Triode Grid to Cathode and Heater: 8.6 pf
- Triode Plate to Cathode and Heater: 9.25 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 pf
- Triode Cathode to All Other Electrodes (Each Diode Unit): 5 pf
- Plate to Triode Cathode and Heater (Each Diode Unit): 1.9 pf
- Triode Cathode to Diode Plate and Heater (Each Diode Unit): 4.8 pf
- Diode Plate to All Other Electrodes (Each Diode Unit): 3 pf

**TRIODE UNIT AS CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- **PLATE VOLTAGE:** 330 max volts
- **GRID VOLTAGE, Positive bias value:** 7.9 max volts
- **PLATE CURRENT:** 1.7 max ma

**Characteristics:**
- **Plate Voltage:** 200 max volts
- **Grid Voltage:** 100 volts
- **Amplification Factor:** 100
- **Plate Resistance (Approx.)**
  - 70000 ohms
  - 21000 ohms
- **Transconductance:** 3500 mhos
- **Grid Voltage (Approx.) for plate current of 10 ma:**
  - 7 volts
  - 8 volts
- **Plate Current:** 1.5 ma

**Maximum Circuit Value:**
- **Grid-Circuit Resistance:** 1.0 max megohm

**DIODE UNITS**

**Maximum Ratings, (Design-Maximum Values):**
- **PLATE CURRENT (Each Unit):**
  - **DC:** 54 max ma
  - **Peak HEATER-CATHODE VOLTAGE:**
    - Heater negative with respect to cathode: 200 max volts
    - Heater positive with respect to cathode: 200 max volts

*The dc component must not exceed 100 volts.
POWER PENTODE

Miniature type used in the output stage of audio-frequency amplifiers. Outline 8E, OUTLINES SECTION. Tube requires miniature non-contact socket and may be mounted in any position.

HEATER VOLTAGE (AC/DC)........... 6.3 volts
HEATER CURRENT.................. 0.76 amperes

DIRECT ELECTRODE CAPACITANCES:
- Grid No.1 to Plate: 5.6 max pf
- Grid No.1 to Cathode: 10.5 pf
- Grid No.2 to Plate: 6.5 max pf
- Grid No.2 to Grid No.3: 6.5 max pf
- Plate to Grid No.2: 0.25 max pf
- Grid No.3 to Plate: 12.6 max pf

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Center Values):
- PLATE VOLTAGE............. 300 max volts
- PLATE CURRENT............ 300 max volts
- Grid-No.2 (Screen-Grid) Voltage: 0 max volts
- Grid-No.2 Input........... 2 max watts
- PLATE DISSIPATION........ 12 max watts
- CATHODE CURRENT.......... 65 max ma
- Peak Heater-Cathode Voltage: 100 max volts
- Heater negative with respect to cathode: 100 max volts
- Heater positive with respect to cathode: 100 max volts
- The dc component must not exceed 100 volts.

Typical Operation:
- Plate Voltage.............. 260 volts
- Grid-No.2 Voltage........ 260 volts
- Grid-No.1 (Control-Grid) Voltage: -7.3 volts
- Peak AF Grid-No.1 Voltage: 6.2 volts
- Zero-Signal Plate Current: 48 ma
- Maximum-Signal Plate Current: 50.6 ma
- Zero-Signal Grid-No.2 Current: 10 ma
- Maximum-Signal Grid-No.2 Current: 10 ma
- Plate Resistance........... 38000 ohms
- Transconductance........ 11800 amhos
- Load Resistance........... 4500 ohms
- Total Harmonic Distortion: 10 per cent
- Maximum-Signal Power Output: 5.7 watts

Maximum Circuit Values:
- Grid-No.1-Circuit Resistance: 0.3 max megohm
- For fixed-bias operation: 1.0 max megohm

PUSH-PULL CLASS AB, AMPLIFIER

Maximum Ratings, (Same as for single-tube class A, amplifier):
- PLATE VOLTAGE............. 250 volts
- PLATE CURRENT............ 300 volts
- Grid-No.2 Supply Voltage: 25 volts
- Cathode-Bias Resistor: 190 ohms
- Peak AF Grid-No.1 Voltage: 22.6 volts
- Zero-Signal Plate Current: 62 ma
- Maximum-Signal Plate Current: 75 ma
- Zero-Signal Grid-No.2 Current: 7 ma
- Maximum-Signal Grid-No.2 Current: 15 ma
- Effective Load Resistance (Plate-to-plate): 8000 ohms
- Total Harmonic Distortion: 10 per cent
- Maximum-Signal Power Output: 11 watts

Maximum Circuit Values:
- Grid-No.1-Circuit Resistance: 0.3 max megohm
- For fixed-bias operation: 1.0 max megohm

BEAM POWER TUBE

Glass octal tubes used as horizontal deflection amplifiers in television receivers. Outline 15C, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position. These types may be supplied with pin No.1 omitted. Type 6BQ6-GT is a DISCONTINUED type listed for reference only.

HEATER VOLTAGE (AC/DC)........... 6.3 volts
HEATER CURRENT.................. 1.2 amperes

Direct Electrode Capacitances (Approx., 6BQ6-GT, 6CU6):
- Grid No.1 to Plate: 0.6 pf
- Grid No.1 to Cathode: 15 pf
- Grid No.2 to Plate: 7 pf
- Grid No.2 to Grid No.3: 5800 pf

TRANSCONDUCTANCE (6BQ6-GT, 6CU6):
- For plate and grid No.2: 4.3 mhos
- For plate and grid No.3: 2.1 mhos

HORIZONTAL DEFLECTION AMPLIFIER

For operation in a 655-line, 30-frame system.

Maximum Ratings, (Design-Center Values):
- DC PLATE VOLTAGE........ 550 volts
- Peak Positive-Pulse Plate Voltage: 600 volts
- Peak Negative-Pulse Plate Voltage: 1200 volts
- Grid-No.2 (Screen-Grid) Voltage: 175 volts
- Peak Positive-Pulse Grid-No.1 (Control-Grid) Voltage: 300 volts
- Peak Cathode Current: 400 ma
- AVERAGE CATHODE CURRENT: 110 ma
- Grid-No.2 Input: 20 ma
- PLATE DISSIPATION: 20 watts
- Plate Resistance........... 10 ohms
- CATHODE DISSIPATION: 2.0 watts
- CATHODE VOLTAGE: 110 volts
- Heater negative with respect to cathode: 200 volts
- Heater positive with respect to cathode: 200 volts
- BULK TEMPERATURE (At hottest point): 220° C

Maximum Circuit Values:
- Grid-No.1-Circuit Resistance: 0.47 megohms
- Grid-No.2-Circuit Resistance: 0.47 megohms
- Grid-No.3-Circuit Resistance: 0.47 megohms
- The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 655-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.
- The dc component must not exceed 100 volts.

MEDIUM-MU TWIN TRIODE

Miniature types used in direct-coupled cathode-drive rf amplifier circuits of vhf television tuners. In such circuits, one triode unit is used as the direct-coupled grounded-cathode driver for the other unit. These types are also used in push-pull cathode-drive rf amplifiers. Outline 8B, OUTLINES SECTION. Tubes require miniature non-contact socket and may be mounted in any position. For typical operation as a resistance-coupled amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION. Type 6BQ7 is a DISCONTINUED type listed for reference only.

HEATER VOLTAGE (AC/DC)........... 6.3 volts
HEATER CURRENT.................. 0.4 amperes

Direct Inter-Electrode Capacitances (6BQ7-A), Unit No.1, Unit No.2:
- Grid to Plate: 1.2 pf
- Grid to Cathode, Heater, and Internal Shield: 2.4 pf
- Cathode to Grid, Heater, and Internal Shield: 1.2 pf
- Plate to Grid, Heater, and Internal Shield: 2.4 pf
- Plate to Grid: 0.12 pf
- Plate to Cathode: 2.6 pf
- Plate of Unit No.1 to Plate of Unit No.2: 0.010 pf
- Plate of Unit No.2 to Plate and Grid of Unit No.1: 0.024 pf
**RCA Receiving Tube Manual**

### CLASS A, AMPLIFIER (Each Unit)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Ratings</td>
<td>250Vmax volts</td>
</tr>
<tr>
<td>PLATE SUPPLY VOLTAGE</td>
<td>220 volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>220 watts</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>20 ma</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE: Heater negative with respect to cathode</td>
<td>2000 ma</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>2000 ma</td>
</tr>
</tbody>
</table>

#### Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6BQ7</td>
<td>6BQ7-A</td>
</tr>
<tr>
<td>Plate Supply Voltage</td>
<td>150 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>220 ohms</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>35 ohms</td>
</tr>
<tr>
<td>Plate Resistance (Approx)</td>
<td>5000 ohms</td>
</tr>
<tr>
<td>Plate Current</td>
<td>9 ma</td>
</tr>
<tr>
<td>Grid Voltage (Approx)</td>
<td>-6.5 volts</td>
</tr>
<tr>
<td>For plate current of 100 ma</td>
<td>-10 volts</td>
</tr>
</tbody>
</table>

#### Maximum Circuit Value:

- Grid-Circuit Resistance: 0.5 max megohms
- 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 900 volts.
- The dc component must not exceed 100 volts.

**AVERAGE PLATE CHARACTERISTICS FOR EACH UNIT**

#### MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

- **6BR8**
  - Related type: 2B82
- **6BR8A**
  - Related type: 4B8S

Miniature types used in wide variety of applications in color and black-and-white television receivers. Especially useful as combined triode oscillator and pentode mixer in vhf television tuners. Type 6BR8-A has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Except for basing arrangement and grid-No.1-to-plate capacitance of pentode unit, these types are identical with miniature types 6U8 and 6U8-A, respectively.

**HALF-WAVE VACUUM RECTIFIER**

- **6BS3**
  - Related types: 12BS3, 17BS3

Novar type used as damper tube in horizontal-deflection circuits of black-and-white television receivers. Outline 16D, OUTLINES SECTION. Tube requires novar nine-contact sock-

### Technical Data

**For operation in a 625-line, 30-frame system**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER VOLTAGE (AC/DC)</td>
<td>6.3 volts</td>
</tr>
<tr>
<td>HEATER CURRENT</td>
<td>1.2 amperes</td>
</tr>
<tr>
<td>DIRECT-INTERELECTRODE CAPACITIES (Approx):</td>
<td></td>
</tr>
<tr>
<td>Plate to Cathode and Heater</td>
<td>6.5 pf</td>
</tr>
<tr>
<td>Cathode to Plate and Heater</td>
<td>9 pf</td>
</tr>
<tr>
<td>Heater to Plate and Heater</td>
<td>2.8 pf</td>
</tr>
</tbody>
</table>

**DAMPER SERVICE**

- Maximum Ratings: 6B8S
  - Related type: 4B8S

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 direct-coupled grounded-cathode driver for the other unit. This type is also used in push-pull cathode-drive rf amplifiers. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/de), 6.3; amperes, .4.

**CLASS A, AMPLIFIER (Each Unit)**

<table>
<thead>
<tr>
<th>Parameter</th>
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</tr>
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<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>150 volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>20 ma</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>20 ma</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE: Heater negative with respect to cathode</td>
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<td>Heater positive with respect to cathode</td>
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<td>Plate Resistance (Approx)</td>
<td>5000 ohms</td>
</tr>
<tr>
<td>Plate Current</td>
<td>10 ma</td>
</tr>
<tr>
<td>Grid Voltage (Approx)</td>
<td>-6.5 volts</td>
</tr>
<tr>
<td>For plate current of 100 ma</td>
<td>-10 volts</td>
</tr>
</tbody>
</table>

**Maximum Circuit Value**

- Grid-Circuit Resistance: 0.5 max megohms
- This value applies to unit No.2 only.

**SHARP-CUTOFF TWIN PENTODE**

- **6B8U8**
  - Related types: 3BU8, 4BU8

Miniature type used as combined sync separator, sync clipper, and age amplifier tube in television receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.
**RCA Receiving Tube Manual**

**Technical Data**

**Maximum Circuit Values:**
- Grid-No.3 Circuit Resistance (Each Unit) 0.5 max megohm
- Grid-1 Circuit Resistance 0.5 max megohm
- *The dc component must not exceed 100 volts.

*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.

---

**CLASS A Amplifier**

**Maximum Ratings, (Design-Maximum Values):**
- **Plate Voltage (Each Unit):** 300 max volts
- **Grid-No.3 Voltage (Suppression Grid Voltage):**
  - Peak positive value: 50 max volts
  - DC negative value: 60 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
- **Grid-No.2 Input:** 0.75 max ma
- **Plate Dissipation (Each Unit):** 1.1 max watts

**Peak Heaters-Cathode Voltage:**
- Heater negative with respect to cathode 200 max volts
- Heater positive with respect to cathode 200 max volts

**Characteristics:**

- **With Both Units Operating:**
  - Plate Voltage (Each Unit): 100 100 volts
  - Grid-No.2 Voltage: 67.5 67.5 volts
  - Grid-No.1 Voltage: 2.2 ma
  - Plate Current (Each Unit): 6.5 3.3 ma
  - Grid-No.2 Current: 6.6 7.8 ma

- **With One Unit Operating:**
  - Plate Voltage: 100 100 volts
  - Grid-No.3 Voltage: 67.5 67.5 volts
  - Grid-No.1 Voltage: 180 μma
  - Grid-No.3 Transconductance: 1500
  - Grid-No.1 Transconductance: 2.2 ma
  - Grid-No.2 Voltage (Approx.) for plate current of 100 ma: -4.5 volts
  - Grid-No.1 Voltage (Approx.) for plate current of 100 ma: -2.3 volts

---

**TWIN DIODE—MEDIUM-MU TRIODE**

6BV8

Miniature type used as combined synchronous detector and chrominance amplifier in color television receivers; also used as combined FM detector and af voltage amplifier. Tube has controlled warm-up time for use in series-connected heater strings. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.6; warm-up time (average), 11 seconds.

**TRIODE UNIT AS CLASS A Amplifier**

**Maximum Ratings, (Design-Maximum Values):**
- **Plate Voltage:** 330 max volts
- **Cathode Resistance:** 330 ohms
- **Plate Dissipation:** 2.7 max watts

**Peak Heaters-Cathode Voltage:**
- Heater negative with respect to cathode 200 max volts
- Heater positive with respect to cathode 200 max volts

**Characteristics:**

- Plate Voltage: 75 200 volts
- Grid Voltage: 0 volts
- Cathode Resistance: 330 ohms
- Amplification Factor: 33
- Plate Resistance (Approx.): 5000 ohms
- Transconductance: 5500 μma
- Plate Current: 14 11 ma
- Grid Voltage (Approx.) for plate current of 100 ma: -11 volts

**Maximum Circuit Values:**
- Grid-Circuit Resistance: 0.1 max megohm
- For fixed-bias operation: 0.5 max megohm
- For cathode-bias operation: 0.5 max megohm
Full-wave Vacuum Rectifier

Miniature type used in full-wave power supplies having high dc output current requirements. Outline 8D, OUTLINES SECTION. Type 6BW4 requires miniature nine-contact socket and may be 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, 0.9.

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 age keyer. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 6.3; amperes, 0.45. Tube requires nine-contact socket and may be operated in any position.

Technical Data

Transconductance........................................... 5200 \(\mu\)hos
Grid-No.1 Voltage (Approx.) for plate current of 10 ma.................................................. 10 volts
Grid-No.2 Current............................................. 10 ma
Grid-No.2 Voltage............................................. 3.5 volts

Maximum Circuit Values:
Grid-No.1 Circuit Resistance: For fixed-bias operation.............................................. 0.1 ma, megohm
For cathode-bias operation...................................... 0.5 ma, megohm

DIODE UNITS—TWO

Values are for each unit

Maximum Ratings, (Design-Maximum Values):

PLATE CURRENT.............................................. 10 ma, ma
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode.................................................. 200 max, volts
Heater positive with respect to cathode.................................................. 200 max, volts

Characteristics, Instantaneous Test Condition:
Tube Voltage Drop for plate current of 23 ma.................................................. 5 volts
*The dc component must not exceed 100 volts.

DIODE UNITS—Each Unit

Maximum Ratings, (Design-Maximum Values):

PLATE CURRENT.............................................. 5 ma, ma
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode.................................................. 200 max, volts
Heater positive with respect to cathode.................................................. 200 max, volts
*The dc component must not exceed 100 volts.

Medium-Mu Twin Triode

Glass octal type used as combined vertical deflection amplifier and vertical deflection oscillator in television receivers. When so operated, it is recommended that unit No.1 (pins 4, 5, and 6) be used as the oscillator. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position.

VERTICAL DEFLECTION OSCILLATOR OR AMPLIFIER—Each Unit

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

Maximum Ratings, (Design-Maximum Values):

DC PLATE VOLTAGE.............................................. 500 max, volts
PEAK POSITIVE-PULSE PLATE VOLTAGE
(Absolute Maximum).............................................. 2000* max, volts
PEAK NEGATIVE-PULSE PLATE VOLTAGE.................................................. 10* max, volts
PEAK grid No.1 CURRENT.................................................. 10 ma, amperes
AVG CATHODE CURRENT.................................................. 10 ma, amperes
PLATE DISPF: For either plate.................................................. 10 ma, watts
For both plates with both units operating.................................................. 12 ma, 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 Values:
Grid-Circuit Resistance.................................................. 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.
*Under no circumstances should this absolute value be exceeded.
*The dc component must not exceed 100 volts.
*For cathode-bias operation.

Full-wave Vacuum Rectifier

Octal type having high perrnance used as a damper tube in horizontal deflection circuits of television receivers or as a rectifier in conventional power-supply applications. Outline 19A, 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 volts (ac/dc), 6.3; amperes, 1.6. Maximum ratings for damper service (each unit): peak inverse plate volts (absolute maximum), 3000 volts; peak plate ma, 235 ma; dc plate ma, 175 ma. Peak heater-cathode volts: heater negative with respect to cathode, 450 volts; heater positive with respect to cathode, 100 ma. This type is used principally for renewal purposes.
PENTAGRID AMPLIFIER

**6BY6**

**Related type:** 3876

**6BY8**

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 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

**Heater Voltage (AC/DC):** 6.3 volts

**Heater Current:** 0.3 amperes

**Direct Inter-electrode Capacitances:**
- Grid No.1 to Plate: 0.08 mF
- Grid No.1 to Grid No.3: 0.22 mF
- Grid No.1 to All Other Electrodes: 5.4 mF
- Grid No.3 to Plate: 0.35 mF
- Grid No.3 to Grid No.4: 0.69 mF
- Grid No.3 to All Other Electrodes: 7.6 mF

**Characteristics:**

**CLASS A1 AMPLIFIER**

- **Plate Voltage:** 350 volts
- **Grid-No.3 Voltage:** -3.5 volts
- **Grid-No.3 to Plate Transconductance:** 500 mhos
- **Grid-No.3 to Plate Transconductance:** 1900 mhos
- **Plate Current:** 6.5 mA
- **Grid-No.3 to Grid-No.4 Current:** 1 mA
- **Grid-No.3 Volts (Approx.) for plate current of 35 mA and grid-No.1 volt = -4:** -15 volts
- **Grid-No.1 Volts (Approx.) for plate current of 0.6 mA and grid-No.3 volt = 0:** -12 volts

**GATED AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

- **PLATE VOLTAGE:** 330 volts
- **Grid-No.3 and Grid-No.4 Supply Voltage:** 330 volts
- **Grid-No.3 Voltage:** -55 volts
- **Positive bias value:** 0 mA
- **Negative bias value:** -27 mA
- **Positive peak value:** 110 mA
- **Plate Dissipation:** 2.3 watts
- **Grid-No.3 Input:** 0.1 mA
- **Grid-No.2 and Grid-No.4 Input:** 1.1 mA

**AVERAGE OPERATION CHARACTERISTICS**

- **Grid-No.1 Supply Voltage:** 20 volts
- **Grid-No.3 Supply Voltage:** 25 volts
- **Grid-No.2 Supply Voltage:** 50 volts
- **Grid-No.1 Current:** 50 mA
- **Grid-No.3 Current:** 60 mA
- **Grid-No.3 Transconductance:** 1500 mhos
- **Grid-No.1 Current (Approx.) for plate current of 100 mA:** -4 mA
- **Plate Current:** 5 mA
- **Grid-No.2 Current:** 10 mA

**Maximum Ratings, (Design-Minimum Values):**

- **Plate Supply Voltage:** 150 volts
- **Grid-No.3 Supply Voltage:** 150 volts
- **Grid-No.2 Supply Voltage:** 150 volts
- **Plate Resistance:** 0.5 ohms
- **Transconductance:** 3000 mhos
- **Grid-No.1 Current (Approx.) for plate current of 100 mA:** -4.2 mA
- **Plate Current:** 5 mA
- **Grid-No.2 Current:** 10 mA

**Maximum Current Values:**

- **Grid-No.1 Current:** 1 mA
- **Grid-No.3 Current:** 3 mA

**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-pervenance diode as a limiter or detector. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Outline 8D, 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.

**PENTODE UNIT AS CLASS A1 AMPLIFIER**

**Maximum Ratings, (Design-Minimum Values):**

- **PLATE VOLTAGE:** 300 mF
- **Grid-No.3 (Suppression-Grid) Voltage:** 0 mF
- **Grid-No.3 (Screen Grid) Supply Voltage:** 300 mF
- **Grid-No.3 Voltage:** See curve page 70
- **Grid-No.1 Supply Voltage:** See curve page 70
- **Grid-No.1 Current (Screen Grid):** -50 mA
- **Plate Dissipation:** 6 mA
- **Grid-No.3 Supply Voltage:** 0.65 max watt
- **Grid-No.2 Supply Voltage (between 150 and 300 volts):** See curve page 70
- **Peak Heater-Cathode Voltage:**
  - Heater positive with respect to cathode: 200 max volts
  - Heater negative with respect to cathode: 200 max volts

**Characteristics:**

- **Plate Supply Voltage:** 150 volts
- **Grid-No.2 Supply Voltage:** 150 volts
- **Grid-No.2 Supply Voltage:** 150 volts
- **Cathode Bias Resistor:** 68 ohms
- **Plate Resistance:** 0.6 mhos
- **Transconductance:** 3000 mhos
- **Grid-No.1 Current (Approx.) for plate current of 10 mA:** -4.2 mA
- **Plate Current:** 5 mA
- **Grid-No.2 Current:** 10 mA

**Maximum Values:**

- **Grid-No.1 Current:** 1 mA
- **Grid-No.3 Current:** 3 mA

**Maximum Current Values:**

- **Grid-No.1 Current:** 1 mA
- **Grid-No.3 Current:** 3 mA

**DIODE UNIT**

**Maximum Ratings, (Design-Minimum Values):**

- **Peak Inverse Plate Voltage:** 430 volts
- **Peak Plate Current:** 100 mA
- **DC Plate Current:** 45 mA
- **Peak Heater-Cathode Voltage:**
  - Heater positive with respect to cathode: 200 max volts
  - Heater negative with respect to cathode: 200 max volts

**Characteristics:**

- **Peak Inverse Plate Voltage:** 430 volts
- **Peak Plate Current:** 100 mA
- **DC Plate Current:** 45 mA
- **Peak Heater-Cathode Voltage:**
  - Heater positive with respect to cathode: 200 max volts
  - Heater negative with respect to cathode: 200 max volts

* The dc component must not exceed 100 volts.
SEMIREMOTE-CUTOFF PENTODE

Miniature type used in gain-controlled video stages of television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

6BZ6

Related types: 3BZ6, 4BZ6, 12BZ6

<table>
<thead>
<tr>
<th>HEATER VOLTAGE (AC/DC)</th>
<th>6.3 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER CURRENT</td>
<td>0.3 ampere</td>
</tr>
</tbody>
</table>

DIRECT INTERELECTRODE CAPACITANCES:

<table>
<thead>
<tr>
<th>Without External Shield</th>
<th>6.016 mF</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Shield</td>
<td>0.005 mF</td>
</tr>
</tbody>
</table>

PLATE DISSIPATION:

<table>
<thead>
<tr>
<th>Without External Shield</th>
<th>7 watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Shield</td>
<td>7 watts</td>
</tr>
</tbody>
</table>

PLATE DISSIPATION:

<table>
<thead>
<tr>
<th>Without External Shield</th>
<th>3.3 watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Shield</td>
<td>3.3 watts</td>
</tr>
</tbody>
</table>

MAXIMUM RATINGS, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>330 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRID-1 to Cathode, Heater, Grid-2, Grid-3, and Internal Shield</td>
<td>80 volts</td>
</tr>
<tr>
<td>GRID-2 to Plate</td>
<td>230 volts</td>
</tr>
<tr>
<td>GRID-3 to Plate</td>
<td>230 volts</td>
</tr>
<tr>
<td>GRID-4 to Plate</td>
<td>230 volts</td>
</tr>
<tr>
<td>PLATE CURRENT</td>
<td>0.35 mA</td>
</tr>
</tbody>
</table>

CHARACTERISTICS:

<table>
<thead>
<tr>
<th>Plate Supply Voltage</th>
<th>125 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No. 5 connected to cathode at socket</td>
<td>125 volts</td>
</tr>
<tr>
<td>Cathode-Grid Resistor</td>
<td>56 ohms</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>8000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>-19 volts</td>
</tr>
<tr>
<td>Grid-1 Voltage (Approx.) for transconductance of 50 µmhos</td>
<td>-4.5 volts</td>
</tr>
<tr>
<td>Grid-1 Voltage (Approx.) for transconductance of 700 µmhos and cathode resistor of 0 ohms</td>
<td>14 ma</td>
</tr>
<tr>
<td>Plate Current</td>
<td>4 ma</td>
</tr>
<tr>
<td>Grid-2 Current</td>
<td>3.6 ma</td>
</tr>
</tbody>
</table>

MAXIMUM CIRCUIT VALUES:

<table>
<thead>
<tr>
<th>Grid No. 1-Circuit Resistance:</th>
<th>0.25 mohm</th>
</tr>
</thead>
<tbody>
<tr>
<td>For fixed-bias operation</td>
<td>1.0 mohm</td>
</tr>
</tbody>
</table>

The dc component must not exceed 100 volts.

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 direct-coupled grounded-cathode driver for the other unit. This type is also used in push-pull cathode-drive rf amplifiers. Outline 8B, 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. Heater volts (ac/dc), 6.3; amperes, 0.4.

6BZ7

Related type: 4BZ7

CLASS A, AMPLIFIER (Each Unit):

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>250 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE DISSIPATION</td>
<td>2.0 watts</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>0.20 mA</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE: Heater negative with respect to cathode</td>
<td>200 volts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE: Heater positive with respect to cathode</td>
<td>200 volts</td>
</tr>
</tbody>
</table>

In cathode-circuit units 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.

Characteristics:

<table>
<thead>
<tr>
<th>Plate Supply Voltage</th>
<th>150 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode-Bias Resistor</td>
<td>200 ohms</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>36</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>500 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>6000 µmhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>10 ma</td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 100 µA</td>
<td>-1 volts</td>
</tr>
</tbody>
</table>

Maximum Circuit Value:

| Grid-Circuit Resistance | 0.6 mohm |

AVERAGE CHARACTERISTICS EACH UNIT:

| Type 6BZ7 | 6.6 volts |

<table>
<thead>
<tr>
<th>PLATE MILLIAMPERES</th>
<th>2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTS</td>
<td>240</td>
</tr>
</tbody>
</table>

6BZ8

MINIMUM-MU TWIN TRIODE

Miniature type used in direct-coupled cathode-drive, rf amplifier circuits in vhf television tuners. In such circuits, one triode unit is used as the direct-coupled grounded-cathode driver for the other unit. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.4. Characteristics as class A, amplifier (each unit): plate supply volts, 120 (250 max); cathode-bias...
resistor, 100 ohms; amplification factor, 45; plate resistance (approx.), 5600 ohms; transconductance, 6000 amhos; plate ma., 20 ma.; plate dissipation, 2.2 ma.; peak heater-cathode voltage, 200 volts. Type 612B8 is used principally for renewal purposes.

**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 moderate frequencies, and 2.5 watts at 150 megacycles per second. Outline 7B, 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 12AU7-A.

**6C4**

### HEATER VOLTAGE (AC/DC)

- 6.3 volts
- 0.15 ampere

### DIRECT INTERELECTRODE CAPACITANCES (Approx.):

- Grid to Plate: 1.6 pf, 1.4 pf
- Grid to Cathode and Heater: 1.8 pf, 1.8 pf
- Plate to Cathode and Heater: 1.3 pf, 2.5 pf

- With external shield connected to cathode.

**CLASS A AMPLIFIER**

**Maximum Ratings, (Design-Center Values):**

- PLATE VOLTAGE 300 max volts
- PLATE CURRENT 3.5 max ma.

**Grid-Plate/Cathode-Voltage:**

- Heater positive with respect to cathode 200 ma.
- Heater negative with respect to cathode 200 ma.

**Characteristics:**

- Plate Voltage 100 volts
- Grid Voltage 0 volts
- Grid Resistance (Approx.) 19.5 ohms
- Transconductance 6250 µhos
- Plate Current 3150 ma.

**AVERAGE PLATE CHARACTERISTICS**

- Type 6C4, 6.3 volts

**RF POWER AMPLIFIER AND OSCILLATOR—Class C Telegraphy**

- **PLATE VOLTAGE:** 300 max volts
- **GRID VOLTAGE:** -300 max volts
- **GRID CURRENT:** 25 max ma.
- **PLATE CURRENT:** 25 max ma.
- **PLATE DISSIPATION:** 5 max watts

**Typical Operation at frequencies up to 50 Mc:**

- **Plate Voltage:** 300 volts
- **Grid Voltage:** -80 volts
- **Plate Current:** 25 ma.
- **Grid Current (Approx.):** 10 ma.
- **Driven Power (Approx.):** 5.35 watts
- **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.

### MEDIUM-MU TRIODE

Metal type 6C5 and glass octal type 6C5-GT used as audio amplifier, oscillator, or detector tube. Outline 2A, OUTLINES SECTION. Tube requires octal socket. Heater voltage (ac/dc), 6.3; amperes, 0.3. Typical operation as class A amplifier: plate voltage, 250 volts; plate resistance, 10,000 ohms; transconductance, 2000 µhos; plate ma., 3.8; plate dissipation, 2.5 ma. Type 6C5-GT is a DISCONTINUED type listed for reference only. Type 6C5 is used principally for renewal purposes.

### SHARP-CUTOFF PENTODE

Glass type used as biased detector and as a high-gain amplifier in radio equipment. Outline 24A, OUTLINES SECTION. Tube requires six-contact socket. Heater voltage (ac/dc), 6.3; amperes, 0.3. For ratings and typical operation data, refer to type 6J7. Type 6C6 is used principally for renewal purposes.

### MEDIUM-MU TRIODE

Glass type used as combined detector, amplifier, and ave tube. Outline 24B, OUTLINES SECTION. Heater voltage (ac/dc), 6.3; amperes, 0.3. This type is similar to, but not interchangeable with, type 85. The 6C7 is a DISCONTINUED type listed for reference only.

### MEDIUM-MU TWIN TRIODE

Glass octal type used as a voltage amplifier and phase inverter in radio equipment. Outline 25A, OUTLINES SECTION. Tube requires octal socket. Heater voltage (ac/dc), 6.3; amperes, 0.3. For ratings and typical operation data, refer to type 6A1. Maximum ratings for each triode unit as class A amplifier: plate voltage, 250 volts; grid voltage, positive-bias voltage, 0 volt; plate dissipation, 1.0 ma. Typical operation: plate voltage, 250 volts; grid voltage, -1.5 volt; plate ma., 30 ma.; plate resistance, 2250 ohms; amplification factor, 95; transconductance, 1800 µhos. This type is used principally for renewal purposes.

### SHARP-CUTOFF DUAL TETRODE

Miniature type used as vhf/rf-amplifier and autodyne mixer tube. Outline 8B, OUTLINES SECTION, except center pin is added to base. Tube requires miniature ten-contact socket and may be mounted in any position. Heater voltage (ac/dc), 6.3; amperes, 0.4.
RCA Receiving Tube Manual

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.1 Voltage: See curve page 70
- CATHODE CURRENT: 20 max ma
- 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: 8.0 max ma
  - For grid-No.2 voltages above 90 volts: See curve page 70
- PEAK HEATER-CATHODE VOLTAGE:
  - Heater negative with respect to cathode: 100 max volts
  - Heater positive with respect to cathode: 160 max volts

Characteristics:
- PLATE Voltage: 125 volts
- Grid-No.2 Voltage: 30 volts
- Grid-No.1 Voltage: 1 volt
- 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 ma: -6 volts

FULL-WAVE VACUUM RECTIFIER

6CA4

Miniature type used in power-supply of compact, audio equipment having moderate de requirements. Outline 25A, OUTLINES SECTION. Tube requires miniature three-contact socket and may be 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, 1.

FULL-WAVE RECTIFIER

Maximum Ratings, (Design-Minimum Values):
- PEAK INVERSE PLATE VOLTAGE: 1000 max volts
- PEAK PLATE CURRENT (Per Plate): 450 max ma
- AC PLATE SUPPLY VOLTAGE (Per Plate, rms): 350 max volts

OPERATION CHARACTERISTICS

FULL-WAVE CIRCUIT, CAPACITOR INPUT TO FILTER

5.64 VOLS.
SUPPLY FREQUENCY (CPS)=60
TOTAL EFFECTIVE PLATE-SUPPLY IMPEDANCE PER PLATE CURVE A+B+C (OHMS 150-200) 200VOLTS PER PLATE

DC OUTPUT VOLTAGE INPUT TO FILTER

DC LOAD MILLIAMPERES

DC VOLTAGE

BEAM POWER TUBE

6CA5

Related types: 12CA5, 25CA5

Maximum Ratings, (Design-Maximum Values):
- PLATE VOLTAGE: 150 max volts
- Grid-No.2 (Screen-Grid) Voltage: 90 max volts
- Grid-No.1 (Control-Grid) Voltage: 70 max volts
- Plate Resistance: 6 ma
- GRID-No.2 INPUT: 1.4 max watts
- PEAK HEATER-CATHODE VOLTAGE:
  - Heater negative with respect to cathode: 200 max volts
  - Heater positive with respect to cathode: 200 max volts
- BULK TEMPERATURE (At hottest point): 180 max °C
- Typical Operation:
  - Plate Voltage: 110 125 volts
  - Grid-No.2 Voltage: 110 125 volts
  - Grid-No.1 (Control-Grid) Voltage: 4 6 volts
  - Peak AP Grid-No.1 Voltage: 4 6 volts
  - Zero-Signal Plate Current: 32 37 ma
  - Maximum-Signal Plate Current: 31 36 ma
  - Grid-No.2 Current (Approx.): 3 4 ma
  - Maximum-Signal Grid-No.2 Current (Approx.): 7 11 ma
  - Plate Resistance (Approx.): 10000 15000 ohms
  - Transconductance: 8100 9200 μmhos
  - Load Resistance: 3500 4500 ohms
  - Total Harmonic Distortion: 6 7 per cent
  - Maximum-Signal Power Output: 1.1 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 megohm

BOOM POWER TUBE

6CB5

6CB5A

Glass octal types used as horizontal deflection amplifiers in color television receivers. Type 6CB5-A, Outline 25A, OUTLINES SECTION.

Type 6CB5 maximum dimensions:
- over-all length, 5-1/8 inches; seated height, 4-19/32 inches; diameter, 2-1/16 inches.
- Tubes require octal socket and may be mounted in any position. Type 6CB5 is a DISCONTINUED type listed for reference only.

HEATER VOLTAGE (AC/DC): 6.3 volts
HEATER CURRENT: 2.5 amperes
DIRECT INTERELECTRODE CAPACITANCE (ADJUST):
- Grid No.1 to cathode: 0.4 pf
- Grid No.1 to plate: 0.4 pf
**RCA Receiving Tube Manual**

**HORIZONTAL DEFLECTION AMPLIFIER**

For operation in a 524-line, 4-frame system

**Maximum Ratings:**

<table>
<thead>
<tr>
<th>Design-Center Values</th>
<th>Design-Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>C PLATE VOLTAGE</td>
<td>700 max volts</td>
</tr>
<tr>
<td>DAK POSITIVE-PULSE PLATE VOLTAGE</td>
<td>6800 max volts</td>
</tr>
<tr>
<td>DAK NEGATIVE-PULSE PLATE VOLTAGE</td>
<td>-1300 max volts</td>
</tr>
<tr>
<td>DAK GRID-NO.2 (SCREEN-GRID) VOLTAGE</td>
<td>200 max volts</td>
</tr>
<tr>
<td>DAK GRID-NO.1 (CONTROL-GRID) VOLTAGE</td>
<td>50 max volts</td>
</tr>
<tr>
<td>DAK NEGATIVE-PULSE GRID-NO.1 VOLTAGE</td>
<td>200 max volts</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>200 max ma</td>
</tr>
<tr>
<td>GRID-NO.2 INPUT VOLTAGE</td>
<td>max 850 ma</td>
</tr>
<tr>
<td>LATE DISCHARGE</td>
<td>23 max volts</td>
</tr>
<tr>
<td>Heater-Grid VOLTAGE</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>LATE DISCHARGE</td>
<td>23 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>LATE DISCHARGE</td>
<td>23 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>LATE DISCHARGE</td>
<td>23 max volts</td>
</tr>
</tbody>
</table>

**AVERAGE CHARACTERISTICS**

**BEAM POWER TUBE**

**6CD6**

**6CD6A**

**Related types:** 6CB6, 4CB6

**SHARP-CUTOFF PENTODE**

Miniature types used in television receivers as intermediate-frequency amplifiers at frequencies up to about 45 megacycles per second and as rf amplifiers in rf television tuners. Tubes feature very high transconductance 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 unby-passed cathode resistor to minimize the effects of regeneration. Type 6CB6-A has a controlled heater warm-up time for use in television receivers employing series-connected heater strings. Outline 7B, 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.

**6CD6G**

**6CD6GA**

**Related type:** 2SCD6G

**HORIZONTAL DEFLECTION AMPLIFIER**

For operation in a 524-line, 4-frame system

**Maximum Ratings:**

<table>
<thead>
<tr>
<th>Design-Center Values</th>
<th>Design-Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>350 max volts</td>
</tr>
<tr>
<td>GRID-NO.2 (SCREEN-GRID) VOLTAGE</td>
<td>max 7000 volts</td>
</tr>
<tr>
<td>GRID-NO.2 SUPPLY VOLTAGE</td>
<td>350 max volts</td>
</tr>
<tr>
<td>LATE DISCHARGE</td>
<td>2.3 max watts</td>
</tr>
<tr>
<td>Heater grid No.2 volts up to 155 volts</td>
<td>0.55 max watt</td>
</tr>
<tr>
<td>Heater grid No.2 volts between 155 and 350 volts</td>
<td>See curve page 70</td>
</tr>
</tbody>
</table>

**HORRIBLE CHARACTERISTICS**

| Type 6CB6-A, 1/2 x 3/4, 6" | 125 volts |
| Plate Supply Voltage | 125 volts |
| Grid No.1, 2, and 3, Connected to cathode at socket | 56 ohms |
| Grid No.2 Supply Voltage | Plate Resistance (Approx.) | 28 ma |
| Cathode-Bias Resistor | Transconductance | 8000 ma |
| Grid No.2 Voltage (Approx.) for plate current of 30 ma | Grid No.2 Voltage (Approx.) for plate current of 2.8 ma and cathode-bias resistor of 0 ohms | 3 volts |
| Plate Current | Grid No.2 Current | 13 ma |
| 3.7 volts |

*The dc component must not exceed 100 volts.*

**AVERAGE CHARACTERISTICS**

**BEAM POWER TUBE**

Glass octal types used as horizontal deflection amplifiers in high-efficiency deflection circuits of television receivers employing either transformer coupling or direct coupling to the deflection yoke. Type 6CD6-GA, Outline 25A, OUTLINES SECTION. Tubes require octal socket. Type 6CD6-GA 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 6CD6-G has a maximum peak positive-pulse plate-voltage rating (Absolute Maximum) of 6600 volts, a maximum plate-dissipation rating of 15 watts, and a maximum bulb-temperature rating (at hottest point) of 210°C. Type 6CD6-G is a DISCONTINUED type listed for reference only.

**HEATER VOLTAGE**

6.3 volts

**HEATER CURRENT**

2.5 amperes

**DIRECT INTERELECTRODE CAPACITANCES (Approx.)**

| Grid No.1 to Plate | 0.025 max | 0.015 max |
| Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 | 6.5 | 6.5 |
| Internal Shielded Grid No.2 and Grid No.3 | 2 | 3 |

**TUBE DIMENSIONS**

Width 3.5 inches

**HORIZONTAL DEFLECTION AMPLIFIER**

For operation in a 524-line, 4-frame system

**Maximum Ratings:**

<table>
<thead>
<tr>
<th>Design-Center Values</th>
<th>Design-Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC PLATE VOLTAGE</td>
<td>700 max volts</td>
</tr>
<tr>
<td>PEAK POSITIVE-PULSE PLATE VOLTAGE (Absolute Maximum)</td>
<td>7000 max volts</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE PLATE VOLTAGE</td>
<td>-1500 max volts</td>
</tr>
<tr>
<td>DC GRID-NO.2 (SCREEN-GRID) VOLTAGE</td>
<td>175 max volts</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE GRID-NO.1 VOLTAGE</td>
<td>200 max volts</td>
</tr>
<tr>
<td>PEAK CATHODE CURRENT</td>
<td>700 ma</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>200 ma</td>
</tr>
</tbody>
</table>

205
SHARP-CUTOFF PENTODE

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 characteristic, this type is used in gain-controlled stages of video if amplifiers. This type is electrically similar to miniature type 6CB6. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 6.3; amperes, 0.3.

CHARACTERISTICS:
- Plate Supply Voltage
- Grid No. 2 Supply Voltage
- Plate Resistance (Approx.)
- Transconductance
- Grid No. 1 Voltage (Approx.) for grid current of 20 µa
- Plate Current
- Grid No. 2 Current

6CG7

Miniature type used as combined vertical deflection and horizontal deflection oscillator in television receivers. Also used as phase inverter, sync separator and amplifier, and resistance-coupled amplifier in radio receivers. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Except for the common heater, each tube is independent of the other. Outline 8D, 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.

HEATER VOLTAGE (AC/DC) 6.3 volts
HEATER CURRENT 0.6 amperes
MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

6CG8

Miniature types used as combined oscillator and mixer tubes 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 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. Type 6CG8-A has a controlled heater warm-up time for use in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tubes require miniature nine-contact socket and may be mounted in any position. Heaters volts (ac/dc), 6.3; amperes, 0.45; warm-up time (average) for 6CG8-A, 11 seconds. Maximum ratings, characteristics, and typical operating values are the same as those of miniature type 6X8. For curves of average characteristics, see type 6X8. The 6CG8 is a DISCONTINUED type listed for reference only.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

6CH8

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-separator, synce-clipper, and phasesplitter circuits. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. For curves of average plate characteristics, refer to type 6AN8. The pentode-unit curve for the 6AN8 applies for this type except that grid No.3, heater, and internal shield (pin 5) are connected to ground.

HEATER VOLTAGE (AC/DC) 6.3 volts
HEATER CURRENT 0.45 amperes

DIRECT INTERELECTRODE CAPACITANCES:

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid to Plate</td>
<td>1.5 pf</td>
</tr>
<tr>
<td>Grid to Cathode, Heater, and Pentode Grid No.3</td>
<td>2.4 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, and Pentode Grid No.3</td>
<td>1.6 pf</td>
</tr>
<tr>
<td>Pentode Unit</td>
<td></td>
</tr>
<tr>
<td>Grid No.1 to Plate</td>
<td>0.04 max</td>
</tr>
<tr>
<td>Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3</td>
<td>4.6 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, Grid No.2, and Grid No.3</td>
<td>4.8 pf</td>
</tr>
<tr>
<td>Pentode Grid No.1 to Triode Plate</td>
<td>0.8 max</td>
</tr>
<tr>
<td>Pentode Plate to Triode Plate</td>
<td>0.06 max</td>
</tr>
<tr>
<td>Heater to Cathode</td>
<td>6.5 pf</td>
</tr>
</tbody>
</table>

*With external shield connected to cathode, except as noted.
*With external shield connected to plate.
LOW-MU TRIODE

Glass octal type used as a vertical-deflection-amplifier tube in television receivers. Outline 14E, OUTLINES SECTION. Tube requires octal socket. Heater volts (ac/dc), 6.3; amperes, 1.25. Characteristics as class A amplifier: plate volts, 250; grid volts, 250; amplification factor, 6.6; plate resistance (approx.), 800; transconductance, 5500; mho; maximum ratings: vertical deflection amplifier (for operation in a 525-line, 30-frame system): de plate volts, 250; peak positive-grid voltage, 250; peak cathode ma, 350; maximum plate dissipation, 12 ma; peak heater-cathode volts, 200. This type is used principally for renewal purposes.

POWER PENTODE

Miniature type used in output stage of video amplifier of television receivers and as wide-band amplifier tube in industrial and laboratory equipment. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

MEDIUM-MU TRIODE—SHARP-CUTOFF TETRODE

Miniature types used as combined vhf oscillator and mixer in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tubes require miniature...
HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

Miniature type used in a variety of applications in television receivers. The pentode unit is used as an intermediate-frequency-amplifier, a video-amplifier, an age-amplifier, or as a reactance tube. The triode unit is used in sweep-oscillator, sync-separator, sync-clipper, and phase-splitter circuits. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.45; warm-up time (average), 11 seconds.

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid-No.2 Voltage</th>
<th>Grid-No.1 Screen-Grid Voltage</th>
<th>Plate Resistance (Approx.)</th>
<th>Transconductance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Unit</td>
<td>300 max volts</td>
<td>0 max volts</td>
<td>100 ohms</td>
<td>1300 μmhos</td>
</tr>
<tr>
<td>Triode Unit</td>
<td>300 max volts</td>
<td>0 max volts</td>
<td>2 max watts</td>
<td>50000 ohms</td>
</tr>
<tr>
<td>Diode Unit</td>
<td>200 max volts</td>
<td>0.5 max volts</td>
<td>200 max volts</td>
<td>60000 ohms</td>
</tr>
</tbody>
</table>

Characteristics:

- Plate Supply Voltage: 250 volts
- Grid-No.2 Supply Voltage: 150 volts
- Cathode-Bias Resistor: 100 ohms
- Amplification Factor: 0.05
- Plate Resistance: 2000 ohms
- Transconductance: 6200 μmhos
- Grid-No.1 Voltage: 1.8 volts
- Grid-No.2 Current: 9.5 ma

TWIN-DIODE—HIGH-MU TRIODE

Miniature type used as combined horizontal phase detector and reactance tube in television receivers employing series-connected heaterstrings. The triode unit is used in sync-separator, sync-amplifier, or audio amplifier circuits. Outline 8B, 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. For curve of average plate characteristics for triode unit, refer to type 6T8-A. Heater volts (ac/dc), 6.3 (series), 3.15 (parallel); amperes, 0.3 (series), 0.6 (parallel); warm-up time (average), 11 seconds.

TRIODE UNIT AS CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid Voltage</th>
<th>Amplification Factor</th>
<th>Plate Resistance (Approx.)</th>
<th>Transconductance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Unit</td>
<td>330 max volts</td>
<td>-2</td>
<td>100 ohms</td>
<td>1300 μmhos</td>
</tr>
<tr>
<td>Triode Unit</td>
<td>250 max volts</td>
<td>-2</td>
<td>200 max watts</td>
<td>50000 ohms</td>
</tr>
<tr>
<td>Diode Unit</td>
<td>200 max volts</td>
<td>-2</td>
<td>200 max volts</td>
<td>60000 ohms</td>
</tr>
</tbody>
</table>

Characteristics:

- Plate Supply Voltage: 100 volts
- Grid Voltage: -2 volts
- Plate Resistance (Approx.): 70 ohms
- Transconductance: 1200 μmhos
- Plate Current: 0.8 ma

DIODE UNITS

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Plate Current (Each Unit)</th>
<th>Peak Heater-Cathode Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Unit</td>
<td>5.5 ma</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Triode Unit</td>
<td>5.5 ma</td>
<td>200 max volts</td>
</tr>
</tbody>
</table>

Characteristics:

- Plate Supply Voltage: 100 volts
- Grid Voltage: -2 volts
- Plate Resistance (Approx.): 70 ohms
- Transconductance: 1200 μmhos
- Plate Current: 0.8 ma

HALF-WAVE VACUUM RECTIFIER

Octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 14F, 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. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater volts (ac/dc), 6.3; amperes, 1.5.

DAMPER SERVICE

For operation in a 325-line, 20-frame system

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Peak Inverse Plate Current</th>
<th>Peak Plate Current</th>
<th>DC Plate Current</th>
<th>Plate Resistance (Approx.)</th>
<th>Transconductance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5500 max volts</td>
<td>1200 max ma</td>
<td>1900 max ma</td>
<td>6.5 max watts</td>
<td>60000 ohms</td>
</tr>
</tbody>
</table>

Characteristics:

- Plate Supply Voltage: 250 volts
- Grid-No.2 Supply Voltage: 150 volts
- Cathode-Bias Resistor: 100 ohms
- Amplification Factor: 0.05
- Plate Resistance: 2000 ohms
- Transconductance: 6200 μmhos
- Plate Current: 1.8 ma
- Grid-No.2 Current: 9.5 ma
**DIODE—REMOTE-CUTOFF PENTODE**

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 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.3.

### PENTODE UNIT AS CLASS A AMPLIFIER

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Triode Unit</th>
<th>Plate Voltage</th>
<th>Grid-No.2 Voltage</th>
<th>Grid-No.1 Control-Grid Voltage (Positive-bias value)</th>
<th>Plate Dissipation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Voltage</td>
<td>300 max volts</td>
<td>300 max volts</td>
<td>See curve page 70</td>
<td>300 max volts</td>
<td>0 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.5 max watt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Grid-No.2 Voltage up to 150 volts.
- Grid-No.2 voltage between 150 and 300 volts.

**PENTODE UNIT AS CLASS A AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Triode Unit</th>
<th>Plate Voltage</th>
<th>Grid-No.2 Voltage</th>
<th>Grid-No.1 Control-Grid Voltage (Positive-bias value)</th>
<th>Plate Dissipation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Voltage</td>
<td>300 max volts</td>
<td>300 max volts</td>
<td>See curve page 70</td>
<td>300 max volts</td>
<td>0 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.5 max watt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Grid-No.2 Voltage up to 150 volts.
- Grid-No.2 voltage between 150 and 300 volts.

- Grid-No.1 Voltage (Approx.) for transconductance of 10 μhos.

**Maximum Circuit Values:**

- Grid-No.1 Circuit Resistance: For fixed-bias operation: 6.25 max megohm
- Grid-No.1 Circuit Resistance: For cathode-bias operation: 1.0 max megohm

**PENT GRID 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 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.3.

### CLASS A AMPLIFIER

**Characteristics:**

- Plate Voltage: 100 volts
- Grid-No.2 Voltage: 30 volts
- Grid-No.3 Voltage: 10 volts
- Plate Resistance (Approx.): 0.7 megohms
- Grid-No.3 Plate Transconductance: 1500 μhos
- Plate Current: 1.1 ma
- Grid-No.3 Plate Voltage (Approx.) for plate current of 150 μa: 1.0 ma
- Grid-No.3 Circuit Resistance: 2.2 volts
- Grid-No.3 Circuit Resistance: 2.5 volts

**Multiple Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Plate Voltage</th>
<th>Grid-No.2 Voltage</th>
<th>Grid-No.3 Voltage</th>
<th>Plate Resistance (Approx.)</th>
<th>Grid-No.3 Plate Transconductance</th>
<th>Plate Current</th>
<th>Grid-No.3 Plate Voltage (Approx.) for plate current of 150 μa</th>
<th>Grid-No.3 Circuit Resistance</th>
<th>Grid-No.3 Circuit Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Voltage</td>
<td>300 max volts</td>
<td>300 max volts</td>
<td>See curve page 70</td>
<td>300 max volts</td>
<td>0 max volts</td>
<td>1 max watt</td>
<td>See curve page 70</td>
<td>1 max watt</td>
<td>1 max watt</td>
</tr>
</tbody>
</table>

**Cathode Current:**

- Grid-No.2 and No.4 voltages between 150 and 300 volts: 14 ma
- For grid-No.2 and No.4 voltages up to 150 volts: 14 ma

---

**MEDIUM-MU TRIODE—SHARP-CUTOFF TETRODE**

**6CQ8**

Related type: 5CQ8

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 a combined vhf oscillator and mixer in tuners of television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. The triode 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-diplexer, sync-separator, and rf amplifier circuits. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

### HEATER Voltages (ac/dc)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Triode Unit</th>
<th>Plate Voltage</th>
<th>Grid-No.2 Voltage</th>
<th>Grid-No.1 Control-Grid Voltage (Positive-bias value)</th>
<th>Plate Dissipation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>6.3 volts</td>
<td>0.45 volts</td>
<td>0.45 volts</td>
<td>0.45 volts</td>
<td>0.45 volts</td>
</tr>
</tbody>
</table>

**DIRECT INTERELECTRODE CAPACITANCES:**

<table>
<thead>
<tr>
<th>Element</th>
<th>Value (pf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1 to Plate</td>
<td>0.019 max</td>
</tr>
<tr>
<td>Grid-No.1 to Grid-No.2 and Internal Shield</td>
<td>0.015 max</td>
</tr>
<tr>
<td>Plate to Grid-No.1</td>
<td>5.0</td>
</tr>
<tr>
<td>Grid-No.1 to Cathode, Heater, Grid-No.2 and Internal Shield</td>
<td>3.5</td>
</tr>
<tr>
<td>Plate to Grid-No.1</td>
<td>3.5</td>
</tr>
</tbody>
</table>

**HEATER WARM-UP Time (Average):**

- Without External Shield: 14 seconds
- With External Shield: 30 seconds

**CLASS A AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Triode Unit</th>
<th>Plate Voltage</th>
<th>Grid-No.2 Voltage</th>
<th>Grid-No.1 Control-Grid Voltage (Positive-bias value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Voltage</td>
<td>300 max volts</td>
<td>300 max volts</td>
<td>See curve page 70</td>
<td></td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.5 max watt</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- For grid-No.2 voltages up to 150 volts.
- For grid-No.2 voltage between 150 and 300 volts.

**Peak Heater-Cathode Voltage:**

- Heater negative with respect to cathode: 260 volts
- Heater positive with respect to cathode: 200 volts

**Characteristics:**

- Plate Voltage: 100 volts
- Grid-No.2 Voltage: 30 volts
- Grid-No.3 Voltage: 10 volts
- Plate Resistance (Approx.): 0.7 megohms
- Grid-No.3 Plate Transconductance: 1500 μhos
- Plate Current: 1.1 ma
- Grid-No.3 Plate Voltage (Approx.) for plate current of 150 μa: 1.0 ma
- Grid-No.3 Circuit Resistance: 2.2 volts
- Grid-No.3 Circuit Resistance: 2.5 volts

**Maximum Circuit Values:**

- Grid-No.1 Circuit Resistance: For fixed-bias operation: 0.5 max megohms
- Grid-No.1 Circuit Resistance: For cathode-bias operation: 1.8 max megohms

**Cathode Current:**

- Grid-No.2 and No.4 voltages between 150 and 300 volts: 14 ma
- For grid-No.2 and No.4 voltages up to 150 volts: 14 ma

---

**6CQ6**

Related type: 5CQ6

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 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.3.
**RCA Receiving Tube Manual**

**PRK Heater-Cathode Voltage:**
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200 max volts

**Maximum Circuit Values:**
- Grid-No.1-Circuit Resistance: 0.47 max megohms
- Grid-No.2-Circuit Resistance: 2.2 max megohms

The dc component must not exceed 100 volts.

**MEDIUM-MU DUAL TRIODE**

6CS7

Related type: 6CS5

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 vertical deflection circuits, and unit No.2 as a vertical deflection amplifier. Outline 8D, 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.

**CLASS A1 AMPLIFIER**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250</td>
<td>690</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amplification</td>
<td>-8.5</td>
<td>-10.5</td>
</tr>
<tr>
<td>Plate Resistance</td>
<td>7700</td>
<td>3400</td>
</tr>
<tr>
<td>Plate Current</td>
<td>10.5</td>
<td>19</td>
</tr>
<tr>
<td>Plate Current for grid voltage of -16 volts</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**VERTICAL DEFLECTION OSCILLATOR AND AMPLIFIER**

For operation in a 625-line, 30-frame system:

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Center Values)</th>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage, max</td>
<td>500</td>
<td>300</td>
</tr>
<tr>
<td>PRK Positive-Pulse Plate Voltage (Max)</td>
<td>2200</td>
<td>2200</td>
</tr>
<tr>
<td>PRK Negative-Pulse Grid Voltage</td>
<td>-500</td>
<td>-300</td>
</tr>
<tr>
<td>PRK Average/Plate Current</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>PRK Average/Cathode Current</td>
<td>1.25</td>
<td>6.5</td>
</tr>
<tr>
<td>PRK Average/Cathode Voltage</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max</td>
<td>200 max</td>
</tr>
<tr>
<td>Grid-Circuit Resistance</td>
<td>2.2 max</td>
<td>2.2 max</td>
</tr>
<tr>
<td>Maximum Circuit Values</td>
<td>2.2 max</td>
<td>2.2 max</td>
</tr>
</tbody>
</table>

The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 625-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

**Beam Power Tube**

Miniature type used in the audio output stage of television receivers. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

**CLASS A AMPLIFIER**

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Maximum Values)</th>
<th>Plate Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>150 max volts</td>
</tr>
</tbody>
</table>

**Technical Data**

| GRID-No.2 (SCREEN-GRID) Voltage         | 130 max volts |
| GRID-No.1 (CONTROL-GRID) Voltage, Positive-bias value | 0 max volts |
| Plate Voltage                           | 200 max volts |
| GRID-No.2 INPUT                        | 1.4 max watts |
| PRK Heater-Cathode Voltage             | 200 max volts |
| Heater negative with respect to cathode | 200 max volts |
| Heater positive with respect to cathode | 200 max volts |

- The dc component must not exceed 100 volts.

**Typical Operation:**

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>120 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRID-No.2 Voltage</td>
<td>110 volts</td>
</tr>
<tr>
<td>GRID-No.1 Voltage</td>
<td>78 volts</td>
</tr>
<tr>
<td>Peak AF Grid-No.1 Voltage</td>
<td>8 volts</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>49 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>90 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>4 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>8.5 ma</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>10000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>7500 umhos</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>2500 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>10 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>2.3 watts</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

| Grid-No.1-Circuit Resistance | 0.1 max megohm |
| Grid-No.2-Circuit Resistance | 0.5 max megohm |

Refer to type 68Q6GTB/6CU6

**6CU6**

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

Miniature type used in a wide variety of applications in color and black-and-white television receivers employing series-connected heater strings. The pentode unit is used as an if amplifier, a video amplifier, an acg amplifier, and a reactance tube. The triode unit is used in low-frequency oscillator, sync-separator, sync-clipping, and phase-splitter circuits. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. For curves of plate characteristics for pentode unit, refer to type 6AN8.

**Heater Voltage (ac/dc):**

6.3 volts

**Heater Warm-Up Time (Average):**

0.45 amperes

11 seconds

**Direct Interelectrode Capacitances (Approx.):**

GRID-No.2 to Plate: 0.66 pf
GRID-No.1 to Cathode: 1.33 pf
Plate to Cathode, Plate to Grid No.2, Plate to Grid No.3: 1.25 pf

**Pentode Unit:**

GRID-No.1 to Plate: 0.065 max pf
GRID-No.1 to Cathode, GRID-No.2, GRID-No.3, Triode Cathode, and Internal Shield: 7 pf
Plate to Cathode, Plate to Pentode Grid No.2, Plate to Pentode Grid No.3, and Internal Shield: 2.4 pf
Pentode Grid No.1 to Triode Plate: 0.08 max pf
Pentode Plate to Triode Plate: 0.07 max pf

**CLASS A AMPLIFIER**

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Maximum Values):</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max</td>
<td>330 max</td>
</tr>
<tr>
<td>GRID-No.2 Supply Voltage</td>
<td>330 max</td>
<td>330 max</td>
</tr>
<tr>
<td>GRID-No.2 (SCREEN-GRID) Voltage, Positive-bias value</td>
<td>0 max volts</td>
<td></td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.8 max</td>
<td>2.8 max</td>
</tr>
<tr>
<td>GRID-No.2 Input</td>
<td>0.65 max</td>
<td>0.65 max</td>
</tr>
<tr>
<td>For grid-No.2 voltages up to 165 volts</td>
<td></td>
<td>See curve page 70</td>
</tr>
<tr>
<td>For grid-No.2 voltages between 165 and 330 volts</td>
<td></td>
<td>See curve page 70</td>
</tr>
<tr>
<td>PRK Heater-Cathode Voltage</td>
<td>200 max</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max</td>
<td>200 max</td>
</tr>
</tbody>
</table>
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Characteristics:  
Triode Unit | Pentode Unit
---|---
Plate Supply Voltage | 125 | 125
Grid-No.2 Supply Voltage | - | -
Grid-No.1 Voltage | - | -
Cathode-Bias Resistor | - | -
Amplification Factor | 1.24 | -
Plate Resistance (Approx.) | 1700 | -
Transconductance | 7800 | -
Grid-No.1 Voltage (Approx.) for plate current of 20 µa | -19 | -4
Plate Current | -12 | -
Plate Current for grid-No.1 voltage of -8 volts and cathode-bias resistor of 0 ohms | -4 | -
 Grid-No.2 Current | 12 | -

* The dc component must not exceed 100 volts.

HIGH-MU TRIODE

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.

HEATER VOLTAGE (AC/DC) | 6.3 volts
HEATER CURRENT | 0.135 amp
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):
Grid to Plate | 0.02 pf
Grid to Cathode, Heater, and Shell | 4.3 pf
Plate to Cathode, Heater, and Shell | 1.6 pf
Plate to Cathode | 0.18 pf
Heater to Cathode | 1.6 pf

CLASS A AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE SUPPLY VOLTAGE | 300 volts
PLATE VOLTAGE | 155 volts
GRID VOLTAGE | 500 volts
NEGATIVE-BIAS VOLTAGE | 0 volts
PEAK POSITIVE VOLTAGE | 1.5 ma watt
PLATE DISSIPATION | 15 ma
CATHODE CURRENT | 100 ma
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode | 100 ma
Heater positive with respect to cathode | 100 ma

AVERAGE PLATE CHARACTERISTICS

Plate Current | Plate Voltage
---|---
0 | 0
300 | 300
400 | 400
500 | 500
600 | 600
700 | 700
800 | 800
900 | 900

AVERAGE PLATE MILLIAMPERES

Plate Current | Plate Voltage
---|---
0 | 0
300 | 300
400 | 400
500 | 500
600 | 600
700 | 700
800 | 800
900 | 900

CHARACTERISTICS:
Plate Supply Voltage | 150
Grid-No.2 Supply Voltage | 125
Cathode-Bias Resistor | 65
Amplification Factor | 9.2
Plate Resistance (Approx.) | -8.5
Transconductance | -8.5
Grid-No.1 Voltage (Approx.) for plate current of 100 ma | -8.5
Plate Current | -8.5
Grid-No.2 Current | -8.5

Maximum Circuit Values:
Grid-No.1-Circuit Resistance:
For fixed-bias operation | 0.5 ma
For cathode-bias operation | 1 max

* The dc component must not exceed 100 volts.

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-clipper circuits. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.75.

CLASS A AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE | 300 volts
GRID-No.2 (SCREEN-GRID) VOLTAGE | See curve page 70
GRID-No.1 VOLTAGE, Positive-bias value | 0 volts
PLATE DISSIPATION | 5 ma watt
GRID-No.2 INPUT:
For grid-No.2 voltage up to 165 volts | 1.1 ma watt
For grid-No.2 voltages between 165 and 300 volts | See curve page 70
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode | 200 ma
Heater positive with respect to cathode | 200 ma

Characteristics:
Plate Supply Voltage | 150
Grid-No.2 Supply Voltage | 155
Cathode-Bias Resistor | 65
Amplification Factor | 9.2
Plate Resistance (Approx.) | 8700
Transconductance | 9.2
Grid-No.1 Voltage (Approx.) for plate current of 100 ma | -8.5
Plate Current | -8.5
Grid-No.2 Current | -8.5

Maximum Circuit Values:
Grid-No.1-Circuit Resistance:
For fixed-bias operation | 0.5 ma
For cathode-bias operation | 1 max

* The dc component must not exceed 100 volts.

SHARP-CUTOFF TETRODE

Miniature type used as rf amplifier in vhf tuners of television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

CHARACTERISTICS:
Plate Supply Voltage | 150
Grid-No.2 Supply Voltage | 125
Cathode-Bias Resistor | 65
Amplification Factor | 9.2
Plate Resistance (Approx.) | 8700
Transconductance | 9.2
Grid-No.1 Voltage (Approx.) for plate current of 100 ma | -8.5
Plate Current | -8.5
Grid-No.2 Current | -8.5

Maximum Circuit Values:
Grid-No.1-Circuit Resistance:
For fixed-bias operation | 0.5 ma
For cathode-bias operation | 1 max

* The dc component must not exceed 100 volts.
**RCA Receiving Tube Manual**

**Technical Data**

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

- Plate Voltage: 180 mA max volts
- Grid-No. 2 (Screen-Grid) Supply Voltage: 180 mA max volts
- Grid-No. 1 Voltage: See curve page 70
- Grid-No. 1 (Control-Grid) Voltage, Positive-bias Value: 0 mA max volts
- Cathode Current: 20 mA max
- Grid-No. 2 Input:
  - For grid-No. 2 voltages up to 50 volts: 0.5 mA max watts
  - For grid-No. 2 voltages between 50 and 180 volts: See curve page 70
  - Plate Disipation: 2 mA max watts
- Peak Heater-Anode Voltage:
  - Heater negative with respect to cathode: 100 mA max volts
  - Heater positive with respect to cathode: 100 mA max volts

**Characteristics:**

- Plate Voltage: 125 volts
- Grid-No. 2 Voltage: 50 volts
- Grid-No. 1 Voltage: 0 volt
- Plate Resistance (Approx.): 0.1 megohm
- Transconductance: 9000 microhm
- Plate Current: 10 mA
- Grid-No. 2 Current: 1.5 mA
- Grid-No. 1 Voltage (Approx.) for plate current of 20 mA: -6 volts

**Maximum Circuit Value:**

- Grid-No. 1 Circuit Resistance: 0.5 max megohm

---

**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 ultra voltages up to 15 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 8E, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.**

**Heater Voltage (dc) Volts:** 6.3 volts

**Heater Current:** 0.45 ampere

**Heater Warm-Up Time (Average):** 11 seconds

**Direct Inter-electrode Capacitances:**

- Grid-No. 1 to Plate: 0.4 max pF
- Grid-No. 1 to Cathode, Heater, Grid-No. 2, and Grid-No. 3: 9 max pF
- Plate Resistance (Approx.)*: 0.673 megohm
- Transconductance: 4800 microhm

- Plate and grid-No. 2, 260; grid-No. 1, 240; plate ma., 46; grid-No. 2 ma., 4.6.

---

**DUAL TRIODE**

**6CY7**

**Related type:** 11C7Y

**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 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.**

**Heater Voltage (ac/dc) Volts:** 6.3 volts

**Heater Current:** 0.2 ampere
RCA Receiving Tube Manual

Maximum Circuit Values:
Grid-No.1-Circuit Resistance:
For fixed-bias operation: 0.5 mohm
For cathode-bias operation: 0.05 mohm

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.

REMOTE-CUTOFF PENTODE
Glass type used in a.c. and d.c. stages of radio receivers employing a.c. Outline 24A, OUTLINES SECTION. Tube requires six-contact socket. Except for interelectrode capacitances, this type is identical electrically with type 6UG7. Refer to type 6SK7 for application information. Heater volts (a.c.), 6.3; amperes, 0.3. This type is used principally for renewal purposes.

6D6

SHARP-CUTOFF PENTODE
Glass type used as detector or amplifier in radio receivers. Outline 24A, OUTLINES SECTION. Heater volts (a.c.), 6.3; amperes, 0.3. For electrical characteristics, refer to type 6G7. Type 6D7 is a DISCONTINUED type listed for reference only.

PENTAGRID CONVERTER
Glass octal type used in superheterodyne circuits. Outline 25, OUTLINES SECTION. Tube requires socket. Heater volts (a.c.), 6.3; amperes, 0.15. Except for interelectrode capacitances and heater rating, the 6G8-G is similar electrically to type 66A-G. Type 6D8-G is a DISCONTINUED type listed for reference only.

6D8G

HALF-WAVE VACUUM RECTIFIER
Glass octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. May be supplied with pin 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. Heater volts (a.c.), 6.3; amperes, 1.2.

6DA4

Related type: 17D4

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

Maximum Ratings, (Design-Maximum Values):
Peak Inverse Plate Current*: 4400 ma
Peak Plate Current: 900 ma
DC Plate Current: 155 ma
Plate Dissipation: 5.5 watts

Plate 6D6: 5.5 volts

Resistor negative with respect to cathode: 4400 ma
Resistor positive with respect to cathode: 3000 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.

The dc component must not exceed 100 volts.

*The dc component must not exceed 100 volts.

BEAM POWER TUBE
Miniature type used as vertical-deflection-amplifier tube in television receivers. Outline 8D, OUTLINES SECTION, except all vertical dimensions of this type are 1/8 inch greater.

6DB5

Technical Data

Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (a.c./d.c.), 6.3; amperes, 1.2. Except for heater ratings, this type is identical with miniature type 12DB5.

SHARP-CUTOFF PENTODE
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 7B, OUTLINES SECTION. Tube requires seven-contact miniature socket and may be mounted in any position.

Heater Voltage (a.c./d.c.): 6.3 volts
Heater Current: 0.3 amperes
Direct Inter-electrode Capacitances:
Grid No.1 to Plate: 0.02 mhos
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield: 6.5 mhos
Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield: 6.5 mhos

Grid-No.1 Input:
For grid-No.2 voltages up to 150 volts: 0.5 mhos
For grid-No.2 voltages between 150 and 300 volts: See curve page 70
Peak Heater-Cathode Voltage:
Heater positive with respect to cathode: 200 volts
Heater positive with respect to cathode: 200 volts

Characteristics:
Plate Supply Voltage: 200 volts
Grid No.3: Connected to cathode at socket
Grid-No.2 Supply Voltage: 150 volts
Cathode-Bias Resistor: 150 ohms
Plate Resistance (Approx.): 350 ohms
Transconductance: 6500 ohms
Grid-No.1 Voltage (Approx.) for transconductance of 50 ohms: 12.5 volts
Plate Current: 6 ma
Grid-No.2 Current: 5 ma

Maximum Circuit Values:
Grid-No.1-Circuit Resistance: 0.55 mohm
For cathode-bias operation: 1.0 mohm

*The dc component must not exceed 100 volts.
TWIN DIODE—SEMIREMOTE-CUTOFF PENTODE

6DC8

Miniature type used as rf- and if-amplifier tubes in radio and television receivers. Outline 8D, OUTLINES SECTION. Tuberequires nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.3.

**PENTODE UNIT AS CLASS A, AMPLIFIER**

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Center Values):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PLATE SUPPLY VOLTAGE</strong></td>
<td>550 mA volts</td>
</tr>
<tr>
<td><strong>GRID NO. 2 VOLTAGE</strong></td>
<td>300 mA volts</td>
</tr>
<tr>
<td>With plate current greater than 8 ma</td>
<td>125 mA volts</td>
</tr>
<tr>
<td>With plate current less than 4 ma</td>
<td>200 mA volts</td>
</tr>
<tr>
<td><strong>PLATE CURRENT</strong></td>
<td>16.5 mA</td>
</tr>
<tr>
<td><strong>GRID NO. 2 INPUT</strong></td>
<td>0.45 ma</td>
</tr>
<tr>
<td><strong>PLATE DISSIPATION</strong></td>
<td>2.25 ma watts</td>
</tr>
<tr>
<td><strong>PEAK Heater-Cathode Voltage</strong></td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>100 mA volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>100 mA volts</td>
</tr>
</tbody>
</table>

**Characteristics:**
- **Plate Voltage:** 300 V
- **Grid No. 2 Voltage:** 100 V
- **Grid No. 1 Voltage:** -15 V
- **M-Factor, Grid No. 2 to Grid No. 1:** 20
- **Plate Resistance (Approx.)** 100 kΩ
- **Transconductance:** 4000 μA/V
- **Current:** 2 mA
- **Transconductance, at grid-No. 1 voltage of -20 volts:** 120 μA/V

**Maximum Circuit Values:**
- **Grid-No. 1-Circuit Resistance:** 3MΩ 200 μA/V

**DIODE UNITS (Each Unit):**

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PEAK INVERSE PLATE VOLTAGE</strong></td>
<td>200 mA volts</td>
</tr>
<tr>
<td><strong>PEAK PLATE CURRENT</strong></td>
<td>5 mA</td>
</tr>
<tr>
<td><strong>AVERAGE PLATE CURRENT</strong></td>
<td>0.8 mA</td>
</tr>
</tbody>
</table>

**HALFWAVE VACUUM RECTIFIER**

6DE4

Glass octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 14F, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. 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.

**HEATER VOLTAGE (AC/DC):** 6.3 volts
**HEATER CURRENT:** 1.6 amperes

**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:** 1500 V
- **D.C. PLATE CURRENT:** 180 mA
- **PLATE DISSIPATION:** 6.6 mA watts

**SHARP-CUTOFF PENTODE**

6DE6

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 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 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC):** 6.3 volts
**HEATER CURRENT:** 0.3 amperes

**DIRECT INTERELECTRODE CAPACITANCES:**
- Grid No. 1 to Plate: 0.05 μF
- Grid No. 1 to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield: 6.6 μF

**Plate to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield:** 2 μF

* With external shield connected to cathode

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- **PLATE VOLTAGE:** 330 mA volts
- **GRAIN-1 CATHODE VOLTAGE, Positive Value:** 0 mA volts
- **GRID NO. 2 (SCREEN-GRID) SUPPLY VOLTAGE:** 330 mA volts
- **GRID NO. 2 VOLTAGE:** See curve page 70
- **GRID NO. 1 (CONTROL-GRID) VOLTAGE, Positive-Value:** 0 mA volts
- **PLATE DISSIPATION:** 2.3 mA watts
- **GRID NO. 2 INPUT:** For grid-No. 2 voltages up to 165 volts: 0.56 μA watts
- **For grid-No. 2 voltages between 165 and 330 volts:** See curve page 70

**PEAK Heater-Cathode Voltage:**
- Heater negative with respect to cathode: 200 mA volts
- Heater positive with respect to cathode: 200 mA volts

**Characteristics:**
- **Plate Supply Voltage:** 125 volts
- **Grid No. 3:**

**AVERAGE PLATE CHARACTERISTICS**

**Technical Data**

**PEAK Heater-Cathode Voltage:**
- Heater negative with respect to cathode: 5500 mA
- Heater positive with respect to cathode: 3000 mA

**Characteristics, Instantaneous Values:**
- Tube Voltage Drop for plate current of 350 mA: 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.
- The dc component must not exceed 900 volts.
- The peak component must not exceed 100 volts.
**DUAL TRIODE**

Miniature type used as combined vertical 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 8D, 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.

**HEATER VOLTAGE (AC/DC):**
- 6.3 volts

**HEATER CURRENT:***
- 0.5 ampere

**DIRECT INTERELECTRODE CAPACITANCES (Approx.):**
- Grid to Plate: 4
- Grid to Cathode and Heater: 0.52
- Plate to Cathode and Heater: 1 pf

**VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER**

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

**Maximum Ratings, (Design-Maximum Voltages):**

<table>
<thead>
<tr>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>230</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>17.5</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>8750</td>
</tr>
<tr>
<td>Plate Current</td>
<td>5.5</td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 10 ma</td>
<td>-20</td>
</tr>
</tbody>
</table>

**BEAM POWER TUBE**

Glass octal type used as output tube in audio-amplifier applications. Outline 14C, OUTLINES SECTION. Tube requires socket and may be mounted in any position. This type may be supplied with pin 1 omitted.

**HEATER VOLTAGE (AC/DC):**
- 6.3 volts

**HEATER CURRENT:***
- 1.2 ampere

**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: 10 pf
- Plate to Cathode, Heater, Grid No. 2, and Grid No. 3: 10 pf

**CLASS A, AUDIO FREQUENCY POWER AMPLIFIER**

**PLATE VOLTAGE:**
- 200 volts

**PLATE DISRUPTION:**
- 125 volts

**PLATE CURRENT:**
- 10 ma

**MAXIMUM GRID CURRENT:**
- 1.25 ma

**PEAK HEATER-CATHODE VOLTAGE:**
- Heater negative with respect to cathode: 200 volts
- Heater positive with respect to cathode: 200 volts

**Maximum Circuit Values:**
- Grid-Circuit Resistance: 2.2 megohms

For grid resistor bias or 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.

**SHARP-CUTOFF PENTODE**

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. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC):**
- 6.8 volts

**HEATER CURRENT:***
- 0.3 ampere

**DIRECT INTERELECTRODE CAPACITANCES:**
- Grid No. 1 to Plate: 0.052 mf
- Grid No. 1 to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield: 0.3 mf
- Plate to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield: 1.9 mf
CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
- **PLATE VOLTAGE**: 330 max volts
- **GRID-NO.9 (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 70
- **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 70

**PEAK HEATER-CATHODE VOLTAGE:**
- Heater negative with respect to cathode: 200 volts
- Heater positive with respect to cathode: 200 max volts

**Characteristics:**
- Plate Supply Voltage: 125 volts
- Grid-No.3 Connected to cathode at socket: 125 volts
- Grid-No.2 Supply Voltage: 56 volts
- Plate Resistance (Approx.): 0.35 megohms
- Transconductance: 9800 μmhos
- Grid-No.1 Voltage (Approx.) for plate current of 20 μa: 6.5 volts
- Plate Current: 12 ma
- Grid-No.2 Current: 5.8 ma

# The dc component must not exceed 100 volts.

**AVERAGE CHARACTERISTICS**

**HALF-WAVE VACUUM RECTIFIER**

Glass octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 14F, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. 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.

**HEATER VOLTAGE (AC/DC):** 6.3 volts
**HEATER CURRENT:** 1.2 amperes

**DIRECT INTERELECTRODE CAPACITANCES (Approx.):**
- Plate to Cathode and Heater: 5.5 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**: 5000 max volts
- **PEAK PLATE CURRENT**: 1100 ma
- **DC PLATE CURRENT**: 175 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: 3000 max volts

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

# The dc component must not exceed 500 volts.

# The dc component must not exceed 100 volts.

**TECHNICAL DATA**

**BEAM POWER TUBE**

Glass octal type used as horizontal-deflection amplifier tube in television receivers having low B-supply voltages. Outline 25A, OUTLINES SECTION. Tube requires octal socket. Vertical mounting is preferred, but horizontal mounting is permissible if pins 1 and 3 are in vertical plane, and plate voltages are 6.3; amperes, 2.5. Except for heater ratings, this type is identical with miniature type 25DN6. Type 6DN6 is used principally for renewal purposes.

**6DN6**
**Related Type:** 25DN6

**MEEDIUM-MU DUAL TRIODE**

Glass octal type used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers. Outline 14B, OUTLINES SECTION. Tuberequires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.9.

**CLASS A, AMPLIFIER**

**6DN7**

**VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER**

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

**Maximum Ratings, (Design-Maximum Values):**
- **PLATE DISSIPATION**: 6.5 max watts
- **PEAK POSITIVE-PULSE PLATE VOLTAGE**: 5000 max volts
- **PEAK NEGATIVE-PULSE GRID VOLTAGE**: 2500 max volts
- **AVERAGE CATHODE CURRENT**: 50 ma
- **PLATE DISSIPATION**: 20000 watts
- **PEAK HEATER-CATHODE VOLTAGE**:
  - Heater negative with respect to cathode: 20000 max volts
  - Heater positive with respect to cathode: 20000 max volts

**6DQ4**

**HALF-WAVE VACUUM RECTIFIER**

Glass octal type used as damper tube in horizontal-deflection circuits of television receivers. Outline 14E, 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. 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):**
  - **Plate Voltage:** 990 max volts
  - **Peak Positive-Pulse Plate Voltage:** 6500 max volts
  - **Grid Voltage:** 190 max volts (Screen-grid) Voltage
  - **Peak Negative-Pulse Grid Voltage:** 250 max volts
  - **AVERAGE CATHODE CURRENT:** 315 max ma

- **Characteristics, Instantaneous Values:**
  - 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.
  - The dc component must not exceed 100 volts.

---

**BEAM POWER TUBE**

Glascoctal type used as horizontal deflection amplifier in color television receivers. Outline 28A, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position.

- **Heater Voltage (AC/DC):** 6.3 volts
- **Heater Current:** 2.5 amperes
- **Direct Interelectrode Capacitance (Approx):**
  - Grid No.1 to Plate: 0.5 pf
  - Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3: 0.5 pf
  - Plate to Cathode, Heater, Grid No.2, and Grid No.3: 11 pf
- **Plate Resistance (Approx):** 500 ohms
- **Transconductance:** 20000 µmhos
- **Mu-Constant, Grid No.2 to Grid No.3:** 3.3

* For plate volts, 175; grid-No.2 volts, 125; grid-No.1 volts, -25; plate ma., 110; grid-No.2 ma., 5.
** For plate and grid-No.2 volts, 125; grid-No.1 volts, -25.

---

**HORIZONTAL DEFECTION 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:** 8000 max volts
  - **Peak Negative-Pulse Grid Voltage:** 200 max volts
  - **AVERAGE CATHODE CURRENT:** 315 max ma

---

**Technical Data**

- **Grid-No.2 Input:** 3.2 max watts
- **Plate Dissipation:** 25 max watts
- **Peak Heater-Cathode Voltage:** 200 max volts
- **Heater positive with respect to cathode:** 200 volts
- **Heater positive with respect to cathode:** 220 max volts
- **Bulb Temperature (At hottest point):** 150°C

- **Maximum Circuit Values:**
  - Grid-No.1-Circuit Resistance: 0.47 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.
  - An adequate series resistor or other means is required to protect the tube in the absence of excitation.
  - The dc component must not exceed 100 volts.

---

**BEAM POWER TUBE**

Glascoctal type used as horizontal-deflection-amplifier tubes in high-efficiency deflection circuits of television receivers. Outline 21, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position. These types may be supplied with pin 1 omitted. Type 6DQ6-A is used principally for renewal purposes.

- **Heater Voltage (AC/DC):** 6.3 volts
- **Heater Current:** 1.2 amperes
- **Direct Interelectrode Capacitance (Approx):**
  - Grid No.1 to Plate: 0.5 pf
  - Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3: 0.5 pf
  - Plate to Cathode, Heater, Grid No.2, and Grid No.3: 0.5 pf
- **Plate Resistance (Approx):** 20000 ohms
- **Transconductance:** 7800 ohms
- **Mu-Constant, Grid No.2 to Grid No.3:** 3.3

**CLASS A, AMPLIFIER**

- **Characteristics:**
  - **Plate Voltage:** 250 volts
  - **Grid-No.2 Voltage:** 150 volts
  - **Grid-No.1 Voltage:** 0 volts
  - **Plate Resistance (Approx):** -25 volts
  - **Transconductance:** 315 ma
  - **Grid-No.1 Voltage (Approx) for grid-No.2 volt=50, plate ma=1:** -40 ma
  - **Plate volts=5000:** -100 ma

---

**HORIZONTAL-DEFECTION AMPLIFIER**

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

- **Maximum Ratings, (Design-Maximum Values):**
  - **DC Plate Voltage:** 600 max volts
  - **Peak Positive-Pulse Plate Voltage:** 770 max volts
  - **Peak Negative-Pulse Grid Voltage:** 770 max volts
  - **AVERAGE CATHODE CURRENT:** 315 max ma

---

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RCA Receiving Tube Manual

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
PLATE DISSIPATION
PEAK HEATER-CATHODE VOLTAGE
Heater negative with respect to cathode
Heater positive with respect to cathode
BULB TEMPERATURE (At hottest point)

Maximum Circuit Values:
Grid-No.1 Circuit Resistance for grid-resistor-bias operation
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 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.
* The dc component must not exceed 100 volts.

AVERAGE CHARACTERISTICS

VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER
For operation in a 525-line, 30-frame system

Maximum Ratings, (Design-Maximum Values): Oscillator Amplifier
DC PLATE VOLTAGE
PEAK POSITIVE-PULSE PLATE VOLTAGE
PEAK NEGATIVE-PULSE GRID VOLTAGE
PEAK CATHODE CURRENT
AVERAGE CATHODE CURRENT
PLATE DISSIPATION
PEAK HEATER-CATHODE VOLTAGE
Heater negative with respect to cathode
Heater positive with respect to cathode

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 scanning cycle is 2.5 milliseconds.
* The dc component must not exceed 100 volts.

AVERAGE PLATE CHARACTERISTICS

DUAL TRIODE
Miniature type containing high-mu and low-mu triodes; used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position.

6DR7
Related types: 100R7, 13DR7

HEATER VOLTAGE (AC/DC): 6.3 volts
HEATER CURRENT: 0.9 amperes
DIRECT INTERELECTRODE CAPACITANCE (Approx.) Grid to Plate: 4.5 pf Grid to Cathode and Heater: 2.2 pf Plate to Cathode and Heater: 0.54 pf

CLASS A, AMPLIFIER


Technical Data

AVERAGE PLATE CHARACTERISTICS

UNIT No. 1

UNIT No. 2
HIGH-MU TRIODE

6DS4
Related type: 2D44

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 1, OUTLINES SECTION. Tube requires nuvisor socket and may be operated in any position.

HEATER VOLTAGE (AC/DC) 6.3 volts
HEATER CURRENT 0.135 ampere
DIRECT INTERELECTRODE CAPACITANCES (Approx.)
Grid to Plate: 0.92 pf
Grid to Cathode, Heater, and Shell: 4.3 pf
Plate to Cathode, Heater, and Shell: 1.8 pf
Plate to Cathode: 0.18 pf
Heater to Cathode: 1.6 pf

Characteristics:
CLASS A, AMPLIFIER
Plate Supply Voltage: 110 volts
Grid Supply Voltage: 0 volts
Cathode Bias Resistor: 150 ohms
Amplification Factor: 63
Plate Resistance (Approx.): 2000 ohms
Transconductance: 9000 μmhos
Plate Current: 6.5 ma
Voltage: 6.5 volts
Grid No. 1 (Control-Grid) Voltage: 100 μa
Grid Voltage (Approx.) for plate current of 10 ma: 0.5 volts
Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE 300* max volts
PLATE CURRENT 150 ma
GATE VOLTAGE 0 volts
GRID VOLTAGE, Negative bias value: 50 volts
GRID VOLTAGE, Peak positive value: 0 max volts
PLATE CURRENT 15 ma
Cathode Current: 15 ma
PEAK HEATER-CATHODE VOLTAGE: 100 volts
Heater negative with respect to cathode: 100 volts
Heater positive with respect to cathode: 100 volts

Typical Operation:
Plate Voltage: 70 volts
Grid Supply Voltage: 0 volts
Grid Resistance: 47000 ohms
Amplification Factor: 68
Plate Resistance (Approx.): 2440 ohms
Transconductance: 156 ma

Maximum Circuit Values:
Grid-Circuit Resistance: 0.5 max megohm
For fixed-bias operation.
For cathode-bias operation: 2.2 max megohms
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.

BEAM POWER TUBE

Miniature type used in the audio output stages of television and radio receivers. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

6DS5

HEATER VOLTAGE (AC/DC) 6.3 volts
HEATER CURRENT 0.8 ampere
DIRECT INTERELECTRODE CAPACITANCES (Approx.)
Grid No. 1 to Plate: 0.19 pf
Grid No. 1 to Cathode, Heater, Grid No. 2, and Grid No. 3: 8.5 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: 270 max volts
Grid-Op. (Control-Grid) VOLTAGE: 270 max volts
Grid-No. 1 (Control-Grid) VOLTAGE, Positive bias value: 0 max volts
PLATE DISPLACEMENT: 9 max watts
Grid-No. 2 Input: 2.2 max watts
Peak Heater-Cathode Voltage: 200 max volts
Heater negative with respect to cathode: 200* max volts
BULK TEMPERATURE (At hottest point): 250 max °C

Typical Operation and Characteristics:
Plate Supply Voltage: 200 250 200 250
Grid-No. 1 Voltage: 0 0 0 0
Cathode-Bias Resistor: 100 100 100 100
Peak A-F Grid-No. 1 Voltage: 7.5 7.5 7.5 7.5
Zero-Signal Plate Current: 34.5 27 35 29
Maximum-Signal Plate Current: 26 25 25 25
Zero-Signal Grid-No. 2 Current: 3.5 3 3 3
Maximum-Signal Grid-No. 2 Current: 9 9 9 9
Plate Resistance (Approx.): 2800 2800 2800 2800
Transconductance: 6000 5800 6000 5800
Load Resistance: 6000 6000 6000 6000
Total Harmonic Distortion: 10 10 10 10
Maximum-Signal Power Output: 2.8 3.6 3.6 3.6

AVERAGE CHARACTERISTICS

Average Plate Characteristics

Average Characteristics

Average Characteristics Type 6DS5}

<Figure 6DS5>
HALF-WAVE VACUUM RECTIFIER

Glass octal type used as damper tube in horizontal-deflection circuits of color television receivers. Outline 14F, 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. 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):

<table>
<thead>
<tr>
<th>Maximum Ratings</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Plate Current</td>
<td>1.50 mA</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>2.5 mA</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>7.5 mA</td>
</tr>
</tbody>
</table>

Characteristics, Instantaneous Values:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage Drop for plate current of 50 mA</td>
<td>28 volts</td>
</tr>
<tr>
<td>*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.</td>
<td></td>
</tr>
<tr>
<td>The dc component must not exceed 100 volts.</td>
<td></td>
</tr>
</tbody>
</table>

BEAM POWER TUBE

Miniature type used as a vertical-deflection-amplifier tube in television receivers employing 110-degree picture-tube systems. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position.

HEATER VOLTAGE (AC/DC)......................... 6.3 volts
HEATER CURRENT......................... 0.25 mA
TRANSCONDUCTANCE...................... 6200 µmhos

* For plate and grid-No.2 volts, 250; grid-No.1 volts, -165; plate ma, 44; grid-No.2 ma, 1.5.

VERTICAL-DEFLECTION AMPLIFIER

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

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Maximum Ratings</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>315 volts</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage</td>
<td>2200 volts</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid-No.1 (Control-Grid) Voltage</td>
<td>50 volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>9 mA</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>2 mA</td>
</tr>
<tr>
<td>Peak Cathode Voltage</td>
<td>200 mA</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 mA</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Grid-No.1-Circuit Resistance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>For fixed-bias operation</td>
<td>0.5 megohm</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>1 megaohm</td>
</tr>
</tbody>
</table>

* 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.

SHARP-CUTOFF PENTODE

Miniature type used as FM detector in television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

Type 6DT6 is a DISCONTINUED type listed for reference only.

HEATER VOLTAGE (AC/DC)......................... 6.3 volts
HEATER CURRENT......................... 0.3 ampere
DIRECT INTERELECTRODE CAPACITANCES (Approx.)*:

| Grid No.1 to Plate | 0.25 µf |
| Grid No.1 to Cathode | 2500 µf |
| Grid No.1 to Grid No.2, Grid No.3, and Internal Shield | 5.6 µf |
| Grid No.3 to Plate | 4.0 µf |
| Grid No.3 to Grid No.2 | 25 µf |
| Grid No.3 to Cathode, Heater, Grid No.1, and Internal Shield | 2.5 µf |

*External shield connected to cathode. For type 6DT6A, value is 1.7 µf.

Characteristics:

<table>
<thead>
<tr>
<th>CLASS</th>
<th>AMPLIFIER</th>
</tr>
</thead>
<tbody>
<tr>
<td>6DT6-A</td>
<td>6DT6</td>
</tr>
</tbody>
</table>

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Maximum Ratings</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>150 volts</td>
</tr>
<tr>
<td>Grid-No.3 (Suppressor Grid)</td>
<td>550 volts</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Supply Voltage</td>
<td>100 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>600 OHMS</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>0.15 megohm</td>
</tr>
<tr>
<td>Transconductance, Grid-No.1 to Plate</td>
<td>1350 µmhos</td>
</tr>
<tr>
<td>Transconductance, Grid-No.3 to Plate</td>
<td>115 µmhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>1.55 mA</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>1.8 mA</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 10 µa</td>
<td>-5.2 volts</td>
</tr>
<tr>
<td>Grid-No.3 Voltage (Approx.) for plate current of 10 µa</td>
<td>-3.5 volts</td>
</tr>
</tbody>
</table>

FM DETECTOR

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Maximum Ratings</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>28 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>330 volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>330 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>200 mA</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage, Positive-bias value</td>
<td>See curve page 78</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>1.75 watts</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>1.14 watts</td>
</tr>
<tr>
<td>For grid-No.2 voltages up to 165 volts</td>
<td>See curve page 78</td>
</tr>
<tr>
<td>For grid-No.2 voltages between 165 and 330 volts</td>
<td>See curve page 78</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>200 mA</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200mA</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Grid-No.1-Circuit Resistance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>For fixed-bias operation</td>
<td>0.25 megohm</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>0.5 megohm</td>
</tr>
</tbody>
</table>

AVERAGE PLATE CHARACTERISTICS

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid-No.3 Connected to Cathode at 600 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 0 0 0 0</td>
<td>-3 Volt Gold</td>
</tr>
<tr>
<td>0 0 0 0 0 0 0</td>
<td>-3 Volt Gold</td>
</tr>
</tbody>
</table>

TYPE 6DT6-A

GRID NO.3 CONNECTED TO CATHODE AT 600 VOLTS
**RCA Receiving Tube Manual**

**HIGH-MU TWIN TRIODE**

Miniature type used in a wide variety of applications in radio and television receivers. Especially useful in push-pull RF amplifiers or as frequency converter in FM tuners. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.3. Peak heater-cathode volts: heater negative with respect to cathode, 200 max; heater positive with respect to cathode, 200 max; (the dc component must not exceed 100 volts). Except for heater and heater-cathode ratings, interelectrode capacitances, and bising arrangement, this type is identical with miniature type 12AT7.

**DIRECT INTERELECTRODE CAPACITANCES (Approx., Each Unit Except as Noted):**

- Grid to Plate: 1.6 pf
- Grid to Cathode, Heater, and Internal Shield: 2.7 pf
- Plate to Cathode, Heater, and Internal Shield: 1.6 pf
- Plate to Grid, Heater, and Internal Shield (Unit No.1): 2.6 pf
- Plate to Grid, Heater, and Internal Shield (Unit No.2): 2.8 pf
- Grid to Cathode, Heater, and Internal Shield (Unit No.1): 5.3 pf
- Grid to Cathode, Heater, and Internal Shield (Unit No.2): 5.3 pf

* With external shield connected to cathode of unit under test.
† With external shield connected to grid of unit under test.

**MEDIUM-MU TRIODE**

Nuvistor type used at frequencies up to 1000 megacycles in uhf oscillator stages of television receivers. Outline 1, OUTLINES SECTION. Tube requires nuvisor socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC):**

- 6.3 volts
- 0.185 amperes

**DIRECT INTERELECTRODE CAPACITANCES (Approx.):**

<table>
<thead>
<tr>
<th>Electrode</th>
<th>Capacity (pf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid to Plate</td>
<td>1.8</td>
</tr>
<tr>
<td>Grid to Cathode, Heater, and Shell</td>
<td>4.4</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, and Shell</td>
<td>1.9</td>
</tr>
<tr>
<td>Plate to Cathode</td>
<td>0.25</td>
</tr>
<tr>
<td>Heater to Cathode</td>
<td>1.4</td>
</tr>
<tr>
<td>Grid to Cathode</td>
<td>3.7</td>
</tr>
</tbody>
</table>

**CLASS A AMPLIFIER**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>300 max volts</td>
</tr>
<tr>
<td>Plate Voltage</td>
<td>125 max volts</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>-55 max volts</td>
</tr>
<tr>
<td>Negative bias value</td>
<td>2 max volts</td>
</tr>
<tr>
<td>Peak positive value</td>
<td>1 max ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>15 ma</td>
</tr>
<tr>
<td>Cathode Current</td>
<td>100 max volts</td>
</tr>
<tr>
<td>Plate Supply Voltage</td>
<td>75 volts</td>
</tr>
<tr>
<td>Cathode Bias Resistor</td>
<td>100 ohms</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>35</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>3100 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>11500 μhos</td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 10 μa</td>
<td>16.5 ma</td>
</tr>
<tr>
<td>Typical Operation as Oscillator at 950 Mc</td>
<td></td>
</tr>
<tr>
<td>Plate Voltage</td>
<td>60 volts</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>2 volts</td>
</tr>
<tr>
<td>Grid Resistor</td>
<td>5600 ohms</td>
</tr>
<tr>
<td>Plate Current</td>
<td>8 ma</td>
</tr>
<tr>
<td>Grid Current</td>
<td>350 ma</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

- Grid-Circuit Resistance: 0.1 max megohm
- For fixed bias operation
- For cathode bias operation: 0.2 max megohm
- For operation at metal-shell temperatures up to 135°C.

**HALF-WAVE VACUUM RECTIFIER**

Novar type used as damper tube in horizontal-deflection circuits of color and black-and-white television receivers. Outline 10D, OUTLINES SECTION. Tube requires novar nine-contact socket and may be 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 this tube, like other power-handling tubes, be adequately ventilated.
6DX8

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

Miniature type used in television-receiver applications. The triode unit is used as a sync-separator, synch-amplifier, key-down, or noise-suppressor tube. The pentode unit is used as a video-output tube. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.72.

CLASS A; AMPLIFIER

<table>
<thead>
<tr>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>550 max</td>
</tr>
<tr>
<td>Plate Voltage, with maximum plate current of 0.1 ma</td>
<td>500</td>
</tr>
<tr>
<td>PLATE CURRENT</td>
<td>500 max</td>
</tr>
<tr>
<td>GRID No.2 Supply Voltage</td>
<td>550</td>
</tr>
<tr>
<td>Grid No.2 Voltage</td>
<td>550</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>10</td>
</tr>
<tr>
<td>GRID No.2 INPUT</td>
<td>1</td>
</tr>
<tr>
<td>PLATE CURRENT</td>
<td>1</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td>200</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200</td>
</tr>
</tbody>
</table>

Characteristics:

<table>
<thead>
<tr>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>200</td>
</tr>
<tr>
<td>Grid No.2 Supply Voltage</td>
<td>200</td>
</tr>
<tr>
<td>Grid No.2 Voltage</td>
<td>200</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>3</td>
</tr>
<tr>
<td>GRID No.2 INPUT</td>
<td>3</td>
</tr>
<tr>
<td>PLATE CURRENT</td>
<td>3</td>
</tr>
<tr>
<td>GRID No.2 Supply Voltage</td>
<td>10</td>
</tr>
<tr>
<td>Plate Current</td>
<td>10</td>
</tr>
</tbody>
</table>
| Typical Operation of Pentode Unit as Video Output Tube:
  | Plate Supply Voltage | 170 | 170 | volts |
  | Series Plate Resistor | 3000 | 3000 | ohms |
  | Grid No.2 Supply Voltage | 170 | 170 | volts |
  | Grid No.2 Voltage | 170 | 170 | volts |
  | CATHODE CURRENT | 2 | 2 | ma |
  | TRANSMITTANCE | 10 | 10 | microamps |
  | Plate Current | 10 | 10 | ma |

MEDIUM-MU TRIODE

Miniature type used as a local-oscillator tube in uhf television receivers covering the frequency range from 470 to 990 megacycles. Outline 7A, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. For curve of average plate characteristics, refer to type 6AF4-A.

<table>
<thead>
<tr>
<th>6DZ4</th>
</tr>
</thead>
<tbody>
<tr>
<td>heater bias operation:</td>
</tr>
<tr>
<td>grid no.1 circuit resistance:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6DZ4</th>
</tr>
</thead>
<tbody>
<tr>
<td>heater voltage (ac/dc):</td>
</tr>
<tr>
<td>heater current:</td>
</tr>
<tr>
<td>grid to plate:</td>
</tr>
<tr>
<td>cathode to plate and heater:</td>
</tr>
<tr>
<td>plate to cathode and heater:</td>
</tr>
</tbody>
</table>

* With external shield connected to cathode.

REMunerating Tube Manual

HEATER VOLTAGE (ac/dc)
HEATER CURRENT
DIRECT INTER-ELECTRODE CAPACITANCES (Approx.):
Plate to Cathode and Heater:
Cathode to Plate and Heater:
Heater to Cathode:

DAMPER SERVICE

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

Maximum Ratings, (Design-Maximum Values):
PEAK INVERSE PLATE VOLTAGE: 5000 max volts
PLATE CURRENT: 1300 max ma
PLATE VOLTAGE: 250 max ma
PLATE DISSIPATION: 8.5 max watts
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode: 5000 max volts
Heater positive with respect to cathode: 300 max volts

Characteristics, instantaneous Value:
Tube Voltage Drop for plate current of 850 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 16 microseconds.
* The dc component must not exceed 900 volts.
* The dc component must not exceed 100 volts.

BEAM POWER TUBE

6DW5

Miniature type used in vertical deflection amplifier service in television receivers employing 110-degree deflection systems. Outline 8E, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 1.2.

CLASS A; AMPLIFIER

<table>
<thead>
<tr>
<th>Pentode</th>
<th>Triode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>60</td>
</tr>
<tr>
<td>Grid No.2 Voltage</td>
<td>150</td>
</tr>
<tr>
<td>Grid No.3 Voltage</td>
<td>0</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>4.3</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>15000</td>
</tr>
<tr>
<td>Plate Current</td>
<td>260</td>
</tr>
<tr>
<td>Grid No.2 Current</td>
<td>3</td>
</tr>
<tr>
<td>Grid No.1 Voltage (Approx. for plate current of 0.1 ma)</td>
<td>-55</td>
</tr>
</tbody>
</table>

VERTICAL DEFLECTION 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 No.1 (CONTROL-GRID) VOLTAGE:
PEAK CATHODE CURRENT:
PLATE DISSIPATION:
GRID No.2 INPUT:
PEAK HEATER-CATHODE VOLTAGE:

Heater negative with respect to cathode:
Heater positive with respect to cathode:

Maximum Circuit Values:
Grid No.1 Circuit Resistance:
For cathode-bias operation:

2.2 max megohms
2.2 max megohms
2.2 max megohms

With 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.
** 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 5 milliseconds.
* The dc component must not exceed 100 volts.
RCA Receiving Tube Manual

CLASS A: AMPLIFIER

Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>80 volts</td>
</tr>
<tr>
<td>Grid Resistor</td>
<td>2700 ohms</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>14</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>2600 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>6700 µmhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>15 ma</td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 20 µA</td>
<td>11 volts</td>
</tr>
</tbody>
</table>

UF OSCILLATOR

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>135 volts</td>
</tr>
<tr>
<td>Grid Voltage, Negative-bias value</td>
<td>50 max volts</td>
</tr>
<tr>
<td>Grid Current</td>
<td>2 max ma</td>
</tr>
<tr>
<td>Cathode Current</td>
<td>50 max ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.3 max watts</td>
</tr>
</tbody>
</table>

Typical Operation as Oscillator of 1000 Mc:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>135 volts</td>
</tr>
<tr>
<td>Grid Resistor</td>
<td>2700 ohms</td>
</tr>
<tr>
<td>Plate Current</td>
<td>15.5 ma</td>
</tr>
<tr>
<td>Grid Current (Approx.)</td>
<td>800 µA</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid Circuit Resistance</td>
<td>Not recommended</td>
</tr>
<tr>
<td></td>
<td>0.5 max ma megohm</td>
</tr>
</tbody>
</table>

* The dc component must not exceed 25 volts.

TWIN POWER PENTODE

Type 6DZ7

Glass octal type used as power amplifier tube in high-fidelity audio equipment. Outline 19A, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater voltage (ac/dc), 6.3; amperes, 1.52.

CLASS A: AMPLIFIER

Characteristics, (Each Unit):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.1 Current</td>
<td>7.3 ma</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>38000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>11300 µmhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>48 ma</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>5.5 ma</td>
</tr>
</tbody>
</table>

PUSH-PULL CLASS AB: AMPLIFIER

Maximum Ratings, (Design-Maximum Values, Per Tube):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>440 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>300 volts</td>
</tr>
<tr>
<td>Grid-No.2 Input (Total)</td>
<td>4 max watts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>18.2 max watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td>Heater negative with respect to cathode.</td>
</tr>
<tr>
<td></td>
<td>200 max volts</td>
</tr>
<tr>
<td></td>
<td>200 max watts</td>
</tr>
</tbody>
</table>

Typical Operation, (Per Tube):

<table>
<thead>
<tr>
<th>Bias</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td></td>
</tr>
<tr>
<td>Cathode</td>
<td></td>
</tr>
<tr>
<td>Bias</td>
<td>Value</td>
</tr>
<tr>
<td>Plate Voltage</td>
<td>400 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>-11 volts</td>
</tr>
<tr>
<td>Peak AF Grid-No.1-to-Grid-No.1 Voltage</td>
<td>22 volts</td>
</tr>
</tbody>
</table>

HEATERS VOLTAGE (AC/DC)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heats</td>
<td>6.3 volts</td>
</tr>
</tbody>
</table>

HEATER CURRENT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5 amperes</td>
</tr>
</tbody>
</table>

Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero-Signal Plate Current</td>
<td>40 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>100 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>15 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>15 mA</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-Plate)</td>
<td>9000 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>2.6 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>18 watts</td>
</tr>
</tbody>
</table>

Maximum Circuit Values, (Each Unit):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1-Circuit Resistance</td>
<td>0.27 max megohm</td>
</tr>
</tbody>
</table>

* The dc component must not exceed 100 volts.

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. Maximum dimensions: over-all length, 4-3/16 inches; diameter, 1-3/16 inches. 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-Design Center Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate-Supply Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Target Voltage</td>
<td>125 min volts</td>
</tr>
</tbody>
</table>

Typical Operation:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate and Target Supply Voltage</td>
<td>200 volts</td>
</tr>
<tr>
<td>Series Triode-Plate Resistance [1]</td>
<td>34 megohms</td>
</tr>
<tr>
<td>Target Current*</td>
<td>3 ma</td>
</tr>
<tr>
<td>Triode-Plate Current*</td>
<td>0.19 ma</td>
</tr>
<tr>
<td>Triode-Grid Voltage (Approx.)</td>
<td>-6.8 volts</td>
</tr>
<tr>
<td>For shadow angle of 6°</td>
<td>0 volts</td>
</tr>
<tr>
<td>For shadow angle of 30°</td>
<td>0 volts</td>
</tr>
</tbody>
</table>

* For zero triode-plate voltage. + Subject to wide variations.

TWIN POWER TRIODE

Glass type used as class A1 amplifier in either push-pull or parallel circuits. Outline 27, OUTLINES SECTION. Heater volts (ac/dc), 6.3; amperes, 0.6. With plate volts of 250 and grid volts of -27.5, characteristics for each unit are: plate resistance, 3000 ohms; transconductance, 1700 µmhos; amplification factor, 6. With plate-to-plate load resistance of 14000 ohms, output for two tubes is 1.6 watts. This is a DISCONTINUED type listed for reference only.

REMOTE-CUTOFF PENTODE

Glass type used in rf and if stages of radio receivers employing a.e. Outline 24A, OUTLINES SECTION. Except for interelectrode capacities, this type is identical electrically with type 6CU7G. Heater volts (ac/dc), 6.3; amperes, 0.3. This is a DISCONTINUED type listed for reference only.

SHARP-CUTOFF TETRODE

Miniature type used as rf amplifier in vhf tuners of television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be operated in any position.

6EA5

Related type: 3EA5
**RCA Receiving Tube Manual**

**DUAL TRIODE**

Glass octal type containing high-mu triode and high-persistence, low-mu triode in same envelope. Used as a combined vertical deflection oscillator and vertical deflection amplifier in television receivers. Outline 14B, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 1.05.

**6EA7**

**VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER**

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

**AVERAGE PLATE CHARACTERISTICS**

For 525-line, 30-frame system, 15 percent of one vertical scanning cycle is 2.5 milliseconds.

* The dc component must not exceed 100 volts.

---

**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 second. Outline 8B, OUTLINES

**SECTION.** Tube requires miniature nine-contact socket and may be mounted in any position.

---

**6EA8**

Related types: 6EA8, 19EA8

---

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>250 max volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No. 1 to Plate</td>
<td>150 max volts</td>
</tr>
<tr>
<td>Grid No. 2 (Screen-Grid) Voltage</td>
<td>100 max volts</td>
</tr>
<tr>
<td>Grid No. 1 (Control-Grid) Voltage, Positive-bias value</td>
<td>0 max volts</td>
</tr>
<tr>
<td>Cathode Current</td>
<td>200 mA</td>
</tr>
<tr>
<td>Grid No. 2 Input</td>
<td>0.5 max watt</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>3.5 max watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>100 max volts</td>
</tr>
</tbody>
</table>

**Characteristics:**

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>250 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No. 1 Voltage</td>
<td>140 volts</td>
</tr>
<tr>
<td>Grid No. 2 Voltage</td>
<td>10 volts</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>0.15 ohm</td>
</tr>
<tr>
<td>Transconductance</td>
<td>8000 µhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>10 ma</td>
</tr>
<tr>
<td>Grid No. 2 Current</td>
<td>12 ma</td>
</tr>
<tr>
<td>Grid No. 1 Voltage (Approx.) for Transconductance of 100 µhos or less</td>
<td>4.5 volts</td>
</tr>
</tbody>
</table>

* The dc component must not exceed 100 volts.

---

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Triode Unit</th>
<th>330 max volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pentode Unit</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid No. 2 (Screen-Grid) Supply Voltage</td>
<td>See curve page 76</td>
</tr>
<tr>
<td>Grid No. 1 Voltage</td>
<td>0 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>3.1 max watts</td>
</tr>
<tr>
<td>Plate No. 2 Input</td>
<td>0.5 max watt</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
</tbody>
</table>

**Characteristics:**

For grid-resistor-bias operation:

| Grid-Circuit Resistance | 1.2 max ohm |

* The duration of the voltage pulse must not exceed 15 percent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 percent of one vertical scanning cycle is 2.5 milliseconds.

* The dc component must not exceed 100 volts.

---

**AVERAGE PLATE CHARACTERISTICS**

For 525-line, 30-frame system, 15 percent of one vertical scanning cycle is 2.5 milliseconds.

* The dc component must not exceed 100 volts.

---

**AVERAGE PLATE CHARACTERISTICS**

For 525-line, 30-frame system, 15 percent of one vertical scanning cycle is 2.5 milliseconds.

* The dc component must not exceed 100 volts.
## High-Mu Triode—Sharp-Cutoff Pentode

**6EB8**

**Related type:** 6E6

Miniature type used in color and black-and-white television receivers. Pentode unit is used as video output amplifier; triode unit is used in sync-separator, sync-clapper, and phase-inverter circuits. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

### Characteristics:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>150</td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>-</td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.3 Voltage</td>
<td>-</td>
<td>125</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>5.0</td>
<td>-</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>50.0</td>
<td>200.000</td>
</tr>
<tr>
<td>Transconductance</td>
<td>8500</td>
<td>6400</td>
</tr>
<tr>
<td>Plate Current</td>
<td>1.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for plate current of 10 μA</td>
<td>-12</td>
<td>-9</td>
</tr>
</tbody>
</table>

### Technical Data

**AVERAGE PLATE CHARACTERISTICS**

**TRIODE UNIT**

---

**PENTODE UNIT**

---

**GRID-NO.2 INPUT:**
- For grid-No.2 voltages up to 165 volts: -115 max watts
- For grid-No.2 voltages between 165 and 300 volts: See curve page 70

**Peak Heater-Cathode Voltage:**
- Heater negative with respect to cathode: 220 max watts
- Heater positive with respect to cathode: 220 max watts

*The dc component must not exceed 100 volts.*

### Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>250</td>
<td>200</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>-</td>
<td>125</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>100.000</td>
<td>75.000</td>
</tr>
<tr>
<td>Transconductance</td>
<td>2700</td>
<td>12500</td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 20 μA</td>
<td>-6</td>
<td>-6</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 100 μA</td>
<td>-9</td>
<td>-9</td>
</tr>
<tr>
<td>Plate Current</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

**AVERAGE CHARACTERISTICS**

**PENTODE UNIT**

---
POWER PENTODE

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 screen-grid voltages with a low a.f. grid-No.1 driving voltage. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

<table>
<thead>
<tr>
<th>HEATER VOLTAGE (AC/DC)</th>
<th>6.3 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER CURRENT</td>
<td>1.2 amperes</td>
</tr>
<tr>
<td>DIRECT INTERELECTRODE Capacitances (Approx.)</td>
<td></td>
</tr>
<tr>
<td>Grid No.1 to Plate</td>
<td>0.55 pf</td>
</tr>
<tr>
<td>Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3</td>
<td>17 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, Grid No.2, and Grid No.3</td>
<td>9 pf</td>
</tr>
</tbody>
</table>

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>150 max volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRID-No.2 Supply Voltage</td>
<td>130 max volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>5.5 max watts</td>
</tr>
<tr>
<td>GRID-No.2 INPUT</td>
<td>2 max watts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>BULB TEMPERATURE (At hottest point)</td>
<td>220 max °C</td>
</tr>
</tbody>
</table>

**Typical Operation:**

<table>
<thead>
<tr>
<th>Plate Supply Voltage</th>
<th>110 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>115 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>0.5 ohms</td>
</tr>
<tr>
<td>Peak A.F. Grid-No.1 Voltage</td>
<td>3 volts</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>40 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>40 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>11.5 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>14.5 ma</td>
</tr>
<tr>
<td>Plate DISSIPATION</td>
<td>11000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>14000 amhos</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>3000 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>7 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>1.4 watts</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

| Grid-No.1-Circuit Resistance: For fixed-bias operation | 0.1 max megohm |
| For cathode-bias operation | 0.5 max megohm |

*The dc component must not exceed 100 volts.

---

SEMIREMOTE-CUTOFF PENTODE

Miniature type used as if-amplifier tube in television receivers. Outline 8C, OUTLINES SECTION. Tube requires nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.3.

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>PLATE SUPPLY VOLTAGE</th>
<th>550 max volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>250 max volts</td>
</tr>
<tr>
<td>GRID-No.2 Supply Voltage</td>
<td>250 max volts</td>
</tr>
<tr>
<td>GRID-No.2 Supply-Grid Voltage</td>
<td>250 max volts</td>
</tr>
<tr>
<td>GRID-No.2 INPUT</td>
<td>9.5 max volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>2.5 max watts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>150 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>150 max volts</td>
</tr>
</tbody>
</table>

**Characteristics:**

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>200 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No.3</td>
<td>Connected to cathode at socket</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>90 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>-2 volts</td>
</tr>
<tr>
<td>Plate DISSIPATION</td>
<td>6.5 megohm</td>
</tr>
<tr>
<td>Transconductance</td>
<td>12500 μmhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>12 ma</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>4.5 ma</td>
</tr>
</tbody>
</table>

**Typical Operation:**

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>200 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>200 volts</td>
</tr>
<tr>
<td>Grid-No.2 Series Resistor</td>
<td>22000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>125 625 1250 μmhos</td>
</tr>
<tr>
<td>RMS Grid-No.1 Voltage, for cross-modulation factor of 0.01</td>
<td>450 160 100 mV</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

| Grid-No.1-Circuit Resistance | 1 max megohm |
MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

6EH8

Miniature type used as combined oscillator and mixer tube in vhf tuners of television receivers having series-connected heater strings. Outline 8B, OUTLINES SECTION. Tube requires nine-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.45; warm-up time (average), 11 seconds. Characteristics as class A amplifier: plate and grid-No.1 voltas, 125 (800 max); grid-No.2 voltage, 30 volts; amplification factor (trio-ode unit), 40; plate resistance (pentode unit, approx.), 0.17 megohms; transconductance, 7500 microhos (trio-ode unit), 6000 microhos (pentode unit); plate ma., 13.5 (trio-ode unit), 12 (pentode unit); grid-No.2 ma. (pentode unit), 4; peak heater-cathode volts, 200 max (the dc component must not exceed 100 volts). This type is used principally for renewal purposes.

SHARP-CUTOFF PENTODE

6EJ7

Related types: 3EJ7, 4EJ7

Miniature type used as if-amplifier tube in television receivers. Outline 8C, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.3.

CLASS A AMPLIFIER

Maximum Ratings, (Design-Center Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>550 max</td>
</tr>
<tr>
<td>Plate Voltage</td>
<td>250 max</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Supply Voltage</td>
<td>550 max</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>250 max</td>
</tr>
<tr>
<td>Cathode Current</td>
<td>25 max</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>0.9 max</td>
</tr>
<tr>
<td>Plate Disipation</td>
<td>2.5 max</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>300 max</td>
</tr>
</tbody>
</table>

Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>190 200 volts</td>
</tr>
<tr>
<td>Grid-No.3</td>
<td>Connected to cathode at socket</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>200 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>2.35 2.6 volts</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>0.35 0.35 megohm</td>
</tr>
<tr>
<td>Transconductance</td>
<td>15000 16000 microhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>10 ma</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>4.1 ma</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1 Circuit Resistance</td>
<td>1 max megohm</td>
</tr>
</tbody>
</table>

BEAM POWER TUBE

6EM5

Related type: 6EM5

Miniature type used as vertical deflection amplifier in television receivers utilizing picture tubes having diagonal deflection angles of 110 degrees. Outline 8E, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

Heater Voltage (ac/dc)              | 6.3 volts |
Heater Current                      | 0.8 amperes |
Direct Interelectrode Capacitance:
  Grid-No.1 to Plate                 | 0.7 max pf |
  Grid-No.1 to Grid-No.2, and Grid-No.3 | 5.1 pf |
Plate to Cathode, Heater, Grid-No.2, and Grid-No.3 | 5.1 pf |
Plate Resistance (Approx.)          | 0.05 megohm |
Transconductance                    | 6100 microhos |

AVERAGE CHARACTERISTICS

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

Maximum Ratings, (Design-Center Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>315 max</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage</td>
<td>2200 max volts</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid-No.2 Voltage</td>
<td>285 max volts</td>
</tr>
<tr>
<td>Peak Cathode Current</td>
<td>250 max</td>
</tr>
<tr>
<td>Plate Disipation</td>
<td>210 ma</td>
</tr>
<tr>
<td>AVERAGE Cathode Current</td>
<td>60 ma</td>
</tr>
<tr>
<td>PLATE CAPACITANCE</td>
<td>10 ma</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>5.5 ma</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>200 max</td>
</tr>
</tbody>
</table>

Bump Temperature (at hottest point): 250°C

Maximum Circuit Values:

Grid-No.1 Circuit Resistance        | 2.2 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 2.3 milliseconds.

Under no circumstance should this absolute value be exceeded.

* The dc component must not exceed 100 volts.

AVERAGE CHARACTERISTICS

TYPE 5EMS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Voltage</td>
<td>250</td>
</tr>
<tr>
<td>Plate Supply Voltage</td>
<td>250</td>
</tr>
<tr>
<td>Plate Voltage</td>
<td>250</td>
</tr>
</tbody>
</table>

Technical Data
DUAL TRIODE

Glass octal type containing high-mu triode and high-rective, low-mu triode in same envelope. Used as combined vertical-deflection amplifier and vertical-deflection oscillator in television receivers employing picture tubes having 110-degree deflection angles and high ultraviolet voltages. Outline 14A, 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).

6EM7

Related types: 10EM7, 13EM7

HEATER VOLTAGE (AC/DC) ........................................... 6.3 volts
HEATER CURRENT ................................................... 0.925 ampere
DIRECT INTERELECTRODE CAPACITANCES .......................... Unit No. 1 Unit No. 2
Grid to Plate ...................................................... 4.8 10 pf
Grid to Cathode and Heater ...................................... 2.2 7 pf
Plate to Cathode and Heater ...................................... 6.8 1.8 pf

CLASS A, AMPLIFIER

Characteristics Unit No. 1 Unit No. 2
Plate Voltage ...................................................... 250 150 volts
Grid Voltage ...................................................... –3 –20 volts
Amplification Factor .............................................. 64 54
Plate Resistance (Approx.) ...................................... 40000 750 ohms
Transconductance .................................................. 1200 7200 amhos
Grid Voltage (Approx.):
For plate current of 10 ma........................................ –6.5 –5 volts
For plate current of 100 ma ....................................... –45 –45 volts
Plate Current ...................................................... 1.4 50 ma
Plate Current, for plate voltage of 60 volts and zero grid voltage – 96 ma
Plate Current, for grid voltage of –28 volts ...................... –10 ma

*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.

VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER

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

Maximum Ratings, (Design-Maximum Values):
DC PLATE VOLTAGE ................................................. 350 max 330 volts
Peak Positive-Pulse Plate Voltage .................................. 1500 volts
Peak Negative-Pulse Grid Voltage ................................ 400 max 250 volts
Peak Cathode Current .............................................. 77 max 175 ma
Average Cathode Current .......................................... 22 ma 50 ma
PLATE DISSIPATION .................................................. 1.8 max 10 ma watts
Peak Heater-Cathode Voltage ..................................... 200 max 200 ma volts
Heater negative with respect to cathode ......................... 200 max 200 max volts
Heater positive with respect to cathode ......................... 200 max 200 max volts

AVERAGE PLATE CHARACTERISTICS

UNIT NO. 2

Technical Data

Maximum Circuit Values:
GRID-CIRCUIT RESISTANCE ........................................... Unit No. 2
For grid-resistor-bias operation ................................ 2.5 max 2.2 max megohms
For cathode-bias operation ........................................ 2.5 max 2.2 max megohms

DIODE—REMOTE-CUTTOFF PENTODE

Miniature type used as combined if amplifier and AM detector in AM and AM/FM radio receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position.

6EQ7

Related types: 12EQ7, 20EQ7

HEATER VOLTAGE (AC/DC) ........................................... 6.3 volts
HEATER CURRENT ................................................... 0.3 ampere
DIRECT INTERELECTRODE CAPACITANCES:
Pentode Unit:
Grid No. 1 to Plate ............................................... Grid No. 1 to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield
Plate to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield
Pentode Grid No. 1 to Diode Plate ................................ Pentode Plate to Diode Plate

PENTODE UNIT AS CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE ..................................................... 300 max volts
GRID-No. 3 (SCREEN-GRID) VOLTAGE:
Positive value ..................................................... 300 max volts
Negative value ..................................................... –300 max volts
GRID-No. 2 (SCREEN-GRID) SUPPLY VOLTAGE ................. See curve page 70
GRID-No. 2 VOLTAGE .............................................. See curve page 70
GRID-No. 1 (CONTROL-GRID) VOLTAGE:
Positive-bias value ............................................... 0 max volts
Negative-bias value ............................................... –60 max volts
PLATE DISSIPATION .................................................. 0.2 max watts
GRID-No. 3 INPUT ..................................................... Grid-No. 2 INPUT
GRID-No. 3 INPUT ..................................................... 0.6 max watts
GRID-No. 2 voltages up to 150 volts ................. See curve page 70
For grid-No. 2 voltages between 150 and 300 volts ........ See curve page 70
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode ......................... 200 max volts
Heater positive with respect to cathode ......................... 200 max volts
BULB TEMPERATURE (At hottest point) ................................ 150 max °C

Characteristics:
Plate Voltage ...................................................... 100 volts
Grid No. 3 ......................................................... Connected to cathode at socket
Internal Shield ..................................................... Connected to cathode at socket
Grid-No. 2 Voltage .................................................. 100 volts
Grid-No. 1 Supply Voltage ........................................ 0 volts
Grid-No. 1 Resistor (By-passed) .................................. 2.2 megohms

AVERAGE CHARACTERISTICS

UNIT NO. 2
**RCA Receiving Tube Manual**

---

**HIGH-MU TRIODE**

Miniature type with frame grid used in vhf tuners of television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.18.

**6ER5**

Related types: 2ER5, 3ER5

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**6ES5**

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**HIGH-MU TRIODE**

Miniature type used as grounded-cathode rf amplifier in vhf television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.2.

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**CLASS A AMPLIFIER**

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**VARIABLE-MU TWIN TRIODE**

Miniature type with high-transconductance, variable mu, and low noise; used as cascode-type amplifier in tuners of television receivers. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.365.

**6ES8**

Related type: 4ES8

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**CLASS A AMPLIFIER (Each Unit)**

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**CASCODE-TYPE AMPLIFIER**

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**HIGH-MU TWIN TRIODE**

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 presamplifiers for mono- and stereophonic phonographs. Outline 8B, 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.

**6EU7**
RCA Receiving Tube Manual

Equivalent Noise and Hum Voltage: (Referenced to Grid, Each Unit):
- Average Value*: 1.8 microvolts rms
  * Measured in "true rms" units under the following conditions: Heater volts (ac), 6.3; plate-supply volts, 250; plate load resistor, 10000 ohms; cathode resistor, 2700 ohms; cathode bypass capacitor, 100 &mu;uf; grid resistor, 0 ohms; amplifier frequency range, 25 to 10000 c.p.s.

Class A1 Amplifier (Each Unit)

Maximum Ratings, (Design-Maximum Values):
- Plate Voltage: 330 max volts
- Grid Voltage: 65 max volts
- Negative-Bias Value: 0 max volts
- Positive-Bias Value: 0 max volts
- Plate Dissipation: 1.2 max watts

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200 max volts

The dc component must not exceed 100 volts.

Characteristics:
- Plate Voltage: 100 250 volts
- Grid Voltage: 1 2 volts
- Amplification Factor: 100 100
- Plate Resistance (Approx.): 82000 62600 ohms
- Transconductance: 1250 1000 &mu;mhos
- Plate Current: 0.5 1.2 ma

Medium-Mu Triode—Sharp-Cutoff Pentode

6EU8

Related type: SE5B

Miniature type used as combined triode oscillator and pentode mixer in television receivers. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.45; warm-up time (average), 11 seconds.

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 70
- Grid No. 1 (Control-Grid) Voltage, Positive-Bias Value: 0 max volts
- Cathode Current: 20 ma
- Grid No. 2 Input: 0.2 max watts
- Plate Dissipation: 3.25 max watts
- Peak Heater-Cathode Voltage: 100 max volts
- Heater positive with respect to cathode: 100 max volts

Characteristics:
- Plate Voltage: 275 max volts
- Grid No. 2 Voltage: 180 max volts
- Grid No. 1 Voltage: 70 max volts
- Plate Resistance (Approx.): 11.5 &mu;ohms
- Transconductance: 8600 &mu;mhos
- Plate Current: 11.5 ma
- Grid No. 1 Voltage (Approx.) for transconductance of 100 &mu;mhos: 9.0 ma

Maximum Circum Value:
- Grid No. 1 Circuit Resistance: 0.5 max &mu;ohms

* The dc component must not exceed 50 volts.

High-Mu Twin Triode

6EV7

Miniature type used as a relay-control tube in remote-control tuning units of television receivers. It is processed specifically for operation under standby conditions. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

Technical Data

Grid-No. 2 Input:
- For grid-No. 2 voltages up to 165 volts: 0.55 max watts
- For grid-No. 2 voltage between 165 and 280 volts: See curve page 70

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200 max volts

Characteristics:
- Plate Supply Voltage: 150 125 volts
- Grid-No. 2 Supply Voltage: 150 125 volts
- Grid-No. 1 Voltage: 56 40 volts
- Cathode Bias Resistor: 8000 5000 ohms
- Amplification Factor: 6000 4000
- Plate Resistance (Approx.): 5000 4000 ohms
- Transconductance: 8500 6400 &mu;mhos
- Grid-No. 1 Voltage (Approx.) for plate current of 10 ma: 12 9 volts
- Plate Current: 18 12 ma
- Grid-No. 2 Current: 4 3 ma
- Cathode Warm-up Time*: 35 24 seconds

Maximum Circuit Value:
- Grid.No. 1 Circuit Resistance: 0.1 max 0.1 max &mu;ohms

* 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 voltage—165, grid volts—0, and heater volts—5.5.
RCA Receiving Tube Manual

**HEATER VOLTAGE (AC/DC):** 6.3 volts
**HEATER CURRENT:** 0.6 ampere

**DIRECT INTERELECTRODE CAPACITANCES (Approx.):**
- Unit No.1: 3.4 pf
- Unit No.2: 3.4 pf
- Grid to Plate: 3 pf
- Grid to Cathode and Heater: 0.33 pf
- Plate to Cathode and Heater: 0.23 pf

**CLASS A, AMPLIFIER (Each Unit):**
- Plate Voltage: 250 volts
- Grid Voltage: 2 volts
- Amplification Factor: 60
- Plate Resistance (Approx.): 1150 ohms
- Transconductance: 5200 µmhos
- Plate Current: 10 ma
- Grid Voltage (Approx.) for plate current of 100 µa: 9 volts

**RELAY-CONTROL SERVICE (Each Unit):**
- Maximum Ratings, (Design-Maximum Values):
  - Plate Voltage: 300 volts
  - Grid Voltage, Positive-bias value: 0 volts
  - Cathode Current: 20 ma
  - Plate Dissipation:
    - When "on" time exceeds 30 seconds in any 2-minute interval: 2.5 watts
    - When "on" time does not exceed 30 seconds in any 2-minute interval: 4.5 watts
  - Peak Heater-Cathode Voltage: 200 volts
- Grid Voltage (Approx.) for plate current of 100 µa: 200 volts

**TYPICAL OPERATION WITH 2500-Ohm-Relay LOAD:**
- With "on" time in any 2-minute interval:
  - More than 30 seconds: Plate Supply Voltage: 250 volts
  - Less than 30 seconds: Zero-Bias Plate Current: 150 ma
- Grid Voltage (Approx.) for plate current of 100 µa: 9 volts

**Maximum Circuit Value:**
- Grid-Circuit Resistance: 3.9 max megohms

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**SHARP-CUTOFF PENTODE**

6EW6

Mineral 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 and high transconductance (14000 µmhos).

---

**TECHNICAL DATA**

**HEATER VOLTAGE (AC/DC):** 6.3 volts
**HEATER CURRENT:** 0.4 ampere

**DIRECT INTERELECTRODE CAPACITANCES:**
- Grid No.1 to Plate: 0.04 max
- Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3 and Internal Shield: 0.03 max
- Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield: 2.4 pf

**CLASS A, AMPLIFIER**

**GRID NO.1 VOLTAGE (SCREEN-GRID) SUPPLY VOLTAGE:** 0 volts
**GRID NO.2 VOLTAGE:** See curve page 70
**GRID NO.1 CONTROL-GRID VOLTAGE, POSITIVE BIAS:** 0 volts
**GRID NO.2 INPUT:** 3.1 volt watts
- For grid-No.2 voltages up to 155 volts: 0.6 volts
- For grid-No.2 voltages between 165 and 330 volts: See curve page 70
**PEAK HEATER-CATHODE VOLTAGE:**
- Heater negative with respect to cathode: 200 volts
- Heater positive with respect to cathode: 200 volts

**Characteristics:**
- Plate Supply Voltage: 125 volts
- Grid No.3: 125 volts
- Grid-No.2 Supply Voltage: 125 volts
- Cathode-Blind Resistor: 56 ohms
- Plate Resistance (Approx.): 14000 µmhos
- Transconductance: 11 ma
- Grid-No.1 Voltage (Approx.) for plate current of 20 ma: 3.2 ma

* With external shield connected to cathode.
* The dc component must not exceed 100 volts.
6EW7

DUAL TRIODE

Neveoval type used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers. Outline 11B, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. For curve of average plate characteristics, Unit No.1, refer to type 6DE7 (Unit No.1).

<table>
<thead>
<tr>
<th>HEATER VOLTAGE (AC/DC)</th>
<th>6.3 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER CURRENT:</td>
<td>0.9 ampere</td>
</tr>
</tbody>
</table>

DIRECT ELECTRODE CAPACITANCES (Approx.):

| Grid to Plate                  | 4.2 pf |
| Grid to Cathode and Heater     | 2.2 pf |
| Plate to Cathode and Heater    | 0.4 pf |

CLASS A AMPLIFIER

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit No.1</th>
<th>Unit No.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 volts</td>
<td></td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>150 volts</td>
<td></td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>15.5</td>
<td></td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>1500 ohms</td>
<td></td>
</tr>
<tr>
<td>Transconductance</td>
<td>8750</td>
<td></td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 10 ma</td>
<td>20 volts</td>
<td></td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 100 ma</td>
<td>10 volts</td>
<td></td>
</tr>
<tr>
<td>Plate Current</td>
<td>5.5 ma</td>
<td></td>
</tr>
<tr>
<td>Plate Current for plate voltage of 60 volts and zero grid voltage</td>
<td>15 ma</td>
<td></td>
</tr>
<tr>
<td>Plate Current for grid voltage of 85 volts</td>
<td>8 ma</td>
<td></td>
</tr>
</tbody>
</table>

VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER

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

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillator</td>
</tr>
<tr>
<td>2500 volts</td>
</tr>
<tr>
<td>PEAK POSITIVE-PULSE PLATE VOLTAGE*</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE GRID VOLTAGE*</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
</tr>
<tr>
<td>PEAK CATHODE CURRENT</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

| Grid-Circuit Resistance: | 2.2 ma |
| For grid-resistance operation | 2.2 ma |

* 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.

AVERAGE CHARACTERISTICS

<table>
<thead>
<tr>
<th>TYPE 6EW7</th>
<th>E2 6.3 VOLS</th>
</tr>
</thead>
</table>

BEAM POWER TUBE

Glass octal tube used as vertical deflection amplifier in television receivers. Outline 11B, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.9.

<table>
<thead>
<tr>
<th>BEAM POWER TUBE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
</tr>
<tr>
<td>Transconductance</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
</tr>
<tr>
<td>Plate DISSIPATION</td>
</tr>
<tr>
<td>GRID-No.2 Input</td>
</tr>
</tbody>
</table>

BEAM POWER TUBE

Glass octal tube used as vertical deflection amplifier in television receivers. Outline 11B, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.9.

<table>
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<tbody>
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<tr>
<td>Grid-No.2 Current</td>
</tr>
<tr>
<td>Plate DISSIPATION</td>
</tr>
<tr>
<td>GRID-No.2 Input</td>
</tr>
</tbody>
</table>

BEAM POWER TUBE

Glass octal tube used as vertical deflection amplifier in television receivers. Outline 11B, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.9.

<table>
<thead>
<tr>
<th>BEAM POWER TUBE</th>
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<tbody>
<tr>
<td>Plate Voltage</td>
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<tr>
<td>Grid-No.2 Voltage</td>
</tr>
<tr>
<td>Transconductance</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
</tr>
<tr>
<td>Plate DISSIPATION</td>
</tr>
<tr>
<td>GRID-No.2 Input</td>
</tr>
</tbody>
</table>

BEAM POWER TUBE

Glass octal tube used as vertical deflection amplifier in television receivers. Outline 11B, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.9.
**RCA Receiving Tube Manual**

**Characteristics:**
- **Plate Voltage:** 250 volts
- **Grid-No.2 Voltage:** 15 volts
- **Grid-No.1 Voltage:** 0 volts
- **Plate Resistance (Approx.):** 50000 ohms
- **Transconductance:** 4000 µhos
- **Grid-No.1 Voltage (Approx.) for plate current of 100 µA:** -50 volts
- **Plate Current:** 100* 43 mA
- **Grid-No.2 Current:** 25* 3.5 mA

**VERTICAL DEFLECTION AMPLIFIER**

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

**Maximum Ratings:** (Design-Maximum Values):
- **DC Plate Voltage:** 350 max volts
- **Peak Positive-Pulse Plate Voltage:** 2500 max volts
- **Peak Negative-Pulse Grid-No.2 (Screen-Grid) Voltage:** -250 max volts
- **Peak Positive-Pulse Cathode Voltage:** 260 max ma
- **Average Cathode Current:** 75 max ma
- **Plate Dissipation:** 12 max watts
- **Grid-No.2 Input:** 7.7 max volts
- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode: 200 max volts
  - Heater positive with respect to cathode: 200 max volts
- **Bulb Temperature (At hottest point):** 200° 13°C

**Maximum Circuit Values:**
- **Grid-No.1-Circuit Resistance:** 1 max megohm
- **For cathode-bias operation:** 2.2 max megohms

*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 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**

Miniature type used in oscillator-mixer and a/c service in FM receivers.

Outline 8B, OUTLINES SECTION.

Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.45.

**CLASS A: AMPLIFIER**

*For each unit unless otherwise specified.*

**Maximum Ratings:** (Design-Maximum Values):
- **Plate Voltage:** 330 max volts
- **Grid Voltage:**
  - Negative-bias value: -50 max volts
  - Positive-bias value: 0 max volts
- **Plate Dissipation:**
  - Total Plate Dissipation (All plates): 5 max watts
  - Heater-Cathode Voltage (Unit No.1):
  - Heater negative with respect to cathode: 100 max volts
  - Heater positive with respect to cathode: 100 max volts

**Characteristics:**
- **Plate Voltage:** 125 volts
- **Grid Voltage:** 1 volt
- **Amplification Factor:** 67
- **Plate Resistance (Approx.):** 13600 ohms
- **Transconductance:** 22000 µhos
- **Grid Voltage (Approx.) for plate current of 20 µA:** -4200 volts
- **Plate Current:** 4.2 ma

**Technical Data**

**HIGH-MU TRIODE**

Metal type 6F5 and glass octal type 6F5-GT used in resistance-coupled amplifier circuits. Outlines 3 and 15A, respectively, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position. Type 6F5-GT may be supplied with pin No.1 omitted. Heater volts (ac/dc), 6.3; amperes, 0.3. Typical operation as class A amplifier: plate volts, 250 (50000 ohms); grid volts, 2; amplification factor, 1000; plate resistance (approx.), 66000 ohms; transconductance, 1500 µhos; plate ma., 0.9. Peak heater-cathode volts, 90 vac. Type 6F5-GT is a DISCONTINUED type listed for reference only. Type 6F5 is used principally for renewal purposes.

**POWER PENTODE**

Metal type 6F6 and glass octal types 6F6G and 6F6-GT used in the audio output stage of ac receivers. Tubes are capable of large power output with relatively small input voltage.

Outlines 5, 6, and 14E, respectively, OUTLINES SECTION. Type 6F6-GT may be supplied with pin No.1 omitted. Tubes require octal socket and may be mounted in any position. It is especially important that these tubes, like other power-handling tubes, be adequately ventilated. Types 6F6-G and 6F6-GT are used principally for renewal purposes. Heater volts (ac/dc), 6.3; amperes, 0.7.

**CLASS A: AMPLIFIER**

**Maximum Ratings:** (Design-Maximum Values):
- **Plate Voltage:** 375 max volts
- **Grid-No.2 Voltage:** 285 max volts
- **Grid-No.2 Input:** 11 max watts
- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode: 90 max volts
  - Heater positive with respect to cathode: 90 max volts

**Typical Operation:**
- **Plate Voltage:** 250 volts
- **Grid-No.1 Voltage:** 25 max volts
- **Peak AP Grid-No.1 Voltage:** 16.5 max volts
- **Zero-Signal Plate Current:** 34 max ma
- **Maximum-Signal Plate Current:** 36 max ma
- **Zero-Signal Grid-No.2 Current:** 6.5 max ma
- **Maximum-Signal Grid-No.2 Current:** 10.5 max ma
- **Amplification Factor:** 6.3
- **Plate Resistance (Approx.):** 78000 ohms
- **Transconductance:** 250000 µhos
- **Load Resistance:** 1200 ohms
- **Total Harmonic Distortion:** 8.5 per cent
- **Maximum-Signal Power Output:** 6.85 watts

**PUSH-PULL CLASS A: AMPLIFIER**

**Maximum Ratings:** (Same as for class A amplifier)

**Typical Operation:** (Values are for two tubes):
- **Plate Voltage:** 315 volts
- **Grid-No.2 Voltage:** 185 volts
- **Peak AP Grid-No.1-to-Grid-No.1 Voltage:** 48 volts
- **Maximum-Signal Plate Current:** 80 ma
- **Zero-Signal Grid-No.2 Current:** 19.5 ma
- **Effective Load Resistance (Plate-to-plate):** 10000 ohms
- **Total Harmonic Distortion:** 8.5 per cent
- **Maximum-Signal Power Output:** 11 watts
LOW-MU TRIODE—REMOTE-CUTOFF PENTODE

Glass type adaptable to circuit design in several ways. Outline 24B, OUTLINES SECTION. Heater volts (ac/dc), 6.3; amperes, 0.3. Typical operation as class A amplifier; pentode unit—plate volts, 250; grid No.2 supply, 100; grid No.1 supply, 50 volts; plate volts, 300; plate resistance, 0.5 megohm; transconductance, 1,100 amhos; plate ma., 6.5; grid No.2 ma., 1.2; triode unit—plate volts, 6.5; grid No.2 supply, 100; plate volts, 6.5; grid No.2 ma., 1.2; triode unit—plate volts, 6.5; grid No.2 supply, 100; plate volts, 6.5; grid No.2 ma., 1.2. This type is used principally for renewal purposes.

MEDIUM-MU TWIN TRIODE

Glass octal type used as voltage amplifier or phase inverter in radio equipment. Outline 23, OUTLINES SECTION. Tube requires octal socket. Except for the heater rating of 6.3 volts (ac/dc) and 0.5 amperes and interelectrode capacitances, each triode unit is identical electrically with type 6F7. Type 6F8-G is used principally for renewal purposes.

DIODE—SHARP-CUTOFF, TWIN-PLATE TETRODE

Miniature type used in frequency-divider and complex-wave generator circuits of electronic musical instruments. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position.

HEATER VOLTAGE (AC DC)........ 6.3 volts
HEATER CURRENT.................. 0.3 amperes
DIRECT INTERELECTRODE CAPACITANCE:
Tetrode Unit:
Grid No.1 to Plate A.................. 0.040 pf
Grid No.1 to Plate B.................. 0.030 pf
Grid No.1 to Cathode, Heater, Grid No.2, and Internal Shield... 5.5 pf
Plate A to Cathode, Heater, Grid No.2... 5.5 pf
Plate B to Cathode, Heater, Grid No.2, and Internal Shield... 5.5 pf
Tetrode Grid No.1 to Diode Plate... 0.029 pf
Tetrode Plate A to Diode Plate... 0.029 pf
Tetrode Plate B to Diode Plate... 0.051 pf

CLASS A AMPLIFIER

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...... 2.2 megs
Plate Resistance (Approx.)... 3200 ohms
Transconductance........... 5.8 ma
Plate Current.................. 1.6 ma
Grid-No.2 Current............. 4 volts
Grid-No.1 Voltage (Approx.) for plate current of 20 ma... 106 volts
Using either Plate A or B, with unused plate grounded
Plate Voltage.................. 100 volts
Grid-No.2 Voltage............. 100 volts
Grid-No.1 Supply Voltage...... 2.2 megs
Grid-No.1 Resistor (Bypassed)........... 13200 ohms
Plate Resistance (Approx.)... 1900 ohms
Transconductance........... 3.2 ma
Plate Current.................. 3 ma
Grid-No.2 Current............. 3 ma

DUAL TRIODE

Glass type containing high-mu and low-mu triode units used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers. Maximum dimensions: over-all length, 2.91 inches; seated height, 2.62 inches; diameter, 1.188 inches. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.925.

CLASS A AMPLIFIER

Characteristics
Unit No. 1
Plate Voltage.................. 250 volts
Grid Voltage.................. 150 volts
Amplification Factor........... 40 ohms
Plate Resistance (Approx.)... 4000 ohms
Transconductance............... 1600 amhos
Unit No. 2
Plate Voltage.................. 60 volts
Grid Voltage.................. 150 volts
Amplification Factor........... 40 ohms
Plate Resistance (Approx.)... 4000 ohms
Transconductance............... 1600 amhos
RCA Receiving Tube Manual

Plate Current: 1.4 ma 95°C 40 ma

Grid Voltage (Approx.):
- For plate current of 10 ma: -5.5 volts
- For plate current of 100 ma: -40 volts
- Transconductance, for plate current of 1 ma: -500 µmho
- Plate Current, for grid voltage of -25 volts: -6 ma

VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER

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

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillator</td>
<td>Amplifier</td>
</tr>
<tr>
<td>DC Plate Voltage</td>
<td>300 max</td>
</tr>
<tr>
<td>Peak Positive-Grid Voltage*</td>
<td>400</td>
</tr>
<tr>
<td>Peak Negative-Grid Voltage*</td>
<td>70</td>
</tr>
<tr>
<td>Average Plate Current</td>
<td>20</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>1.5 max</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater negative with respect to cathode...</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater positive with respect to cathode...</td>
<td>200 max</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

Grid-Circuit Resistance:
- For grid-resistor-bias or cathode-bias operation... 2.2 max 2.2 max megohms
- This value can be measured by a method involving a recurring waveform that the maximum ratings of the tube will not exceed.
- 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.

BEAM POWER TUBE

Glass octal type used in the audio output stages of compact stereophonic phonographs and in radio and television receivers. Tube has high sensitivity at very low plate and screen-grid voltages; it can deliver relatively high plate output at low values of plate load resistance. Outline 14F, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position.

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Voltage (AC/DC)</td>
<td>6.3 volts</td>
</tr>
<tr>
<td>Heater Current</td>
<td>1.2 amperes</td>
</tr>
<tr>
<td>Direct Interelectrode Capacitance (Approx.):</td>
<td>0.44 pf</td>
</tr>
<tr>
<td>Grid No.1 to Plate</td>
<td>15 pf</td>
</tr>
<tr>
<td>Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3</td>
<td>9 pf</td>
</tr>
</tbody>
</table>

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>175 max volts</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>175 max volts</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>2.4 max watts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>14.5 max watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td>300 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode...</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode...</td>
<td>200 max volts</td>
</tr>
</tbody>
</table>

Typical Operation:

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>130 145 volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>130 145 volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>-12.5 -16 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>-12.5 -15 ohms</td>
</tr>
<tr>
<td>Peak A.F. Grid-No.1 Voltage</td>
<td>12.5 -15 11.9 15.4 volts</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>40 mA</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>94</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>4 4.2 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>15 18</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>800 ohms</td>
</tr>
</tbody>
</table>

Technical Data

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5E5</td>
<td>Voltage</td>
</tr>
<tr>
<td>Grid-No.1 to Grid-No.2</td>
<td>12.5</td>
</tr>
<tr>
<td>Grid-No.2 to Ground</td>
<td>11.9 15.4 volts</td>
</tr>
<tr>
<td>Plate to Ground</td>
<td>12.5</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>94</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>4 4.2 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>15 18</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>800 ohms</td>
</tr>
</tbody>
</table>

Maximum Ratings: (Some as for class A, amplifier)

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>130 145 volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>130 145 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>75 75 ohms</td>
</tr>
<tr>
<td>Peak A.F. Grid-No.1-to-Grid-No.1 Voltage</td>
<td>25.5 28.8 volts</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>150 160 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>150 160 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>0.7 20 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>0.7 20 ma</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-Plate)</td>
<td>1600 1600 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>6 6 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>7 8.5 watts</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

Grid-No.1-Circuit Resistance: 0.1 max 0.5 max megohms
- The dc component must not exceed 100 volts.
MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

Miniature type used as combined oscillator and mixer tube in vhf television receivers employing series-connected heaterstrings. Outline 8R, OUTLINES SECTION. Tuberequires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.45; warm-up time (average), 11 seconds.

CLASS A. AMPLIFIER

**Maximum Ratings, (Design-Maximum Values):**

- **Plates Voltage:**
  - 330 max volts
- **Grid No. 2 Screen-Grid Supply Voltage:**
  - 330 max volts
- **Grid No. 2 Voltage:**
  - 0 max volts
- **Grid No. 1 Control-Grid Voltage, Positive-bias Value:**
  - 0.56 max volts
- **Grid No. 1 Input:**
  - For grid-No. 2 voltages up to 165 volts...
  - For grid-No. 2 voltages between 165 and 330 volts...
  - 2.5 max watts
- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode...
  - Heater positive with respect to cathode...
  - 200 max volts
  - 200 max volts
  - 200 max volts

**Characteristics:**

- **Plate Voltage:**
  - 125 volts
- **Grid No. 2 Voltage:**
  - 0 volts
- **Power Amplification Factor:**
  - 5000
- **Plate Resistance (Approx.)**
  - 7.5 max
- **Transconductance:**
  - 11 ma

- **Grid-No. 1 Current:**
  - 4 ma
- **Grid-No. 1 Voltage (Approx.) for plate current of 30 ma:**
  - -6.5 volts

*The dc component must not exceed 100 volts.

HIGH-MU TRIODE

Miniature type used as an rf amplifier in vhf tuners of television receivers. Outline 7B, OUTLINES SECTION. Tube requires seven-contact socket and may be mounted in any position.

HEATER VOLTAGE (AC/DC): 6.3 volts
HEATER CURRENT: 0.45 amperes

DIRECT INTERELECTRODE CAPACITANCES (Approx.):

- Grid to Plate: 0.52 pf
- Grid to Plate, Heater, and Internal Shield: 3.2 pf
- Plate to Cathode: 2.2 pf
- Plate to Cathode, Heater, and Internal Shield: 1 pf

*With external shield connected to cathode.

CLASS A. AMPLIFIER

**Maximum Ratings, (Design-Maximum Values):**

- **Plates Voltage:**
  - 150 max volts
- **Grid Voltage:**
  - 0 max volts
- **Cathode Current:**
  - 2.2 max watts
- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode...
  - Heater positive with respect to cathode...
  - 100 max volts
  - 100 max volts

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** technical data **

**Plate Voltage:**
- 135 volts

**Grid Voltage:**
- 250 volts

**Plate Resistance (Approx.)**
- 5600 ohms

**Transconductance:**
- 9000 µhos

**Plate Current:**
- 11 ma

**Grid Voltage (Approx.) for plate current of 100 µa:**
- -7.5 volts

**Maximum Circuit Values:**

**Grid-Circuit Resistance:**
For cathode-bias operation...

**AVERAGE PLATE CHARACTERISTICS**

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**6FH8**

Miniature type used in complex-wave generator applications. Sharp-cutoff tetrode unit has pair of additional plates. Outline 8B, OUTLINES SECTION. Tube requires nine-contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC):** 6.3 volts
**HEATER CURRENT:** 0.45 amperes

**DIRECT INTERELECTRODE CAPACITANCES (Approx.):**

- Grid to Plate: 1.4 pf
- Grid to Plate, Heater, and Plate No. 1: 2.8 pf
- Grid to Plate, Heater, and Plate No. 1, and Plate No. 1B: 1 pf
- Tetrode Grid No. 1 to Triode Plate: 0.06 max pf
- Tetrode Grid No. 1 to Triode Plate: 0.008 max pf

*With external shield connected to cathode.

CLASS A. AMPLIFIER

**Maximum Ratings, (Design-Maximum Values):**

- **Plates Voltage:**
  - 100 volts
- **Grid Voltage:**
  - 40 volts
- **Plate Resistance (Approx.)**
  - 7400 ohms
- **Transconductance:**
  - 5400 µhos
- **Plate Current:**
  - 7.9 ma
- **Grid Voltage (Approx.) for plate current of 100 µa:**
  - -7 volts

**Tetrode Unit with Plates No. 1A and No. 1B Connected to Cathode at Socket:**

**Plate-No. 2 Voltage:**
- 250 volts

**Grid-No. 2 Voltage:**
- 250 volts

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**6F7**

Duodec type used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers. Outline 12B, OUTLINES SECTION. Tube requires duodec twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.9.

**6FM7**

Duoic 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 amplifier. Outline 12B, OUTLINES SECTION. Tube requires duodec twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.05.

**CLASS A AMPLIFIER**

- **Plate Voltage**: 260 volts
- **Grid Voltage**: 150 volts
- **Amplification Factor**: 1500
- **Grid Resistance**: 2000 ohms
- **Transconductance**: 7700 microhms
- **Plate Current**: 50 ma
- **Plate Voltage**: 500 volts
- **Grid Voltage**: 150 volts
- **Amplification Factor**: 1500
- **Grid Resistance**: 2000 ohms
- **Transconductance**: 7700 microhms
- **Plate Current**: 50 ma

**VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER**

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

- **Maximum Ratings (Design-Maximum Values)**:
  - DC Plate Voltage: 550 volts
  - Peak Positive-Pulse Plate Voltage: 2500 volts
  - Peak Negative-Pulse Plate Voltage: -2500 volts
  - Peak Cathode Current: 150 ma
  - Average Cathode Current: 50 ma
  - Peak Heater-Cathode Voltage: 200 volts
  - Heater positive with respect to cathode: 200 volts

**6F8**

Miniature type used as combined FM detector and AF voltage amplifier in FM receivers. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.45.
**DIRECT INTERELECTRODE CAPACITANCES (Appox.):**

<table>
<thead>
<tr>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid to Plate</td>
<td>3.8</td>
</tr>
<tr>
<td>Grid to Cathode and Heater</td>
<td>2.4</td>
</tr>
<tr>
<td>Plate to Cathode and Heater</td>
<td>0.34</td>
</tr>
<tr>
<td>Plate of Unit No. 1 to Plate of Unit No. 2</td>
<td>1</td>
</tr>
</tbody>
</table>

**BEAM HEXODE**

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 internally connected to the cathode and grid No.4, and aligned with grid No.3. Outline TB, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.2.

**CLASS A: AMPLIFIER**

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
</tr>
<tr>
<td>Grid-No.3 (Screen-grid) Voltage</td>
</tr>
<tr>
<td>Grid-No.1 (Control-grid) Voltage</td>
</tr>
<tr>
<td>Negative-bias value</td>
</tr>
<tr>
<td>Positive-bias value</td>
</tr>
<tr>
<td>Cathode Current</td>
</tr>
<tr>
<td>Plate Current</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
</tr>
</tbody>
</table>

**SHARP-CUTOFF TETRODE**

Miniature type used as RF amplifier in VHF tuners of television receivers. Outline 8D, OUTLINES SECTION. Tube requires seven-contact socket and may be mounted in any position.

**CLASS A: AMPLIFIER**

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
</tr>
<tr>
<td>Grid-No.3 Voltage</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
</tr>
<tr>
<td>Plate Current</td>
</tr>
<tr>
<td>Plate Disipation</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.)</td>
</tr>
</tbody>
</table>

**MEDIUM-MU TWIN TRIODE**

Miniature type used as combined vertical- and horizontal-deflection oscillator in television receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Except for direct interelectrode capacitances, this type is identical with miniature type 6C7G. For typical operation as a resistance-coupled amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION.
CATHODE CURRENT...

GRID-No.2 INPUT...

PLATE DISSIPATION...

PEAK HEATER-CATHODE VOLTAGE...

Features:
- Heater negative with respect to cathode.
- Heater positive with respect to cathode.

Characteristics:
- Plate Voltage: 125 volts
- Grid-No.2 Voltage: -1 volt
- Grid-No.1 Voltage: -1 volt
- Plate Resistance (Approx.): 8000 ohms
- Grid-No.1 Voltage (Approx.): for plate current of 20 ma

Maximum Circuit Values:
- Grid-No.1-Circuit Resistance: 0.5 ma mohm

* The dc component must not exceed 100 volts.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

6FV8

6FV8A

Related type: 5F8

CLASS A AMPLIFIER

Pentode Unit

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 90 volts...

For grid-No.2 voltages between 90 and 180 volts...

See curve page 70

20 ma watt

See curve page 70

200 max volts

200 max volts

Maximum Circuit Values:
- Grid-No.1-Circuit Resistance: 0.5 ma mohm

* The dc component must not exceed 100 volts.

BEAM POWER TUBE

Glass octode type used as horizontal-deflection amplifier in television receivers. Outline 18A, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.12.

HORIZONTAL-DEFLECTION AMPLIFIER

For operation in a 525-line, 3-frame system

Maximum Ratings, (Design-Maximum Values):

PLATE DISSIPATION...

PEAK NEGATIVE-PULSE PLATE VOLTAGE...

PEAK NEGATIVE-PULSE GRID VOLTAGE...

PEAK CATHODE CURRENT...

AVERAGE CATHODE CURRENT...

PLATE DISSIPATION...

PEAK HEATER-CATHODE VOLTAGE...

Heater negative with respect to cathode...

Heater positive with respect to cathode...

200 max volts

200 max volts

3 ma mohm

6FV5

Maximum Circuit Values:
- Grid-No.1-Circuit Resistance: 1 ma mohm

* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 3-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

* The dc component must not exceed 100 volts.

* An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

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 direct-coupled grounded-cathode drive for the other unit. Outline 18B, OUTLINES SECTION. Tube requires nixie contact socket.

Heater voltages (ac/dc), 6.3; amperes, 0.4. Characteristics as class A amplifier (each unit):
- plate volts, 100 (250 ma); grid volts, -12; amplification factor, 33; plate resistance (approx.), 2500 ohms; transconductance, 13000 µmhos; plate ma., 15; cathode ma., 22 ma; plate dissipation, 2.2 ma watts; peak heater-cathode volts, 200 ma (the dc component must not exceed 100 volts). This type is used principally for renewal purposes.

DUAL TRIODE

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 amplifier. Outline 12D, OUTLINES SECTION.
RCA Receiving Tube Manual

Tube requires duodec element-socket and matrix may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.65.

Class A: Amplifier

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>-3</td>
<td>5</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>65</td>
<td>6</td>
</tr>
<tr>
<td>Plate Residual Resistance (Approx.)</td>
<td>8000</td>
<td>800</td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 30 mA</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>Grid Voltage (Approx) for plate current of 50 mA</td>
<td>1.4</td>
<td>45 ma</td>
</tr>
<tr>
<td>Plate Current (Approx) for grid voltage of -25 volts</td>
<td>-10 ma</td>
<td>10 ma</td>
</tr>
</tbody>
</table>

Vertical-Deflection Oscillator and Amplifier

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

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th></th>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC PLATE VOLTAGE</td>
<td>330 max</td>
<td>275 max</td>
</tr>
<tr>
<td>PEAK POSITIVE-PULSE PLATE VOLTAGE</td>
<td>400 max</td>
<td>250 max</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE PLATE VOLTAGE</td>
<td>70 max</td>
<td>175 ma</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>20 ma</td>
<td>50 ma</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>1 ma</td>
<td>7 ma</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>200 ma</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 ma</td>
<td></td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 ma</td>
<td></td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

Grid-Circuit Resistance: 2.2 ma 20 ma 2 ma 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.

The dc component must not exceed 100 volts.

Power Pentode

Glass octal type used in output stage of radio receivers where moderate power output is required. Outline 22, OUTLINE SECTION. Tube requires octal socket. Except for inter-electrode capacitances and a plate resistance of 27000 ohms, this tube is electrically identical with type 6AK6. Heater volts (ac/dc), 6.3; amperes, 0.15. Type 6G6G is used principally for renewal purposes.

Beam Power Tube—Sharp-Cutoff Pentode

Duodec element type used as FM detector and audio-frequency output amplifier in television receivers. Outline 12B, OUTLINE SECTION. Tube requires duodec twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.2.

Beam Power Tube Unit as Class A: Amplifier

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>150 max</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>135 max</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>65 ma</td>
</tr>
<tr>
<td>PEAK NEGATIVE-CATHODE VOLTAGE</td>
<td>6.5 ma</td>
</tr>
<tr>
<td>PEAK NEGATIVE-CATHODE VOLTAGE</td>
<td>1.8 ma</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 ma</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 ma</td>
</tr>
</tbody>
</table>

Technical Data

Typical Operation:

<table>
<thead>
<tr>
<th></th>
<th>120 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>110 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>-8 volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>8 volts</td>
</tr>
<tr>
<td>Zero-Grid Plate Current</td>
<td>49 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>4 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>4 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>80 ma</td>
</tr>
<tr>
<td>Transconductance</td>
<td>1000 ohms</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>250 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>10 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>2.3 watts</td>
</tr>
</tbody>
</table>

Pentode Unit as Class A: Amplifier

<table>
<thead>
<tr>
<th></th>
<th>150 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>0 volts</td>
</tr>
<tr>
<td>Grid-No.3 (Suppressor-Grid) Voltage</td>
<td>100 volts</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Supply Voltage</td>
<td>560 ohms</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>9.5 ohms</td>
</tr>
<tr>
<td>Transconductance, Grid No.1 to Plate.</td>
<td>1000 ohms</td>
</tr>
<tr>
<td>Transconductance, Grid No.2 to Plate.</td>
<td>400 ohms</td>
</tr>
<tr>
<td>Plate Current</td>
<td>1.3 ma</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>2 ma</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 10 mA</td>
<td>-4.5 volts</td>
</tr>
<tr>
<td>Grid-No.3 Voltage (Approx.) for plate current of 10 mA</td>
<td>-4.5 volts</td>
</tr>
</tbody>
</table>

Pentode Unit as FM Detector

<table>
<thead>
<tr>
<th></th>
<th>380 max volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>28 volts</td>
</tr>
<tr>
<td>Grid-No.2 VOLTAGE</td>
<td>330 volts</td>
</tr>
<tr>
<td>Grid-No.2 CURRENT</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>0 volts</td>
</tr>
<tr>
<td>Grid-No.2 INPUT</td>
<td>1.7 max watts</td>
</tr>
<tr>
<td>For grid-No.2 voltages between 165 and 350 volts</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>200 ma</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 ma</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 ma</td>
</tr>
</tbody>
</table>

Beam Power Tube

Neonovol type used as output tube in audio-amplifier applications. Outline 11C, OUTLINE SECTION. Tube requires neonovol nine-contact socket and may be mounted in any position.

<table>
<thead>
<tr>
<th></th>
<th>6.3 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER VOLTAGE (AC/DC)</td>
<td>1.2 amperes</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>90 pf</td>
</tr>
<tr>
<td>Grid-No.1 to Plate</td>
<td>80 pf</td>
</tr>
<tr>
<td>Grid-No.2 to Grid-No.3</td>
<td>7 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Grid No.2, and Grid No.3</td>
<td>7 pf</td>
</tr>
</tbody>
</table>

Class A: Amplifier

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>150 max</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>135 max</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>65 ma</td>
</tr>
<tr>
<td>PEAK NEGATIVE-CATHODE VOLTAGE</td>
<td>6.5 ma</td>
</tr>
<tr>
<td>PEAK NEGATIVE-CATHODE VOLTAGE</td>
<td>1.8 ma</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 ma</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 ma</td>
</tr>
</tbody>
</table>

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**BEAM POWER TUBE**

Duodecar type used as horizontal-deflection amplifier tube in television receivers. Outline 20, OUTLINES SECTION. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 5.3; amperes, 1.2.

**CLASS A Amplifier**

- **Plate Voltage**: 60 volts
- **Grid-No.2 (Screen-Grid) Voltage**: 150 volts
- **Grid-No.1 (Control-Grid) Voltage**: 0 volts
- **Triode Amplification Factor**: 1.4
- **Plate Resistance (Approx.)**: 18000 ohms
- **Transconductance**: 7300 μmhos
- **Plate Current**: 345 ma
- **Grid-No.2 Current**: 27 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

<table>
<thead>
<tr>
<th>Maximum Ratings</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Supply Voltage</td>
<td>770 ma volts</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage</td>
<td>6500 ma volts</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid-No.1 Voltage</td>
<td>-1500 ma volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>220 ma volts</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid-No.1 Voltage</td>
<td>-330 ma volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage</td>
<td>-55 ma volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>175 ma volts</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>17.5 ma watts</td>
</tr>
<tr>
<td>Peak Heaters-Cathode Voltage</td>
<td>3.5 ma watts</td>
</tr>
</tbody>
</table>

Heater negative with respect to cathode.

Heater positive with respect to cathode.

Bulb Temperature (At hottest point) 200 ma 120°C

**Maximum Circuit Values**

- Grid-No.1-Circuit Resistance: 1 ma megohm
- Grid-No.2-Circuit Resistance: 0.5 ma megohm
- Plate Resistance: 0.1 ma megohm

* The dc component must not exceed 100 volts.

---

**BEAM POWER TUBE**

Duodecar type used as horizontal-deflection amplifier in television receivers. Outline 12D, OUTLINES SECTION. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.2.

**CLASS A Amplifier**

- **Plate Voltage**: 60 volts
- **Grid-No.2 (Screen-Grid) Voltage**: 150 volts
- **Grid-No.1 (Control-Grid) Voltage**: 0 volts
- **Triode Amplification Factor**: 4.2
- **Plate Resistance (Approx.)**: 4700 μmhos
- **Transconductance**: 341* 1.6 ma
- **Plate Current**: 341 ma
- **Grid-No.2 Current**: 1.6 ma
- **Grid-No.1 Voltage (Approx.) for plate current of 1 ma**: -46 volts

* An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

* The dc component must not exceed 100 volts.
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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: 1500 max volts
DC Grid-No.2 Voltage: 220 max volts
Peak Negative-Pulse Grid-No.1 Voltage: 930 max volts
Negative DC Grid-No.1 Voltage: 55 max volts
Peak Cathode Current: 900 max ma
Averaging Cathode Current: 169 max ma
Plate Dissipation: 9 W watts
Grid-No.2 Input: 2.5 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 Values:

Grid-No.1-Circuit Resistance: 10 megohms
*Triode connection (grid-No.3 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.
+The duration of the voltage pulse must not exceed 15 percent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 percent of one horizontal scanning cycle is 10 microseconds.

DUAL TRIODE

Novar type containing high-mu and high-pervane, low-mu triode units used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers. Outline 10A, OUTLINES SECTION. Tube requires 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.

6GF7

Related types: 100GF7, 10GF7

Heater Voltage (ac/dc): 6.3 volts
Heater Current: 0.985 amperes

Direct Inter-electrode Capacitances (Approx.):

Grid to Plate: 9 pf
Grid to Plate and Grid-No.1: 4.6 pf
Plate to Grid-No.1 and Plate to Cathode and Plate to Grid-No.2: 2.4 pf
Plate to Cathode and Heater: 0.26 pf

CLASS A AMPLIFIER

Characteristics:

Grid: 250 volts
Amplification Factor: 64
Plate Resistance (Approx.): 4000 ohms
Transconductance: 1500 µmhos
Grid Voltage: 4.6 volts
For plate current of 10 µa: 5.5 volts
For plate current of 100 µa: 45 volts
Plate Current: 1.4 ma
For plate voltage of 60 volts and zero grid voltage: 95 ma
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):

DC Plate Voltage: 330 max volts
Peak Positive-Pulse Plate Voltage (Absolute Maximum): 1500 max volts
Peak Negative-Pulse Grid Voltage: -400 max volts
Peak Cathode Current: 77 max ma
Averaging Cathode Current: 22 max ma

Technical Data

Plate Dissipation: 1.5 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 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.

MEDIUM-MU TRIODE -

SHARP-CUTOFF PENTODE

6GH8

6GH8A

Miniature types used in multivibrator-type horizontal-deflection circuits in television receivers. Also used for age-amplifier or sync-separator applications in such receivers. Outline 8B, OUTLINES SECTION. Tubes require miniature nine-contact socket and may be mounted in any position. Type 6GH8-A is specially controlled to assure low inter-electrode leakage.

Heater Voltage (ac/dc): 6.3 volts
Heater Current: 0.45 amperes
Heater Warm-up Time (Average): 11 seconds

Direct Inter-electrode Capacitances:

Triode Unit:

6GH8 6GH8A

Grid to Plate: 1.5 pf 1.7 pf
Grid to Cathode, Heater, Pentode Grid No.3, Pentode Cathode, and Internal Shield: 3.4 pf 3 pf
Plate to Cathode, Heater, Pentode Grid No.4, Pentode Cathode, and Internal Shield: 1.7 pf 1.4 pf
Heater to Cathode: 3 pf 3 pf
Pentode Unit:

Grid No.1 to Plate: 0.02 max 0.02 max pf
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield: 5.5 pf 5 pf
Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield: 2.6 pf 2.6 pf
Heater to Cathode, Grid No.3, and Internal Shield: 3 pf 3 pf

AVERAGE PLATE CHARACTERISTICS

TRIODE UNIT

Type 6GH8

[Graph and data table]

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CLASS A Amplifier

### Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Plate Voltage</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Plate Resistance</td>
<td>5400</td>
<td>20000</td>
</tr>
<tr>
<td>Transconductance</td>
<td>2500</td>
<td>7500</td>
</tr>
<tr>
<td>Plate Current</td>
<td>13.5</td>
<td>12</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>-4</td>
<td>-4</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 10 μA</td>
<td>-8</td>
<td>-8</td>
</tr>
</tbody>
</table>

**HORIZONTAL-DEFLECTION OSCILLATOR**

For operation in a 325-line, 30-frame system

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max</td>
<td>350 max</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Peak Cathode Current</td>
<td>600 ma</td>
<td>600 ma</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>200 ma</td>
<td>200 ma</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>0.55 ma</td>
<td>0.55 ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.5 max</td>
<td>2.5 max</td>
</tr>
<tr>
<td>Peak Heater Cathode Voltage</td>
<td>200 max</td>
<td>200 max</td>
</tr>
</tbody>
</table>

Heater negative with respect to cathode:
- 200 volts for triode operation
- 200* max for pentode operation

*The dc component must not exceed 100 volts.

**HORIZONTAL-DEFLECTION AMPLIFIER**

For operation in a 325-line, 30-frame system

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max</td>
<td>350 max</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Peak Cathode Current</td>
<td>600 ma</td>
<td>600 ma</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>200 ma</td>
<td>200 ma</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>0.55 ma</td>
<td>0.55 ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.5 max</td>
<td>2.5 max</td>
</tr>
<tr>
<td>Peak Heater Cathode Voltage</td>
<td>200 max</td>
<td>200 max</td>
</tr>
</tbody>
</table>

Heater negative with respect to cathode:
- 200 volts for triode operation
- 200* max for pentode operation

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

Miniature type used as oscillator in horizontal-deflection circuits of television receivers. Outline 5B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. For curve of average characteristics see type 6GW6.

**beam power tube**

Novar type used in high-efficiency horizontal-deflection-amplifier circuits of television receivers. Outline 15A, OUTLINES SECTION. Tube requires Novar nine-contact socket and may be operated in any position. For curve of average characteristics see type 6GW6.

### Technical Data

<table>
<thead>
<tr>
<th></th>
<th>Triode Connection</th>
<th>Pentode Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Voltage (ac/dc)</td>
<td>6.3 volts</td>
<td></td>
</tr>
<tr>
<td>Heater Current</td>
<td>1.2 amperes</td>
<td></td>
</tr>
<tr>
<td>Direct Plate-Electrode Capacitances (Approx.)</td>
<td>0.26 pf</td>
<td></td>
</tr>
<tr>
<td>Grid-No.1 to Plate</td>
<td>1.2 pf</td>
<td></td>
</tr>
<tr>
<td>Grid-No.1 to Cathode, Heater, Grid-No.2, and Grid-No.3</td>
<td>15 pf</td>
<td></td>
</tr>
<tr>
<td>Grid to Cathode, Heater, Grid-No.2, and Grid-No.3</td>
<td>6.5 pf</td>
<td></td>
</tr>
</tbody>
</table>

**HORIZONTAL-DEFLECTION AMPLIFIER**

For operation in a 325-line, 30-frame system

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max</td>
<td>350 max</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Peak Cathode Current</td>
<td>600 ma</td>
<td>600 ma</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>200 ma</td>
<td>200 ma</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>0.55 ma</td>
<td>0.55 ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.5 max</td>
<td>2.5 max</td>
</tr>
<tr>
<td>Peak Heater Cathode Voltage</td>
<td>200 max</td>
<td>200 max</td>
</tr>
</tbody>
</table>

Heater negative with respect to cathode:
- 200 volts for triode operation
- 200* max for pentode operation

**BULB TEMPERATURE (At hottest point):**
- 240° Celsius

**Maximum Ratings, (Design-Maximum Values):**
- 1 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.

*The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 325-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.

*The dc component must not exceed 100 volts.

**HIGH-MU TRIODE**

Miniature type with frame grid used as a grounded-cathode rf-amplifier tube in vhf tuners of television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be operated in any position.
## RCA Receiving Tube Manual

### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Voltage (ac/dc)</td>
<td>6.3 volts</td>
</tr>
<tr>
<td>Heater Current</td>
<td>0.18 amperes</td>
</tr>
<tr>
<td>Direct Interelectrode Capacitances (Approx.)</td>
<td></td>
</tr>
<tr>
<td>Grid to Plate</td>
<td>0.92 pf</td>
</tr>
<tr>
<td>Grid to Cathode, Heater, and Internal Shield.</td>
<td>5 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, and Internal Shield.</td>
<td>3.5 pf</td>
</tr>
<tr>
<td>Heater to Cathode</td>
<td>2.5* pf</td>
</tr>
</tbody>
</table>

### Class A Amplifier

#### Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>200 ma</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>300 ma</td>
</tr>
<tr>
<td>Negative-bias value</td>
<td>-50 ma</td>
</tr>
<tr>
<td>Positive-bias value</td>
<td>0 ma</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>22 ma</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>100 ma</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>100 ma</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>100 ma</td>
</tr>
</tbody>
</table>

### Characteristics:

- Plate Voltage: 155 volts
- Grid Voltage: -1 volt
- Amplification Factor: 78
- Plate Resistance (Approx.): 5400 ohms
- Transconductance: 15000 µmhos
- Plate Current: 11.5 ma
- Grid Voltage (Approx.) for transconductance of 150 µmhos: -4.2 volts
- Grid Voltage (Approx.) for transconductance of 1500 µmhos: -2.5 volts
- Input Resistance*: 11.2 kΩ
- Noise Figure: 4.7 db

### Maximum Circuit Values:

- Grid-Circuit Resistance: 1 mamegohm
- For cathode-bias operation: 1 ma megohm

---

### Power Pentode

**6GK6**

Miniature type used in the output stage of audio amplifying equipment and also in the video output stage of television receivers. Outline 8E, OUT LINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position.

---

### Push-Pull Class AB and B Amplifier

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Voltage (ac/dc)</td>
<td>6.3 volts</td>
</tr>
<tr>
<td>Heater Current</td>
<td>0.18 amperes</td>
</tr>
<tr>
<td>Direct Interelectrode Capacitances:</td>
<td></td>
</tr>
<tr>
<td>Grid No. 1 to Plate</td>
<td>0.14 ma</td>
</tr>
<tr>
<td>Grid No. 1 to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield.</td>
<td>7 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield.</td>
<td>14 ma</td>
</tr>
</tbody>
</table>

---

### Average Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No. 1 Voltage</td>
<td>135 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>19 volts</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>28000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>11300 µmhos</td>
</tr>
<tr>
<td>Peak A.P. Grid-No. 1 Voltage</td>
<td>7.3 µmhos</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>48 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>50.6 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No. 2 Current</td>
<td>6.0 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No. 2 Current</td>
<td>10 ma</td>
</tr>
<tr>
<td>Effective Load Resistance (plate to plate)</td>
<td>5200 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>10%</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>5.7 watts</td>
</tr>
</tbody>
</table>

---

End of Document
Maximum Circuit Values:
Grid-No.1-Circuit Resistance:
For fixed-bias operation 0.3 max megohm
For cathode-bias operation 1 max megohm

DUAL TRIODE

6GL7

Glass type containing high-mu triode and high-permanence, low-mu triode in same envelope. Used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers. Outline 14B, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.05.

CLASS A, AMPLIFIER

Characteristics:

<table>
<thead>
<tr>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>50</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>6</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>3000</td>
</tr>
<tr>
<td>Transconductance</td>
<td>2290</td>
</tr>
<tr>
<td>Grid Voltage (Approx.): For plate current of 20 μA</td>
<td></td>
</tr>
<tr>
<td>For plate current of 200 μA</td>
<td></td>
</tr>
<tr>
<td>Plate Current</td>
<td>2</td>
</tr>
</tbody>
</table>

VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Unit No. 1</th>
<th>Unit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillator Amplifier</td>
<td></td>
</tr>
<tr>
<td>DC PLATE VOLTAGE</td>
<td>350</td>
</tr>
<tr>
<td>PEAK POSITIVE-PULSE PLATE VOLTAGE</td>
<td>1500</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE GRID VOLTAGE</td>
<td>0</td>
</tr>
<tr>
<td>PEAK CATHODE CURRENT</td>
<td>125</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>1</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>36</td>
</tr>
</tbody>
</table>
| PEAK HEATER-CATHODE VOLTAGE:
  Heater negative with respect to cathode | 200 | 200 |
  Heater positive with respect to cathode | 200* | 200* |

Maximum Circuit Values:
Grid-Circuit Resistance:
For fixed-bias operation 1 max megohm
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 52-line, 30-frame system, 16 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.
- The dc component must not exceed 100 volts.

SEMIREMOTE-CUTOFF PENTODE

6GM6

6GN8

Related type: 6GN6

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 7B, OUTLINES SECTION. Tube requires seven-contact socket and may be mounted in any position.

HEATER VOLTAGE (ac/dc) 6.3 volts
HEATER CURRENT 0.4 ampere

DIRECT INTERELECTRODE CAPACITANCES:

- Grid No.1 to Plate:
  Grid No.1 to Cathode 0.056 max
  Grid No.1 to Heater 0.026 max
  Grid No.1 to Grid No.3 0.0 max
  Grid No.1 to Internal Shield 0.0 max
- Plate to Plate:
  Plate to Cathode 16 max
  Plate to Heater 10 max
  Plate to Grid No.2 0.0 max
  Plate to Grid No.3 0.0 max
  Plate to Grid No.4 0.0 max
- Internal Shield:
  Internal Shield to Grid No.1 2.4 max
  Internal Shield to Grid No.2 3.4 max
  Internal Shield to Grid No.3 0.0 max
  Internal Shield to Grid No.4 0.0 max

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

6GN8

Related types: 6GN8, 16GN8

Miniature type used in color and black-and-white television receivers. Triode unit is used as sync-separator, sync-clipper, phase inverter, or sound-if amplifier. Pentode unit is used in output stage of video amplifier. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. For direct inter-elecrode capacitances, refer to type 6EB8; curve for average plate characteristics of triode unit is same as for type 6EB8. Heater volts (ac/dc), 6.3; amperes, 0.75.

CLASS A, AMPLIFIER

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid-No.2 Supply Voltage</th>
<th>Grid-No.1 Voltage (Approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>200*</td>
<td></td>
</tr>
</tbody>
</table>

Plate Supply Voltage
Grid No.3 Connected to cathode at socket
Grid No.2 Supply Voltage 125 volts
Cathode-Bias Resistor 36 ohms
Plate Resistance (Approx.) 0.2 megohm
Transconductance 12500 μmhos
Grid-No.1 Voltage (Approx.) for transconductance of 60 μmhos
Plate Current 14 ma
Grid-No.2 Current 3.4 ma

* With external shield connected to cathode.
* The dc component must not exceed 100 volts.

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

6GN8

Related types: 6GN8, 16GN8

Miniature type used in color and black-and-white television receivers. Triode unit is used as sync-separator, sync-clipper, phase inverter, or sound-if amplifier. Pentode unit is used in output stage of video amplifier. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. For direct inter-elecrode capacitances, refer to type 6EB8; curve for average plate characteristics of triode unit is same as for type 6EB8. Heater volts (ac/dc), 6.3; amperes, 0.75.
### RCA Receiving Tube Manual

#### Technical Data

**CLASS A; AMPLIFIER**

**Characteristics:**

<table>
<thead>
<tr>
<th>Triode Connection</th>
<th>Pentode Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>150</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>150</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>-22.5</td>
</tr>
<tr>
<td>Mu Factor, grid No.2 to grid No.1</td>
<td>4.4</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>-</td>
</tr>
<tr>
<td>Transconductance</td>
<td>-</td>
</tr>
<tr>
<td>Plate Current</td>
<td>30*</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>32*</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate ma = 1</td>
<td>-</td>
</tr>
</tbody>
</table>

**HORIZONTAL-DEFLECTION AMPLIFIER**

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

**Maximum Ratings, (Design-Maximum Values):**

- **DC Plate Supply Voltage**: 770 ma 120 volts
- **Peak Positive-Pulse Plate Voltage**: 6500 ma 120 volts
- **Peak Negative-Pulse Plate Voltage**: 1600 ma 120 volts
- **DC Grid-No.2 Voltage**: 220 ma 120 volts
- **DC Grid-No.1 Voltage**: 220 ma 120 volts
- **Peak Negative-Pulse Grid-No.1 Voltage**: -65 ma 120 volts
- **Peak Cathode Current**: 650 ma 120 volts
- **Average Cathode Current**: 175 ma 120 volts
- **Grid-No.2 Input**: 3.5 ma 120 volts
- **Plate Dissipation**: 20 ma 120 volts
- **Peak Heater-Cathode Voltage**: 220 ma 120 volts
- **Heater positive with respect to cathode**: 220 ma 120 volts
- **Bulb Temperature (At hottest point)**: 240 ma 120 °C

**Maximum Circuit Values:**

- **Grid-No.1 Circuit Resistance**: 1 ma 120 ohms
- **For grid resistor bias operation**: 1 ma 120 ohms

**MEDIUM-MU TWIN TRIODE**

- **6GU7**

**Outline 8D, 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 amperes

**Heater Warm-Up Time (Average)**: 11 seconds

**Direct Interelectrode Capacitances (Approx.)**

<table>
<thead>
<tr>
<th>Grid No.1 to Plate</th>
<th>Unit No.1</th>
<th>Unit No.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid to Plate</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Grid to Cathode</td>
<td>0.44</td>
<td>0.34</td>
</tr>
<tr>
<td>Plate to Cathode</td>
<td>0.44</td>
<td>0.34</td>
</tr>
<tr>
<td>Plate to Unit No.2</td>
<td>0.44</td>
<td>0.34</td>
</tr>
</tbody>
</table>

**CLASS A; AMPLIFIER (Each Unit)**

**Maximum Ratings, (Design-Maximum Values):**

- **Plate Voltage**: 330 ma 120 volts
- **Grid Voltage, Positive-bias value**: 100 ma 120 volts
- **Plate Dissipation**: 5 ma 120 volts
- **Peak Heater-Cathode Voltage**: 200 ma 120 volts

**Characteristics:**

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>150</th>
<th>250</th>
<th>volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid Voltage</td>
<td>-10.5</td>
<td>-10.5</td>
<td>volts</td>
</tr>
</tbody>
</table>

---

**Average Characteristics**

- **Plate Supply Voltage**: 250 ma volts
- **Grid-No.1 Supply Voltage**: 150 ma volts
- **Grid-No.1 Voltage**: 0 ma volts
- **Cathode-Bias Resistor**: 100 ohms
- **Amplification Factor**: 100
- **Plate Resistance (Approx.)**: 3700 ohms
- **Transconductance**: 13000 µmhos
- **Grid Voltage (Approx.) for plate current of 20 ma**: -5 ma volts
- **Grid-No.1 Voltage (Approx.) for plate current of 100 ma**: -5 ma volts
- **Plate Current**: 55 ma 25 ma
- **Grid-No.2 Current**: 18 ma 5.5 ma

**Maximum Circuit Values:**

- **Triode**
  - Grid-No.1-Circuit Resistance: 0.5 ma 0.25 ma megohm
  - For fixed-bias operation: 1 ma 1 ma megohm
  - For cathode-bias operation: (*)

  (* The dc component must not exceed 100 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.

---

**Beam Power Tube**

- **6GT5**

**Related Types:**

- 12GT5, 17GT5

---

**Average Characteristics**

- **Type 6G9B**: 50 ma 90 ma volts
- **Grid-No.2 Volts (Approx.)**: 18 ma 5.5 ma

---

**BEAM POWER TUBE**

Novar type used as a horizontal-deflection amplifier in television receivers. Outline 17A, OUTLINES SECTION. Tube requires novar nine-contact socket and may be mounted in any position. For curve of average characteristics, refer to type 6GW6.
RCA Receiving Tube Manual

Amplification Factor.......................................................... 17
Plate Resistance (Approx.).................................................. 5500 ohms
Transconductance............................................................ 3100 \(\mu\)hos
Grid Voltage (Approx.) for plate current of 50 \(\mu\)A.............. -23 volts
Plate Current............................................................... 11.5 \(\mu\)A
Plate Current for grid voltage of -14 volts.............................. 4 \(\mu\)A

Maximum Circuit Values:
Grid-Circuit Resistance:
For fixed-bias operation........................................... 1 \(\Omega\) max megohm

* The dc component must not exceed 100 volts.

AVERAGE PLATE CHARACTERISTICS

TYPE 6G5T

![Graph](image)

**BEAM POWER TUBE**

Duodec-type used as horizontal-deflection amplifier in television receivers. Outline 16C, OUTLINES SECTION. Tube requires duodec twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 1.2.

**CLASS A AMPIFIER**

Characteristics:
Plate Voltage......................................................... 5000 60 250 volts
Grid-\(\#2\) (Screen-Grid) Voltage............................ 150 150 150 volts
Grid-\(\#1\) (Control-Grid) Voltage.................................. -0 0 -22.6 volts
Plate Resistance (Approx.)................................. 18000 ohms
Transconductance................................................... 7500 \(\mu\)hos
Triode Amplification Factor........................................ 4.5
Plate Current......................................................... 345\% 65 \(\mu\)A
Grid-\(\#2\) Current..................................................... 27\% 1.8 \(\mu\)A
Grid-\(\#1\) Voltage (Approx.) for plate current of 1 \(\mu\)A...... -100 - -42 volts

HORIZONTAL-DEFLECTION AMPLIFIER

For operation in a 525-line, 50-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.............. -10000 max volts
DC Grid-\(\#2\) Voltage.................................................. 220 max volts

Technical Data

**Peak Negative-Pulse Grid-\(\#1\) Voltage**........................ -330 max volts
**DC Grid-\(\#1\) Voltage**........................................ -55 max volts
**Peak Cathode Current**....................................... 550 max ma
**Average Cathode Current**................................ 175 max ma
**Plate Dissipation**.............................................. 17.5 max watts
**Grid-\(\#2\) Input**................................................ 3.5 max watts
**Peak Heater-Cathode Voltage:**
Heater negative with respect to cathode..................... 200 max volts
Heater positive with respect to cathode...................... 200 max volts

Bulb Temperature (At hottest point).......................... 200 max \({^\circ}\)C

Maximum Circuit Values:
Grid-\(\#1\)-Circuit Resistance........................................ 1 \(\Omega\) max megohm

* Grid No. 5 tied to plate; plate and grid-\(\#2\) volts, 50; grid-\(\#1\) 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.

* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 50-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.

* The dc component must not exceed 100 volts.

**HIGH-MU TRIODE—POWER PENTODE**

6G58

Miniature type used for sync-amplifier and video-output applications in television receivers. Outline 8E, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.9.

CLASS A AMPIFIER

Maximum Ratings, (Absolute-Maximum Values):
Plate Supply Voltage............................................... 550 max volts
Peak Plate Voltage................................................ 2000 max volts
DC Plate Voltage.................................................. 250 max volts
Grid-\(\#2\) (Screen-Grid) Supply Voltage........................ 550 max volts
Grid-\(\#1\) Voltage..................................................... 250 max volts
Peak Cathode Current............................................. 200 max \(\mu\)A
Average Cathode Current...................................... 15 max 75 max ma
Grid-\(\#2\) Input......................................................... 2 max watts
Plate Dissipation................................................... 0.5 max 7 max volts
Peak Heater-Cathode Voltage:
Heater negative with respect to cathode..................... 220 max volts
Heater positive with respect to cathode...................... 220 max volts

Characteristics:
Plate Voltage........................................................................ 100 50 65 170 volts
Grid-\(\#2\) Voltage....................................................... 170 219 170 volts
Grid-\(\#1\) Voltage....................................................... -0.8 -1 -1.5 volts
Amplification Factor.................................................. 50 - - -
Mu-Factor, Grid-\(\#1\) to Grid-\(\#2\)................................. 50 - - -
Plate Resistance (Approx.)................................. 7600 ohms
Transconductance................................................... 6000 \(\mu\)hos
Plate Current......................................................... 5 \(\mu\)A 200 \(\mu\)A 40 \(\mu\)A
Grid-\(\#2\) Voltage..................................................... 40 \(\mu\)A 50 \(\mu\)A 70 \(\mu\)A

Maximum Circuit Values:
Grid-\(\#1\)-Circuit Resistance:
For fixed-bias operation........................................ 1 \(\Omega\) max 1 \(\Omega\) max megohm
For cathode-bias operation..................................... 3.3 \(\Omega\) max 2.2 \(\Omega\) max megohms

* Maximum pulse duration 5 per cent of a cycle with a maximum of 1 millisecond.

* Maximum pulse duration 50 microseconds. If a larger flyback is required, this value may be reduced to 40 microseconds.

* This value can be measured by a method involving a recurrent waveform such that the maximum tube ratings will not be exceeded.

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293
**BEAM POWER TUBE**

Glass octal type used as horizontal-deflection amplifier in high-efficiency deflection circuits of television receivers. Outline 21, OUTLINES SECTION. Tube requires octal socket and may be operated in any position.

**6GW6**

Related types: 12GW6, 17GW6

**HEATER VOLTAGE (AC/DC):**
- Plate Voltage: 6.3 volts
- Heater Voltage: 1.2 volts

**DIRECT INTERELECTRODE CAPACITANCE (Approx.)**
- Grid No. 1 to Plate: 0.5 pf
- Plate to Cathode, Heater, Grid No. 2, and Grid No. 3: 7 pf

**CLASS A AMPLIFIER**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>60</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>0</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>150</td>
</tr>
<tr>
<td>Transconductance</td>
<td>320*</td>
</tr>
<tr>
<td>Plate Current</td>
<td>52*</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage (Approx.) for plate current of 1 mA</td>
<td>42</td>
</tr>
</tbody>
</table>

**HORIZONTAL-DEFLECTION AMPLIFIER**

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

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Supply Voltage</td>
</tr>
<tr>
<td>AC Plate Supply Voltage</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage*</td>
</tr>
<tr>
<td>Peak Negative-Pulse Plate Voltage*</td>
</tr>
<tr>
<td>DC Grid-No. 1 (Control-Grid) Voltage</td>
</tr>
<tr>
<td>Peak Positive-Pulse Grid-No. 1 Voltage</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid-No. 1 Voltage</td>
</tr>
<tr>
<td>Average Cathode Current</td>
</tr>
<tr>
<td>Grid-No. 2 Input Current</td>
</tr>
<tr>
<td>Plate Dissipation*</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
</tr>
<tr>
<td>Buld Temperature (At hottest point)</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

- Grid-No. 1-Circuit Resistance: 1 max megohm

---

**SHARP-CUTOFF PENTODE**

Miniature type used for FM sound-detection service in a locked-oscillator, quadrature-grid FM detector circuits, as combined detector, limiter, and radio-voltage driver. Tube has two independent control grids, and has controlled heater warm-up time for use in circuits employing series-connected heater strings. Outline 78, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

**6G6X**

Related type: 6G6X

**HEATER VOLTAGE (AC/DC):**
- Plate Voltage: 6.3 volts
- Heater Voltage: 0.45 volts

**HEATER WARM-UP TIME (Average):**
- 11 seconds

**DIRECT INTERELECTRODE CAPACITANCE (Approx.):**
- Grid No. 1 to Plate: 0.025 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: 1.5 pf
- Grid No. 3 to Cathode, Heater, Grid No. 1, Grid No. 2, Plate, and Internal Shield: 6.5 pf

**CLASS A AMPLIFIER**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>150</td>
</tr>
<tr>
<td>Grid-No. 2 Supply Voltage</td>
<td>0</td>
</tr>
<tr>
<td>Grid-No. 1 Supply Voltage</td>
<td>100</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>0</td>
</tr>
<tr>
<td>Plate Dissipation (Approx.)</td>
<td>0.14</td>
</tr>
<tr>
<td>Transconductance, grid No. 1 to plate</td>
<td>3700</td>
</tr>
<tr>
<td>Transconductance, grid No. 3 to plate</td>
<td>3700</td>
</tr>
<tr>
<td>Plate Current</td>
<td>3.7 ma</td>
</tr>
<tr>
<td>Grid-No. 3 Current</td>
<td>3</td>
</tr>
<tr>
<td>Grid-No. 2 Supply Voltage (Approx.)</td>
<td>7</td>
</tr>
<tr>
<td>Grid-No. 1 Supply Voltage (Approx.)</td>
<td>4.5</td>
</tr>
</tbody>
</table>

**FM SOUND DETECTOR**

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No. 3 Supply Voltage</td>
<td>300 max</td>
</tr>
<tr>
<td>Grid-No. 3 Supply Voltage (Approx.)</td>
<td>-100 max</td>
</tr>
<tr>
<td>Positive value (dc and peak ac)</td>
<td>25 max</td>
</tr>
</tbody>
</table>

---

**ROUND-TO-ROUND MILLIAMPERES**

<table>
<thead>
<tr>
<th>PLATE MILLIAMPERES (I2)</th>
<th>GRID VOLS (V2)</th>
<th>GRID-NO. 3 VOLS (+50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>45</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>55</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>65</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>70</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>75</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>80</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>85</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

---

**AVERAGE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>PLATE VOLTS</th>
<th>PLATE MILLIAMPERES (I2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>150</td>
<td>0</td>
</tr>
<tr>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>250</td>
<td>0</td>
</tr>
<tr>
<td>300</td>
<td>0</td>
</tr>
<tr>
<td>350</td>
<td>0</td>
</tr>
<tr>
<td>400</td>
<td>0</td>
</tr>
<tr>
<td>450</td>
<td>0</td>
</tr>
<tr>
<td>500</td>
<td>0</td>
</tr>
<tr>
<td>550</td>
<td>0</td>
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<tr>
<td>600</td>
<td>0</td>
</tr>
<tr>
<td>650</td>
<td>0</td>
</tr>
<tr>
<td>700</td>
<td>0</td>
</tr>
<tr>
<td>750</td>
<td>0</td>
</tr>
<tr>
<td>800</td>
<td>0</td>
</tr>
<tr>
<td>850</td>
<td>0</td>
</tr>
<tr>
<td>900</td>
<td>0</td>
</tr>
</tbody>
</table>

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Technical Data

Grid-No.2 Current: 3 ma
Grid-No.3 Supply Voltage (Approx.) for plate current of 20 µa: 7 volts
Grid-No.1 Supply Voltage (Approx.) for plate current of 20 µa: -4.5 volts

GATED AGC AMPLIFIER AND NOISE INVERTER
For operation in a 555-line, 3-frame system

Maximum Ratings, (Design-Maximum Values):
Plate Voltage: 300 max volts
PEAK Power-Pulse Plate Voltage*: 600 max volts
Grid-No.3 (Control-grid) Voltage:
Negative-bias value: -100 max volts
Positive-bias value: 0 max volts
Grid-No.2 (Screen-grid) Supply Voltage: 300 max volts
See curve page 70
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.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 70

Peak Heater-Cathode Voltage:
Heater negative with respect to cathode: 200 max volts
Heater positive with respect to cathode: 200 max volts

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

AVERAGE CHARACTERISTICS

Grid-No.2 Supply Voltage: 300 max volts
Grid-No.1 Supply Voltage: 17 max watts
Grid-No.3 Input:
For grid-No.3 voltages up to 150 volts: 1.6 max volts
For grid-No.3 voltages between 150 and 300 volts: See curve page 70

Cut-Off Voltage:
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 70

Peak Heater-Cathode Voltage:
Heater negative with respect to cathode: 200 max volts
Heater positive with respect to cathode: 200 max volts

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

* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 555-line, 3-frame system, 16 per cent of one horizontal scanning cycle is 16 microseconds.
* The dc component must not exceed 100 volts.

6GY8

HIGH-MI TRIPLE TRIODE

Miniature type used in r-f amplifiers, mixers, and automatic-frequency-control service in FM radio receivers.
Outline BB, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be operated in any position. Heater volts (ac/dc), 6.3; amperes, 0.45.

Class A, Amplifier
Values are for each unit, except as noted

Maximum Ratings, (Design-Maximum Values):
Plate Voltage: 330 max volts
Grid Voltage, Positive-bias value: 6 max volts
Plate Dissipation: 6 max watts
Total Plate Dissipation (All plates): 6 max watts
Peak Heater-Cathode Voltage (Units No.1 and No.2):
Heater negative with respect to cathode: 100 max volts
Heater positive with respect to cathode: 100 max volts

Characteristics:
Plate Supply Voltage: 125 volts
Grid Voltage: -1 volts
Cathode-Bias Resistor: 220 ohms
Amplification Factor: 65
Plate Resistance (Approx.): 14000 ohms
Transconductance: 45000 µmhos
Plate Current: 4.5 mA
Grid Voltage (Approx.), for plate current of 20 µa: 3.6 volts

TWIN DIODE

Metal type 6H6 and glass octal type 6H6-GT used as detectors, low-voltage rectifiers, and avc tubes. Except for the common heater, the two diode units are independent of each other. For diode detector considerations, refer to ELECTRON TUBE APPLICA-
RCA Receiving Tube Manual

TIONS SECTION. Type 6H6-GT is a DISCONTINUED type listed for reference only. Heater volts (ac/dc), 6.3; amperes, 0.3.

Maximum Ratings:

**RECTIFIER OR DOUBLER**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Voltage (volts)</th>
<th>Current (ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Inverse Plate Voltage</td>
<td>420 max</td>
<td></td>
</tr>
<tr>
<td>Peak Plate Current (Per Plate)</td>
<td>48 max</td>
<td></td>
</tr>
<tr>
<td>DC Output Current (Per Plate)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Peak Heaters-Cathode Voltage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Heater negative with respect to cathode</td>
<td>330 max</td>
<td></td>
</tr>
<tr>
<td>- Heater positive with respect to cathode</td>
<td>330 max</td>
<td></td>
</tr>
</tbody>
</table>

Typical Operation As Half-Wave Rectifier:

- AC Plate Voltage (Per Plate, rms) = 117 volts
- DC Output Current (Per Plate) = 8 ma
- In half-wave service, the two units may be used separately or in parallel.

When a filter-input capacitor larger than 49 μ 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.

**INSTALLATION AND APPLICATION**

Types 6H6 and 6H6-GT require an octal socket and may be mounted in any position. Type 6H6-GT may be supplied with pin No.1 omitted. Type 6H6 maximum dimensions: over-all length, 1-3/4 inches; seated height, 1-3/16 inches; diameter, 1-5/16 inches. Type 6H6-GT, Outline 14C, 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 and 6H6-GT 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 and 6H6-GT are more adaptable because each diode has its own separate cathode.

**HIGH-MU TRIODE**

Miniature type used as r.f-amplifier tube in v.h.f. television tuners. Outline 7A, OUTLINES SECTION, except vertical dimensions are 1-1/16 shorter. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.18.

**CLASS A, AMPLIFIER**

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Voltage (volts)</th>
<th>Current (ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>220 max</td>
<td></td>
</tr>
<tr>
<td>DC Plate Supply Voltage</td>
<td>600 max</td>
<td></td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>50 max</td>
<td></td>
</tr>
<tr>
<td>Cathode Current</td>
<td>22 max</td>
<td></td>
</tr>
<tr>
<td>Plate Bias</td>
<td>2.6 max</td>
<td></td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Heater negative with respect to cathode</td>
<td>110 max</td>
<td></td>
</tr>
<tr>
<td>- Heater positive with respect to cathode</td>
<td>110 max</td>
<td></td>
</tr>
</tbody>
</table>

Characteristics and Typical Operation:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Fixed Bias</th>
<th>Cathode Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Supply Voltage</td>
<td>135</td>
<td>135</td>
</tr>
<tr>
<td>Plate-Load Resistor</td>
<td>-</td>
<td>1000</td>
</tr>
</tbody>
</table>

**POWERS PENTODE**

Miniature type used as vertical deflection-amplifier tube in television receivers. Outline 9E, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.76.

**6HB6**

Related type: 15HB6

Characteristics:

- Plate Supply Voltage: 60 250 250 volts
- Grid No.3 Connected to cathode at socket
- Grid-No.2 Supply Voltage: 250 120 250 volts
- Grid-No.1 Voltage: 0 0 0 volts
- Cathode-Bias Resistor: 33 100 ohms
- Mu-Factor, Grid No.2 to Grid No.1: 33
- Plate Resistance (Approx.): 2400 2400 ohms
- Plate Current: 150 40 40 ma
- Grid-No.2 Current: 4 5 6.2 ma
- Grid-No.1 Voltage (Approx.) for plate current of 100 ma: -6.6 -13 volts

**VERTICAL-DEFLECTION AMPLIFIER**

For operation in 525-line, 30-frame system

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Voltage (volts)</th>
<th>Current (ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>250 max</td>
<td></td>
</tr>
<tr>
<td>Peak Positive-Plate Voltage</td>
<td>2500 max</td>
<td></td>
</tr>
<tr>
<td>DC Grid-No.2 (Screen-Grid) Voltage</td>
<td>300 max</td>
<td></td>
</tr>
<tr>
<td>DC Grid-No.1 (Control-Grid) Voltage</td>
<td>-100 max</td>
<td></td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>2 max</td>
<td></td>
</tr>
<tr>
<td>Plate Bias</td>
<td>10 max</td>
<td></td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Heater negative with respect to cathode</td>
<td>200 max</td>
<td></td>
</tr>
<tr>
<td>- Heater positive with respect to cathode</td>
<td>200 max</td>
<td></td>
</tr>
</tbody>
</table>

Class A, Amplifier

**BEAM POWER TUBE**

Duodecar type used as vertical-deflection amplifier in television receivers. Outline 12D, OUTLINES SECTION. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.8.

**6HE5**

Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Voltage (volts)</th>
<th>Current (ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>60 250 250</td>
<td></td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Beam Power Tube**

**6HF5**

Duodecar type used as horizontal-deflection amplifier in color television receivers. Outline 16D, OUTLINES SECTION. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc) 6.3; amperes, 2.25.

**Characteristics**

<table>
<thead>
<tr>
<th>CLASS A AMPLIFIER</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>5000</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>125</td>
</tr>
<tr>
<td>Triode Amplification Factor</td>
<td>3</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>5600</td>
</tr>
<tr>
<td>Throat Diam. (Actual)</td>
<td>1.50</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>1200</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 1 ma</td>
<td>100</td>
</tr>
</tbody>
</table>

**Horizontal-Deflection Amplifier**

For operation in a 558-line, 30-frame system

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Supply Voltage</td>
<td>900</td>
<td>max</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage (Absolute Maximum)</td>
<td>7500</td>
<td>max</td>
</tr>
<tr>
<td>Peak Negative-Pulse Plate Voltage</td>
<td>1100</td>
<td>volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>190</td>
<td>volts</td>
</tr>
<tr>
<td>Peak Positive-Pulse Grid-No.1 Voltage</td>
<td>350</td>
<td>volts</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid-No.1 Voltage</td>
<td>110</td>
<td>volts</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>315</td>
<td>ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>55</td>
<td>watts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 1 ma</td>
<td>200</td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>45</td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>7</td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 100 ma</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

**Technical Data**

**High-Mu Triode—Sharp-Cutoff Pentode**

Miniature type used in color and black-and-white television receivers. The triode unit is used in high-gain, sound-iff stages and in sync-separator, sync-clipping, and phase-inverter circuits; pentode unit is used as video-output amplifier. Outline 6D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. For curves of average characteristics, refer to type 6AW8-A for the triode unit and to type 6EB8 for the pentode unit.

**Class A Amplifier**

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Supply Voltage</td>
<td>330</td>
<td>max</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>125</td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>0.1</td>
<td>max</td>
</tr>
<tr>
<td>Cathode Bias Resistor</td>
<td>10</td>
<td>ohms</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>1750</td>
<td>ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>4000</td>
<td>ohms</td>
</tr>
<tr>
<td>Plate Current</td>
<td>4</td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 100 ma</td>
<td>40</td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 20 ma</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**Medium-Mu Triode—Sharp-Cutoff Pentode**

Miniature type used in color and black-and-white television receivers. Outline 6B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be operated in any position. For curves of average characteristics, refer to type 6L6-A for the triode unit and to type 6B6-A for the pentode unit.
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nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.34.

CLASS A: AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>125 max</td>
<td>250 max volts</td>
</tr>
<tr>
<td>GRID-No.2 (SCREEN-GRID) VOLTAGE</td>
<td>15 max</td>
<td>150 max volts</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>1 5 max</td>
<td>5 ma</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>0.5 max</td>
<td>0.5 ma watts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>100 max</td>
<td>100 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>100 max</td>
<td>100 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>100 max</td>
<td>100 max volts</td>
</tr>
</tbody>
</table>

Characteristics:

- Plate Voltage: 100 170 volts
- Grid-No.2 Voltage: 0 150 volts
- Grid-No.1 (Control-Grid) Voltage: 0 12 volts
- Amplification Factor: 17 70
- Mu-Factor, Grid-No.2 to Grid-No.1: 70 70
- Plate Resistance (Approx.): 5600 12000 megohms
- Transconductance: 14 10 ma
- Plate Current: 14 10 ma
- Grid-No.2 Current: 3.3 ma

Maximum Circuit Values:

- Grid-No.1-Circuit Resistance: 0.55 megohms
- For fixed-bias operation: 0.5 max 0.5 max megohms
- For cathode-bias operation: 0.5 max 0.5 max megohms

DIODE—SHARP-CUTOFF PENTODE

6HJ8

Miniature type used as combined video-detector and if-amplifier tube in television receivers employing series-connected heater strings. Outline 6A, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.45; warm-up time (average), 11 seconds.

PENTODE UNIT AS CLASS A: AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>330 max</td>
<td>330 max volts</td>
</tr>
<tr>
<td>GRID-No.2 (SCREEN-GRID) SUPPLY VOLTAGE</td>
<td>-</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>GRID-No.2 VOLTAGE</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GRID-No.1 (CONTROL-GRID) VOLTAGE, Positive bias voltage</td>
<td>0 max</td>
<td>0 max volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>2.5 max</td>
<td>2.5 ma watts</td>
</tr>
<tr>
<td>GRID-No.2 INPUT: For grid-No.2 voltages up to 165 volts</td>
<td>0.55 max watt</td>
<td>-</td>
</tr>
<tr>
<td>For grid-No.2 voltages between 165 and 330 volts</td>
<td>See curve page 70</td>
<td>-</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>3.2 max watts</td>
<td>-</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE: For grid-No.2 voltages up to 165 volts</td>
<td>200 max watts</td>
<td>-</td>
</tr>
<tr>
<td>For grid-No.2 voltages between 165 and 330 volts</td>
<td>200 max volts</td>
<td>-</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>125 volts</td>
<td>125 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>125 volts</td>
<td>-</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>56</td>
<td>1</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>6.8 megohms</td>
<td>-</td>
</tr>
<tr>
<td>Transconductance</td>
<td>11.5 ma</td>
<td>-</td>
</tr>
<tr>
<td>Plate Current</td>
<td>11.5 ma</td>
<td>-</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>3.6 ma</td>
<td>-</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 20 ma</td>
<td>-6 volts</td>
<td>-</td>
</tr>
<tr>
<td>No cathode-bias resistor.</td>
<td>-8 volts</td>
<td>-</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

- Grid-No.1-Circuit Resistance: 1 max - megohms
- Plate Resistance: 5000 5000 ohms
- Transconductance: 7000 70000 µmhos
- Plate Current: 12 ma
- Grid-No.2 Current: 4.5 ma

Characteristics:

- PLATE VOLTAGE | 330 max | 330 max volts |
- GRID-No.2 VOLTAGE | - | See curve page 70 |
- GRID-No.1 VOLTAGE (Approx.) for plate current of 20 ma | -8 volts | - |

SEMIREMOTE-CUTOFF PENTODE

6HR6

Related type: 1988

HEATER VOLTAGE (AC/DC) | 6.3 volts |
HEATER CURRENT | 0.45 amperes |
RCA Receiving Tube Manual

Heater Warm-up Time (Average)........................................ 11 seconds

Direct Inter-electrode 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

Class A. Amplifier

Maximum Ratings, (Design-Maximum Values):
- Plate Supply Voltage: 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 70
- Grid-No.1 (Control-Grid) Voltage: Negative-bias value: 50 max volts
- Positive-bias value: 0 max volts
- Plate Dissipation: 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 70

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 200 volts
- Heater positive with respect to cathode: 150 volts

AveraGe CHARACTERISTICS

<table>
<thead>
<tr>
<th>Plate Volts</th>
<th>Vcur</th>
<th>Wmin</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0.5</td>
<td>0.01</td>
</tr>
<tr>
<td>150</td>
<td>0.8</td>
<td>0.05</td>
</tr>
<tr>
<td>200</td>
<td>1.0</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Characteristics:
- Plate Supply Voltage: 200 volts
- Grid No.3: Connected to cathode at socket
- Grid-No.2 Supply Voltage: 115 volts
- Grid-No.1 Supply Voltage: 0 volts
- Cathode-Bias Resistor: 68 ohms
- Plate Resistance (Approx.): 0.9 megohm
- Transconductance: 8500 μmhos
- Grid-No.1 Voltage (Approx.) for transconductance of 60 ohms: -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
- Grid-No.2 Circuit Resistance:
  - For fixed-bias operation: 0.05 max megohm
  - For cathode-bias operation: 1 max megohm

Technical Data

Sharp-Cutoff Pentode

Miniature type used as if-amplifier and limiter tube in FM receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

- HeaTer VoltAge (AC DC): 8.3 volts
- HeaTer Current: 0.45 ampere
- HeaTer Warm-up Time (Average): 11 seconds

Direct Inter-electrode 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

Class A. Amplifier

Maximum Ratings, (Design-Maximum Values):
- Plate Supply Voltage: 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 70
- Grid-No.1 (Control-Grid) Voltage: Negative-bias value: -50 max volts
- Positive-bias value: 0 max volts
- Plate Dissipation: 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 70

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200 max volts

Characteristics:
- Plate Supply Voltage: 75 volts
- Grid No.3: Connected to cathode at socket
- Grid-No.2 Supply Voltage: 75 volts
- Grid-No.1 Supply Voltage: 0 volts
- Cathode-Bias Resistor: 68 ohms
- Amplification Factor (Approx.): 50
- Plate Resistance (Approx.): 0.9 megohm
- Transconductance: 8500 μmhos
- Plate Current: 8.8 ma
- Grid-No.2 Current: 2.8 ma
- Grid-No.1 Voltage (Approx.) for plate current of 20 ma: -4 volts
**RCA Receiving Tube Manual**

**SHARP-CUTOFF TWIN PENTODE**

Miniature type used in age 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 age amplifier. **Outline 8D, OUTLINES SECTION.** Tube requires miniature nine-contact socket and may be operated in any position.

**Heater Voltages (AC/DC)**
- 6.8 volts

**Heater Current:**
- 0.3 amperes

**Direct Inter-electrode Capacitances:**
- Grid No.3 to Plate (Each Unit): 2 pf
- Grid No.1 to All Other Electrodes: 6 pf
- Grid No.3 (Each Unit) to All Other Electrodes: 3.8 pf
- Plate (Each Unit) to All Other Electrodes: 3 pf
- Grid No.3 (Unit No.1) to Grid No.3 (Unit No.2): 0.015 maz pf

**Technical Data**

**Grid No.2 Voltage**
- 57.5 volts

**Grid No.1 Voltage**
- 57.5 volts

**Transconductance, Grid No.3 to Plate:**
- 450 mhos

**Transconductance, Grid No.1 to Plate:**
- 1100 mhos

**Plate Current:**
- 2 ma

**Grid No.3 Voltage (Approx.) for plate current of 100 μA:**
- 3.5 volts

**Grid No.1 Voltage (Approx.) for plate current of 100 μA:**
- 2.3 volts

**Cathode Current:**
- 7.1 ma

**Maximum Circuit Values:**
- Grid No.3-Circuit Resistance (Each Unit): 0.05 maz megohm

* The dc component must not exceed 100 volts.

* With plate and grid No.3 of other unit connected to ground.

**AVERAGE CHARACTERISTICS**

**Grid No.3 Voltage**
- 0 volts

**Grid No.3 Voltage**
- 0 volts

**SHARP-CUTOFF PENTODE**

Miniature type used as sound-detector tube in FM and television receivers employing series-connected heater strings. Tube has two independent control grids. **Outline 7B, OUTLINES SECTION.** Tube requires miniature seven-contact socket and may be mounted in any position.

**Heater Voltage (AC/DC)**
- 6.3 volts

**Heater Current**
- 0.46 amperes

**Heater Warm-up Time (Approx.)**
- 11 seconds

**Direct Inter-electrode Capacitances (Approx.)**
- Grid No.1 to Plate: 0.022 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 pf

**AVERAGE CHARACTERISTICS**

**SHARP-CUTOFF PENTODE**

- 6HZ8

**Class A, Amplifier**

**Maximum Ratings, (Design-Maximum Values):**

**Plate Voltage (Each Unit):**
- 300 maz volts

**Grid-No.3 (Sweeping-grids) Voltage (Each Unit):**
- Peak positive value: 10 maz volts
- DC negative value: 10 maz volts
- DC positive value: 3 maz volts

**Grid-No.2 (Screen-grid) Voltage:**
- 120 maz volts

**Grid-No.1 (Control-grid) Voltage, Negative-Value:**
- 40 maz volts

**Cathode Current:**
- 12 maz ma

**Plate Dissipation (Each Unit):**
- 1.1 maz watts

**Grid-No.2 Input:**
- 0.75 maz watt

**Peak Heater-Cathode Voltage:**
- Heater negative with respect to cathode: 200 maz volts
- Heater positive with respect to cathode: 200 maz volts

**Characteristics:**
- With One Unit Operating

**Plate Voltage:**
- 100 volts

**Grid-No.3 Voltage:**
- 0 volts

**AVERAGE CHARACTERISTICS**

**SHARP-CUTOFF PENTODE**

- 6HZ6
### RCA Receiving Tube Manual

**CLASS A. AMPLIFIER**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>150 volts</td>
</tr>
<tr>
<td>Grid-No.3 Supply Voltage</td>
<td>0 volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>100 volts</td>
</tr>
<tr>
<td>Grid-No.1 Supply Voltage</td>
<td>0 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>180 ohms</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>0.11 mhos</td>
</tr>
<tr>
<td>Transconductance, Grid No.1 to Plate</td>
<td>3400 mhos</td>
</tr>
<tr>
<td>Transconductance, Grid No.3 to Plate</td>
<td>600 mhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>3.2 ma</td>
</tr>
<tr>
<td>Grid-No.3 Current</td>
<td>3.2 ma</td>
</tr>
<tr>
<td>Grid-No.3 Supply Voltage (Approx.) for plate current of 20 µa</td>
<td>-7 volts</td>
</tr>
<tr>
<td>Grid-No.1 Supply Voltage (Approx.) for plate current of 20 µa</td>
<td>-4.5 volts</td>
</tr>
</tbody>
</table>

**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 70
  - Grid-No.1 (Control-Grid) Voltage:
    - Negative-bias value: -50 max volts
    - Positive-bias value: 0 max volts
  - Plate Disipation: 1.7 max watts
  - Grid-No.2 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 curve page 70

**Peak Heater-Cathode Voltage:**
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200 max volts

- **Maximum Circuit Values:**
  - Grid-No.2-Circuit Resistance: 0.68 max mohms
  - Grid-No.1-Circuit Resistance:
    - For fixed-bias operation: 0.22 max mohms
    - For cathode-bias operation: 0.47 max mohms

*The dc component must not exceed 100 volts.*

### Technical Data

**AVERAGE CHARACTERISTICS**

**MEDIUM-MU TRIODE**

Metal type 6J5 and glass octal type 6J5-GT used as detectors, amplifiers, or oscillators in radio equipment. These types feature high transconductance together with comparatively high amplification factor. Outlines 2 and 14C, respectively, OUTLINES SECTION.

- **6J5 GT**
  - Related type: 12J5 GT
  - Tubes require octal socket and may be mounted in any position. For typical operation as resistance-coupled amplifiers, refer to RESISTANCE-COUPLED AMPLIFIER SECTION. Type 6J5-GT is used principally for renewal purposes.

**Heater Voltage (ac/dc):** 6.3 volts
**Heater Current:** 6.3 ampere
**Direct Interelectrode Capacitances (Approx.):**
- Grid to Plate: 38 pf
- Grid to Cathode and Heater: 3.4 pf
- Plate to Cathode and Heater: 3.6 pf

* Shell connected to cathode.
** Base shield and external shield connected to cathode.*
MEDIUM-MU TWIN TRIODE

Miniature types 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, can also be used as a mixer at frequencies as high as 600 megacycles per second. Outline 7B, OUTLINES SECTION, requires at least seven-contact socket and may be mounted in any position. Type 6J6 is a DISCONTINUED type listed for reference only.

HEATER VOLTAGE (AC/DC) 6.3 volts
HEATER CURRENT 0.45 ampere
HEATER WARM-UP TIME (AVERAGE) for 6J6-A 14 seconds

DIRECT INTERELECTRODE CAPACITANCES (Each Unit, Approx.)
- Grid to Plate: 1.6 pF
- Grid to Cathode and Heater: 2.7 pF
- Plate to Cathode and Heater (Unit No.1): 0.4 pF
- Plate to Cathode and Heater (Unit No.2): 0.4 pF

CLASS A, AMPLIFIER (Each Unit):

Maximum Ratings, (Design-Center Values):
PLATE VOLTAGE 300 volts
GRID VOLTAGE, Positive-bias value 10 volts
GRID VOLTAGE, Negative-bias value -10 volts
PLATE DISSIPATION 1.5 watts
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode, 100 volts
Heater positive with respect to cathode, 100 volts

Characteristics:
Plate Voltage 100 volts
Cathode-Bias Resistor 501 ohms
Amplification Factor 28.0
Plate Resistance (Approx.) 2100 ohms
Transconductance 6300 microhos
Plate Current 8.5 ma

Maximum Circuit Values:
Grid-Circuit Resistance 1.0 max megohm

RF POWER AMPLIFIER AND OSCILLATOR—Class C, Telegraphy

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values, Each Unit):</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE 200 volts</td>
</tr>
<tr>
<td>GRID VOLTAGE</td>
</tr>
<tr>
<td>Negative-bias value -40 volts</td>
</tr>
<tr>
<td>Positive-bias value 0 volts</td>
</tr>
</tbody>
</table>

SHARP-CUTOFF PENTODE

Metal type 6J7 and glass octal types 6J7-G and 6J7-GT are used as biased detectors or high-gain audio amplifiers in radio receivers. Outlines 3, 23, and 15A, respectively, OUTLINES SECTION. Type 6J7-G is a DISCONTINUED type listed for reference only. All types require octal socket and may be mounted in any position. Heater watts (ac/dc) 6.3 volts, 8.0, 0.3.

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Center Values):
PLATE VOLTAGE 500 volts
GRID NO.2 (SCREEN-GRID) VOLTAGE See curve page 70
GRID NO.3 VOLTAGE 300 volts
PLATE DISSIPATION 0.79 watts
GRID NO.2 CURRENT For grid-no.2 voltages to 100 volts 0.10 max watts
For grid-no.2 voltages between 150 and 300 volts 0.15 max volts
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode 90 volts
Heater positive with respect to cathode 90 volts

Characteristics:
Plate Voltage 100 volts
Grid No.3 Connected to cathode at socket
Grid No.2 Voltage 100 volts
Grid No.1 Voltage Connected to cathode at socket
Plate Resistance (Approx.) 500 ohms
Transconductance 1185 microhos
Grid No.2 Voltage (Approx.) for plate current of 10 ma 7 volts
Plate Current 2 ma
Grid No.2 Current 0.5 ma

Maximum Circuit Values:
Grid-No.1 Circuit Resistance 1.0 max megohm

CLASS A, AMPLIFIER (Triode Connection)

Maximum Ratings, (Design-Center Values): 
PLATE VOLTAGE 250 volts
GRID NO.1 VOLTAGE, Positive-bias value 0 max volts
GRID NO.2 VOLTAGE 150 volts
PLATE DISSIPATION 0.15 watts
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode 90 volts
Heater positive with respect to cathode 90 volts

Characteristics:
Plate Voltage 180 volts
Grid No.1 Voltage 63 volts
Amplification Factor 20
Plate Resistance (Approx.) 11000 ohms
Transconductance 5.3 microhos

Maximum Circuit Values:
Grid-No.1 Circuit Resistance 1.0 max megohm

* Greater than 1.0 megohm.
* Grids No.2 and No.3 connected to plate.

*
**TRIODE—HEPTODE CONVERTER**

Glass octal type used as a combined triode oscillator and heptode mixer in radio receivers. Outline 23, OUTLINES SECTION: Tube requires octal socket. Heater volts (ac/dc, 6.3), amperes. 9.3. Typical operation—Heptode unit: plate volts, 250 (200 ma); grid-No.4 and No.4, volts, 100 ma; grid-No.1, volts, 250 ma; plate resistance, 1.5 megohms; conversion transconductance, 290 microamperes; plate ma., 1.4; grid-No.2 and No.4 ma., 2.8. Triode unit: plate volts, 250 ma; applied through 2000-ohm dropping resistor; grid resistor, 20000 ohms; plate ma., 0.0. This is a DISCONTINUED type listed for reference only.

**BEAM POWER TUBE**

Novar type used as high-efficiency horizontal-deflection-amplifier tube in television receivers. Outline 34A, OUTLINES SECTION. Tube requires tube in triode unit: plate volts, 250 ma; plate current, 1.4; grid-No.2 and No.4 ma., 2.8. Triode unit: plate volts, 250 ma; plate current, 1.4. Plate voltage, 250 ma; plate resistance, 1.5 megohms; conversion transconductance, 290 microamperes; plate ma., 1.4; grid-No.2 and No.4 ma., 2.8. This is a DISCONTINUED type listed for reference only.

**CLASS A AMPLIFIER**

**SHARP-CUTOFF PENTODE**

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 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

**Technical Data**

**PEAK POSITIVE-PULSE PLATE VOLTAGES**

- 6500 max volts
- 1500 max volts

**DC GRID-No.3 VOLTAGE**

- 70 volts
- 120 volts

**PEAK POSITIVE-PULSE GRID-No.1 VOLTAGE**

- 850 volts
- 550 volts

**CATHODE CURRENT**

- 175 ma
- 500 ma

**PLATE DISSIPATION**

- 15.7 watts
- 5.5 watts

**GRID-No.2 VOLTAGE**

- Heater negative with respect to cathode...
- Heater positive with respect to cathode...

**BULB TEMPERATURE (At hottest point)**

- 240°C

**Maximum Circuit Values:**

- Grid-No.1-Circuit Resistance: For grid-resistor-bias operation...
- 1 ma. microamm.

- 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 maximum 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.

- For horizontal-deflection service, a positive voltage may be applied to grid No.3 to minimize "noise" interference in both vhf and uhf television receivers. A typical value for this purpose is 50 volts.

- An adequate bias resistor or other means is required to protect the tube in the absence of excitation.

- The dc component must not exceed 100 volts.

**SHARP-CUTOFF PENTODE**

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 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.
MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

6JC8

Miniature type used as combined vhf oscillator and mixer tube in television receivers employing series-connected heaterstrings. Outline 6B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.45; warm-up time (average), 11 seconds.

CLASS A: AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>275 max</td>
<td>275 max</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>275 max</td>
<td>275 max</td>
</tr>
<tr>
<td>Grid-No.3 Voltage</td>
<td>0 max</td>
<td>0 max</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>1.7 max</td>
<td>2.8 max</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>–</td>
<td>0.45 max</td>
</tr>
<tr>
<td>For grid-No.2 voltages up to 165 volts</td>
<td>–</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>For grid-No.2 voltages between 187.5 and 275 volts</td>
<td>–</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>200 max</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200° max</td>
<td>200° max</td>
</tr>
</tbody>
</table>

Characteristics:

- Plate Voltage: 125 volts
- Grid-No.3 Voltage: – 70 – 125 volts
- Grid-No.1 Voltage: – 1 – 0 – 1 volt
- Plate Resistance (Approx.): 6000 ohms
- Transconductance: 6000 µmhos
- Plate Current: 12 ma
- Grid-No.2 Current: – 9 ma
- Grid-No.1 Voltage (Approx.) for plate current of 20 µa: – 2.2 ma

Maximum Circuit Values:

- Grid-No.1-Circuit Resistance: 0.25 max megohm
- Grid-No.3-Circuit Resistance: 1 max megohm

* The dc component must not exceed 100 volts.

SHARP-CUTOFF PENTODE

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 mounted in any position.

Heater Voltage (ac/dc): 6.3 volts
Heater Current: 0.3 ampere

Direct Inter-electrode Capacitance:
- Grid No.1 to Plate: 0.019 max pf
- Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Shield: 8.2 pf
- Plate to Cathode, Heater, Grid No.2, Grid No.3, and Shield: 3 pf

CLASS A: AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>330 max</td>
</tr>
<tr>
<td>Grid-No.3 Supply Voltage</td>
<td>125 volts</td>
</tr>
<tr>
<td>Grid-No.1 Supply Voltage</td>
<td>125 volts</td>
</tr>
<tr>
<td>Grid-No.1 Control-Grid Voltage</td>
<td>125 volts</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>16000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>14000 µmhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>10 ma</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>4 ma</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for transconductance of 600 µmhos</td>
<td>4.5 volts</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

- Grid-No.1-Circuit Resistance: 0.25 max megohm
- Grid-No.3-Circuit Resistance: 1 max megohm

* The dc component must not exceed 100 volts.
BEAM POWER TUBE

Novar type used as horizontal-deflection-amplifier tube in color television receivers. Outline 18B, OUTLINES SECTION. Tube requires novar nine-contact socket and may be mounted in any position.

HEATER VOLTAGE (AC/DC) .......... 6.3 volts
HEATER CURRENT ................. 2.5 amperes
DIRECT INTERELECTRODE CAPACITANCES (Approx.)
Grid No.1 to Plate .................. 6.44 pf
Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3 21 pf
Plate to Cathode, Heater, Grid No.2, and Grid No.3 11 pf

CLASS A AMPLIFIER

Characteristics:
Plate Voltage .......... 125 70 175 volts
Grid-No.3 (Suppressor Grid) Connected to cathode at socket
Grid-No.2 (Screen-Grid) Voltage .......... 125 125 volts
Grid-No.1 (Control-Grid) Voltage .......... 25 0 – 25 volts
Amplification Factor ................. 1.2
Plate Resistance (Approx.) .......... 5500 ohms
Transconductance .......... 10000 amhos
Plate Current ................. 800 115 ma
Grid-No.2 Current .......... 40 5 ma
Grid-No.1 Voltage (Approx, for plate current of 1 ma) ........ 157 volts

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 .......... 7000 max volts
PEAK NEGATIVE-PULSE PLATE VOLTAGE .......... 1100 max volts
DC GRID-NO.3 VOLTAGE .......... 75 volts
DC GRID-NO.2 VOLTAGE .......... 190 volts
PEAK NEGATIVE-PULSE GRID-NO.1 VOLTAGE .......... 250 max volts
PEAK CATHODE CURRENT .......... 1100 max ma
AVERAGE CATHODE CURRENT .......... 315 max ma
GRID-NO.2 INPUT ................. 3.2 max volts
PLATE DISCHARGES .......... 24 max watts
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode .......... 200 max volts
Heater positive with respect to cathode .......... 200 max volts
BULB TEMPERATURE (At hottest point) .......... 240 max °C

AVERAGE CHARACTERISTICS

Maximum Circuit Voltages:
Grid-No.1-Circuit Resistance .......... 0.47 max megohms
For grid-resistor-bias operation ° .......... 0.10 max megohms
For plate-pulsed operation (horizontal-deflection circuits only) ........ 10 max megohms

1 This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.
2 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.
3 In this service, a positive voltage may be applied to grid No.3 to minimise "mirrors" interference; a typical value for this voltage is 30 volts.
4 An adequate bias resistor or other means is required to protect the tube in the absence of excitation.
5 The dc component must not exceed 100 volts.

SEMIREMOTE-CUTOFF PENTODE

Miniature type used in the gain-controlled picture tube-amplifier stages of television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. For curves of average plate characteristics, refer to type 6BZ6.

HEATER VOLTAGE (AC/DC) .......... 6.3 volts
HEATER CURRENT ................. 0.3 amperes

DIRECT INTERELECTRODE CAPACITANCES:
Grid No.1 to Plate ................. 0.025 max volts
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield ........ 7 7 pf
Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield ........ 2 3 pf

CLASS A AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE .......... 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 .......... 0 volts
GRID-No.1 (CONTROL-GRID) VOLTAGE, Positive-bias value .......... See curve page 70
GRID-No.2 INPUT ................. See curve page 70

For grid-No.2 voltages up to 150 volts .......... 0.55 max watts
For grid-No.2 voltages between 150 and 300 volts .......... See curve page 70
**RCA Receiving Tube Manual**

**PEAK HEATER-CATHODE VOLTAGE:**
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200 max volts

**Characteristics:**
- Plate Supply Voltage: 125 volts
- Grid-No. 2 Supply Voltage: 125 volts
- Cathode-Bias Resistor: 56 ohms
- Transconductance: 8000 µmhos
- Transconductance Range for Grid-No. 1 voltage of 4.5 volts: 4000-9000 µmhos
- Grid-No. 1 Voltage (Approx.) for transconductance of 60 µmhos and no cathode-bias resistor: -15 volts
- Plate Current: 14 ma
- Grid-No. 2 Current: 3.6 ma

**Maximum Circuit Values:**
- Grid-No. 1 Circuit Resistance: 0.25 max µmegohm
- For fixed-bias operation: 0.25 max µmegohm
- For cathode-bias operation: 1 max µmegohm

*With external shield connected to cathode.*

*The dc component must not exceed 100 volts.*

---

**BEAM-DEFLECTION TUBE**

**6JH8**

Miniature type used in color-deflecting and burst-gate circuits in color television receivers. This type has two plates and two deflecting electrodes; the control grid varies beam deflection. Outline 88D, OUTLINES SECTION. 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**

**Maximum Ratings, (Design Maximum Values):**
- Plate Voltage (Each Plate): 330 max volts
- Peak Deflecting-Electrode Voltage (Each Electrode): Negative value: -150 volts, Positive value: 150 volts
- Grid-No. 1 (Control-Grid) Voltage: 380 max volts
- Cathode Current: 33 max ma
- Plate Dissipation (Each Plate): 3 max watts
- Grid-No. 1 Current: 1 max ma

**Maximum Circuit Values:**
- Grid-No. 1 Circuit Resistance: 0.1 max µmegohm
- For fixed-bias operation: 0.25 max µmegohm

---

**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
- Cathode-Bias Resistor: 229 ohms
- Transconductance: 4400 µmhos
- Total Plate Current: 14 ma
- Grid-No. 1 Current: 1.5 ma
- Grid-No. 1 Voltage (Approx.) for total plate current of 10 ma: -18 volts

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**HIGH-MU TRIODE—SHARP-CUTOFF PENTODE**

**6JT8**

Miniature type with frame-grid pentode unit used in television receivers. The triode unit is used as a voltage-amplifier or sync-separator tube, and the pentode unit is used as a video-amplifier tube. Outline 11A, OUTLINES SECTION, except base is small and square with square miniatures. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.725.

---

**CLASS A: AMPLIFIER**

**Maximum Ratings, (Design Maximum Values):**

<table>
<thead>
<tr>
<th>Triodes</th>
<th>Penetode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid-No. 2 (Screen-Grid) Supply Voltage</td>
<td>-</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>-</td>
</tr>
<tr>
<td>Grid-No. 1 (Control-Grid) Voltage, Positive-bias value</td>
<td>0 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>1 max watt</td>
</tr>
</tbody>
</table>

**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 70
- Peak Heater-Cathode Voltage: 200 max volts
- Heater positive with respect to cathode: 200 max volts

**Characteristics:**
- Plate Supply Voltage: 250 volts
- Grid-No. 2 Supply Voltage: 250 volts
- Cathode-Bias Resistor: 229 ohms
- Amplification Factor | 100 |
- Plate Resistance (Approx.): 35000 ohms
- Transconductance: 20000 µmhos
- Plate Current: 1.5 ma
- Grid-No. 2 Current: 17 ma
- Grid-No. 1 Voltage (Approx.): -5 volts
- Grid-No. 1 Voltage (Approx.) for plate current of 20 ma: -5.3 volts

**Maximum Circuit Values:**
- Grid-No. 1 Circuit Resistance: 0.5 max, 0.25 max, 0.1 max
- For fixed-bias operation: 0.5 max wa, 0.25 max w, 0.1 max
- For cathode-bias operation: 1 max, 1 max, 1 max

*The dc component must not exceed 100 volts.

*The maximum ratings of the tube will not be exceeded.*

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**QUADRUPOLE DIODE**

**6JU8**

Miniature type 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. Outline 88D, OUTLINES 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):** 6.3 volts
**Heater Current:** 0.6 ma
**Direct Inter-electrode Capacitance (Approx.):**
- Plate of Unit No. 1 and Cathode of Unit No. 2 to Cathode of Unit No. 1: 1.8 pf
- Plate of Unit No. 1 and Cathode of Unit No. 2 to Plate of Unit No. 2: 2.2 pf
- Plate of Unit No. 2 to Heater and Internal Shield: 0.62 pf
Plate of Unit No.3 and Cathode of Unit No.4 to Cathode of Unit No.3: 1.9 pf
Plate of Unit No.3 and Cathode of Unit No.4 to Plate of Unit No.4: 3.2 pf
Plate of Unit No.4 to Heater and Internal Shield: 0.94 pf
Cathode of Unit No.1 to Heater and Internal Shield: 1.8 pf
Cathode of Unit No.2 to Heater and Internal Shield: 1.9 pf

Maximum Ratings, (Design-Maximum Values, Each Unit):
PEAK INVERSE PLATE VOLTAGE: 300 max volts
PEAK PLATE CURRENT: 54 max ma
DC OUTPUT CURRENT: 9 max ma
PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode: 300 max volts
Heater positive with respect to cathode: 300 max volts

Characteristics, Instantaneous Values, (Each Unit):
Plate Current for plate voltage of 10 volts: 60 ma

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

6J8V
Related type: 6V6

Miniature type used in a wide variety of applications in television receivers, particularly those having low-voltage "B" supplies and employing series-connected heater strings. The triode unit is used in sound-if, keyed-age, synchro-separator, synchro-amplifier, and noise-suppression circuits. The pentode unit is especially useful as a video amplifier tube. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

HEATER VOLTAGE (AC/DC): 6.8 volts
HEATER CURRENT: 0.6 ampere
HEATER WARM-UP TIME (AVERAGE): 11 seconds
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 pf
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield: 0.8 pf
Grid No.2 to Cathode, Heater, Grid No.3, and Internal Shield: 3.2 pf
Pentode Grid No.1 to Triode Plate: 0.012 max pf
Pentode Plate to Triode Plate: 0.24 max pf

AVERAGE PLATE CHARACTERISTICS

AVERAGE CHARACTERISTICS

PENTODE UNIT

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE: 300 max volts
GRID-No.1 (CONTROL GRID) VOLTAGE:
Positive-bias value: 0 max volts
Negative-bias value: -50 max volts
PLATE DISSIPATION:
GRID-No.2 INPUT:
Heater negative with respect to cathode: 200 max volts
Heater positive with respect to cathode: 200 max volts

Characteristics:
PLATE VOLTAGE: 200 125 200
GRID-No.2 Voltage: -200 125 200
GRID-No.1 Voltage: -2 0 -1.2
Amplification Factor: 70
Plate Resistance (Approx.): 0.0175 -0.1 0.15 megohm
Transconductance: 4000 11500 10700 µmhos
Plate Current: 51 22 22
GRID-No.2 Current: 14 4 4
GRID-No.1 Voltage (Approx.) for plate current of 20 ma: -5 -5.5 -9
Maximum Circuit Values:
GRID-No.1 Current Resistance: 0.5 max 0.25 max megohm
For cathode-bias operation: 1 max 1 max megohm
*The dc component must not exceed 100 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.

AVERAGE CHARACTERISTICS

Plate Volts: 0 50 100 150 200 250 300 350 Plate Volts: 0 50 100 150 200 250 300

HIGH-MU TRIODE

Glass octal type used as voltage amplifier in radio equipment. Outline 16A, OUTLINES SECTION. Tube requires octal socket. Heater voltages (ac/dc): 6.3; amperes, 0.3. Characteristics as class A1, amplifier: plate volts, 250 max; grid volts, -2; amplification factor, 70; plate resistance, 5500 ohms; transconductance, 1400 uhmhos; plate ma., 1.1. This is a DISCONTINUED type listed for reference only.

6K5GT
POWER PENTODE

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 voltage. Tube may be used singly or in push-pull. This type may be supplied with No. 1 omitted. Tube requires octal socket and may be mounted in any position. Outline 14C, OUTLINES SECTION. It is especially important that this tube, like other power-handling tubes, be adequately ventilated.

6K6GT

**Heater Voltage (AC/DC)**: 6.3 volts

**Heater Current**: 0.4 amperes

**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: 5.6 pf
- Plate to Cathode, Grid No. 2, and Grid No. 3: 6.0 pf

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values)**:
- **Plates Voltage**: 315 ma volts
- **Grid No. 2 (Screen-Grid) Voltage**: 255 ma volts
- **Grid No. 2 Input**: 9.0 ma watts
- **Peak Heater-Cathode Voltage**: 200 volts
- **Peak Heater-Cathode Voltage**: 200 volts

*The de component must not exceed 100 volts.

**Typical Operation**:
- **Plate Voltage**: 100 volts
- **Grid No. 2 Voltage**: 7 volts
- **Grid No. 1 (Control-Grid) Voltage**: 7 volts
- **Peak AF Grid No. 1 Voltage**: 9 volts
- **Zero-Signal Plate Current**: 30 ma
- **Zero-Signal Grid No. 1 Current**: 30 ma
- **Maximum-Signal Plate Current**: 25 ma
- **Maximum-Signal Grid No. 1 Current**: 25 ma
- **Plate Resistance (Approx.)**: 14 ohms
- **Transconductance**: 25 ohms
- **Load Resistance**: 1200 ohms
- **Total Harmonic Distortion**: 3.4 per cent
- **Maximum-Signal Power Output**: 3.4 watts

**Typical Push-Pull Operation** (Values are for two tubes):
- **Plate Supply Voltage**: 250 volts
- **Grid No. 2 Supply Voltage**: 250 volts
- **Grid No. 1 Voltage**: 250 volts
- **Cathode Bias Resistor**: 400 ohms
- **Peak AF Grid No. 1 Voltage**: 51 volts
- **Zero-Signal Plate Current**: 66 ma
- **Maximum-Signal Plate Current**: 66 ma
- **Zero-Signal Grid No. 1 Current**: 66 ma
- **Maximum-Signal Grid No. 1 Current**: 66 ma
- **Effective Load Resistance (Plate-to-plate)**: 1200 ohms
- **Total Harmonic Distortion**: 4 per cent
- **Maximum-Signal Power Output**: 9.8 watts

**Maximum Collector Current**: 25 ma

**Grid No. 1-Circuit Resistance**:
- For fixed-bias operation: 0.5 ma
- For cathode-bias operation: 0.5 ma

**Characteristics (Triode Connection)**:
- **Plate Voltage**: 250 volts
- **Grid No. 1 Voltage**: 35 ma
- **Plate Current**: 37.5 ma
- **Transconductance**: 25 ma
- **Amplification Factor**: 6.8
- **Plate Resistance (Approx.)**: 2500 ohms
- **Grid No. 1 Voltage (Approx.) for Plate current of 0.6 ma**: 45 volts

*Grid No. 2 connected to plate.

**VERTICAL DEFLECTION AMPLIFIER (Triode Connection)**

**Maximum Ratings**:
- For operation in a 525-line, 30-frame system
- **DC Plate Voltage**: 600 volts
- **Peak Positive-Pulse Plate Voltage! (Absolute maximum)**: 1000 volts

**Technical Data**

**PEAK NEGATIVE-PULSE GRID-NO. 1 VOLTAGE**: -50 ma volts
**PEAK CATHODE CURRENT**: 25 ma
**PLATE VOLTAGE**: 350 volts
**PEAK HEATER-CATHODE VOLTAGE**: 250 ma volts

**Maximum Circuit Values**:
- Grid No. 1-Circuit Resistance: 2.2 ma
- Grid No. 2-Circuit Resistance: 2.2 ma

**REMOTE-CUTOFF PENTODE**

Metal type 6K7 and glass octal types 6K7-G and 6K7-GT used if rf and if stages of radio receivers, particularly those employing ac outlets 3, 23, and 1SA, respectively, OUTLINES SECTION. These tubes require octal socket and may be mounted in any position. For voltage and current supplies and application, refer to type 88K7. Heater voltage (ac/dc), 6.8; amperes, 0.3. Typical operation as class A amplifier: plate volts 250 (300 ma); grid No. 3 connected to cathode at socket; grid No. 2 supply volts, 300 ma; grid No. 2, 125 ma; grid No. 1, -1 volt; plate resistance, 0.6 megohm; transconductance, 150 ma; grid No. 2 ma; plate disconnection, 2.75 ma watts; grid No. 2 input, 0.35 ma watts. Types 6K7 and 6K7-GT are used principally for renewal purposes. Type 6K7-G is a DISCONTINUED type listed for reference only.

**TRIODE-HEXODE CONVERTER**

Metal type 6K8 and glass octal types 6K8-G and 6K8-GT used as combined triode oscillator and hexode mixer tubes in radio receivers. Type 6K8, Outline 4; type 6K8-G, Outline 23, OUTLINES SECTION. Tube requires octal socket. Heater voltage (ac/dc), 6.8; amperes, 0.3. Typical operation in converter service: hexode plate volts, 250 (300 ma); hexode grid resistance, 0.3 ohms; plate voltage, 0 (0 ma); triode plate volts, 100 (125 ma); triode grid resistance, 50000 ohms; hexode plate resistance (approx.), 0.6 megohm; conversion transconductance, 250 ma; hexode plate ma, 3.8; triode grid and hexode grid-No. 1 ma, 0.15; total cathode ma, 12.5 (16 ma). Types 6K7-G and 6K7-GT are DISCONTINUED types listed for reference only. Type 6K8 is used principally for renewal purposes.

**THREE-UNIT TRIODE**

Duodecar type containing one medium-mu triode and two high-mu triode units used as combined age, synchro, and noise-inverter tube in television receivers employing series-connected heater streams. Outline 12A, OUTLINES SECTION. Tube requires duodecar 12-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.8; amperes, 0.6; warm-up time (average), 11 seconds.

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values)**:
- **Plate Voltage**: 330 volts
- **Grid Voltage**: 330 volts
- **Negative-bias value**: 50 ma
- **Positive-bias value**: 50 ma
- **Cathode Current**: 25 ma
- **Plate Disconnection**: 2.75 ma

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PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode
Heater positive with respect to cathode

Characteristics:
Plate Voltage ........................................ 250 max
Grid Voltage ........................................ -5 to -2 volts
Amplification Factor .................................. 17 to 100
Plate Resistance (Approx.) .......................... 7700 ohms
Transconductance ..................................... 2000 ma
Plate Current .......................................... 10 max
Grid Voltage (Approx.) for plate current of 10 ma ........ -24 volts

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

6KA8
Related type: 8KA8

Miniature type used in color and black-and-white television receivers employing series-connected heater strings. The triode unit is used in synseparating circuits; the pentode unit has two independent control grids and is used in gated AGC-amplifier and noise-inverter circuits. Outline 8D, 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 6AW8-A.

HEATER VOLTAGE (A/C) .................................. 6.3 volts
HEATER CURRENT ..................................... 0.6 ampere
HEATER WARM-UP TIME (AVERAGE) ...................... 11 seconds
DIRECT INTERELECTRODE CAPACITANCES:
Triode Unit:
Grid to Plate .......................................... 2.2 pf
Grid to Cathode, Heater, and Internal Shield ........ 2.2 pf
Plate to Cathode, Heater, and Internal Shield ......... 2.8 pf
Pentode Unit:
Grid-No.1 to Plate .................................... 0.1 max pf
Grid-No.1 to Cathode, Heater, Grid-No.2, Grid-No.3, Internal Shield .. 2.5 pf
Grid-No.1 to Grid-No.3 .................................. 0.5 pf
Grid-No.3 to Plate ..................................... 2.2 pf
Grid-No.3 to All Other Electrodes, Heater, and Internal Shield .... 7 pf

CLASS A. AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE ......................................... 500 max volts
Grid Voltage:
Positive-bias value .................................... 0 max volts
Negative-bias value .................................... 50 max volts

AVERAGE CHARACTERISTICS—PENTODE UNIT

AVERAGE CHARACTERISTICS—PENDOTE UNIT

TABLE 6KA8
<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid-No.3 Voltage</th>
<th>Grid-No.2 Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 volts</td>
<td>100 volts</td>
<td>200 volts</td>
</tr>
<tr>
<td>200 volts</td>
<td>100 volts</td>
<td>200 volts</td>
</tr>
<tr>
<td>100 volts</td>
<td>100 volts</td>
<td>200 volts</td>
</tr>
</tbody>
</table>

PLATE DISRUPTION

1.1 max watts

PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode
Heater positive with respect to cathode

Characteristics:
Plate Supply Voltage .................................. 200 volts
Grid-No.3 Supply Voltage ............................ 100 volts
Grid-No.2 Supply Voltage ............................ 200 volts
Grid-No.1 Supply Voltage ............................ 200 volts
Cathode-Bias Resistor ................................ 100 ohms
Amplification Factor .................................. 1.1 max
Plate Resistance (Approx.) .......................... 17500 ohms
Transconductance, Grid No.1 to Plate ................. 4000 µmhos
Transconductance, Grid No.3 to Plate ............... 600 µmhos
Plate Current .......................................... 4 max
Grid-No.2 Current .................................... 2.8 max
Grid-No.1 Supply Voltage (Approx.) .................. 5 volts
For plate current of 10 ma ................................ 100000 ohms
For plate current of 20 ma ............................ 4000 µmhos
For plate current of 20 ma ............................ 600 µmhos
For plate current of 20 ma ............................ 4 volts
For plate current of 20 ma ............................ 7 volts

Maximum Circuit Values:
Grid-Circuit Resistance ................................ 6.28 megohms
For fixed-bias operation ............................... 1 megohm

GATED AGC AMPLIFIER AND NOISE INVERTER

Maximum Ratings, (Design-Maximum Values):
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 SUPPLY VOLTAGE ............................ 300 max volts
GRID-No.1 VOLTAGE ..................................... See curve page 70
GRID-No.1 CONTROL-GRID VOLTAGE:
Positive-bias value .................................... 0 max volts
Negative-bias value .................................... 50 max volts
PLATE DISRUPTION ..................................... 2 max watts

PLATE DISRUPTION:
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 page 70
For grid-No.2 voltages between 150 and 300 volts .... See curve page 70
For grid-No.2 voltages between 150 and 300 volts .... See curve page 70
For grid-No.2 voltages between 150 and 300 volts .... See curve page 70
For grid-No.2 voltages between 150 and 300 volts .... See curve page 70
For grid-No.2 voltages between 150 and 300 volts .... See curve page 70
For grid-No.2 voltages between 150 and 300 volts .... See curve page 70
Maximum Circuit Values:

Grid-No.3 Circuit Resistance: 0.68 mohm
Grid-No.1 Circuit Resistance:
  For fixed-bias operation: 0.5 mohm
  For cathode-bias operation: 1 mohm

*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 100 volts.

MEDIUM-MU TRIODE
SHARP-CUTOFF PENTODE

6KD8

Miniature type used as combined vhf oscillator and mixer tube in television receivers. Outline 8B.

OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.4.

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

Plate Voltage: 300 max volts
Grid-No.2 (Screen-Grid) Supply Voltage: 200 max volts
Grid-No.2 Voltage: See curve page 70
Grid-No.1 (Control-Grid) Voltage, Positive-bias value 200 max volts
Plate Dissipation: 2.5 max watts

For grid-No.2 voltages up to 165 volts
For grid-No.2 voltages between 165 and 280 volts
Peak Heater-Cathode Voltage:
Heater negative with respect to cathode: 200 max volts
Heater positive with respect to cathode: 200 max volts

Characteristics:
Plate Voltage: 125 volts
Grid-No.2 Voltage: 6 volts
Grid-No.1 Voltage: 1 volt
Amplification Factor: 40
Plate Resistance (Approx.): 9.2 mohm
Transconductance: 13.5 ma
Plate Current: 3.5 ma
Grid-No.2 Current: 9 ma
Grid-No.1 Voltage (Approx.): 20 ma

Maximum Circuit Values:
Grid-No.1 Circuit Resistance:
  For fixed-bias operation: 0.5 mohm
  For cathode-bias operation: 1 mohm

* The dc component must not exceed 100 volts.

MEDIUM-MU TRIODE—
SHARP-CUTOFF PENTODE

6KE8

Related type: 5KE8

OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

Heater Voltage (AC/DC): 6.3 volts
Heater Current: 0.4 amperes
Direct Interelectrode Capacitances:
Triode Unit:
  Grid to Plate: 1.3 pf
  Grid to Cathode, Heater, Pentode Cathode, Pentode Grid: 2.4 pf
  Plate to Cathode, Heater, Pentode Cathode, Pentode Grid: 2.4 pf
  Grid No. 3, and Internal Shield: 2 pf
  Plate to Cathode, Heater, Pentode Cathode, Pentode Grid: 2.4 pf
  Grid No. 3, and Internal Shield: 2 pf

* 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 100 volts.
**DIODE—SHARP-CUTOFF PENTODE**

Miniature type used in combined IF-amplifier and AM-detector service in AM and AM/FM broadcast receivers. Pentode unit may also be used as an rf or IF-amplifier or limiter tube; the diode unit may be used for ac or detection. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. For curves of average plate characteristics for pentode unit, refer to type 6AU6.

**6KL8**

Related type: 12KL8

HEATER VOLTAGE (AC/DC)................. 6.3 volts
HEATER CURRENT...................... 0.3 ampere
DIRECT INTERELECTRODE CAPACITANCES:

<table>
<thead>
<tr>
<th>Pentode Unit</th>
<th>Grid No. 1 to Plate</th>
<th>Grid No. 1 to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield</th>
<th>Plate to Cathode, Heater, Grid No. 2, and Grid No. 3, and Internal Shield</th>
<th>Plate to Grid No. 1 to Diode Plate</th>
<th>Pentode Plate to Diode Plate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.002 ma</td>
<td>5 ma</td>
<td>0.015 ma</td>
<td>0.09 ma</td>
<td></td>
</tr>
</tbody>
</table>

**PENTODE UNIT AS CLASS A AMPLIFIER**

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>300 ma</th>
<th>volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRID NO. 3 (SUSPENSION-GRID) VOLTAGE:</td>
<td>-300 ma</td>
<td>volts</td>
</tr>
<tr>
<td>.</td>
<td>300 ma</td>
<td>volts</td>
</tr>
<tr>
<td>GRID NO. 2 (SCREEN-GRID) SUPPLY VOLTAGE:</td>
<td>550 volts</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>550 volts</td>
<td></td>
</tr>
<tr>
<td>GRID NO. 1 (CONTROL-GRID) VOLTAGE:</td>
<td>200 ma</td>
<td>volts</td>
</tr>
<tr>
<td>.</td>
<td>200 ma</td>
<td>volts</td>
</tr>
<tr>
<td>GRID NO. 1 INPUT</td>
<td>0.2 ma</td>
<td>watts</td>
</tr>
<tr>
<td>.</td>
<td>0.2 ma</td>
<td>watts</td>
</tr>
<tr>
<td>GRID NO. 2 INPUT</td>
<td>0.2 ma</td>
<td>watts</td>
</tr>
<tr>
<td>.</td>
<td>0.2 ma</td>
<td>watts</td>
</tr>
<tr>
<td>GRID NO. 3 INPUT</td>
<td>0.2 ma</td>
<td>watts</td>
</tr>
<tr>
<td>.</td>
<td>0.2 ma</td>
<td>watts</td>
</tr>
<tr>
<td>FOR GRID NO. 2 VOLTAGES UP TO 150 VOLTS</td>
<td>0.6 ma</td>
<td>watts</td>
</tr>
<tr>
<td>.</td>
<td>0.6 ma</td>
<td>watts</td>
</tr>
<tr>
<td>FOR GRID NO. 2 VOLTAGES BETWEEN 150 AND 300 VOLTS</td>
<td>0.2 ma</td>
<td>watts</td>
</tr>
<tr>
<td>.</td>
<td>0.2 ma</td>
<td>watts</td>
</tr>
</tbody>
</table>

**PLATE DIMENSION:**

| PEAK HEATER-CATHODE VOLTAGE: | 200 ma | volts |
| . | 200 ma | volts |
| BULB TEMPERATURE (At hottest point) | 150 ma | °C |

**Characteristics:**

| Plate Voltage | 150 volts |
| . | 150 volts |
| Grid No. 2 Voltage | 100 volts |

**Technical Data**

| Grid No. 1 Supply Voltage | 9 volts |
| . | 9 volts |
| Grid No. 1 Resistor (Bypassed) | 2.2 megohm |
| . | 2.2 megohm |
| Plate Resistance (Approx.) | 9.55 megohm |
| . | 9.55 megohm |
| Plate Current | 5.5 ma |
| . | 5.5 ma |
| Grid No. 2 Current | 2.2 ma |
| . | 2.2 ma |
| Grid No. 1 Voltage (Approx.) for plate current of 10 ma | 4.2 volts |
| . | 4.2 volts |

**DIODE UNIT**

Maximum Ratings, (Design-Maximum Values):

| PLATE CURRENT | 1 ma |
| . | 1 ma |
| PEAK HEATER-CATHODE VOLTAGE: | 4 ma |
| . | 4 ma |
| HEATER NEGATIVE WITH RESPECT TO CATHODE | 200 ma |
| . | 200 ma |
| HEATER POSITIVE WITH RESPECT TO CATHODE | 200 ma |
| . | 200 ma |

Characteristics, Instantaneous Values:

| Tube Voltage Drop for plate current of 2 ma | 10 ma |
| . | 10 ma |

*The dc component may not exceed 100 volts.

**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 8D, 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
DIRECT INTERELECTRODE CAPACITANCES:

<table>
<thead>
<tr>
<th>Tetrode Unit</th>
<th>Grid No. 1 to Plate No. 1A</th>
<th>Grid No. 1 to Plate No. 1B</th>
<th>Grid No. 1 to Plate No. 2</th>
<th>Grid No. 1 to Plate No. 3</th>
<th>Grid No. 1 to Plate No. 2B</th>
<th>Plate No. 1A to Plate No. 3</th>
<th>Plate No. 1B to Plate No. 2B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.02 ma</td>
<td>0.02 ma</td>
<td>0.06 ma</td>
<td>0.06 ma</td>
<td>0.06 ma</td>
<td>0.06 ma</td>
<td>0.06 ma</td>
</tr>
<tr>
<td></td>
<td>1.3 ma</td>
<td>1.3 ma</td>
<td>1.3 ma</td>
<td>1.3 ma</td>
<td>1.3 ma</td>
<td>1.3 ma</td>
<td>1.3 ma</td>
</tr>
</tbody>
</table>

**AVERAGE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>TYPE 6KM8</th>
<th>E12, 3-VOLTS</th>
<th>GRID NO. 2 VOLS X 100</th>
<th>PLATES 1A, 1B, AND 2 CONNECTED TOGETHER AT SOCKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>6KM8</td>
<td>500 ma</td>
<td>volts</td>
<td>100 ma</td>
</tr>
<tr>
<td>.</td>
<td>100 ma</td>
<td>volts</td>
<td>100 ma</td>
</tr>
<tr>
<td>.</td>
<td>100 ma</td>
<td>volts</td>
<td>100 ma</td>
</tr>
<tr>
<td>.</td>
<td>100 ma</td>
<td>volts</td>
<td>100 ma</td>
</tr>
</tbody>
</table>
**RCA Receiving Tube Manual**

**TEUTRODE UNIT AS CLASS A, AMPLIFIER**

*Plates No. 1A, 1B, and 2 connected together*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>100 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>100 volts</td>
</tr>
<tr>
<td>Grid-No. 1 Supply Voltage</td>
<td>0 volts</td>
</tr>
<tr>
<td>Grid-No. 1 Resistor (Bypassed)</td>
<td>2.2 megohms</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>3600 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>3400 μhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>4.2 ma</td>
</tr>
<tr>
<td>Grid-No. 2 Current</td>
<td>1.7 ma</td>
</tr>
<tr>
<td>Grid-No. 1 Voltage (Approx.) for plate current of 20 μa</td>
<td>-4 volts</td>
</tr>
</tbody>
</table>

*Triode Connection—Plates No. 1A, 1B, and 2 connected to grid No. 2*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>100 volts</td>
</tr>
<tr>
<td>Grid-No. 1 Supply Voltage</td>
<td>0 volts</td>
</tr>
<tr>
<td>Grid-No. 1 Resistor (Bypassed)</td>
<td>2.2 megohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>4500 μhos</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>45</td>
</tr>
<tr>
<td>Plate Current</td>
<td>5.5 ma</td>
</tr>
</tbody>
</table>

*Separate plate operation; plates not under test ground*

**TEUTRODE UNIT AS FREQUENCY DIVIDER AND COMPLEX-WAVE GENERATOR**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage (Each plate)</td>
<td>330 max watts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>320 max watts</td>
</tr>
<tr>
<td>Grid-No. 1 (control-grid) Voltage</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Grid-No. 2 Input</td>
<td>0 max volts</td>
</tr>
<tr>
<td>For grid-No. 2 voltages up to 165 volts</td>
<td>0.65 max watt</td>
</tr>
<tr>
<td>See curve page 70</td>
<td>0.65 max watt</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>1 max watt</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
</tbody>
</table>

**AVERAGE PLATE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Voltage (Volts)</th>
<th>Plate Cur. (Ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>4.2</td>
</tr>
<tr>
<td>200</td>
<td>5.5</td>
</tr>
<tr>
<td>300</td>
<td>6.2</td>
</tr>
<tr>
<td>400</td>
<td>6.8</td>
</tr>
</tbody>
</table>

**Technical Data**

**Highest Circuit Values:**

<table>
<thead>
<tr>
<th>Grid-No. 1 Circuit Resistance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 max megohms</td>
<td></td>
</tr>
</tbody>
</table>

**Diode Unit:**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Current</td>
<td>1 max ma</td>
</tr>
<tr>
<td>Tube Voltage Drop for plate current of 2 ma</td>
<td>10 volts</td>
</tr>
</tbody>
</table>

*The dc component must not exceed 100 volts*

**High-Mu Triode—Sharp-Cutoff Pentode**

**6K78**

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 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 5.3; amperes, 0.6.

**Class A, Triode:**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid-No. 2 Supply Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid-No. 1 (control-grid) Voltage</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Grid-No. 2 Input</td>
<td>6.5 max volts</td>
</tr>
<tr>
<td>For grid-No. 2 voltages up to 165 volts</td>
<td>0.55 max watt</td>
</tr>
<tr>
<td>See curve page 70</td>
<td>0.55 max watt</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>125 volts</td>
</tr>
<tr>
<td>Grid-No. 1 Voltage</td>
<td>5 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Input</td>
<td>6.5 max volts</td>
</tr>
<tr>
<td>For grid-No. 2 voltages up to 165 volts</td>
<td>0.5 max meegohms</td>
</tr>
<tr>
<td>See curve page 70</td>
<td>0.5 max meegohms</td>
</tr>
</tbody>
</table>

**High-Mu Triode—Sharp-Cutoff Pentode**

**6KV8**

Related type: **11KV4**

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-amplifier applications. The pentode unit is used as a video output tube. Outline 8D, 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 6A8-A.

**Heater Voltage (AC/DC):**

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5 volts</td>
</tr>
</tbody>
</table>

**Heater Current:**

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75 ampere</td>
</tr>
</tbody>
</table>

**Direct Interelectrode Capacitances (Approx.):**

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.7 pf</td>
</tr>
</tbody>
</table>

*The dc component must not exceed 100 volts.*
**RCA Receiving Tube Manual**

**GRID TO CATHODE, HEATER, PENTODE CATHODE, PENTODE GRID NO.3, AND INTERNAL SHIELD.**

<table>
<thead>
<tr>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 pf</td>
<td>2.4 pf</td>
</tr>
</tbody>
</table>

**TRIODE GRID TO PENTODE PLATE.**

<table>
<thead>
<tr>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.015 ma</td>
<td>4.8 pf</td>
</tr>
</tbody>
</table>

**PENTODE UNIT.**

<table>
<thead>
<tr>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.09 ma</td>
<td>0.17 pf</td>
</tr>
</tbody>
</table>

**CLASS A: AMPLIFIER**

**MAXIMUM RATINGS.**

<table>
<thead>
<tr>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>300 ma</td>
</tr>
<tr>
<td>GRID-NO.2 (SCREEN-GRID) SUPPLY VOLTAGE</td>
<td>300 ma</td>
</tr>
<tr>
<td>GRID-NO.2 VOLTAGE</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>GRID-NO.1 (CONTROL-GRID) VOLTAGE, Positive-bias Voltage</td>
<td>0 ma</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>1 ma</td>
</tr>
<tr>
<td>GRID-NO.2 Input</td>
<td>1 ma</td>
</tr>
<tr>
<td>For grid-No.2 voltages up to 150 volts</td>
<td></td>
</tr>
<tr>
<td>For grid-No.2 voltages between 150 and 300 volts</td>
<td></td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>HEATER NEGATIVE WITH RESPECT TO CATHODE</td>
<td>200 ma</td>
</tr>
<tr>
<td>HEATER POSITIVE WITH RESPECT TO CATHODE</td>
<td>200 ma</td>
</tr>
</tbody>
</table>

**CHARACTERISTICS.**

<table>
<thead>
<tr>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE SUPPLY VOLTAGE</td>
<td>200</td>
</tr>
<tr>
<td>GRID-NO.2 SUPPLY VOLTAGE</td>
<td>125</td>
</tr>
<tr>
<td>GRID-NO.1 SUPPLY VOLTAGE</td>
<td>0</td>
</tr>
<tr>
<td>CATHODE-BIAS RESISTOR</td>
<td>82</td>
</tr>
<tr>
<td>AMPLIFICATION FACTOR</td>
<td>1.0</td>
</tr>
<tr>
<td>PLATE RESISTANCE (Approx.)</td>
<td>17500</td>
</tr>
<tr>
<td>TRANSCONDUCTANCE</td>
<td>55000</td>
</tr>
<tr>
<td>PLATE CURRENT</td>
<td>4</td>
</tr>
<tr>
<td>GRID-NO.2 CURRENT</td>
<td>3.3 ma</td>
</tr>
<tr>
<td>GRID-NO.1 VOLTAGE (Approx.) for plate current of 100 ma</td>
<td>-4.5</td>
</tr>
<tr>
<td>MAXIMUM CIRCUIT VALUES.**</td>
<td></td>
</tr>
<tr>
<td>GRID-NO.1-CIRCUIT RESISTANCE</td>
<td>0.5 ma</td>
</tr>
</tbody>
</table>

**AVG CHARACTERISTICS.**

<table>
<thead>
<tr>
<th>TYPE 6K6S</th>
<th>TYPE 6K7B</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>250</td>
</tr>
<tr>
<td>GRID-NO.2 VOLTAGE</td>
<td>250</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>19 ma</td>
</tr>
<tr>
<td>GRID-NO.2 INPUT</td>
<td>2.5 ma</td>
</tr>
</tbody>
</table>

**BEAM POWER TUBE**

**MEDIUM-MU TRIOIDE**

Glass octal type used as detector, amplifier, or oscillator in radio receivers. Outline 22, OUTLINES SECTION. Heater voltages: 6.3 volts, 0.5 ampere. Typical operation and characteristics: plate volts, 250 ma; grid volts, -9; plate ma, 5 plate resistance, 9000 ohms; amplification factor, 17; transconductance, 1900 mho; grid voltage for cathode-current cutoff, -20. This is a DISCONTINUED type listed for reference only.

**6L5G**

**6L6**

**6L6G**

**6L6GB**

**6L6GC**

**BEAM POWER TUBE**

Metal type 6L6 and glass octal types 6L6-G, 6L6-GB, 6L6-GC 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, sensitivity, and high efficiency. Power output at all levels has low third- and higher-order harmonics. Type 6L6, Outline 8; types 6L6-GB and 6L6-GC, Outline 19C; 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 6L6-G is a DISCONTINUED type listed for reference only. Type 6L6-GC can be used in place of types 6L6, 6L6-G, and 6L6-GB. Type 6L6-GC may be supplied with pin 1 omitted.

**HEATER VOLTAGE (AC/DC) | 6.3 volts**

**HEATER CURRENT | 0.9 ampere**

**DIRECT CURRENT CAPACITANCE (Approx.)**

| Grid-No.1 to Plate | 0.4 ma | 0.6 ma |
| Grid-No.1 to Cathode, Grid-No.2, and Grid-No.3 | 10 ma | 10 ma |
| Plate to Cathode, Grid-No.1, Grid-No.2, and Grid-No.3 | 12 ma | 6.5 ma |

**CLASS A: AMPLIFIER**

**MAXIMUM RATINGS.**

<table>
<thead>
<tr>
<th>6L6, 6L6-G, 6L6-GB, 6L6-GC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
</tr>
<tr>
<td>GRID-NO.2 (SCREEN-GRID) VOLTAGE</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
</tr>
<tr>
<td>GRID-NO.2 INPUT</td>
</tr>
</tbody>
</table>

**PEAK HEATER-CATHODE VOLTAGE.**

| Plate current | 200 ma | 200 ma |
| Heater positive with respect to cathode | 180 ma | 180 ma |
| Heater negative with respect to cathode | 180 ma | 180 ma |

**TYPICAL OPERATION.**

| PLATE VOLTAGE | 250 ma | 250 ma |
| GRID-NO.2 VOLTAGE | 250 ma | 250 ma |
| GRID-NO.1 (CONTROL-GRID) VOLTAGE | -14 ma | -18 ma |
| PEAK AF GRID-No.1 VOLTAGE | 14 ma | 18 ma |
| ZERO-SIGNAL PLATE CURRENT | 72 ma | 84 ma |
| MAXIMUM-SIGNAL PLATE CURRENT | 7 ma | 15 ma |
| ZERO-SIGNAL GRID-No.2 CURRENT | 5 ma | 7.5 ma |
| MAXIMUM-SIGNAL GRID-No.2 CURRENT | 5 ma | 7.5 ma |
| PLATE RESISTANCE (Approx.) | 25000 ohms | 35000 ohms |
| TRANSCONDUCTANCE | 65000 mhos | 52000 mhos |
| LOAD RESISTANCE | 4500 ohms | 4200 ohms |
| TOTAL HARMONIC DISTORTION | 15 per cent | 15 per cent |
| MAXIMUM-SIGNAL POWER OUTPUT | 6.5 watts | 10.8 watts |

**CLASS A: AMPLIFIER (Triode Connection)**

**MAXIMUM RATINGS.**

<table>
<thead>
<tr>
<th>6L6, 6L6-G, 6L6-GB, 6L6-GC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
</tr>
</tbody>
</table>

332
### Technical Data

#### PUSH-PULL CLASS AB2 AMPLIFIER

**Maximum Ratings:** (Same as for class A amplifier)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>270</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>270</td>
</tr>
<tr>
<td>Peak A.F. Grid-No.1 Voltage</td>
<td>175</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>150</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>156</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-plate)</td>
<td>3000</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>2</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>15.5</td>
</tr>
</tbody>
</table>

#### PUSH-PULL CLASS AB AMPLIFIER

**Maximum Ratings:** (Same as for class A amplifier)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>360</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>360</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>225</td>
</tr>
<tr>
<td>Peak A.F. Grid-No.1 Voltage</td>
<td>270</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>150</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>200</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-plate)</td>
<td>3000</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>2</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>18.5</td>
</tr>
</tbody>
</table>

### PENTAGRID MIXER

Metal type 6L7 and glass octal type 6L7-G used as mixers in superhetodcyne circuits having a separate oscillator stage, as well as in other applications where dual control is desirable in a single stage. The two separate control grids are shielded from each other and the coupling between oscillator and signal circuits is very small. For additional information, refer to Frequency Conversion, ELECTRON TUBE APPLICATIONS SECTION.

Refer to type 6A5S/6N5

### DIRECT-COUPLED POWER TRIODE

Glass octal type used as class A power amplifier. Outline 25, OUTLINES SECTION. Heater volts (ac/dc), 6.5; anode voltage, 0.8. For electrical characteristics, refer to type 6N8. Type 6N6-G is a DISCONTINUED type listed for reference only.

Refer to type 6N7/6N7GT

### MEDIUM-MU TWIN POWER TRIODE

Metal type 6N7 and glass octal type 6N7-GT used in output stage of radio receivers as class B power amplifier or with units in parallel as a class A amplifier. Outlines 5 and 14C, respectively, OUTLINES SECTION. Tubes require output socket. Heater volts (ac/dc), 6.5; anode voltage, 0.8. Typical operation as class A amplifier: plate volts, 400 max; grid volts, 0; amplification factor, 15; plate load, 150 max; at cut-off. These types are used principally for renewal purposes.
MEDIUM-MU TRIODE

Glass octal type used as detector, amplifier, or oscillator in radio receivers. Outline 14C, OUTLINES SECTION. Heater voltages (ac/dc), 6.3 volts; (ac), 100 ma, except for interelectrode capacitance of 5.0 mm, this type is identical electrically with type 75. Type 6T5-GT is a DISCONTINUED type listed for reference only.

LOW-MU TRIODE—REMOTE-CUTOFF PENTODE

Glass octal type used as an amplifier, Outline 23, OUTLINES SECTION. Heater voltages (ac/dc), 6.3 volts; (ac), 100 ma, except for interelectrode capacitance, this type is identical electrically with type 8P7. Type 6P7-G is a DISCONTINUED type listed for reference only.

TWIN DIODE—HIGH-MU TRIODE

Metal type 6Q7 and glass octal types 6Q7-G and 6Q7-GT used as combined detector, amplifier, and video tube in radio receivers. Outlines 1, 23, and 15A, respectively, OUTLINES SECTION. Types 6Q7 and 6Q7-GT are used principally for renewal purposes. Type 6Q7-GT is a DISCONTINUED type listed for reference only. Tubes require octal socket. Heater voltages (ac/dc), 6.3 volts; (ac), 100 ma. These types are anharmonically in most respects to types 6SL7 and 6AT6. Maximum ratings and typical operation of the triode are the same as those for type 6AT6 except that with a plate voltage of 100 volts, the transconductance is 1200 amhos and the plate resistance 58000 ohms. For triode, grid-bias considerations and diode curves, refer to type 6A6V.

THREE-UNIT TRIODE

Duodecar type containing one medium-mu and two high-mu triode units used as combined sync-clipper and gated-age-amplifier tube in television receivers employing series-connected heater strings. Outline 12A, OUTLINES SECTION. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater voltages (ac/dc), 6.3; amperes, 0.6; warm-up time (average), 11 seconds.

6Q7
6Q7G
6Q7GT

Related type: 12A7GT

Characteristics
Plate Voltage
Grid Voltage
Amplification Factor
Plate Resistance (Approx.)
Transconductance
Plate Current
Grid Voltage (Approx.) for plate current of 10 μA

CLASS A; AMPLIFIER

Unit No. 1

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid Voltage</th>
<th>Amplification Factor</th>
<th>Plate Resistance (Approx.)</th>
<th>Transconductance</th>
<th>Plate Current</th>
<th>Grid Voltage (Approx.) for plate current of 10 μA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>0</td>
<td>2000</td>
<td>2000</td>
<td>1200</td>
<td>2000</td>
<td>-13</td>
</tr>
</tbody>
</table>

GATED AGC AMPLIFIER AND SYNC CLIPPER

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

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>STRAY STATE VOLTAGE</th>
<th>PEAK-POSITIVE-PULSE GRID VOLTAGE</th>
<th>DC GRID VOLTAGE</th>
<th>PLATE DISSIPATION</th>
<th>PEAK H/B-WATTS GRID VOLTAGE</th>
<th>PEAK CATHODE CURRENT</th>
<th>AVERAGE CATHODE CURRENT</th>
<th>PLATE DISSIPATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>330 max</td>
<td>50 max</td>
<td>50 max</td>
<td>60 max</td>
<td>-100 max</td>
<td>100 max</td>
<td>600 mdw</td>
<td>30 ma</td>
<td>30 ma</td>
</tr>
</tbody>
</table>

For cathode-bias operation:

For cathode-bias operation, the duration of the voltage pulse must not exceed 10 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 3.5 milliseconds. The dc component must not exceed 100 volts.

MEDIUM-MU TRIODE

Miniature types having high performance used as vertical deflection amplifiers in television receivers. Type 6S4A has a controlled heater warm-up time for use in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tubes require miniature nine-contact socket and may be mounted in any position. Type 6S4 is a DISCONTINUED type list for reference only.

6S4
6S4A

Characteristics:

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>Grid Voltage</th>
<th>Amplification Factor</th>
<th>Plate Resistance (Approx.)</th>
<th>Transconductance</th>
<th>Plate Current</th>
<th>Grid Voltage (Approx.) for plate current of 50 μA</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 max</td>
<td>0</td>
<td>16.5</td>
<td>3700</td>
<td>4500</td>
<td>24 ma</td>
<td>-42 volts</td>
</tr>
</tbody>
</table>

VERTICAL DEFLECTION AMPLIFIER

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

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>DC PLATE VOLTAGE</th>
<th>PEAK POSITIVE-PULSE GRID VOLTAGE</th>
<th>PEAK NEGATIVE-PULSE GRID VOLTAGE</th>
<th>PEAK CATHODE CURRENT</th>
<th>AVERAGE CATHODE CURRENT</th>
<th>PLATE DISSIPATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 mdw</td>
<td>2000</td>
<td>2200</td>
<td>105 ma</td>
<td>30 ma</td>
<td>8.5 mdw</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Grid-Circuit Resistance</th>
<th>For cathode-bias operation</th>
<th>For cathode-bias operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 mdw</td>
<td>2.2 mdw</td>
<td>2.2 mdw</td>
</tr>
</tbody>
</table>

Maximum ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>PLATE DISSIPATION</th>
<th>PEAK H/B-WATTS GRID VOLTAGE</th>
<th>PEAK CATHODE CURRENT</th>
<th>AVERAGE CATHODE CURRENT</th>
<th>PLATE DISSIPATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5 mdw</td>
<td>200</td>
<td>105 ma</td>
<td>30 ma</td>
<td>8.5 mdw</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Grid-Circuit Resistance</th>
<th>For cathode-bias operation</th>
<th>For cathode-bias operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 mdw</td>
<td>2.2 mdw</td>
<td>2.2 mdw</td>
</tr>
</tbody>
</table>

The duration of the voltage pulse must not exceed 10 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 3.5 milliseconds.

The dc component must not exceed 100 volts.
REMOTE-CUTOFF PENTODE

Metal type 6S7 and glass octal type 6S7-G used in rf and if stages of automobile receivers employing acce. Outlines 4 and 21, respectively. OUTLINES SECTION. Type 6S7 is used principally for renewal purposes. Type 6S7-G is a DISCONTINUED type listed for reference only. Tubes require octal socket. Heater volts, 6.3 volts; anode, 150 volts. Typical operation as class A amplifier: plate volts, 250 (300 max); grid- No.2 volts, see curve page 96; grid-No.2 supply volts, 300 volts; grid-No.1 volts, -3.0 volts; grid-No.3 connected to cathode at socket; plate ma.; 8.6; grid-No.2 ma., 2; plate resistance (Approx.), 1.0 meg ohms; transconductance, 1400 microamps; plate dissipation, 2.55 watts; grid-No.2 input; for grid-No.2 voltages up to 156 volts, 0.25 ma. watts; for grid-No.2 voltages between 156 and 300 volts, see curve page 66. Peak heater-cathode volts, 90 volts.

TRIPLE DIODE—HIGH-MU TRIODE

Glass octal type used as audio amplifier, AM detector, and FM detector in AM/FM receivers. Diode unit No.2 is used for AM detection, and diode units No.1 and No.3 are used for FM detection. Outline 18A, OUTLINES SECTION, except over-all length is 3.8 max.; inches and socket height is 4.16 max. inches. Tubes require octal socket. Heater volts (ac/dc), 6.3; anode, 6.3 volts. Typical operation of triode unit as class A amplifier: plate volts, 250 (300 max); grid volts, -2; amplification factor, 100; plate resistance (Approx.), 10 ohms; transconductance, 1100 microamps; plate dissipation, 0.5 ma. watts; plate ma.; 0.9; peak heater-cathode volts, 88 volts. Maximum plate ma.; for diode units, 1.5 ma. (each unit). Peak heater-cathode volts (diode unit No.1), 90 volts. For diode operation curves, refer to type 6A6 V. Type 6S8GT is used principally for renewal purposes.

PENTAGRID CONVERTER

Metal type 6S7 and glass octal type 6S7-GT used as converters in superheterodyne circuits. They are similar in performance to type 6BS6. For general discussion of pentagrid types, see Frequency Conversion in ELECTRON TUBE APPLICATIONS SECTION. Both tubes have excellent frequency stability. Tubes require octal socket and may be mounted in any position. Outlines 2 and 14C, respectively. OUTLINES SECTION. Type 6S7-GT is used principally for renewal purposes.

HIGH-MU TWIN TRIODE

Metal type 6SF5 and glass octal type 6SF5-GT are used in resistance-coupled amplifier circuits. Outlines 2 and 14C, respectively, OUTLINES SECTION. Type 6SF5-GT may be supplied with pin No.1 omitted. Tubes require octal socket. Characteristics, application, and references under type 6SF5 apply to types 6SF5 and SSF5-GT. Heater volts (ac/dc), 6.3; anode, 6.3 volts. These types are used principally for renewal purposes.

Technical Data

GRID-No.2-AND-NO.4 SUPPLY VOLTAGE

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate</td>
<td>300 ma.</td>
</tr>
<tr>
<td>Grid-No.2</td>
<td>100 ma.</td>
</tr>
</tbody>
</table>

GRID-No.3 (CONTROL-GRID) VOLTAGE

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate</td>
<td>-50 ma.</td>
</tr>
<tr>
<td>Grid-No.3</td>
<td>0 ma.</td>
</tr>
</tbody>
</table>

PLATE DISIPATION

<table>
<thead>
<tr>
<th>Watts</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate</td>
<td>1 ma.</td>
</tr>
<tr>
<td>Grid-No.3</td>
<td>1 ma.</td>
</tr>
</tbody>
</table>

GRID-No.2-AND-NO.4 INPUT

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate</td>
<td>14 ma.</td>
</tr>
<tr>
<td>Grid-No.3</td>
<td>ma.</td>
</tr>
</tbody>
</table>

Peak Anode- Cathode Voltage

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate</td>
<td>90 ma.</td>
</tr>
<tr>
<td>Grid-No.3</td>
<td>90 ma.</td>
</tr>
</tbody>
</table>

Typical Operation

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 and shell (SSF5-GT) only</td>
<td>140 ma.</td>
</tr>
<tr>
<td>Grid-No.2 and shell (SSF5-GT) only</td>
<td>100 ma.</td>
</tr>
<tr>
<td>Grid-No.3 Voltage (Approx.) for transconductance of 10 microamps</td>
<td>3.3 ma.</td>
</tr>
<tr>
<td>Grid-No.3 Voltage (Approx.) for conversion transconductance of 100 microamps</td>
<td>9.5 ma.</td>
</tr>
<tr>
<td>Plate Current</td>
<td>9 ma.</td>
</tr>
<tr>
<td>Plate Current</td>
<td>6.5 ma.</td>
</tr>
<tr>
<td>Plate Current</td>
<td>12.3 ma.</td>
</tr>
</tbody>
</table>

NOTE: The transconductance between grid No.1 and grids No.2 and No.4 connected to plate (not oscillating) is 4500 microamps under the following conditions: grids No.1, No.3 at 0 volts; grids No.2 and No.4 and plate at 100 volts; for SSF5-GT only, grid No.3 and shell are connected to cathode at socket.

The characteristics shown with separate excitations correspond very closely to those obtained in a self-excited oscillator circuit operating with zero bias.

CONVERTER

Maximum Ratings, (Design-Center Values)

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 and No.4 (Screen-Grid) Voltage</td>
<td>300 ma.</td>
</tr>
<tr>
<td>Grid-No.2 and No.4 (Screen-Grid) Voltage</td>
<td>100 ma.</td>
</tr>
</tbody>
</table>

6SB7Y

6S7

6S7G

6S8GT

6SA7

6SA7GT

6SC7

6SF5

6SF5 GT

338

339
## Technical Data

### Class A; Amplifier

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 max</td>
<td>300 max</td>
</tr>
<tr>
<td>Grid No.1 Voltage</td>
<td>0 to 100 volts</td>
<td>100 volts</td>
</tr>
<tr>
<td>Grid No.2 Supply Voltage</td>
<td>0 max</td>
<td>50 volts</td>
</tr>
<tr>
<td>Grid No.2, 50 volts</td>
<td>2.5 max</td>
<td>3.6 max</td>
</tr>
<tr>
<td>Grid No.2 Input</td>
<td>0.7 max volts</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>90 max</td>
<td>90 volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>90 volts</td>
<td></td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>90 volts</td>
<td></td>
</tr>
</tbody>
</table>

### Typical Operation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>180</td>
<td>200</td>
</tr>
<tr>
<td>Grid No.2 Voltage</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Grid No.1 Voltage</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Plate Resistance (Approx)</td>
<td>8500</td>
<td>7800</td>
</tr>
<tr>
<td>Transconductance</td>
<td>2300</td>
<td>1550</td>
</tr>
<tr>
<td>Grid No.1 Voltage (Approx)</td>
<td>300 max</td>
<td></td>
</tr>
<tr>
<td>Plate Current</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Grid No.2 Current</td>
<td>3.9</td>
<td>3.9</td>
</tr>
</tbody>
</table>

### Pentode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 max</td>
</tr>
<tr>
<td>Grid No.2 Voltage</td>
<td>300 max</td>
</tr>
<tr>
<td>Grid No.1 Voltage</td>
<td>500 volts</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>100</td>
</tr>
<tr>
<td>Plate Resistance (Approx)</td>
<td>8500</td>
</tr>
<tr>
<td>Transconductance</td>
<td>2300</td>
</tr>
<tr>
<td>Grid No.1 Voltage (Approx)</td>
<td>300 max</td>
</tr>
<tr>
<td>Plate Current</td>
<td>6.0</td>
</tr>
<tr>
<td>Grid No.2 Current</td>
<td>3.9</td>
</tr>
</tbody>
</table>

### Remote-Cutoff Pentode

Metal type 6SK7 and glass octal type 6SK7-GT used as rf or if amplifiers in radio receivers. Outline 2 and 14C, respectively, OUTLINES SECTION. Tubs require octal socket. Grid No.1 voltage (ac/dc), 6.3; amperes, 0.3. Characteristics as class A; amplifier: plate voltages, 250 (300 max); grid No.3 connected to socket at 100 max. Plate No.2, all grid voltages, 0.7 max; plate resistance (approx), 0.3 megohms; transconductance, 2000 amhos; plate ma, 9.2; grid No.3, ma, 4.1; plate dissipation, 3 ma watts; peak heater-cathode volts, 90 max. These types are used principally for renewal purposes.

### High-MU Twin Triode

Glass octal type used as phase inverter in radio equipment. Each unit may also be used in resistance-coupled amplifier circuits. Outline 14C, 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 phase inverter or resistance-coupled amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION.

### Diode—Remote-Cutoff Pentode

Metal type used as combined rf or if amplifier and detector or aec tube in radio receivers. Also as resistance-coupled amplifier. Outline 2, OUTLINES SECTION. Tube requires octal socket. heater voltages (ac/dc), 6.3; amperes, 0.3. Typical operation of pentode unit as class A; amplifier: plate volts, 250 (300 max); grid No.2, 100 (300 max); grid No.1, 36. Plate resistance (approx), 0.3 megohms; transconductance, 2000 amhos; plate ma, 12.4; grid No.2, ma, 3.3; plate dissipation, 3 ma watts; grid No.2 input, 0.6 ma watts; peak heater-cathode volts, 90 max. For diode operation currents, refer to type 6A6E. Type 6SF7 is used principally for renewal purposes.

### Sharp-Cutoff Pentode

Metal type used as f-l amplifier tube in wide-band and high-frequency applications (up to 18 megacycles). Outline 2, OUTLINES SECTION. Tube requires octal socket. heater voltages (ac/dc), 6.3; amperes, 0.3. Characteristics as class A; amplifier: plate volts, 250 (300 max); grid No.2, 150 (300 max); grid No.1, 2.5 volts; plate resistance (approx), 0.3 megohm; transconductance, 4900 amhos; plate ma, 10.8; grid No.3, ma, 4.1; plate dissipation, 3 ma watts; grid No.2 input, 0.7 ma watts; peak heater-cathode volts, 90 max. This type is used principally for renewal purposes.

### Sharp-Cutoff Pentode

Metal type used as f-l amplifier tube in high-frequency, wide-band applications, and as a limiter tube in FM equipment. Outline 2, OUTLINES SECTION. Tube requires octal socket. heater voltages (ac/dc), 6.3; amperes, 0.3. Characteristics as class A; amplifier: plate volts, 250 (300 max); grid No.2, 150 (300 max); grid No.1, volts, 2.5 (0 max); plate resistance (approx), 0.3 megohm; transconductance, 4900 amhos; plate ma, 10.8; grid No.3, ma, 4.1; plate dissipation, 3 ma watts; grid No.2 input, 0.7 ma watts; peak heater-cathode volts, 90 max. This type is used principally for renewal purposes.

### SEMIREMOTE-CUTOFF PENTODE

Metal type used as f-l amplifier tube in wide-band and high-frequency applications (up to 18 megacycles). Outline 2, OUTLINES SECTION. Tube requires octal socket. heater voltages (ac/dc), 6.3; amperes, 0.3. Characteristics as class A; amplifier: plate volts, 250 (300 max); grid No.2, 0.005 ma volts; grid No.2, 2.5 ma; grid No.1, 7.0 ma. Grid No.1 to Plate. Grid No.1 to Grid No.2 and Grid No.3. Grid No.2 to Plate, 2.5 ma. Grid No.1 to Plate, 11 ma. With grid No.2 and No.3 connected to plate.

### 6SF7

Related type: 1257

### 6SG7

Related type: 1257

### 6SH7

Related type: 1257

### 6SJ7

Related types: 1257, 1257GT

### 6SJ7GT

Related type: 1257GT

### 6SK7

Related type: 1257

### 6SK7GT

Related types: 1257, 1257GT
**RCA Receiving Tube Manual**

**Characteristics:**
- **Plate Voltage:** 250 volts
- **Grid Voltage:** 10 volts
- **Amplification Factor:** 20
- **Plate Resistance (Approx.):** 44000 ohms
- **Transconductance:** 25000 amhos
- **Plate Current:** 2.3 ma

**6SN7GT 6SN7GTA**

**Medium-Mu Twin Triode**

Glass octal types used as combined vertical oscillators and vertical deflection amplifiers, and as horizontal deflection oscillators, in television receivers. Each unit may also be used in multivibrator or resistance-coupled amplifier circuits in radio equipment. Type 6SN7-GTB has a controlled heater warm-up time to permit use in d.c. series-connected heater strings. Outline 14C, OUTLINES SECTION. Tubes require 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. Types 6SN7-GT and 6SN7-GTA are DISCONTINUED types listed for reference only.

**Heater Voltage (AC/DC):** 6.3 volts
**Heater Current:** 0.6 ampere
**Heating Time (Average) for 6SN7-GTB:** 11 seconds
**Direct Inter-electrode Capacitances (Approx.) for 6SN7-GTB:**
  - Grid to Plate: Unit No. 1 4.0 pf, Unit No. 2 3.8 pf
  - Grid to Cathode and Heater: 2.2 pf
  - Plate to Cathode and Heater: 0.7 pf

**CLASS A; AMPLIFIER (Each Unit):**

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
<th>6SN7-GTB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plate Voltage:</strong></td>
<td>450 max volts</td>
</tr>
<tr>
<td><strong>Cathode Current:</strong></td>
<td>20 max ma</td>
</tr>
<tr>
<td><strong>Plate Disipation:</strong></td>
<td>For either plate: 5 max watts</td>
</tr>
<tr>
<td><strong>Peak Heater-Cathode Voltage:</strong></td>
<td>For both plates with both units operating: 7.5 max volts</td>
</tr>
<tr>
<td><strong>Heater negative with respect to cathode:</strong></td>
<td>230 max volts</td>
</tr>
<tr>
<td><strong>Heater positive with respect to cathode:</strong></td>
<td>230 max volts</td>
</tr>
</tbody>
</table>

**Characteristics:**
- **Plate Voltage:** 90 volts
- **Grid Voltage:** 0 volts
- **Amplification Factor:** 29
- **Plate Resistance (Approx.):** 6700 ohms
- **Transconductance:** 3000 amhos

**AVERAGE PLATE CHARACTERISTICS**

**Technical Data**

| Plate Current for grid voltage of -12.5 volts | 10 mA |
| Grid Voltage (Approx.) for plate current of 10 mA | -7 1.8 volts |

**Maximum Circuit Value:**
- **Grid-Circuit Resistance:** For fixed-bias operation 1.0 max megohm
- **Oscillator (Each Unit):**
  - **Vertical Deflection Oscillator:**
    - **6SN7-GTB**
    - **Horizontal Deflection Oscillator**
  - **Maximum Ratings, (Design-Center Values):**
    - **DC Plate Voltage:** 450 max volts
    - **DC Negative-Pulse Grid Voltage:** 1000 max volts (Absolute maximum)
    - **AVERAGE CATHODE CURRENT:** 20 max ma
    - **PLATE DISIATION:**
      - For either plate: 5 max watts
      - For both plates with both units operating: 7.5 max watts
    - **PEAK HEATER-CATHODE VOLTAGE:**
      - For either plate: 200 max volts
      - For both plates with both units operating: 200 max volts

**Maximum Circuit Value:**
- **Grid-Circuit Resistance:** For fixed-bias operation 2.2 max megohms

**TWIN DIODE—HIGH-MU TRIODE**

Metal type 6S97 and glass octal type 6S97-GT used as combined detector, amplifier, and ave tube in radio receivers. Outlines 2 and 14C, respectively, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position. These types are similar electrically to type 6Q7 in many respects, but they have a higher-mu triode. Diode-biasing of the triode unit is not suitable because of the probability of triode plate-current cutoff even with relatively small signal voltages applied to the diode circuit. Type 6S97-GT is used principally for renewal purposes.

**Heater Voltage (AC/DC):** 6.3 volts
**Heater Current:** 0.3 ampere
**Direct Inter-electrode Capacitances for 6S97:**
- **Tetrod Unit:**
  - **Grid to Plate:** 1.6 pf
  - **Grid to Cathode and Heater:** 3.2 pf
  - **Plate to Cathode and Heater:** 3.2 pf

**Related Types:**
- 12S97, 12S97GTA

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MEDIUM-MU TRIODE

Miniature type used as oscillator in tuners of uhf television receivers. Outline 1A, OUTLINES SECTION. Tube requires minimum seven-contact socket. Heater voltages (ac/dc): 63; amperes: 0.225. Characteristics as class A amplifier: plate-supply voltages: 90; cathode-bias resistor, 15 ohms; plate ma., 18; amplification factor, 18; transconductance, 7000 ohms. Maximum ratings as oscillator in uhf television receivers: plate volts: 290 ma.; grid ma. 8 ma.; plate ma. 30 ma.; plate dissipation, 5.5 ma. watts; peak heater-cathode volts, 50 ma. This type is used principally for renewal purposes.

TWIN DIODE—HIGH-MU TRIODE

Glass octal tube used as combined detector, amplifier, and a-c tube in radio receivers. Outline 25, OUTLINES SECTION. Heater voltages (ac/dc): 6.3; amperes: 0.15. Typical operation as amplifier: plate volts, 250 ma.; grid volt, -1; plate ma., 1.2; plate resistance (approx.), 6200 ohms. Amplification factor, 65; transconductance, 1050 ohms. For diode operation, refer to type 6A6. Type 677-G is a DISCONTINUED type listed for reference only.

TRIPLE DIODE—HIGH-MU TRIODE

Miniature tubes 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. Type 6T8-A has a controlled heater warm-up delay for use in receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tubes require minimum nine-contact socket and may be mounted in any position. For typical operation as resistance-coupled amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION. Type 6T8 is a DISCONTINUOUS type listed for reference only.

TWIN DIODE—MEDIUM-MU TRIODE

6SR7

Related type: 12SR7

REMOTE-CUTOFF PENTODE

Metal type used in rf or If stages of radio receivers particularly those employing a-e. Outline 2, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater voltages (ac/dc): 6.3; amperes: 0.15. Typical operation as amplifier: plate volts, 250 ma.; grid volt (approx.), 900 ma.; plate ma., 90; grid No. N. volts, 8.5; plate dissipation, 2.5 ma. watts. For diode operation, refer to type 6A6. Type 6SR7 is used principally for renewal purposes.

TWIN DIODE—MEDIUM-MU TRIODE

6ST7

Metal type used as combined detector, amplifier, and a-c tube. Within maximum ratings this type is identical to type 6B6F except for interelectrode capacitances and heater current. Outline 2, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater voltages (ac/dc): 6.3; amperes: 0.15. Maximum ratings of triode unit, as class A amplifier: plate volts, 250 ma.; grid volt, -1; plate ma., 1.2; plate resistance (approx.), 1850 ohms; plate ma., 9 grid No. 9 ma., 2; plate dissipation, 2.25 ma. watts; grid No. 9 input, 0.35 ma. watts. Type 6ST7 is used principally for renewal purposes.

TWIN DIODE—MEDIUM-MU TRIODE

6SZ7

Metal type used as combined detector, amplifier, and a-c tube in radio receivers. Except for heater-current rating and interelectrode capacitances, this type is essentially the same electrically as type 6AT7. Outline 2, OUTLINES SECTION. Tube requires octal socket. Heater voltages (ac/dc): 6.3; amperes: 0.15. For diode operation, refer to type 6A6. Type 6SZ7 is a DISCONTINUED type listed for reference only.
**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

Minisurace types used as combined oscillator and mixer tubes in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. Type 6U8-A has a controlled heater warm-up time for use in television receivers employing series-connected heater strings. Outline SE, OUTLINES SECTION. Tubes require minimum nine-contact socket and may be mounted in any position. Type 6U8 is a DISCONTINUED type listed for reference only.

**6U8**

**6U8A**

**HEATER VOLTAGE (AC/DC):**

<table>
<thead>
<tr>
<th></th>
<th>6.3</th>
<th>6.45</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEATER CURRENT:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.45</td>
<td>6.45</td>
</tr>
<tr>
<td><strong>HEATER WARM-UP TIME (Average) for 6U8-A:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With External Shield</td>
<td>11</td>
<td>seconds</td>
</tr>
<tr>
<td>Without External Shield</td>
<td>11</td>
<td>seconds</td>
</tr>
</tbody>
</table>

**DIRECT INTERELECTRODE CAPACITANCES:**

<table>
<thead>
<tr>
<th>Triode Unit</th>
<th>Grid to Plate</th>
<th>Grid to Cathode, Heater, Pentode Cathode, Pentode Grid No.3, and Internal Shield</th>
<th>Plate to Cathode, Heater, Pentode Cathode, Pentode Grid No.3, and Internal Shield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.6</td>
<td>1.6</td>
<td>pf</td>
</tr>
<tr>
<td></td>
<td>2.8</td>
<td>2.8</td>
<td>pf</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>2</td>
<td>pf</td>
</tr>
</tbody>
</table>

**Pentode Unit:**

| Grid No.1 to Plate | 0.100 max | |
| Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield | 0.000 max | pf |
| Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield | 5.0 | 5.0 | pf |
| Triode Cathode to Heater | 2.6 | 3.5 | pf |
| Pentode Cathode, Pentode Grid No.3, and Internal Shield to Heater | 3 | 3.0 | 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 |

* With external shield connected to pin 4 except as noted.
* With external shield connected to pin 6.

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE-VOLTAGE</td>
<td>330 max</td>
</tr>
<tr>
<td>GRID-NO.2 SCREEN-GRID SUPPLY VOLTAGE</td>
<td></td>
</tr>
<tr>
<td>GRID-NO.2 VOLTAGE</td>
<td></td>
</tr>
<tr>
<td>GRID-NO.1 CONTROL-GRID VOLTAGE (Positive bias voltage)</td>
<td>0 max</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>2.5 max</td>
</tr>
<tr>
<td>GRID-NO.2 INPUT</td>
<td>0.655 max</td>
</tr>
<tr>
<td>For grid-No.2 voltages up to 165 volts</td>
<td></td>
</tr>
<tr>
<td>For grid-No.2 voltages between 165 and 330 volts</td>
<td></td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200*max</td>
</tr>
</tbody>
</table>

**Characteristics:**

<table>
<thead>
<tr>
<th></th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE-VOLTAGE</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td></td>
<td>110</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td></td>
<td>-1</td>
</tr>
<tr>
<td>AMPLIFICATION FACTOR</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>PLATE RESISTANCE (APPROX.)</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>TRANSMISSION</td>
<td></td>
<td>7500</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate dissipation</td>
<td></td>
<td>13.5</td>
</tr>
<tr>
<td>GRID-NO.2 CURRENT</td>
<td></td>
<td>13.5</td>
</tr>
<tr>
<td>PLATE CURRENT</td>
<td></td>
<td>3.5</td>
</tr>
</tbody>
</table>

* The dc component must not exceed 180 volts.
HALF-WAVE VACUUM RECTIFIER

6V3A

Miniature type used as a damper tube in horizontal deflection circuits of television receivers. Outline 3B, OUTLINES SECTION, except vertical dimensions are 7/32 inch shorter than shown. Tube requires miniature nine-contact socket and may be 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, 1.75.

DAMPER SERVICE

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

Maximum Ratings, (Design-Center Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Inverse Plate Voltage (Absolute Maximum)</td>
<td>6000 max volts</td>
</tr>
<tr>
<td>Peak Plate Current</td>
<td>0.02 max ma</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>350 ma</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage: Heater negative with respect to cathode (Absolute Maximum)</td>
<td>6750 max volts</td>
</tr>
</tbody>
</table>

* 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.

6V6GT

BEAM POWER TUBE

Metal type 6V6 and glass octal types 6V6-GT and 6V6-GTA are used as output amplifiers in automobile, battery-operated, and other receivers in which reduced plate-current drain is desirable. Outlines 5, 14C, and 14C, respectively, OUTLINES SECTION. Type 6V6-GT may be supplied with pin No.1 omitted. Tubes require octal socket and may be mounted in any position. These tubes are equivalent in performance to type 6AQ5-A. Refer to type 6AQ5-A for average plate characteristic curves. Type 6V6-GT is a DISCONTINUED type listed for reference only.

Heater Voltage (ac/dc) | 40 volts |
Heater Current | 0.45 amperes |
Heater Wake-Up Time (Average) | 11 seconds |

DIRECT INTERELEETRODE CAPACITANCES (Approx.):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No.1 to Plate</td>
<td>0.3 pf</td>
</tr>
<tr>
<td>Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3</td>
<td>10 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, Grid No.2, and Grid No.3</td>
<td>10 pf</td>
</tr>
<tr>
<td>With shell connected to cathode.</td>
<td></td>
</tr>
</tbody>
</table>

6V6-GTA

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>350 max volts</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-grid) Voltage</td>
<td>315 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>14 max watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage: Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
</tbody>
</table>

Typical Operation:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>180 250 315 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>180 250 315 volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-grid) Voltage</td>
<td>8.5 12.5 13 volts</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>29 45 75 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>30 47 75 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>3 4.5 2.2 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>3 4.5 2.2 ma</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>68000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>4000</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>4000</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>8%</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>100000</td>
</tr>
</tbody>
</table>

HALF-WAVE VACUUM RECTIFIER

6V7G

Glass octal type used as combined detector, amplifier, and axe tube. Outline 25, OUTLINES SECTION. Except for interelectrode capacitances, this type is identical electrically with type 65. Heater volts (ac/dc), 6.3; amperes, 0.3. For diode operating curves, refer to type 6AQ5. Type 6V7G is a DISCONTINUED type listed for reference only.

TWIN DIODE—LOW-MU TRIODE

6W4GT

Glass octal type used as damper tube in television receivers. Outline 12C, OUTLINES SECTION. This tube may be supplied with pin No.1 omitted. 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. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Power-reflector operation of this type is not recommended.
**RCA Receiving Tube Manual**

**HEATER VOLTAGE (AC)...** 6.3 volts
**HEATER CURRENT...** 1.2 amperes
**DIRECT EXTERNAL CAPACITANCES (APPROX.)...**
- Plate to Cathode and Heater... 6 pf
- Cathode to Plate and Heater... 13 pf
- Heater to Cathode... 7 pf

**DAMPER**

For operation in a 355-line, 30-frame system

**Maximum Ratings, (Design-Maximum Values):**
- **Peak Inverse Plate Voltage (Absolute Maximum)**: 3650 volts
- **Peak Plate Current**: 150 ma
- **DC Plate Current**: 125 ma
- **Plates Dissipation**: 3.5 watts
- **Peak Heater-Cathode Voltage**: 2500 volts
- **Heater negative with respect to cathode (Absolute Maximum)**
- **Heater positive with respect to cathode**

**Characteristics, Instantaneous Values:**
- Tube Voltage Drop for plate current of 250 ma: 21 volts

**6W6GT**

**Related type:** 126W6GT

**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 14C, OUTLINES SECTION. This type may be supplied with pin No.1 omitted. Tube requires octal socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC)...** 6.3 volts
**HEATER CURRENT...** 1.2 amperes
**DIRECT EXTERNAL CAPACITANCES (APPROX.)...**
- Grid No.1 to Plate... 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... 9 pf

**CLASS A1 AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- **Plate Voltage**: 330 ma, volts
- **Grid-No.2 (Screen-Grid) Voltage**: 165 ma, volts
- **Plates Dissipation**: 1.35 ma, watts
- **Grid-No.2 Input**: 200 ma, volts
- **Peak Heater-Cathode Voltage**: 200 max, volts
- **Heater negative with respect to cathode**
- **Heater positive with respect to cathode**

**AVG-PLATE CHARACTERISTICS**

**TRIODE CONNECTION**

**VERTICAL DEFLECTION AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- **DC PLATE VOLTAGE**: 1200 max, volts
- **DC GRID-No.2 (SCREEN-GRID) VOLTAGE**: -275 max, volts
- **AVG-GRID CURRENT**: 66 ma, ma
- **AVG-PLATE CURRENT**: 8.5 ma, ma
- **PLATES DISSIPATION**: 1.2 ma, watts
- **GRID-No.2 INPUT**: 200 ma, volts

**Maximum Circuit Values:**
- **Grid-No.1 Circuit Resistance**: 0.1 max, megohms
- **For cathode-bias operation**

**AVERAGE PLATE CHARACTERISTICS**

**TRIODE CONNECTION**

**350**
RCA Receiving Tube Manual

SHARP-CUTOFF PENTODE

Glass octal type used as biased detector or high-gain amplifier in radio receivers. Outline 28, OUTLINE SECTION. Tube requires octal socket. Heater volts (ac/dc), 6.3; amperes, 0.15. Maximum ratings: plate volts, 300 volts; grid-No.2 (screen-grid) volts, 100 volts; grid-No.3 supply volts, 300 volts; grid-No.1 (control-grid) volts, 0 volts; plate dissipation, 0.5 watts; plate: 6W7-G is a DISCONTINUED type listed for reference only.

FULL-WAVE VACUUM RECTIFIER

Miniature type used in power supply of automobile and co-operated radio receivers. Equivalent in performance to other types 6X4 and 6X5-GT. Type 6X4 requires miniature seven-contact socket and may be mounted in any position. Outline 7C, OUTLINE 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. Heater volts (ac/dc), 6.3; amperes, 0.6.

FULL-WAVE RECTIFIER

Maximum Ratings, (Design-Maximum Values):

- Peak Inverse Plate Voltage: 1250 volts
- Steady-State Peak Plate Current (Per Plate): 250 ma
- AC Plate Supply Voltage (Per Plate, rms): 350 volts
- DC Output Voltage: 50 volts
- DC Output Current: 45 ma
- Hot-Switching Transient Plate Current: 45 ma
- Peak Heater-Cathode Voltage: 450 ma
- Heater positive with respect to cathode: 200 ma

Operation Characteristics:

- Full-Wave Circuit, Choke Input to Filter

Typical Operation:

<table>
<thead>
<tr>
<th>Filter Input</th>
<th>Choke</th>
<th>Vibrator Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitor</td>
<td>Choke</td>
<td>Capacitor</td>
</tr>
<tr>
<td>AC Plate Supply Voltage (Each plate, rms)</td>
<td>325</td>
<td>400</td>
</tr>
<tr>
<td>Effective Plate Supply Impedance (Each plate)</td>
<td>625</td>
<td>10</td>
</tr>
<tr>
<td>DC Output Current</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>DC Output Voltage at Input to Choke (Approx.)</td>
<td>325</td>
<td>340</td>
</tr>
</tbody>
</table>

The 6X4 is used in vibrator operation with a minimum duty cycle of 75 per cent.

The 6X4 is used in the choke-input circuit is recommended. Such circuits limit the hot-switching current to the value no higher than that of the peak plate current. When the choke-input circuits are used, a maximum current is used per plate of 0.1 amperes during the initial cycles of the hot-switching current.

The 6X4 is used in the choke-input circuit is recommended. Such circuits limit the hot-switching current to the value no higher than that of the peak plate current. When the choke-input circuits are used, a maximum current is used per plate of 0.1 amperes during the initial cycles of the hot-switching current.

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. In such service, the 6X8 gives performance comparable to that obtainable with a 6AG6 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 as a pentode mixer or as a triode-connected mixer depending on signal-to-noise considerations. Outline 8B, OUTLINE SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.
RCA Receiving Tube Manual

HEATER VOLTAGE ................................................................. 6.3 volts
HEATER CURRENT ............................................................... 0.45 ampere

DIRECT INTERELECTRODE CAPACITANCES:

Without With

TRIODE UNIT: Shield* External
Grid to Plate ......................................................... 1.5 1.5 pf
Grid to Cathode and Heater ...................... 2 2 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 pf
Plate to Cathode, Heater, Grid No.2, and Grid No.3 .... 0.9 1.6 pf
Pentode Grid No.1 to Triode Plate ........ 0.65 max 0.64 max pf
Pentode Plate to Triode Plate ............... 0.05 max 0.008 max pf
Heater to Cathode .............................................. 6.5 6.5* pf

* With external shield connected to cathode except as noted.
* With external shield connected to pentode plate.

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid No.2 (Screen-Grid) Supply Voltage</th>
<th>Grid No.2 Voltage</th>
<th>Grid No.1 Control-Grid Voltage, Positive bias value</th>
<th>Plate Dissipation</th>
<th>Grid No.2 Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>275 max</td>
<td>275 max volts</td>
<td>See curve page 70</td>
<td>0 max volts</td>
<td>1.7 max watts</td>
<td>0.45 max volts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For grid No.2 voltages up to 137.5 volts
For grid No.2 voltages between 137.5 and 275 volts
Heater negative with respect to cathode
Heater positive with respect to cathode

Characteristics:

Triode Unit Pentode Unit
Plate Voltage ...................................................... 125 125 volts
Grid No.3 ......................................................... 125 volts
Grid No.2 Voltage ................................................. 1 volt
Amplification Factor ............................................. 40
Plate Resistance (Approx.) ...................................... 6000 30000 ohms
Transconductance ................................................. 5500 amhos
Plate Current ..................................................... 12 9 ma
Grid No.2 Current .................................................. 2.2 ma
Grid No.1 Voltage (Approx.) for plate current of 26 ma ... 0.5 volts

* The dc component must not exceed 100 volts.

AVERAGE PLATE CHARACTERISTICS

Technical Data

AVERAGE PLATE CHARACTERISTICS
PENTODE UNIT

6Y5

FULL-WAVE VACUUM RECTIFIER

Glass type used in power supply of radio receivers. Maximum dimensions: over-all length, 3-9/16 inches; seated height, 2-9/16 inches; diameter, 1-9/16 inches. Heater volts (ac/dc), 6.3; amperes, 0.6. The maximum ac plate voltage per plate is 550 volts (rms), and the dc output current is 50 ma. This is a DISCONTINUED type listed for reference only.

BEAM POWER TUBE

6Y6G
6Y6GA

Glass octal types used as output amplifier in radio receivers. Also used in rf-operated, high-voltage power supplies in television equipment. Except for envelope size and direct interelectrode capacitances, type 6Y6-G and type 6Y6-GA are identical. Outlines 26B and 19B, respectively, OUTLINES SECTION. Tubes require octal socket and may be mounted in any position.

HEATER VOLTAGE (DC/AC) ............................................... 6.3 volts
HEATER CURRENT .......................................................... 1.25 amperes

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 ... 15 12 pf
Plate to Cathode, Heater, Grid No.2, and Grid No.3 .... 11 7.5 pf

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Center Values):

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid No.2 (Screen-Grid) Supply Voltage</th>
<th>Grid No.2 Voltage</th>
<th>Grid No.2 Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 max volts</td>
<td>See curve page 70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For grid No.2 voltages up to 100 volts
For grid No.2 voltages between 100 and 200 volts

Plate Dissipation .................................................. 15 15 watts
Peak Heater-Cathode Voltage: Heater negative with respect to cathode
Heater positive with respect to cathode

Typical Operation:
Plate Voltage ..................................................... 125 200 volts
Grid No.2 Voltage .................................................. 125 132 volts
Grid No.1 Control-Grid Voltage ............. -15.5 -14 volts
Peak AP Grid No.1 Voltage ................. 19.3 14 volts

354
355
**BEAM POWER TUBE**

Glass lock-in type used as output amplifier in radio receivers in which the plate voltage available for the output stage is relatively low. Outline 13B, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 6.3; amperes, 0.75. Typical operation and maximum ratings as class A amplifier: plate volts, 110 (125 max); grid-No.1 voltage, 110 (125 max); plate resistance, 6.5 kohms; plate current, 5 ma; plate-dissipation, 10 milliwatts; maximum total harmonic distortion, 10 per cent; maximum signal power output, 1.5 watts; peak heater-cathode volts, 50 ma. This type is used principally for renewal purposes.

**TWIN DIODE**

Glass lock-in type used as detector, low-voltage rectifier, or arc tube. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 6.3; amperes, 0.3. Maximum ratings: rectifier: ac plate volts per plate (rms), 150; dc output ma, per plate, 8; peak ma, per plate, 40; peak heater-cathode volts, 330. The application of this type is similar to that of metal type 6K6. Type 7A6 is used principally for renewal purposes.

**REMOTE-CUTOFF PENTODE**

Glass lock-in type used as rf or if amplifier in radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 6.3; amperes, 0.3. For maximum ratings, typical operation, and curves, refer to metal type 6K7. Type 7A7 is used principally for renewal purposes.

**OCTODE CONVERTER**

Glass lock-in type used as converter in superheterodyne circuits. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 6.3; amperes, 0.1. Typical operation and maximum ratings as frequency converter: plate volts, 250 (300 max); grid-No.3 and-No.5 volts, 100 ma; grid-No.2 supply volts, 250 applied through a 2000-ohm dropping resistor (300 ma); grid-No.2 volts, 200 ma; plate dissipation, 1 max watt; grid-No.3 input, 0.75 max watt; grid-No.4 voltage, 3 (0 ma); grid-No.1 resistor, 500 ohms; plate ma, 3 grid-No.2 and-No.5, 5 ma; grid-No.2 ma, 4.2; grid-No.1 ma, 0.4; plate resistance (approx.), 0.7 megohm; conversion transconductance, 500 micromhos; peak heater-cathode volts, 90 ma. This type is used principally for renewal purposes.

**POWER PENTODE**

Lock-in type used in output stage of video amplifier of television receivers. Outline 13B, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 6.3; amperes, 0.5. Characteristics and maximum ratings as class A amplifier: plate supply volts, 300 ma; grid-No.3 supply volts, 150 (300 max); grid-No.2 volts, see curve page 70; grid-No.1 voltage, positive bias value, 0 ma; grid-No.2 input, for grid-No.2 voltages up to 150 ma, 1.2 megohm; transform voltage, 3000 volts; max heater-cathode volts, 90 ma. Type 7AD7 is a DISCONTINUED type listed for reference only.
**RCA Receiving Tube Manual**

**MEDIUM-MU TWIN TRIODE**
Glass lock-in type used as voltage amplifier or phase inverter in radio equipment. Outline 18A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 6.3; anodes, 0.3. Characteristics and maximum ratings as Class A amplifier: plate supply voltages, 250 (300 max); grid voltages, positive/bias value, 0 max; plate resistance (approx.), 6000 ohms, peak heater-cathode volts, 90 max. This type is used principally for renewal purposes.

**SHARP-CUTOFF PENTODE**
Glass lock-in type used as rf amplifier in ac/dc receivers or in mobile equipment where low heater current drain is important. Outline 18A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 6.3; anodes, 0.15. Characteristics and maximum ratings as class A amplifier: plate and grid-No.2 supply voltages, 250 (300 max); grid-No.1 voltages, positive/bias value, 0 max; plate dissipation, 2 max watts; grid-No.2 input, 0.75 max watt; grid No.3 and interal shield connected to cathode at socket; plate resistance (approx.), greater than 1 megohm; transconductance, 4200 μmhos; cathode bias resistor, 220 ohms; plate ma., 6; grid-No.2 ma., 2; peak heater-cathode volts, 90 max. This type is used principally for renewal purposes.

**MEDIUM-MU TWIN TRIODE**
Miniature type used as combined vertical deflection amplifier and vertical deflection oscillator in television receivers. This type has a controlled heater warm-up time for use in receivers employing series-connected heater strings. Each unit may also be used as a horizontal deflection oscillator, or in audio mixer, phase inverter, multivibrator, syne separator and amplifier, and resistance-coupled amplifier circuits in radio equipment. Outline 18B, OUTLINES SECTION. Heater volts (ac/dc), 7 in series arrangement, 3.5 in parallel arrangement; anodes, 0.3 (series), 0.6 (parallel); warm-up time (average) in parallel arrangement, 11 seconds. Except for heater ratings, this type is identical with miniature type 12AU7-A.

**HIGH-MU TRIODE**
Glass lock-in type used in resistance-coupled amplifier circuits. Outline 18A, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 6.3; anodes, 0.3. Except for interelectrode capacitance, this type has the same maximum ratings and characteristics as metal type 6F7G and 6F8G. Type 7B4 is used principally for renewal purposes.

**POWER PENTODE**
Glass lock-in type used in output stage of radio receivers. Outline 18B, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 6.3; anodes, 0.4. Except for interelectrode capacitances, this type is the same electrically as metal type 6K6-GT. Type 7B5 is used principally for renewal purposes.

**TWIN DIODE—HIGH-MU TRIODE**
Glass lock-in type used as combined detector, amplifier, and arc tube. Outline 18A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 6.3; anodes, 0.3. Except for interelectrode capacitances, this type is the same electrically as metal type 6Q7. Type 7B6 is used principally for renewal purposes.

**REMOTE-CUTOFF PENTODE**
Glass lock-in type used as rf or if amplifier in radio receivers employing ac/dc. Outline 18A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 6.3; anodes, 0.15. Characteristics and maximum ratings as class A amplifier: plate voltages, 250 (300 max); grid-No.2 voltages, 100 max; grid-No.1 voltages, 0.3 (positive/bias value, 0 max); grid No.3 and internal shield connected to cathode at socket; plate ma., 8.5; grid-No.2 ma., 1.7; grid-No.2 input, 0.25 max watt; plate dissipation, 2.35 watts; grid-No.1 dissipation, 0.75 watts; transconductance, 1750 μmhos; peak heater-cathode volts, 90 max. Type 7B7 is used principally for renewal purposes.

**PENTAGRID CONVERTER**
Glass lock-in type used as frequency converter in heterodyne circuits. Outline 18A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 6.3; anodes, 0.3. Except for interelectrode capacitances, this type is the same electrically as metal type 6A4. Type 7B8 is used principally for renewal purposes.

**BEAM POWER TUBE**
Glass lock-in type used as output amplifier in radio receivers. Outline 18B, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 6.3; anodes, 0.45. Refer to metal type 6V6 for maximum ratings and typical operation as class A amplifier and as push-pull class A amplifier. Type 7C5 is used principally for renewal purposes.

**TWIN DIODE—HIGH-MU TRIODE**
Glass lock-in type used as combined detector, amplifier, and arc tube. Outline 18A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 6.3; anodes, 0.15. Characteristics and maximum ratings of triode unit as class A amplifier: plate voltages, 250 (300 max); grid voltages, -1 (positive/bias value, 0 max); plate ma., 1.5; amplification factor, 100; plate resistance (approx.), 0.1 megohm; transconductance, 1000 μmhos; peak heater-cathode volts, 90 max. For diode operation curves and triode application, refer to miniature type 6AV6. Type 7C6 is used principally for renewal purposes.
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## SHARP-CUTOFF PENTODE

- **7L7**
  - Glass lock-in type used as rf amplifier in radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (ac/dc), 6.3; amperes, 0.3. Typical operation as class A amplifiers: plate volts, 250 (300 max); grid-No.2 volts, 100; grid-No.1 volts, 2; plate resistance, 1.22 megohms; conversion transconductance, 3100 umhos; plate ma., 1.5; total cathode ma. (both units), 10.2. This is a DISCONTINUED type listed for reference only.

## MEDIUM-MU TWIN TRIODE

- **7N7**
  - Glass lock-in type used as voltage amplifier or phase inverter in radio equipment. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (ac/dc), 6.3; amperes, 0.6. For maximum ratings and typical operation of each triode unit, refer to metal type 6S7G. The application of this type is similar to that of glass-oval type 6S77G-T. Type 7N7 is used principally for renewal purposes.

## PENTAGRID CONVERTER

- **7Q7**
  - Glass lock-in type used as converter in superheterodyne circuits. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (ac/dc), 6.3; amperes, 0.3. For maximum ratings, typical operation in converter service and curves, refer to metal type 6S7Q. Type 7Q7 is used principally for renewal purposes.

## TWIN DIODE—REMOTE-CUTOFF PENTODE

- **7R7**
  - Glass lock-in type used as combined detector, amplifier, and audio tube. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (ac/dc), 6.3; amperes, 0.3. Characteristics and maximum ratings of pentode unit as class A amplifier: plate volts, 250 ma.; grid-No.2 supply volts, 250 ma.; grid-No.2 volts, 100; grid-No.1 volts, 1 (punctum). Typical operation as triode tube: plate resistance (approx.), 1.8 megohms; transconductance, 2000 umhos; plate ma., 0.7; grid-No.2 ma., 2.1; peak heater-cathode volts, 90 ma. Refer to type 6A6V for diode curves. Type 7R7 is used principally for renewal purposes.

## TRIODE—HEPTODE CONVERTER

- **7S7**
  - Glass lock-in type used as combined triode oscillator and heptode mixer in radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (ac/dc), 6.3; amperes, 0.5. Typical operation of heptode unit: plate volts, 250 (300 max); grid-No.2 and-No.4 volts, 100; grid-No.1 volts, 2; plate resistance, 1.25 megohms; conversion transconductance, 325 umhos; plate ma., 1.6; grid-No.2 and-No.4 ma., 2.9. Typical operation of triode unit: plate supply volts, 250 (300 max); applied through a 2000-ohm dropping resistor, with a 0.1-ohm capacitor; grid resistor, 50000 ohms; plate ma., 5.0; total cathode ma. (both units), 10.8. This is a DISCONTINUED type listed for reference only.

---

**Technical Data**

## SHARP-CUTOFF PENTODE

- **7V7**
  - Glass lock-in type used as rf or if amplifier in radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (ac/dc), 6.3; amperes, 0.3. Maximum ratings as class A amplifier: plate volts, 250 ma.; grid-No.2 supply volts, 250 ma.; grid-No.2 volts, 100; grid-No.1 volts, 2; plate resistance, 1.25 megohms; plate ma., 5.0; total cathode ma. (both units), 10.2. This is a DISCONTINUED type listed for reference only.

## FULL-WAVE VACUUM RECTIFIER

- **7Y4**
  - Glass lock-in type used in power supply of automobile radio receivers and compact ac-operated receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (ac/dc), 6.3; amperes, 0.5. Maximum ratings: peak inverse plate voltage, 1250; peak plate ma., 100; plate supply volts, 250; peak plate current, 100; peak heater-cathode volts, 45. For typical operation, refer to miniature type 6X4. Type 7Y4 is used principally for renewal purposes.

## MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

- **8AU8**
  - Miniature type used in a wide variety of applications in television receivers employing series-connected heater strings. The pentode unit is used as a video amplifier, an if amplifier, or
an acg amplifier. The triode unit is used in sync-amplifier, sync-separator, sycle, and phase-inverter circuits. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.45. Except for heater ratings, this type is identical with type 6AU8.

**HIGH-MU TRIODE—**
**SHARP-CUTOFF PENTODE**

8AW8A

Related type: 6AW8A

Miniature type used in a wide variety of applications in television receivers employing series-connected heater strings. The pentode unit is used as an amplifier and the triode unit is used in low-frequency oscillator or sync circuits. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AW8-A.

**TWIN DIODE—**
**MEDIUM-MU TWIN TRIODE**

8B10

Related type: 6B10

Duodecar type used as combined horizontal-deflection oscillator and horizontal phase detector in television receivers employing series-connected heater strings. Outline 12A, OUTLINES SECTION. Heater volts (ac/dc), 8.5; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodecar type 6B10.

**MEDIUM-MU TRIODE—**
**SHARP-CUTOFF PENTODE**

8BA8A

Related type: 6BA8A

Miniature type used in a wide variety of applications in color and black-and-white television receivers employing series-connected heater strings. The pentode unit is used as an amplifier, an acg amplifier, or a reactance tube. The triode unit is used in low-frequency oscillator and phase-splitter circuits. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 8.4; amperes, 0.45. Except for heater ratings, this type is identical with miniature type 6BA8-A.

**MEDIUM-MU TRIODE—**
**SHARP-CUTOFF PENTODE**

8BH8

Related type: 6BH8

Miniature type used in a wide variety of applications in television receivers employing series-connected heater strings. The pentode unit is used as an amplifier, a video amplifier, or an acg amplifier. The triode unit is used in low-frequency oscillator circuits. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.45. Except for heater ratings, this type is identical with type 6BH8.

**TWIN DIODE—**
**HIGH-MU TRIODE**

8BN8

Related type: 8BN8

Miniature type used in a wide variety of applications in color and black-and-white television receivers employing 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 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.45. Except for heater ratings, this type is identical with type 6BN8.

**POWER PENTODE**

8BQ5

Related type: 6BQ5

Miniature type used in the output stage of audio-frequency amplifiers employing series-connected heater strings. Outline 8E, OUTLINES SECTION. Heater volts (ac/dc), 8; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6BQ5.

**MEDIUM-MU TWIN TRIODE**

8CG7

Related type: 6CG7

Miniature type used as combined vertical deflection and horizontal deflection oscillator in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CG7.

**MEDIUM-MU DUAL TRIODE**

8CM7

Related type: 6CM7

Miniature type used as combined vertical oscillator and vertical deflection amplifier in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CM7.

**TWIN DIODE—**
**HIGH-MU TRIODE**

8CN7

Related type: 6CN7

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 audio-amplifier circuits. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 8.4 (series), 4.2 (parallel); amperes, 0.225 (series), 0.45 (parallel); warm-up time (average), 11 seconds (parallel). Except for heater ratings, this type is identical with type 6CN7.
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MEDIUM-MU DUAL TRIODE

8CS7
Related type: 6CS7

Miniature type used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.45; heater warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6CS7.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

8CX8
Related type: 6CX8

Miniature type used in television receivers employing series-connected heater strings. Pentode unit is used as video amplifier; triode unit is used in sound if amplifier, sweep-oscillator, sync-separator, sync-amplifier, and sync-clipping circuits. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6CX8.

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

8EB8
Related type: 6EB8

Miniature type used in color and black-and-white television receivers employing series-connected heater strings. The pentode unit is used as a video output amplifier; the triode unit is used in sync-separator, sync-clipping, and phase-inverter circuits. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6EB8.

BEAM POWER TUBE

8EM5
Related type: 6EM5

Miniature type used as vertical deflection amplifier in television receivers utilizing picture tubes having diagonal deflection angles of 110 degrees and employing series-connected heater strings. Outline 8E, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6EM5.

TWIN DIODE—SHARP-CUTOFF PENTODE

8ET7
Related type: 6ET7

Miniature type used in television receivers employing series-connected heater strings. The pentode unit is used as a video amplifier and the diodes are used as a horizontal phase inverter. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 8; amperes, 0.6; warm-up time (average), 11 seconds.

Technical Data

PENTODE UNIT AS CLASS A: AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 maz volts</td>
</tr>
<tr>
<td>Grid-No.2 (SCREEN-OFF) Voltage</td>
<td>330 maz volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>See curve page 79</td>
</tr>
<tr>
<td>Grid-No.1 (CONTROL-GRID) Voltage, Positive-bias value.</td>
<td>0 maz volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>1.1 maz watts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Plate Voltage</td>
<td>155 maz volts</td>
</tr>
<tr>
<td>Plate Current</td>
<td>18 m</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 100 ma</td>
<td>-10 ma</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1-Circuit Resistance</td>
<td>69</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>110</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>220</td>
</tr>
<tr>
<td>Transconductance</td>
<td>11500</td>
</tr>
<tr>
<td>Plate Current</td>
<td>25 ma</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>55 ma</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 100 ma</td>
<td>-10 ma</td>
</tr>
</tbody>
</table>

DIODE UNITS

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Current</td>
<td>3 maz</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>200 maz</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 maz</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 maz</td>
</tr>
</tbody>
</table>

Characteristics, Instantaneous Value:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube Voltage Drop for plate current of 1.5 ma</td>
<td>10 volts</td>
</tr>
<tr>
<td>This value can be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not be exceeded.</td>
<td></td>
</tr>
</tbody>
</table>

MEDIUM-MU TWIN TRIODE

8FQ7
Related type: 6FQ7

Miniature type used as combined vertical- and horizontal-deflection oscillator in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 8.4; amperes, 0.45. Except for heater ratings, the 8FQ7 is identical with type 6FQ7.

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

8GN8
Related type: 6GN8, 10GN8

Miniature type used in color and black-and-white television receivers employing series-connected heater strings. Triode unit is used in voltage-amplifier applications; pentode unit is used in output stage of video amplifier. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 8; amperes, 0.6; heater warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6GN8.
HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

8JV8
Related type: 6JV8

Miniature type used in a wide variety of applications in television receivers, particularly those having low-voltage "B" supplies and employing series-connected heater strings. The triode unit is used in sound, keyed-age, sync-separator, sync-amplifier, and noise-suppression circuits. The pentode unit is especially useful as a video amplifier tube. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.5; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6JV8.

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

8KA8
Related type: 6KA8

Miniature type used in color and black-and-white television receivers employing series-connected heater strings. The triode unit is used in sync-separator circuits; the pentode unit has two independent control grids and is used in gated-age-amplifier and noise-inverter circuits. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 8.4; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6KA8.

MEDIUM-MU TWIN TRIODE

9AU7
Related types: 7AU7, 12AU7A

Miniature type used as combined vertical-deflection-amplifier and vertical-deflection-oscillator in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 9.4 (series), 4.7 (parallel); amperes, 0.225 (series), 0.45 (parallel); warm-up time (average), 11 seconds (parallel). Except for heater ratings, this type is identical with type 12AU7-A.

TWIN DIODE—HIGH-MU TRIODE

9BR7

Miniature type used as combined sync separator and horizontal phase detector in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater volts (ac/dc), 9.4 (series), 4.7 (parallel); amperes, 0.3 (series), 0.6 (parallel); warm-up time (average), 11 seconds. Characteristics of triode unit as class A amplifier: plate supply volts, 250 (300 max); cathode-bias resistor, 220 ohms; amplification factor, 60; plate resistance (approx.), 19600 ohms; transconductance, 4000 µmhos; plate ma., 10; plate dissipation, 2.5 max watts. Maximum ratings of diode unit: peak inverse plate volts, 300 ma.; peak plate ma., 69 ma.

MEDIUM-MU TRIODE—SHARP-CUTOFF TETRODE

9CL8

Miniature type used as combined oscillator and mixer in v.h.f. tuners of television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tuberequires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 9.5; amperes, 0.3; warm-up time (average), 11 seconds.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

9U8A
Related type: 9U8A

Miniature type used in television receivers employing series-connected heater strings. Tube is used as combined oscillator and mixer tube in v.h.f. tuners of television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. Outline 8B, OUTLINES SECTION. Heater voltage (ac/dc), 9.45; amperes, 0.3; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6U8-A.

POWER TRIODE

10

Glass type used as an audio-frequency amplifier. Outline 28, OUTLINES SECTION. Tube requires four-contact socket. Filament volts (ac/dc), 7.5; amperes, 1.25. Typical operation as class A: power amplifier; plate volts, 425 ma.; grid volts, -40; peak af grid volts, 50; plate ma., 18; plate resistance, 5000 ohms; transconductance, 1500 µmhos; load resistance, 10200 ohms; undistorted output watts, 1.6. This is a DISCONTINUED type listed for reference only.

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

10C8

Miniature type used in diversified applications in television receivers employing series-connected heater strings. The pentode unit is used as a general-purpose amplifier tube; the triode unit is used in vertical-deflection-oscillating, sync-separator, sync-clipping, and sync-amplifier circuits. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater volts (ac/dc), 16.5; amperes, 0.3; warm-up time (average), 11 seconds. Characteristics of triode unit as class A amplifier: plate supply volts, 250 (300 max); cathode-bias resistor, 390 ohms; amplification factor, 65; plate resistance (ap-
**RCA Receiving Tube Manual**

**DUAL TRIODE**

Miniature type used as combined vertical oscillator and vertical deflection amplifier in television receivers employing series-connected heater strings. 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 8D, OUTLINES SECTION. Heater volts (ac/dc), 9.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6DE7.

**DUAL TRIODE**

Miniature type used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 9.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, the 10DR7 is identical with type 6DR7.

**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-age, or noise-suppressor tube. The pentode unit is used as a video output tube. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 10.2; amperes, 0.45. Except for heater ratings, this type is identical with miniature type 6DX8.

**DUAL TRIODE**

Glass octal type used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers employing series-connected heater strings. Outline 19, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 9.7; amperes, 0.6; warm-up time (average), 11 seconds. For maximum ratings and characteristics, refer to type 6EG7.

**Technical Data**

**DUAL TRIODE**

Glass octal type containing high-mu triode and high-pervenance, low-mu triode in same envelope. Used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers employing series-connected heater strings. Outline 14A, OUTLINES SECTION. Heater volts (ac/dc), 9.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6EM7.

**DUAL TRIODE**

Novar type containing high-mu and high-pervenance, low-mu triode units used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers employing series-connected heater strings. Outline 10A, OUTLINES SECTION. Heater volts (ac/dc), 9.7; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6G7.

**HIGH-MU TRIODE—SHARP-CUTOFF PENTODE**

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, phase-inverter, or sound-in-amplifier tube. The pentode unit is used in the output stage of video amplifiers. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 10.5; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6GN8.

**HIGH-MU TRIODE—SHARP-CUTOFF TETRODE**

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 circuit; pentode unit is used as a video-output amplifier. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 10.5; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6HF8.
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.

CLASS A: AMPLIFIER

<table>
<thead>
<tr>
<th>Triode</th>
<th>Tetrode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>Plate Voltage</td>
</tr>
<tr>
<td>300 max volts</td>
<td>339 max volts</td>
</tr>
<tr>
<td>Grid-No.1 (Screen-Grid) Supply Voltage</td>
<td>~</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage, Positive-bias value.</td>
<td>9 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>1 max 5 max watts</td>
</tr>
</tbody>
</table>

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 curve page 70

Peak Plate-Cathode Voltage:
- Heater negative with respect to cathode, 200 max 200 max volts
- Heater positive with respect to cathode, 200*max volts

Characteristics:

- Triode Unit
  - 135 200 30 135 200 volts
- Plate Voltage
- Grid-No.2 Voltage
  - -0.5 -0.5 -1.5 -1.5 volts
- Grid-No.1 Voltage
  - 0 0.5 0.5 0.5
- Amplification Factor
  - 60 40 20 20
- Plate Resistance
  - 23000 17000 6650 7000 ohms
- Transconductance
  - 2 4 17 18 ma
- Plate Current
  - 2 4 17 18 ma
- Grid-No.2 Current
  - 0.5 1.2 4.2 4 ma
- Grid-No.1 Voltage (Approx.)
  - -6.0 -7 -5 -5 volts

Maximum Circuit Values:

- Triode Unit
  - 0.5 max 0.25 max megohm
- For cathode-bias operation
  - 1 megohm

* The 4c component must not exceed 100 volts.

* This value can be measured by a method involving a recurring waveform such that the maximum ratings of the tube will not be exceeded.

DETECTOR AMPLIFIER

Glass type used as detector and amplifier in battery-operated receivers. Filament volts (dc), 1.1; amperes, 0.25. Typical operation as class A amplifier: plate volts, 150 volts; grid volts, -15; plate resistance (approx.), 15000 ohms; transconductance, 440 microamps; plate ma., 3. This is a DISCONTINUED type listed for reference only.

SEMIREMOTE-CUTOFF TWIN PENTODE

11AR11

Related type: 6AR11

Duodec type used as if-amplifier tube in television receivers employing series-connected heater strings. Outline 12A, OUTLINES SECTION. Heater volts (ac/dc), 11.2; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodec type 6AR11.

DUAL TRIODE

11CY7

Related type: 6CY7

Miniature type used in television receivers employing series-connected heater-strings. Low-mu triode unit is used as vertical-deflection amplifier; high-mu triode unit is used as vertical-deflection oscillator. Outline 3D, OUTLINES SECTION. Heater volts (ac/dc), 11; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater rating, this type is identical with miniature type 6CY7.
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**HEATER-VOLTAGE RANGE (AC/DC)**: 10.0 to 15.9 volts

**HEATER CURRENT (Approx.) at 12.6 volts**: 0.2 amperes

**DIRECT INTERELECTRODE CAPACITANCE**:
- Grid No. 1 to Plate: 0.7 mauf.
- Grid No. 1 to Cathode, Heater, Grid No. 2, and Grid No. 3: 8.5 mauf.

*For longest life, it is recommended that the heater be operated within the voltage range of 11 to 14 volts.

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Center Values):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>315 mA</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>285 mA</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>12 mA</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>2 mA</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>90 mA</td>
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<tr>
<td>Heater negative with respect to cathode</td>
<td>90 mA</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>256 mA (\mu)C</td>
</tr>
<tr>
<td>Bulb Temperature (At hottest point)</td>
<td>256 mA</td>
</tr>
</tbody>
</table>

**Typical Operation with 12.6 Volts on Heater**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>250 volts</td>
</tr>
<tr>
<td>Cathode-Bias Bias Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>250 volts</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>250 volts</td>
</tr>
<tr>
<td>Transconductance</td>
<td>250 volts</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>250 volts</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>250 volts</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>250 volts</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values**

- Grid-No.1 Circuit Resistance: 0.1 mauf megohm
- For fixed-bias operation: 0.1 mauf megohm
- For cathode-bias operation: 0.5 mauf megohm

**PUSH-PULL CLASS AB, AMPLIFIER**

**Maximum Ratings (Same as for single-tube class A, amplifier):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Peak AP Grid-No.1 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>250 volts</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>250 volts</td>
</tr>
<tr>
<td>Peak AP Grid-No.2 Grid-No.1 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>250 volts</td>
</tr>
</tbody>
</table>

**AVERAGE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>250 volts</td>
</tr>
<tr>
<td>Cathode-Bias Bias Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>250 volts</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>250 volts</td>
</tr>
<tr>
<td>Transconductance</td>
<td>250 volts</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>250 volts</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>250 volts</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>250 volts</td>
</tr>
</tbody>
</table>

**Technical Data**

- **Effective Load Resistance (Plate-to-plate)**: 10000 ohms
- **Total Harmonic Distortion**: 5 per cent
- **Maximum-Signal Power Output**: 10 watts

**Maximum Circuit Values**

- Grid-No.1 Circuit Resistance: 0.1 mauf megohm
- For fixed-bias operation: 0.1 mauf megohm
- For cathode-bias operation: 0.5 mauf megohm

**REMOTE-CUTOFF PENTODE**

*Miniature type used as rf and if amplifier in automobile receivers operating from a 12-volt storage battery. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 15.6 volts, 0.15. Characteristics as class A amplifier: heater volts, 12.6; plate and grid-No.2 volts, 12.6 (30 mauf); grid-No.3 connected to cathode at socket; grid-No.1 volts, 0; grid-No.1 resistor (by-passed), 2.2 megohms; plate resistance (approx.), 0.5 megohms; transconductance, 730 \(\mu\)hos; plate ma., 0.55; grid-No.2 ma., 0.2; cathode ma., 20 ma; peak heater-cathode volts, 30 ma. This type is used principally for renewal purposes.*

**PENTAGRID CONVERTER**

*Miniature type used as combined oscillator and mixer in low & voltage automobile radio receivers operating directly from a 12-volt storage-battery system. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.15. Typical operation in converter service: heater volts, 12.6; plate and grid-No.2 and No.4 volts, 12.6 (15 mauf); grid-No.3 volts, 0; grid-No.1 volts (peak-to-peak), 4.5; grid-No.3 resistor, 2.2 megohms; grid-No.1 resistor, 2500 ohms; plate resistance (approx.), 0.4 megohms; conversion transconductance, 320 \(\mu\)hos; plate ma., 0.55; grid-No.2 and No.4 ma., 1.5; grid-No.3 ma., 1.0; total cathode ma., 20 ma. Maximum diode plate ma (each unit), 1 ma. Peak heater-cathode volts, 30 ma. Type 12AD6 is a DISCONTINUED type listed for reference only. Type 12AE6-A is used principally for renewal purposes.*

**TWIN DIODE—MEDIUM-MU TRIODE**

*Miniature types used as combined detector and rf amplifier in automobile radio receivers operating from a 12-volt storage battery. Outline 7B, OUTLINES SECTION. Tubes require miniature seven-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.15. Characteristics of triode unit as class A amplifier: heater volts, 12.6; plate and grid-No.2 volts, 12.6 (50 mauf); grid-No.3 volts, 10; plate resistance (approx.), 9000 ohms; amplification factor, 16.7; transconductance, 1300 \(\mu\)hos; plate ma., 1; total cathode ma., 20 ma. Maximum diode plate ma (each unit), 1 ma. Peak heater-cathode volts, 30 ma. Type 12AE6 is a DISCONTINUED type listed for reference only. Type 12AE6-A is used principally for renewal purposes.*

**DUAL TRIODE**

*Miniature type with medium-mu and low-mu triode units used as transistor-driver in audio-output stage of hybrid car radio. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.15. Characteristics as class A amplifier: heater volts, 12.6; plate and grid-No.2 volts, 12.6 (15 mauf); grid-No.3 resistor, 1.5 megohms (unit No.1), 1 megohms (unit No.2); amplification factor, 15 (unit No.1), 6.4 (unit No.2); plate resistance (approx.), 3500 ohms (unit No.1), 2000 ohms (unit No.2); transconductance, 400 \(\mu\)hos (unit No.1), 200 \(\mu\)hos (unit No.2); plate ma., 1.5 (unit No.1), 0.7 (unit No.2). Maximum ratings as audio driver (each unit): plate volts, 15 mauf; grid volts, 0; plate dissipation, 1 watt; peak heater-cathode volts, 16 mauf. This type is used principally for renewal purposes.*

**12AC6**

**12AD6**

**12AE6**

**12AE6A**

**12AE7**
HALF-WAVE VACUUM RECTIFIER

Miniature type used as a damper tube in horizontal-deflection circuits of television receivers employing series-connected heater strings. Outline 9B, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6AF3.

REMOTE-CUTTOFF PENTODE

Miniature type used as if and rf amplifier in automobile radio receivers operating from a 12-volt storage battery. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.15. Characteristics as class A; amplifier: heater volts, 12.6; plate and grid-No.2 volts, 12.6 (16 max); grid-No.3 connected to cathode at socket; grid-No.1 supply volts, 9 max; grid-No.1 resistor (by-passed), 2.2 megohms; plate resistance (approx.), 0.35 megohm; transconductance, 1500 mhos; plate ma., 1.1; grid-No.2 ma., 0.45; peak heater-cathode volts, 16 mzs. This type is used principally for renewal purposes.

MEDIUM-MU TWIN TRIODE

Glass-encased tube used as audio amplifier in radio equipment. Outline 14B, OUTLINES SECTION, except over-all length is 3-1/16 mzs and seated length is 2-1/2 inches, requires no socket. Heater volts (ac/dc), 12.6; amperes, 0.15. Characteristics and maximum ratings (each unit) as class A; amplifier: plate volts, 180 mzs; grid volts, -6.5; amplification factor, 16; transconductance, 1900 mhos; plate resistance (approx.), 8400 ohms; plate ma., 7.6. Twist type is used principally for renewal purposes.

TWIN DIODE—HIGH-MU TRIODE

Miniature type used as combined detector and rf voltage amplifier in automobile radio receivers operating from a 12-volt storage battery. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (ac/dc), 10 to 15.9 volts; amperes at 12.6 volts, 0.15. Characteristics as unit: grid volts, 9; amplification factor, 55; plate resistance (approx.), 45000 ohms; transconductance, 1200 mhos; plate ma., 0.75; total cathode ma., 20 max; peak heater-cathode volts, 50 max. Maximum rating of each diode unit: plate ma., 1 max. This type is used principally for renewal purposes.

TWIN DIODE

Miniature, high-pervenance type used as detector in FM and television circuits. It is especially useful as a ratio detector in ac/dc FM receivers. Outline 7A, OUTLINES SECTION. Heater volts (ac/dc), 12.8; amperes, 0.15. Except for heater rating, this type is identical with miniature type 6AL5.

MEDIUM-MU TRIODE—POWER TETRODE

Miniature type used in automobile-radio receivers operating from a 12-volt storage battery. The triode unit performs the trigger function and the tetrode unit performs the relay-acuating function in automatic station-selection circuits. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.55. Characterization of triode unit as class A; amplifier: heater volts, 12.6; plate volts, 12.5 (80 max); grid volts (developed across 2.2-megohm resistor), -0.9; amplification factor, 16; plate resistance (approx.), 16000 ohms; transconductance, 1000 mhos; plate ma., 0.5; cathode ma., 20 max. Tetrode unit: heater volts, 12.6; plate volts, 12.5 (80 max); grid-No.1 (space-charge-grid) volts, 12.6 (15 absolute max); grid-No.2 (control-grid) volts, (developed across 2.2-megohm resistor), -0.5 (20 max); amplification factor (grid-No.2 to plate), 7.2; plate resistance (approx.), 480 ohms; transconductance (grid-No.2 to plate), 16000 mhos; plate ma., 40; grid-No.1 ma., 15. Peak heater-cathode volts, 50 max. This type is used principally for renewal purposes.

BEAM POWER TUBE—SHARP-CUTTOFF PENTODE

Duodeclet type used as FM detector and audio-frequency output amplifier in television receivers employing series-connected heater strings. Outline 25B, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodeclet type 6AL11.

BEAM POWER TUBE

Miniature type used as output amplifier primarily in automobile radio receivers operating from a 12-volt storage battery. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.225. Except for heater ratings, this type is identical with miniature type 6AQ5. Within its maximum ratings, the performance of the 12AQ5 is equivalent to that of the larger type 12V6-GT.

TWIN DIODE—HIGH-MU TRIODE

Miniature type used as combined detector, amplifier, and ave tube in compact ac/dc radio receivers. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6AT6.

HIGH-MU TWIN TRIODE

Miniature type used as push-pull cathode-drive amplifier or frequency converter in the FM and television broadcast bands. Outline 8B, OUTLINES SECTION. 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. For typical operation as a resistance-coupled amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION.

**Heater Arrangement:**
<table>
<thead>
<tr>
<th>Series</th>
<th>Parallel</th>
<th>Volts</th>
<th>Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 AU</td>
<td>0.15</td>
<td>0.3</td>
<td>6.3</td>
</tr>
</tbody>
</table>

**Direct Inter-electrode Capacitances:**
- Grid to Plate (Each unit)...
- Grid to Cathode and Heater (Each unit)...
- Plate to Cathode and Heater...
- Unit No. 1...
- Unit No. 2...
- Cathode-Grid Operation...
- Cathode to Plate (Each unit)...
- Cathode to Grid and Heater (Each unit)...
- Plate to Grid and Heater (Each unit)...
- Heater to Cathode (Each unit)...

**Class A Amplifier (Each Unit)**

**Maximum Ratings:**
- Design-Center Value
- Plate Voltage...
- Plate Disipation...
- Plate Voltage...
- Heater negative with respect to cathode...
- Heater positive with respect to cathode...

**Characteristics:**
- Plate Voltage...
- Cathode-Bias Resistor...
- Amplification Factor...
- Plate Resistance (Approx.)...
- Transconductance...
- Grid Voltage (Approx.) for plate current of 10 μA...
- Plate Current...

**AVERAGE PLATE CHARACTERISTICS FOR EACH UNIT**

**Technical Data**

**Medium-MU Twin Triode**

**12AU7**

**Related types:** 7AU7, 9AU7

**Description:**
Miniature type used as phase inverter 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 oscillator and vertical deflection amplifier, and as horizontal deflection oscillator, in television receivers. The 12AU7-A is also useful in applications critical as to microphones. Outline 8B, 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. Type 12AU7 is a DISCONTINUOUS TYPE listed for reference only.

**Heater Arrangement:**
<table>
<thead>
<tr>
<th>Series</th>
<th>Parallel</th>
<th>Volts</th>
<th>Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 AU</td>
<td>0.15</td>
<td>0.3</td>
<td>6.3</td>
</tr>
</tbody>
</table>

**Direct Inter-electrode Capacitances for 12AU7-A (Approx.):**
- Grid to Plate...
- Grid to Cathode and Heater...
- Plate to Grid and Heater...
- Plate to Cathode and Heater...

**Class A Amplifier (Each Unit Unless Otherwise Specified)**

**Maximum Ratings for 12AU7-A (Design-Maximum Values):**
| Plate Voltage...
| Plate Disipation...
| Both Plates (Both units operating)...
| Cathode Voltage...
| Heater Voltage...
| Heater positive with respect to cathode...

**Characteristics for 12AU7-A:**
- Plate Voltage...
- Grid Voltage...
- Amplification Factor...
- Plate Resistance (Approx.)...
- Transconductance...
- Plate Current...
- Grid Voltage (Approx.) for plate current of 10 μA...

**Average Plate Characteristics for Each Unit**

**Sharp-Cutoff Pentode**

Miniature type used in compact ac/dc radio equipment as an rf amplifier especially in high-frequency, wide-band applications. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc) 12.6; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6AU6.

**12AU6**

**Related types:** 3AU6, 4AU6, 6A6U6
### RCA Receiving Tube Manual

#### Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-Circuit Resistance</td>
<td>0.85 mF/megohm</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>1.0 mF/megohm</td>
</tr>
<tr>
<td>Oscillator (Each Unit, Unless Otherwise Specified) For operation in a 325-line, 50-frame system</td>
<td></td>
</tr>
<tr>
<td>Vertical Deflection</td>
<td></td>
</tr>
<tr>
<td>Horizontal Deflection</td>
<td></td>
</tr>
<tr>
<td>DC Plate Voltage</td>
<td>350 mV/megohm</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid Voltage</td>
<td>450 mV/megohm</td>
</tr>
<tr>
<td>Peak Cathode Current</td>
<td>165 mV/megohm</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>2 V/megohm</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.75 max, 2.75 max watts</td>
</tr>
<tr>
<td>Both Plates (Both units operating)</td>
<td>200 volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 volts</td>
</tr>
</tbody>
</table>

#### Vertical-Deflection Amplifier (Each Unit Unless Otherwise Specified) For operation in a 325-line, 50-frame system

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>330 mV/megohm</td>
</tr>
<tr>
<td>Peak Positive-Pulse Grid Voltage</td>
<td>1200 mV/megohm</td>
</tr>
<tr>
<td>Peak Negative-Pulse Grid Voltage</td>
<td>375 mV/megohm</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>2 V/megohm</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2.75 max, 2.75 max watts</td>
</tr>
<tr>
<td>Both Plates (Both units operating)</td>
<td>200 volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 volts</td>
</tr>
</tbody>
</table>

#### BEAM POWER TUBE

**12AV5GA**

Glass octal type used as horizontal deflection amplifier in television receivers employing series-connected heater strings. Outline 19B, OUTLINE SECTION. Heater volts (ac/dc), 12.6 amperes, 0.6 warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 5AV5-GA.

#### TWIN DIODE—HIGH-MU TRIODE

**12AV6**

Miniature type used as combined detector, amplifier, and audio tube in automobile and ac-operated receivers. Outline 7B, OUTLINE SECTION. Heater volts (ac/dc), 12.6 amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6AV6.

#### MEDIUM-MU TWIN TRIODE

**12AV7**

Miniature type used as frequency converter in hf"t"s antennas of television receivers, as well as mixer, oscillator, or mixer. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater volts (ac/dc), 12.6 (series), 0.3 (parallel), 0.6 (series), 0.45 (parallel). Characteristics as class A, amplifier (each unit): plate volts, 150 (300 volts); plate current, 2.7 ma; plate dissipation, 200 volts; heater voltage, 9 volts. This type is used principally for renewal purposes.

#### SHARP-CUTOFF PENTODE

**12AW6**

Miniature type used as an rf or if amplifier up to 400 megacycles in compact ac/dc FM receivers. Outline 7B, OUTLINE SECTION. Tube requires miniature seven-contact socket. Heater volts (ac/dc), 12.6 amperes, 0.15. Except for heater ratings and terminal connections, this type is identical with miniature type 6AG5.

#### HALF-WAVE VACUUM RECTIFIER

**12AX3**

Duodecatype type used as damper tube in horizontal-deflection circuits of television receivers employing series-connected heater strings. Outline 12C, OUTLINE SECTION. Heater volts (ac/dc), 12.6 amperes, 0.6 warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodecatype 6AX3.

#### HALF-WAVE VACUUM RECTIFIER

**12AX4GT, 12AX4GTA, 12AX4GTB**

Glass octal types used as damper tubes in horizontal-deflection circuits of television receivers. Types 12AX4-GTA and 12AX4-GB have a controlled heater warm-up time of use for series-connected heater strings. Outline 14C, OUTLINE SECTION. These types may be supplied with pin No. 1 omitted. Heater volts (ac/dc), 12.6 amperes, 0.6 warm-up time (average) for 12AX4-GTA and 12AX4-GTB, 11 seconds. Except for heater rating, these types are identical with glass octal type 6AX4-GT. Type 12AX4-GT is a DISCONTINUED type listed for reference only.

#### HIGH-MU TWIN TRIODE

**12AX7, 12AX7A**

Miniature type used as phase inverter or twin resistance-coupled amplifier in radio equipment. The 12AX7 is also used in diversified applications such as multivibrators or oscillators in industrial control devices. Type 12AX7-A has controlled hum and noise characteristics and is used in high-fidelity audio-amplifier applications. Outline 8B, OUTLINE SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Each triode unit is independent of the other except for...
### RCA Receiving Tube Manual

**Plate Dissipation**: 1.5 mW, watts
**Peak Heater-Cathode Voltage**: 10 mV, volts
**Peak Hea

### Technical Data

**Plate Dissipation**: 1.5 mW, watts
**Cathode Current**: 10 mV, ma
**Peak Heater-Cathode Voltage**: 90 mV, volts
**Heater positive with respect to cathode**: 100 mV, volts
**Heater negative with respect to cathode**: 90 mV, volts

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**HIGH-MU TWIN TRIODE**

Miniature type used in direct-coupled cathode-drive rf amplifier circuits of medium-gain television tuners. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc): 12.6 (series), 0.6 (parallel); amperes: 0.225 (series), 0.45 (parallel); warm-up time (average), 12A27-A, 11 seconds. Type 12A27 is a DISCONTINUED type listed for reference only. For characteristics, class A amplifier, refer to miniature type 12AT7.

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**LOW-MU TWIN TRIODE**

Miniature type having high power used as vertical deflection amplifier in television receivers. This type has a controlled heater warm-up time for use in series-connected heat strings. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc): 12.6 (series), 0.6 (parallel); amperes: 0.3 (series), 0.4 (parallel); warm-up time (average), 11 seconds.

---

**MEDIUM-MU TWIN TRIODE**

Miniature type used in the first stages of high-gain audio-frequency amplifiers where reduction of microphones, leakage noise, and hum are important considerations. Outline 8B, OUTLINES SECTION. 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. 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 high-gain amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION.

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**HALF-WAVE VACUUM RECTIFIER**

Novel type used as damper tube in horizontal-deflection circuits of black-and-white television receivers. Tube has controlled warm-up time for use in series-connected heater strings. Outline 17A, OUTLINES SECTION. Heater volts (ac/dc): 12.6; amperes: 0.6; warm-up time (average), 11 seconds. Except for heater rating, this type is identical with novot type 6AY3.

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**12AY3**

**12AY7**

**12B4A**

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### Class A Amplifier

**12AZ7**

**12AZ7-A**

**11A7Z**

**Design-Maximum Values**

---

**CLASS A AMPLIFIER (Each Unit)**

**Maximum Ratings (Design-Maximum Values):**

** plateau voltage**: 1200 mV, volts
**grid voltage**: 500 mV, volts
**amplification factor**: 10,000
**plate resistance**: 10,000 ohms

---

**CLASS A AMPLIFIER (Each Unit)**

**Maximum Ratings (Design-Maximum Values):**

**plate voltage**: 1200 mV, volts
**grid voltage**: 500 mV, volts
**amplification factor**: 10,000
**plate resistance**: 10,000 ohms

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### 12AY3

**Related types:**

6AY3, 17AY3

### 12AY7

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### 12B4A
RCA Receiving Tube Manual

**PENTAGRID CONVERTER**

Miniature type used as converter in ac/dc receivers for both standard broadcast and FM bands. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6B6E.

**TWIN DIODE—MEDIUM-MU TRIODE**

Miniature type used as combined detector, amplifier, and anode tube primarily in automobile radio receivers and for 12-volt battery. Outline 7T, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6B6.

**MEDIUM-MU TWIN TRIODE**

Miniature types used as combined vertical deflection amplifiers and vertical oscillators, and as horizontal deflection oscillators, in television receivers. Type 12BH7-A has a controlled heater warm-up time for use in series-connected heater strings. These types are also used in other applications including phase-inverter circuits and multivibrator circuits. Outline 5D, 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. Type 12BH7 is a DISCONTINUED type listed for reference only.

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**TRIODE—PENTODE**

Glass octal type used as combined detector and rf or if amplifier in ac/dc receivers. Heater volts (ac/dc), 12.6; amperes, 0.3. Characteristics of triode unit: plate volts, 90; grid volts, 6; amplification factor, 30; plate resistance, 3000 ohms; transconductance, 2000 µhos; plate ma., 2.8. Characteristics of pentode unit: plate volts, 90; grid No. 1 volts, 90; grid No. 3 volts, 90; plate resistance, 5000 ohms; transconductance, 1800 µhos; plate ma., 2.5. This is a DISCONTINUED type listed for reference only.

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**REMOTE-CUTOFF PENTODE**

Miniature type used as rf amplifier in ac/dc standard broadcast receivers, in FM receivers, and in other wide-band, high-frequency applications. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6B6A.

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**PENTAGRID CONVERTER**

Miniature type used as converter in ac/dc superheterodyne circuits especially those for the FM broadcast band. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater rating, this type is identical with miniature type 6B7A. Type 12B7A is used principally for renewal purposes.

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**REMOTE-CUTOFF PENTODE**

Miniature type used as rf or if amplifier in radio receivers. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater rating, this type is identical with miniature type 6B6D. Type 12BD6 is used principally for renewal purposes.

---

**CLASS A; AMPLIFIER (Each Unit)**

Maximum Ratings, (Design-Center Values):

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid Voltage</th>
<th>Cathode Current</th>
<th>Plate Dissipation</th>
<th>Plate to Cathode and Heater</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 mV volts</td>
<td>-50 mV volts</td>
<td>20 mA</td>
<td>7 watts</td>
<td>200 volts</td>
</tr>
</tbody>
</table>

Characteristics:

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Grid Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 volts</td>
<td>-10.5 volts</td>
</tr>
</tbody>
</table>
AMPLIFICATION FACTOR

Plate Resistance (Approx.) .................................................. 16.5
Transconductance .......................................................... 5300 ohms
Grid Voltage (Approx.) for plate current of 90 µA .................. 3100 µhms
Grid-Cathode Resistance .................................................. 11.5 ma
Plate Grid, for grid of -14 volts ........................................ 4 ma

MAXIMUM CIRCUIT VALUES:

Grid-Circuit Resistance:
For fixed-bias operation .................................................. 0.65 max mohms
For cathode-bias operation ............................................. 1.0 max mohms

OSCILLATOR (Each Unit)

For operation in a 255-line, 30-frame system

VERTICAL DEFLECTION AMPLIFIER (Each Unit)

For operation in a 255-line, 30-frame system

BEAM POWER TUBE

Miniature type used in audio output stages of television and radio receivers employing series-connected heater strings. Outline 3D, OUTLINES SECTION. Heater voltage (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts, 200 ma. When the heater is positive with respect to the cathode, the de component of the heater-cathode voltage must not exceed 100 volts. Except for heater ratings, this type is identical with miniature type 68K5. Type 12BK5 is used principally for renewal purposes.

REMOTE-CUTOFF PENTODE

Miniature type used as if and rf amplifier in automobile radio receivers operating from a 12-volt storage battery. Outline 3B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (ac/dc), 10 to 15.5; amperes at 12.6 volts, 0.15. Characteristics as class A; amplifier: heater volts, 12.6; plate and grid- No. 2 volts, 12.6 max; grid-No. 2 connected to cathode at socket; grid-No. 1 volt, 0 max; grid-No. 1 resistor, 22 megohms; plate resistance (approx.), 0.5 megohms; transconductance, 1500 µhms; plate ma., 1.5; grid-No. 2 ma., 0.5; cathode ma., 20 ma; peak heater-cathode volts, 20 ma. This type is used principally for renewal purposes.

BEAM POWER TUBE

Glass octal type used as horizontal-deflection amplifier in television receivers employing series-connected heater strings. Outline 16G, OUTLINES SECTION. This type may be supplied with pin No. 1 omitted. Heater voltage (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 6BQ6-GTB/8CU6.

TWIN DIODE—HIGH-MU TRIODE

Miniature type used as combined sync separator and horizontal phase detector in television receivers. Outline 2B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater voltage (ac/dc), 12.6 (series); 6.3 (parallel); amperes, 0.255 (series); 0.46 (parallel). For maximum ratings, characteristics, and curves of triode unit, refer to type 12AT7. Maximum ratings of diode units (each unit): peak inverse plate volts, 300 ma; peak plate ma, 60 ma; peak heater-cathode volts, 200 ma (the de component must not exceed 100 volts). Type 12BR7 is used principally for renewal purposes.

HALF-WAVE VACUUM RECTIFIER

Novar type used as damper tube in horizontal-deflection circuits of black-and-white television receivers employing series-connected heater strings. Outline 10D, OUTLINES SECTION.

Heater voltage (ac/dc), 12.6 amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6BS3.
**SHARP-CUTOFF PENTODE**

**12BV7**

Miniature type used as video amplifier in television receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater volts (ac/dc), 12.6 (series), 6.3 (parallel); amperes, 0.6 (series), 0.6 (parallel).

Maximum ratings as class A amplifier: plate volts, 300 ma; grid-No. 3 volts, 0 ma; grid-No. 2 volts, 1/4 ma; grid-No. 1 volt, 50 ma; plate dissipation, 6.55 ma watt; grid-No. 3 input, 1 ma watt; peak heater-cathode volts, 200 ma (the dc component must not exceed 100 volts). This type is used principally for renewal purposes.

**12BW4**

Related type: 6BW4

Miniature type used in full-wave power supplies having high dc output current requirements. Outline 8D, OUTLINES SECTION. Type 12BW4 requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 12.6; amperes 0.45. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Except for heater ratings, this type is identical with miniature type 6BW4.

**SHARP-CUTOFF PENTODE**

**12BY7**

**12BY7A**

Miniature types used as video amplifier in television receivers. Type 12BY7-A has a controlled heater warm-up time for use in series-connected heater strings. Outline 8D, OUTLINES SECTION. Tubes require miniature nine-contact socket and may be mounted in any position. Type 12BY7 is a DISCONTINUED type listed for reference only.

**HEATER ARRANGEMENT:**
- **Series**
- **Parallel**

**HEATER VOLTAGÉ (AC/DC):** 12.6 volts

**HEATER CURRENT:** 0.6 amperes

**HEATER WARM-UP TIME (Average) for 12BY7-A:** 11 seconds

**DIRECT INTERELECTRODE CAPACITANCES: Grid No. 1 to Plate:** 0.063 pf
- **Grid No. 1 to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield:** 16.2 pf
- **Plate to Cathode, Heater, Grid No. 2, Grid No. 3, and Internal Shield:** 3.5 pf

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**
- **Plate Supply Voltage:** 380 ma volts
- **Grid-No. 3 (Suppression-grid) Voltage, Positive value:** 190 ma volts
- **Grid-No. 4 (Control-grid) Voltage:** -55 ma volts
- **Negative bias value:** -55 ma volts
- **Positive bias value:** 0 ma volts
- **Grid-No. 2 Input:** 1.2 ma watts
- **Grid-No. 1 Input:** 6.5 ma watts
- **Plate Dissipation:** 200 ma watts
- **Plate Dissipation:** 200 ma watts

**Characteristics:**
- **Plate Supply Voltage:** 250 volts
- **Grid-No. 3 Supply Voltage:** 160 volts
- **Plate Supply Voltage:** 9300 ohms
- **Transconductance:** 11,000 mhos
- **Plate Current:** 5.75 ma
- **Grid-No. 1 Voltage (Approx.) for plate current of 20 ma:** -11.6 volts

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**SEMIREMOTE-CUTOFF PENTODE**

**12BZ6**

Related types: 32B6, 48B4, 68B6

Miniature type used in gain-controlled video if stages of television receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6BZ6.

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**HIGH-MU TWIN TRIODE**

**12BZ7**

Miniature type used in sync-separator and sync-amplifier circuits of television receivers. This tube is also used in clipping circuits and in general-purpose audio amplifier applications.

Outline 8D, OUTLINES SECTION. 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).

**CLASS A, AMPLIFIER** (Both Units)

**Maximum Ratings, (Design-Maximum Values):**
- **Plate Voltage:** 300 ma volts
- **Grid Voltage:** 0 ma volts
- **Negative bias value:** -50 ma volts
- **Positive bias value:** 0 ma volts
- **Plate Dissipation:** 1.5 ma watts
- **Peak Heater-Cathode Voltage:**
  - **Heater negative with respect to cathode:** 180 ma volts
  - **Heater positive with respect to cathode:** 180 ma volts

**Characteristics:**
- **Plate Voltage:** 250 volts
- **Grid Voltage:** 2 volts
- **Amplification Factor:** 100
- **Plate Resistance (Approx.)**
  - 31,000 ohms
- **Transconductance:**
  - 32,000 mhos
- **Plate Current:** 2.6 ma
A. amplifier: plate supply volts, 150 (300 max); cathode-bias resistor, 150 ohms; amplification factor, 40; plate resistance (approx.), 8200 ohms; transconductance, 4800 μA/m; plate ma., 9; plate dissipation, 2.5 watt max. Pentode unit: plate supply volts, 200 (300 max); grid-No.2 supply volts, 125 (300 max); cathode-bias resistor, 82 ohms; plate resistance (approx.), 0.15 megohm; transconductance, 7000 μA/m; plate ma., 15; grid-No.2 ma., 8.4; plate dissipation, 2.75 watt max; grid-No.2 input, 0.9 ma watt. Peak heater-cathode volts, 200 max (the de component must not exceed 100 volts when heater is positive with respect to cathode). This type is used principally for renewal purposes.

BEAM POWER TUBE

Miniature type used in the audio output stage of television receivers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater rating, this type is identical with miniature type 6CU5.

Refer to type 12B66-G8T/12C6U

REMOTE-CUTOFF PENTODE

Miniature type used as rf amplifier in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.45. Characteristics as class A amplifier: heater volts, 12.6; plate and grid-No.2 voltages, 12.5 (15 max); grid-No.1 volts 0 ma; grid-No.1 resistor (by-passed), 2.2 megohms; plate resistance (approx.), 0.04 megohm; transconductance, 3000 μA/m; plate ma., 3; grid-No.2 ma., 1.4; peak heater-cathode volts, 30 Watt. This type is used principally for renewal purposes.

DIODE—REMOTE-CUTOFF PENTODE

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 7B, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6CR6.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

Miniature type used in television receivers employing series-connected heater strings. Pentode unit is used as video amplifier; triode unit is used in sweep-oscillator sync-amplifier, sync-separator, and sync-clipping circuits. Outline 8D, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater voltage range (ac/dc), 40 to 15.9; amperes at 12.6 volts, 0.45. Characteristics as output amplifier: heater volts, 12.6; plate and grid-No.2 voltages, 12.5 (15 max); grid-No.1 volts 0 ma; grid-No.1 resistor (by-passed), 2.2 megohms; plate resistance (approx.), 0.04 megohm; transconductance, 3000 μA/m; plate ma., 4.5; grid-No.2 ma., 3.5; peak heater-cathode volts, 16 ma. This type is used principally for renewal purposes.
BEAM POWER TUBE
Miniature type used as vertical-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION, except all vertical dimensions of this type are 1/8 inch greater. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds.

CLASS A, AMPLIFIER

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>300 mA volts</td>
</tr>
<tr>
<td>GRID NO.2 (SCREEN-GRID) VOLTAGE</td>
<td>100 mA volts</td>
</tr>
<tr>
<td>GRID NO.2 INPUT</td>
<td>1.25 mA volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>60 mA watts</td>
</tr>
<tr>
<td>PEAK, HACER, CATHODE VOLTAGE</td>
<td>10 mA volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>260 mA volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 mA volts</td>
</tr>
<tr>
<td>Typical Operation:</td>
<td></td>
</tr>
<tr>
<td>PLATE SUPPLY VOLTAGE</td>
<td>260 volts</td>
</tr>
<tr>
<td>GRID NO.2 SUPPLY VOLTAGE</td>
<td>155 volts</td>
</tr>
<tr>
<td>CATHODE BIAS RESISTOR</td>
<td>180 ohms</td>
</tr>
<tr>
<td>PEAK, AP GRID NO.1 VOLTAGE</td>
<td>8.5 volts</td>
</tr>
<tr>
<td>ZERO SIGNAL PLATE CURRENT</td>
<td>44 mA</td>
</tr>
<tr>
<td>MAXIMUM SIGNAL PLATE CURRENT</td>
<td>47 mA</td>
</tr>
<tr>
<td>ZERO SIGNAL GRID NO.2 CURRENT</td>
<td>2.2 mA</td>
</tr>
<tr>
<td>MAXIMUM SIGNAL GRID NO.2 CURRENT</td>
<td>8.5 mA</td>
</tr>
<tr>
<td>PLATE RESISTANCE</td>
<td>28,000 ohms</td>
</tr>
<tr>
<td>TRANSCONDUCTION</td>
<td>8000 ohms/ma</td>
</tr>
<tr>
<td>LOAD RESISTANCE</td>
<td>4000 ohms</td>
</tr>
<tr>
<td>TOTAL HARMONIC DISTORTION</td>
<td>10% power</td>
</tr>
<tr>
<td>MAXIMUM SIGNAL POWER OUTPUT</td>
<td>3.8 watts</td>
</tr>
<tr>
<td>Maximum Circuit Values:</td>
<td></td>
</tr>
<tr>
<td>GRID NO.1 CIRCUIT RESISTANCE:</td>
<td>0.1 ma megohm</td>
</tr>
<tr>
<td>For fixed-bias operation:</td>
<td>2.2 ma megohms</td>
</tr>
<tr>
<td>For cathode-bias operation:</td>
<td>2.2 ma megohms</td>
</tr>
</tbody>
</table>

VERTICAL-DEFLECTION AMPLIFIER
For operation in a 355-line, 30-frame system

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC PLATE VOLTAGE</td>
<td>300 mA volts</td>
</tr>
<tr>
<td>PEAK, POSITIVE-PLATE VOLTAGE (Absolute Maximum)</td>
<td>200 mA volts</td>
</tr>
<tr>
<td>DC GRID NO.2 (SCREEN-GRID) VOLTAGE</td>
<td>105 volts</td>
</tr>
<tr>
<td>PEAK, GRID NO.1 (CONTROL-GRID) VOLTAGE</td>
<td>250 volts</td>
</tr>
<tr>
<td>PEAK CATHODE CURRENT</td>
<td>200 mA</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>150 mA</td>
</tr>
<tr>
<td>PEAK GRID NO.2 INPUT</td>
<td>1.25 mA volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>10 ma watts</td>
</tr>
<tr>
<td>PEAK HACER, CATHODE VOLTAGE:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>260 mA volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 mA volts</td>
</tr>
<tr>
<td>Maximum Circuit Values:</td>
<td></td>
</tr>
<tr>
<td>GRID NO.1 CIRCUIT RESISTANCE:</td>
<td>0.1 ma megohm</td>
</tr>
<tr>
<td>For fixed-bias operation:</td>
<td>2.2 ma megohms</td>
</tr>
<tr>
<td>For cathode-bias operation:</td>
<td>2.2 ma megohms</td>
</tr>
</tbody>
</table>

* The d component must not exceed 10 volts.
* The excursion of the edge pulse must not exceed 15% of one vertical scanning cycle. In a 355-line, 30-frame system, 15% of one vertical scanning cycle is 2.5 milliseconds.
* Under no conditions should this absolute maximum value be exceeded.

DIODE—REMOTE-CUTOFF PENTODE
Miniature type used in automobile radio receivers; pentode unit is used as rf or hf amplifier. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15.6; amperes at 12.6 volts, 0.5. Characteristics of pentode unit as class A: amplifier: heater volts, 12.6; plate and grid 2.0 volts, 0.5; heater-cathode volts, 30 volts. Maximum diode plate, 5. Tube voltage drop for plate current of 20 ma, 5 volts. This type is used principally for renewal purposes.

DIODE—SHARP-CUTOFF PENTODE
Miniature type used as if-amplifier tube in television receivers. Outline B, OUTLINES SECTION. Heater volts (ac/dc), 12.6 amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6DK6.

TWIN DIODE—POWER TETRODE
Miniature type used as combination detector and power amplifier in low-B-voltage automobile radio receivers operating from 12-volt storage-battery system. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15.6; amperes at 12.6 volts, 0.5. Typical operation of tetrode unit as class A: amplifier: heater volts, 12.6; plate and grid No.2 volts, 12.6 (30 mA); grid No.2 power input, 10 milliwatts; plate dissipation, 0.5; heater-cathode volts, 30 volts. Diode characteristics (each unit): heater volts, 12.6; plate volts, 10; plate ma., 1. This type is used principally for renewal purposes.

TWIN DIODE—POWER TETRODE
Miniature type used as combination detector and power amplifier in low-B-voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15.6; amperes at 12.6 volts, 0.5. Typical operation of tetrode unit as audio driver: heater volts, 12.6; plate volts, 12.6 (30 mA); grid No.2 (control-grid) volts obtained by rectification through a 2.2-megohm resistor, 2 to 30 mA; peak grid No.2 volts (obtained from 0.1-megohm source), 2.5; grid No.1 (space-charge grid) volts, 12.6 (16 absolute volts); plate ma., 0.5; plate resistance (approx.), 400 ohms; transformer (grid No.2 to plate), 15000 ohms; grid No.2 plate ma. (each unit), 5. Peak heater-cathode volts, 30 volts. This type is used principally for renewal purposes.

HALF-WAVE VACUUM RECTIFIER
Glas octal type used as damper tube in horizontal-deflection circuits of television receivers employing series-connected heater strings. Outline 14F, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater rating, this type is identical with glass octal type 6DM4.

BEAM POWER TUBE
Glas octal type used as horizontal-deflection-amplifier tubes in television receivers employing series-connected heater strings. Outline 21, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, these types are identical with glass octal type 6DQ6-A and 6DQ6-B, respectively.
RCA Receiving Tube Manual

POWER PENTODE

Miniature type used as video-output-amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater volts (ac/dc), 12.6 (series), 6.3 (parallel); amperes, 0.3 (series), 0.6 (parallel); warm-up time (average), 11 seconds. Characteristics as class A: amplifier; plate supply volts, 200 (380 max); grid-No.3 connected to cathode at socket; grid-No.2 supply volts, 125 (300 max); cathode-bias resistor, 68 ohms; plate current ma, 26; grid-No.2 ma, 5.6; plate dissipation, 6.6 max watts; grid-No.2 input, 1.1 max watt; peak heater-cathode volts, 200 max (the dc component must not exceed 100 volts when heater is positive with respect to cathode). This type is used principally for renewal purposes.

12DQ7
12DS7
12DS7A

TWIN DIODE—POWER TETRODE

Miniature types used as combined detectors and power-amplifier driver in low B-plate-voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.4. Maximum ratings of tetrode unit as audio driver: plate and grid-No.3 control grid) volts, 16 max; grid-No.1 (space-charge-grid) volts, 16 max; peak heater-cathode volts, 16 max. Characteristics and typical operation with grid-No.2 resistor high, refer to type 12DL8. Maximum diode plate ma (each unit), 5. Type 12DS7A is a DISCONTINUED type listed for reference only. Type 12DS7 is used principally for renewal purposes.

12D9T5

BEAM POWER TUBE

Miniature type used as vertical-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6DT5.

12DT8

HIGH-MU TWIN TRIODE

Miniature type used as push-pull rf amplifier and as combined oscillator and mixer in FM tuners. Also useful in a wide variety of applications in radio and television receivers. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, interelectrode capacitances, and basting arrangement, this type is identical with miniature type 12AT7. Except for heating ratings, type 12DT8 is identical with miniature type 6DT8.

12DU7

TWIN-DIODE—POWER TETRODE

Miniature type used as combined detector, audio, and power-amplifier driver in low B-plate-voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.25. Typical operation of tetrode unit as audio driver: heater volts, 12.6; plate and grid-No.3

12DV8

DUAL TRIODE

Miniature type containing high-mu and medium-mu triodes; used as amplifier and phase inverter in audio equipment. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 12.6 (series), 6.3 (parallel); amperes, 0.15 (series), 0.3 (parallel).

12DW7

Technical Data

TWIN DIODE—POWER TETRODE

Miniature type used as combined detector and power-amplifier driver in low B-plate-voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.4. Typical operation of tetrode unit as audio driver: heater volts, 12.6; plate and grid-No.1 (space-charge-grid) supply volts, 12.6 (16 max); grid-No.1 resistor, 4.7 megohms; cathode-bias resistor, 18 ohms; peak grid-No.2 supply volts (obtained from 0.3-megohm signal source), 1.2; plate resistance (approx.), 900 ohms; transconductance (grid-No.2 to plate), 8500 milliamps; amplification factor (grid-No.2 to plate), 7.5; indicated plate ma, 5.8; grid-No.1 ma, 54; load resistance, 1250 ohms; indicated signal power output, 5 milliwatts. Maximum diode plate ma (each unit), 5. Peak heater-cathode volts, 16 max. This type is used principally for renewal purposes.

12DV8

DUAL TRIODE

Miniature type containing high-mu and medium-mu triodes; used as amplifier and phase inverter in audio equipment. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 12.6 (series), 6.3 (parallel); amperes, 0.15 (series), 0.3 (parallel).

12DW7

Class A Amplifier

Maximum Ratings (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit 1</th>
<th>Unit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>630 volts</td>
<td>530 volts</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>0.0 volts</td>
<td>0.0 volts</td>
</tr>
<tr>
<td>Negative-bias value</td>
<td>65 ma</td>
<td>65 ma</td>
</tr>
<tr>
<td>Positive-bias value</td>
<td>9 ma</td>
<td>9 ma</td>
</tr>
<tr>
<td>Cathode Current</td>
<td>22 ma</td>
<td>22 ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>3.3 max</td>
<td>3.3 max</td>
</tr>
<tr>
<td>Peak Heater Cathode</td>
<td>200 volts</td>
<td>200 volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 Volts</td>
<td>200 Volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 Volts</td>
<td>200 Volts</td>
</tr>
</tbody>
</table>

Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit 1</th>
<th>Unit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>100 volts</td>
<td>100 volts</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>0.0 volts</td>
<td>0.0 volts</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Plate Resistance (approx.)</td>
<td>8000 ohms</td>
<td>6200 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>125 ohms</td>
<td>125 ohms</td>
</tr>
<tr>
<td>Plate Current</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Grid Voltage (approx.)</td>
<td>22 ohms</td>
<td>22 ohms</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit 1</th>
<th>Unit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-Circuit Resistance</td>
<td>0.25 ma</td>
<td>0.25 ma</td>
</tr>
<tr>
<td>For fixed-bias operation</td>
<td>1 ma</td>
<td>1 ma</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>1 ma</td>
<td>1 ma</td>
</tr>
</tbody>
</table>

* The dc component must not exceed 100 volts.

395
**MEDIUM-MU TRIODE—REMOTE-CUTOFF TETRODE**

**12DY8**

Miniature type used in low B+ voltage automobile radio receivers operating directly from low-voltage storage-battery systems. The triode unit is used for relay service in a signal-seeking receiver. Outline 8B, OUTLINES SECTION.

Tube requires miniature nine-contact socket. Heaters in the triode unit: 12.6 volts, 0.75 ma.; 2:1000 ohms (triode unit); grid-No. 1 resistor (pentode unit), 2.2 megohms; amplification factor (triode unit), 20; plate resistance (approx.), 10000 ohms (triode unit), 5000 ohms (tetrode unit); transconductance, 2500 microamps (triode unit), 1000 microamps (tetrode unit); peak heater-cathode volts, 16 ma. This type is used primarily for renewal purposes.

**REMOTE-CUTOFF PENTODE**

**12DZ6**

Miniature type used as rf or if amplifier in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 7B, OUTLINES SECTION.

Tube requires miniature seven-contact socket and may be mounted in any position.

**Heater-Voltage Range**

<table>
<thead>
<tr>
<th>Range (ac/dc)</th>
<th>0 to 15.6 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current (Anp)</td>
<td>0.19 amps</td>
</tr>
</tbody>
</table>

**Direct Interelectrode Capacitances:**

| Grid No. 1 to Plate | 0.05 muf |
| Grid No. 1 to Cathode, Grid No. 2, Grid No. 3, and Internal Shield | 9.5 muf |
| Plate to Cathode, Grid No. 2, Grid No. 3, and Internal Shield | 4 muf |

**CLASS A AMPLIFIER**

**Maximum Ratings**

| Plate Voltage | 16 ma volts |
| Screen-Grid Voltage | 16 ma volts |
| Control-Grid Voltage, Positive-bias Value | 0 volts |

**Heater Negative with Respect to Cathode**

| Plate Voltage | 16 ma volts |
| Control-Grid Voltage | 16 ma volts |

**Characteristics with 12.6 Volts on Heaters**

| Grid No. 3 | 12.5 volts |

**AVERAGE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Plate Volts (ac)</th>
<th>Grid No. 3 Volts (ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 volts</td>
<td>8.4 volts</td>
</tr>
<tr>
<td>10 volts</td>
<td>6.9 volts</td>
</tr>
<tr>
<td>8 volts</td>
<td>5.3 volts</td>
</tr>
</tbody>
</table>

**REMOTE-CUTOFF PENTODE**

**12EA6**

Miniature type used as rf amplifier in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 8B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heaters in the triode unit: 12.6 volts, 0.75 ma.; 2:1000 ohms (triode unit), 20; plate resistance (approx.), 10000 ohms (triode unit), 5000 ohms (tetrode unit); transconductance, 2500 microamps (triode unit), 1000 microamps (tetrode unit); peak heater-cathode volts, 16 ma. This type is used primarily for renewal purposes.

**MEDIUM-MU TRIODE—SEMIREMOTE-CUTOFF PENTODE**

**12EC8**

Miniature type used as combined vhf oscillator and mixer in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 8B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heaters in the triode unit: 12.6 volts, 0.75 ma.; 2:1000 ohms (triode unit), 20; plate resistance (approx.), 10000 ohms (triode unit), 5000 ohms (tetrode unit); transconductance, 2500 microamps (triode unit), 1000 microamps (tetrode unit); peak heater-cathode volts, 16 ma. This type is used primarily for renewal purposes.

**BEAM POWER TUBE**

**12ED5**

Miniature type used as audio-output amplifier in radio and television receivers employing series-connected triode microphone. Outline 18, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 12.6; amperes, 0.45; warm-up time (average), 11 seconds.

**CLASS A AMPLIFIER**

**Maximum Ratings**

| Plate Voltage | 150 ma volts |
| Grid-No. 2 Screen-Grid Voltage | 150 ma volts |
| Grid-No. 2 Input | 1.5 ma watts |
| Plate Dissipation | 6.25 ma watts |
PEAK HEATER-CATHODE VOLTAGE:  
Heater negative with respect to cathode.  
Heater positive with respect to cathode.  

Typical Operation:  
Plate Voltage ........................................ 110  
110 volts  
500 volts  
Grid-No.1 Voltage ..................................... 110  
110 volts  
500 volts  
Peak AF Grid-No.1 Voltage .............................. 4  
4 volts  
4.5 volts  
Peak Zero-Grid Voltage ................................ 4  
4 volts  
4.5 volts  
Zero-Signal Plate Current .............................. 32  
32 ma  
36 ma  
Maximum-Signal Plate Current ......................... 31  
31 ma  
36 ma  
Zero-Signal Grid-No.2 Current ......................... 4  
4 ma  
7 ma  
Maximum-Signal Grid-No.2 Current .................... 4  
4 ma  
7 ma  
Plate Resistance (Approx.) ........................... 14000  
14000 ohms  
Transconductance ................................. 8100  
5500 µmhos  
Load Resistance ................................. 4500  
4500 µmhos  
Total Harmonic Distortion .......................... 5  
5 per cent  
Maximum-Signal Power Output ......................... 1.1  
1.5 watts  

* The dc component must not exceed 100 volts.  
* The dc component must not exceed 100 volts.  

Maximum Circuit Values:  
Grid-No.1-Circuit Resistance:  
For fixed-bias operation .......................... 0.1 ma  
0.1 megohm  
For cathode-bias operation ......................... 0.5 ma  
0.5 megohm  

PENTAGRID AMPLIFIER  
Miniature type used as rf amplifier in low  
B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 1B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater- 
voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.19. Characteristics as class A amplifiers: heater set, 12.6; plate and grid-No.2  
and-No.4 volts, 12.6 (16 ma); grid-No.3 connected to grid-No.1 through 0.1-megohm resistor; grid-No.1 voltages (developed across 2.2-megohm resistor), 0.6; plate resistance (approx.), 0.15 megohms; transconductance (grid-No.1 to plate), 1000 µmhos; plate ma, 6; grid-No.2 ma, 6; grid-No.3 ma, 2.8; cathode ma, 20 ma; peak heater-cathode volts, 16 volts. This type is used principally for replacement purposes.  

12EG6  

POWER PENTODE  
Miniature type used in the audio output stage of radio and television receivers employing series-connected heaters. Outline 7C, OUTLINES SECTION. Heater voltages (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode voltage when the heater is negative with respect to the cathode, 300 volts max. Except for heater and heater-cathode ratings, this type is identical with miniature type 6EH5.  

12EH5  

REMOTE-CUTOFF PENTODE  
Miniature type used as if and rf amplifier in low  
B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 73B, OUTLINES SECTION. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.19. Characteristics as class A amplifiers: heater set, 12.6; plate and grid-No.2, 12.6 (16 ma); grid-No.3 connected to cathode at socket; grid-No.1 supply volts, 0; grid-No.1 resistor (by-passed), 2.2 megohms; plate resistance (approx.), 0.06 megohms; transconductance, 4500 µmhos; plate ma, 6; grid-No.2 ma, 6; cathode ma, 175; peak, 1 (average); plate dissipation, 7.5 watts; grid-No.2 input, 1.25 watts; peak heater-cathode voltage when the heater is negative with respect to the cathode, 300 volts (the dc component must not exceed 200 volts); heater positive with respect to the cathode, 200 volts (the dc component must not exceed 100 volts). This type is used principally for replacement purposes.  

12EK6  

DIODE—POWER TETRODE  
Miniature type used as combined detector and audio-amplifier tube in low  
B+ voltage automobile-radio receivers operating directly from 12-volt storage-battery systems. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (ac/dc), 9.9 to 15.9; amperes at 12.6 volts, 0.15. Characteristics of triode unit as class A amplifier: heater set, 12.6; plate set, 12.6 (30 ma); grid volts, 0; amplification factor, 56; plate resistance (approx.), 45000 ohms; transconductance, 1200 µmhos; plate ma, 0.7; cathode ma, 20 ma; peak heater-cathode volts, 30 volts. Maximum diode plate ma (each unit), 1. This type is used principally for renewal purposes.  

12EM6  

BEAM POWER TUBE  
Glass octal type used as vertical-deflection  
amplifier tube in television receivers employing series-connected heater strings. Outline 14C, OUTLINES SECTION. Tube requires octal socket. This tube may be supplied with pin No. 1 omitted. Heater voltage (ac/dc), 12.6; amperes, 0.5; warm-up time (average), 11 seconds. Peak heater-cathode voltage when the heater is negative with respect to the cathode, 300 volts max. Maximum ratings, heater set, 12.6; dc grid-No.2 volts, 100 ma; plate power (approx.), 28000 µmhos; transconductance, 40000 µmhos; maximum rating as vertical  
deflection amplifier (for operation in a 552-line, 5-iframe system): plate set, 300 ma; peak positive-pulse plate volts, 1200 volts; plate ma, 150 ma; peak negative-pulse grid-No.1 volts, 150 volts; cathode ma, 175 (peak), 150 (average); plate dissipation, 7.5 watts; grid-No.2 input, 1.25 watts; peak heater-cathode voltage, 300 volts (the dc component must not exceed 200 volts); heater positive with respect to the cathode, 200 volts (the dc component must not exceed 100 volts). This type is used principally for renewal purposes.  

12EN6  

DIODE—REMOTE-CUTOFF PENTODE  
Miniature type used as combined detector and AM detector in AM and FM radio receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater voltage (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6EQ7.  

12EQ7  

Related types:  
6EQ7, 20EQ7  

Technical Data  

TWIN-DIODE—HIGH-MU TRIODE  
Miniature type used as combined detector  
and audio-amplifier tube in low  
B+ voltage automobile-radio receivers operating directly from 12-volt storage-battery systems. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.15. Characteristics of triode unit as class A amplifier: heater volts, 12.6; plate volts, 12.6 (30 ma); grid volts, 0; amplification factor, 56; plate resistance (approx.), 45000 ohms; transconductance, 1200 µmhos; plate ma, 0.7; cathode ma, 20 ma; peak heater-cathode volts, 30 volts. Maximum diode plate ma (each unit), 1. This type is used principally for renewal purposes.  

12EL6  

Related types:  
6EL6, 20EL6  

308
HIGH-MU TRIODE
Glass octal type used in resistance-coupled amplifier circuits of ac/dc receivers. Outline 15A, OUTLINES SECTION. This type may be supplied with pin No.1 omitted. Heater voltages (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with glass-socket type 6FS-GT. Type 12FS-GT is a DISCONTINUED type listed for reference only.

TWIN DIODE—REMOTE-CUTOFF PENTODE
12F8
Miniature type used as combiner detector and rf voltage amplifier in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.15. Typical operation of pentode unit as class A amplifier: heater volts, 12.6; plate and grid-voltage range (10 mA), 0 to 0.8; plate and grid-voltage range (30 mA), 0 to 0.3 V. No.2 voltage, 12.4 (30 mA); grid No.3 connected to cathode at socket; grid-No.1 voltage, 0; plate resistance (approx.), 0.33 megohms; transconductance, 1000 μmhos; plate ma., 1; grid-No.2 ma., 0.38; peak heater-cathode volts, 30 mA. Maximum diode plate ma. (each unit), 1. This type is used principally for renewal purposes.

TWIN DIODE—LOW-MU TRIODE
12FK6
Miniature type used as combined detector and rf amplifier in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater-voltage range (ac/dc) .... 10.0 to 15.9 volts
Heater Current (Approx.) at 12.5 volts .......... 0.15 ampe
DIRECT INTERELECTRODE CAPACITANCES (Approx.):
Triode Grid to Triode Plate .......... 1.6 pf
Triode Grid to Cathode and Heater .......... 1.8 pf
Triode Plate to Cathode and Heater .......... 0.7 pf
Plate of Diode Unit No.1 to Plate of Diode Unit No.2 .......... 0.9 pf
* For longest life, it is recommended that the heater be operated within the voltage range of 11 to 14 volts.

AVGABLE CHARACTERS
TRIODE UNIT

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Technical Data

TRIODE UNIT AS CLASS A, AMPLIFIER

| Maximum Ratings, (Design-Maximum Values): | \(16\) max volts |
| PLATE VOLTAGE | 16 max volts |
| GRID VOLTAGE | 0 max volts |
| Positive-bias value | -16 max volts |
| Negative-bias value | -16 max volts |
| PEAK HEATER-CATHODE VOLUME | 16 max volts |
| Heater positive with respect to cathode | 16 max volts |
| Heater negative with respect to cathode | 16 max volts |

Characteristics with 12.6 Volts on Heater:

| Plate Voltage | 12.6 volts |
| Grid Supply Voltage | 0 |
| Grid Resistance (Bypassed) | 2.2 megohms |
| Plate Resistance (Approx.) | 1200 ohms |
| Transconductance | 1250 μmhos |
| Amplification Factor | 7.5 |
| Plate Current | 1.5 mA |
| Grid Voltage (Approx.) for plate current of 10 μA | -4 volts |

Maximum Circuit Values:

| DIODE UNITS |
| Grid-Circuit Resistance | 10 max megohms |

---

TWIN DIODE—MEDIUM-MU TRIODE

12FM6
Miniature type used as combined detector and rf voltage amplifier in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (ac/dc), 10 to 15.9; amperes at 12.6 volts, 0.15. Characteristics of triode unit as class A: amplifier: heater volts, 12.6; plate voltage, 12.6; (30 mA) grid; grid resistance (bypassed), 2.2 megohms; amplification factor, 10; plate resistance (approx.), 7500 ohms; transconductance, 1250 μmhos; plate ma., 1; peak heater-cathode volts, 30 mA. Maximum diode plate ma. (each unit), 1. This type is used principally for renewal purposes.

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HIGH-MU TWIN DOUBLE-PLATE TRIODE

12FQ8
Miniature type used in frequency-divider and complex-wave-generator circuits of electronic musical instruments. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 12.6; amperes, 0.15.

CLASS A, AMPLIFIER

| Characteristics, (Each Unit): |
| Plate Voltage | 250 volts |
| Grid Voltage | 1.5 volts |
| Amplification Factor | 95 |
| Plate Resistance (Approx.) | 12500 ohms |
| Transconductance | 12500 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): |
| PLATE A VOLTAGE | 530 max volts |
| PLATE B VOLTAGE | 530 max volts |
| Positive-bias value | 0 max volts |
| Negative-bias value | 0 max volts |
| PLATE A DISSIPATION | 0.5 max watt |
| PLATE B DISSIPATION | 0.5 max watt |
**RCA Receiving Tube Manual**

**Peak Heater-Cathode Voltage:**
- Heater negative with respect to cathode: 200 max volts
- Heater positive with respect to cathode: 200* max volts
* The dc component must not exceed 100 volts.

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**DIODE—**

**12FR8**
Miniature type used as combined if amplifier, af amplifier, and second detector in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 8D, OUTLINES SECTION, except vertical dimensions are 3/16 inch shorter. Tube requires miniature nine-contact socket and may be operated in any position. Heater-voltage range (dc), 10 to 15.8; amperes at 12.6 volts, 0.32.

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**CLASS A, AMPLIFIER**

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>16 max</td>
<td>16 max</td>
</tr>
<tr>
<td>GRID-No.2 Voltage</td>
<td>16 max</td>
<td>16 max</td>
</tr>
<tr>
<td>GRID-No.2 Voltage*</td>
<td>16 max</td>
<td>16 max</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>0.4 mho</td>
<td>0.4 mho</td>
</tr>
<tr>
<td>Transconductance</td>
<td>1200</td>
<td>2700</td>
</tr>
<tr>
<td>Plate Current</td>
<td>1</td>
<td>1.9 ma</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>0.7 ma</td>
<td>0.7 ma</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.)</td>
<td>-2.8 volts</td>
<td>-2.8 volts</td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 10 ma</td>
<td>-3.5 volts</td>
<td></td>
</tr>
</tbody>
</table>

* Developed across a 2.2-megaohm grid-No.1 resistor.

**Maximum Circuit Values:**
- Grid-No.1-Circuit Resistance: 10 max, 10 max, megalohms

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**DIODE UNIT**

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Center Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE CURRENT</td>
</tr>
</tbody>
</table>

**Characteristics, Instantaneous Value:**
- Tube Voltage: Drop for plate current of 2 ma, 10 volts

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**MEDIUM-MU TWIN TRIODE**
Miniature type used in relay-control tuning units of television receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

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**HEATER ARRANGEMENT:**
- Series: 12.6, 6.3, 12.6, 6.9 volts
- Parallel: 6.45, 6.9 amperes

**DIRECT INTERELECTRODE CAPACITANCES (Each Unit, Approx.):**
- Grid to Plate: 6, 6 pf
- Grid to Cathode and Heater: 0.6, 6 pf
- Plate to Cathode and Heater: 5.5, 5.5 pf

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**12FX5**
Related type: 60FX5
Miniature type used in output stages of audio amplifiers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 60FX5.
MEDIUM-MU TRIODE—PENTAGRID CONVERTER

12FX8

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 7B, OUTLINES SECTION, except vertical dimensions are 3/16 inch shorter. Tube requires miniature nine-contact socket and may be operated in any position. Heater-voltage range (de), 10 to 15.2; amperes at 12.6 volts, 0.27.

HEPTODE UNIT AS CONVERTER

Maximum Ratings, (Design-Center Values):

| Plate Voltage | 16 maz volts |
| Control-Grid | Grid-No. 3 (Control-Grid) Voltage | 16 maz volts |
| Negative-bias value | 0 maz volts |
| Positive-bias value | 16 maz volts |
| Grid-No. 2 and No. 4 (Screen Grid) Voltage | 16 maz volts |
| Peak Heater-Cathode Voltage | 16 maz volts |
| Heater voltage | 16 maz volts |
| Heater positive with respect to cathode | 16 maz volts |

Typical Operation and Characteristics with 12.6 Volts on Heater.*

Plate Voltage: 12.6 volts
Grid-No. 3 Voltage*: 0.5 volts
Grid-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 megohms
Conversion Transconductance: 200 μmhos
Grid-No. 3 Voltage (Approx.) for conversion transconductance of 10 μmhos: 3 volts
Plate Current: 290 ma
Grid-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
Grid-No. 3 Voltage: 0 volts
Grid-No. 1 Voltage: 0 volts
Amplification Factor (between grid No. 1 and grids No. 2 and No. 4 connected to plate): 2.5
Transconductance (between grid No. 1 and grids No. 2 and No. 4 connected to plate): 3600 μmhos
Cathode Current: 4.4 ma
Grid-No. 1 Voltage (Approx.) for plate current of 10 μa: 4.5 volts
* With grids No. 2 and No. 4 connected to plate and with 12.6 volts on heater.

Maximum Circuit Values:

Grid-No. 3 Circuit Resistance: 10 maz megohms
* 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 maz volts |
| Plate Voltage | 12.6 volts |
| Amplification Factor | 0.5 volts |
| Conversion Transconductance | 0.5 megohms |
| Plate Current (Approx.) | 1.25 ma |
| Grid Voltage (Approx. for plate current of 10 μa) | 3.2 volts |
| * Developed across a 2.2-megohm grid resistor |

Technical Data

PENTAGRID CONVERTER

Miniature type used as converter in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket. Heater-voltage range (de), 10 to 15.2; amperes at 12.6 volts, 0.15. Typical operation as converter: heater voltage, 12.6; plate and grid-No. 2 and No. 4 volts, 12.6 (16 maz); grid-No. 3 supply voltage, 0 maz; grid-No. 3 resistance (by-passed), 2.2 megohms; ma grid-No. 1 volts, 1.6; grid-No. 1 resistor, 33000 ohms; plate resistance (approx.), 1 megohm; conversion transconductance, 140 μmhos; plate ma., 0.3; grid-No. 2 and No. 4 ma, 0.8; grid-No. 1 ma, 0.66; peak heater-cathode volts, 16 maz. This type is used principally for renewal purposes.

BEAM POWER TUBE

Glass octal type used as horizontal-deflection amplifier in television receivers employing series-connected heater strings. Outline 21, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 12.6; amperes, 0.1; warm-up time (average), 11 seconds.

12GA6

CLASS A, AMPLIFIER

| Plate Voltage | 50 volts |
| Screen-Grid Voltage | 150 volts |
| Control-Grid Voltage | 0 volts |
| Triode Amplification Factor | 4.1 |
| Plate Resistance (Approx.) | 20000 ohms |
| Transconductance | 6600 μmhos |
| Plate Current | 345° 75 ma |
| Grid-No. 2 Current | 30° 2.4 ma |
| Grid-No. 1 Voltage (Approx.) for plate current of 1 ma | -46 volts |

HORIZONTAL-DEFLECTION AMPLIFIER

For operation in a 255-line, 30-frame system

Maximum Ratings, (Design-Maximum Values):

Peak Positive-Pulse Plate Voltage*: 770 maz volts
Peak Negative-Pulse Plate Voltage*: 6500 maz volts
Peak Positive-Pulse Grid-No. 1 Voltage: 1500 maz volts
Peak Negative-Pulse Grid-No. 1 Voltage: 2200 maz volts
Peak Cathode Current: 550 maz ma
Average Cathode Current: 175 ma ma
Plate Disipation*: 17.5 ma watts
Grid-No. 2 Input: 4.5 ma watts
Peak Heater-Cathode Voltage: 200 volts
Heater negative with respect to cathode
Heater positive with respect to cathode
Built Temperature (At hottest point): 2200 maz °C

Maximum Circuit Values:

Grid-No. 1 Circuit Resistance: 1 maz megohms
* This value can be measured by a method involving a recurrent waveform such that the maximum ratings will not be exceeded.
* This rating is applicable where the duration of the voltage pulse does not exceed 15 per cent of one horizontal scanning cycle. In a 255-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 19 microseconds.
* An adequate bias resistor or other means is required to protect the tube in the absence of excitation.
* The dc component must not exceed 100 volts.

404
**12GE5**

**BEAM POWER TUBE**

Duodecar type used as horizontal-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 20, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodecar type 6GE5.

**12GJ5**

**BEAM POWER TUBE**

Novar type used in horizontal-deflection-amplifier circuits of television receivers employing series-connected heater strings. Outline 18A, OUTLINES SECTION. Tube requires novar nine-contact socket and may be operated in any position. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6GJ5.

**12GN7**

**SHARP-CUTOFF PENTODE**

Miniature type with frame grid used as video amplifier tube in television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts, 6.3 (series), 12.6 (parallel); amperes, 0.6 (series), 0.3 (parallel); warm-up time (average), 11 seconds.

**CLASS A: AMPLIFIER**

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>400 max volts</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-grid) Supply Voltage</td>
<td>330 max volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Grid-No.1 (Control-grid) Voltage, Positive-bias Value</td>
<td>6 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>7.6 max watts</td>
</tr>
<tr>
<td>Gain-No.2 Input</td>
<td>For grid-No.2 voltages up to 155 volts: 1.5 max watts, For grid-No.2 voltages between 155 and 380 volts: See curve page 70</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>For grid-No.2 voltages up to 155 volts: 200 max volts, For grid-No.2 voltages between 155 and 380 volts: See curve page 70</td>
</tr>
</tbody>
</table>

**Characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>50</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>0</td>
</tr>
<tr>
<td>Cathode-Blas Resistor</td>
<td>50</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>0.05</td>
</tr>
<tr>
<td>Transconductance</td>
<td>36000</td>
</tr>
<tr>
<td>Plate Current</td>
<td>70</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>6.6</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 100 ma</td>
<td>-6.7</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1 Circuit Resistance</td>
<td>0.25 max megohms</td>
</tr>
</tbody>
</table>

*The dc component must not exceed 100 volts. This value can be measured by a method involving a recurrent waveform such that the maximum rating of the tube will not be exceeded.*

---

**12GT5**

**BEAM POWER TUBE**

Novar type used as horizontal-deflection amplifier in television receivers employing series-connected heater strings. Outline 17A, OUTLINES SECTION. Tube requires novar nine-contact socket and may be operated in any position. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this tube is identical with novar type 6GT5.

**12GW6**

**BEAM POWER TUBE**

Glass octal type used as horizontal-deflection amplifier in high-efficiency deflection circuits of television receivers employing series-connected heater strings. Outline 21, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 12.6; amperes, 0.6; heater warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 6GW6.

**12H6**

**TWIN DIODE**

Metal type used as detector, low-voltage rectifier, or arc tube in ac/dc radio receivers. Maximum dimensions: over-all length, 1-7/16 inches; seated height, 1-3/16 inches, diameter, 1-1/32 inches. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with metal type 6H6.

**MEDIUM-MU TRIODE**

Glass octal type used as detector, amplifier, or oscillator in ac/dc radio equipment. Outline 14C, OUTLINES SECTION. This type may be supplied with pin No.1 omitted. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater rating and base, this type is identical with glass octal type 6J5-GT. Type 12J5-GT is used principally for renewal purposes.

**12J5GT**

**SHARP-CUTOFF PENTODE**

Glass octal type used as biased detector or high-gain audio amplifier in ac/dc radio receivers. Outline 15A, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater rating, this type is identical with glass octal type 6J7-GT. Type 12J7-GT is used principally for renewal purposes.

**12J7GT**

**TWIN DIODE—POWER TETRODE**

Miniature type used as combined detector and audio driver in low B+ voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 48, OUTLINES SECTION. Tube requires miniature nine-contact socket. Heater-voltage range (ac/dc), 10 to 15; amperes at 12.6 volts, 0.325. Typical operation of tetrode unit as audio driver: heater volts, 12.6; plate and grid-No.2
RCA Receiving Tube Manual

voltage, 12.5 (30 mA); grid-No.1 voltage, 0; peak af grid-No.1 voltage, 2.25; grid-No.1 resistor, 400k; bypassed by 1-μf capacitor; zero-signal plate ma, 12; zero-signal grid-No.2 ma, 1.5; plate resistance (approx.), 350 ohms; load current, 2700 ma; maximum-signal power output, 20 milliwatts. Maximum plate ma (each unit), 0. Peak heater-cathode volts, 30 ma. This type is used principally for renewal purposes.

BEAM POWER TUBE

Novar type used as high-efficiency horizontal-deflection-oscillator tube in television receivers employing series-connected heater strings. Outline 18A, OUTLINES SECTION. Heater voltage (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6J8B.

POWER TETRODE

Miniature type used as power amplifier in low-B voltage automobile radio receivers operating directly from 12-volt storage-battery systems. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater-voltage range (ac/dc), 15.0 to 15.9; amperes (approx.) at 12.6 volts, 0.4. Maximum ratings and characteristics are the same as those of the tetrode unit of miniature type 12DL8.

REMOTE-CUTOFF PENTODE

Glass octal type used as rf or if amplifier in ac/dc receiver particularly those employing ac/dc receiver sections. Outline 16A, OUTLINES SECTION. Heater voltage (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with glass octal type 6UK-1GT. Type 12K7GT is used principally for renewal purposes.

TRIODE—HEXODE CONVERTER

Metal type used as combined triode oscillator and hexode mixer in ac/dc radio receivers. Outline 4, OUTLINES SECTION. Heater voltage (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with metal type 6K8. Type 12K8 is used principally for renewal purposes.

DIODE—SHARP-CUTOFF PENTODE

Miniature type used in combined if-amplifier and AM-detector service in AM and AM/FM broadcast receivers employing series-connected heater strings. Pentode unit may also be used as an rf- or if-amplifier or limiter tube; the diode unit may be used for ac or dc detection. Outline 8D, OUTLINES SECTION. Heater voltage (ac/dc), 12.6; amperes, 0.15; warm-up time (average), 17 seconds. Except for heater ratings, this type is identical with miniature type 6KL8.

Technical Data

BEAM POWER TUBE

Glass octal type used in audio output stages of television receivers employing series-connected heater strings. Outline 16C, OUTLINES SECTION. This type may be supplied with pin No. 1 omitted. Heater voltage (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts: heater negative with respect to cathode, 300 ma; heater positive with respect to cathode, 200 ma (the dc component must not exceed 100 volts). Except for heater and heater-cathode ratings, this type is identical with glass octal type 6567GT. Type 12L6GT is used principally for renewal purposes.

TWIN DIODE—HIGH-MU TRIODE

Glass octal type used as combined detector, amplifier, and ac/dc radio receiver. Outline 16A, OUTLINES SECTION. Heater voltage (ac/dc), 12.6; amperes, 0.15. Except for heater rating, this type is identical with glass octal type 6T7GT. Type 12Q7GT is used principally for renewal purposes.

BEAM POWER TUBE

Miniature type used as a vertical deflection amplifier in television receivers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

HEATER VOLTAGE (AC/DC)

12.6 volts

HEATER CURRENT

0.6 amperes

HEATER WARM-UP TIME (Average)

11 seconds

PLATE RESISTANCE (Approx.)

13000 ohms

TRANSCONDUCTANCE

7000 ohms

* For plate and grid-No.2 voltage, 110; grid-No.1 voltage, 8.5; plate ma, 40; grid-No.2 ma, 3.3.

VERTICAL DEFLECTION AMPLIFIER

For operation in a 555-line, 30-frame system

Maximum Ratings (Design-Center Values)

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Current</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC PLATE VOLTAGE</td>
<td>150 max</td>
<td>150 max</td>
</tr>
<tr>
<td>PEAK OF-F-BASE PLATE VOLTAGE (Absolute Maximum)</td>
<td>1600 max</td>
<td>150 max</td>
</tr>
<tr>
<td>GRID-NO.1 (CONTROL-GRID) VOLTAGE</td>
<td>150 max</td>
<td>150 max</td>
</tr>
<tr>
<td>PEAK OF-F-BASE GRID-NO.1 (CONTROL-GRID) VOLTAGE</td>
<td>150 max</td>
<td>150 max</td>
</tr>
<tr>
<td>PEAK CATHODE CURRENT</td>
<td>150 ma</td>
<td>45 ma</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>45 ma</td>
<td>45 ma</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>5 max</td>
<td>5 max</td>
</tr>
<tr>
<td>GRID-NO.2 INPUT</td>
<td>1 max</td>
<td>1 max</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>300 max</td>
<td>200 max</td>
</tr>
<tr>
<td>HEATER negative with respect to cathode</td>
<td>300 max</td>
<td>200 max</td>
</tr>
<tr>
<td>HEATER positive with respect to cathode</td>
<td>200 max</td>
<td>200 max</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

Grid-No.1 Circuit Resistance: 2.2 m ohms

† For cathode-bias operation, the duration of the pulse voltage must not exceed 15 percent of one vertical scanning cycle. In a 555-line, 30-frame system, 15 percent of one vertical scanning cycle is 5.6 milliseconds.

‡ Under no circumstances should this absolute value be exceeded.

§ The dc component must not exceed 100 volts.

TRIPLE DIODE—HIGH-MU TRIODE

Glass octal type used as audio amplifier, AM detector, and FM detector in AM/FM receivers. Outline 15B, OUTLINES SECTION. Heater voltage (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with glass octal type 6587GT. Type 12S8GT is a DISCONTINUED type listed for reference only.

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**PENTAGRID CONVERTER**

Metal type 12SA7 and glass octal type 12SA7-GT used as converter in ac/dc receivers. Outlines 2 and 14C, respectively, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, these types are identical with metal type 6S6A7 and glass octal type 6SA7-GT. Type 12SA7-GT is used principally for renewal purposes.

**HIGH-MU TWIN TRIODE**

Metal type used as phase inverter or voltage amplifier in ac/dc radio equipment. Outline 2, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with metal type 6SC7. Type 12SC7 is used principally for renewal purposes.

**HIGH-MU TRIODE**

Metal type 12SF5 and glass octal type 12SF5-GT used in resistance-coupled amplifier circuits of ac/dc radio equipment. Outlines 2 and 14C, respectively, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, these types are identical with metal type 6SF5 and glass octal type 6SF5-GT, respectively. Type 12SF5-GT is a DISCONTINUED type listed for reference only. Type 12SF5 is used principally for renewal purposes.

**DIODE—REMOTE-CUTOFF PENTODE**

Metal type used as combined rf or if amplifier and detector or avc tube in ac/dc radio receivers. Outline 2, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with metal type 6SF7. Type 12SF7 is used principally for renewal purposes.

**SEMIREMOTE-CUTOFF PENTODE**

Metal type used as if amplifier in ac/dc receivers involving high-frequency, wide-band applications. Outline 2, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with metal type 6SG7. Type 12SG7 is used principally for renewal purposes.

**SHARP-CUTOFF PENTODE**

Metal type used as rf amplifier in ac/dc receivers involving high-frequency, wide-band applications and as limiter tube in FM equipment. Outline 2, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is identical with metal type 6SH7. Type 12SH7 is used principally for renewal purposes.

**SHARP-CUTOFF PENTODE**

Metal type 12SJ7 and glass-octal type 12SJ7-GT used as rf amplifiers and biased detectors in ac/dc radio receivers. Outline 2 and 14C, respectively, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, these types are identical with metal type 6SJ7 and glass-octal type 6SJ7-GT. Type 12SJ7-GT is a DISCONTINUED type listed for reference only.

**REMOTE-CUTOFF PENTODE**

Metal type 12SK7 and glass octal type 12SK7-GT used as rf and if amplifiers in ac/dc radio receivers. Outlines 2 and 14C, respectively, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, these types are identical with metal type 6SK7 and glass octal type 6SK7-GT. Type 12SK7-GT is used principally for renewal purposes.

**HIGH-MU TWIN TRIODE**

Glass octal type used as phase inverter or resistance-coupled amplifier in ac/dc radio equipment. Outline 14C, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater rating, this type is identical with glass octal type 6SL7-GT.

**MEDIUM-MU TWIN TRIODE**

Glass octal types used as combined vertical oscillators and vertical deflection amplifiers, and as horizontal deflection oscillators in television receivers. May also be used in multivibrator or resistance-coupled amplifier circuits in radio receivers. Outline 14C, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.3. Except for heater ratings, these types are identical with glass octal types 6SN7-GT and 6SN7-GTB, respectively. Type 12SN7-GT is a DISCONTINUED type listed for reference only.
TWIN DIODE—HIGH-MU TRIODE
12SQ7
12SQ7GT
Related types: 6SQ7, 6SQ7GT
Metal type 12SQ7 and glass octal type 12SQ7-GT used as combined detector, amplifier, and AVC tube in ac/dc radio receivers. Outlines 2 and 14C, respectively, OUTLINES SECTION.
Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, these types are identical with metal type 6SQ7 and glass octal type 6SQ7-GT.

TWIN DIODE—MEDIUM-MU TRIODE
12SR7
12SR7GT
Related types: 6SR7, 6SR7GT
Metal type 12SR7 and glass octal type 12SR7-GT used as combined detector, amplifier, and AVC tube in ac/dc radio receivers. Outlines 2 and 14C, respectively, OUTLINES SECTION.
Heater volts (ac/dc), 12.6; amperes, 0.15. Exception for heater rating, type 12SR7 is identical with type 6SR7, and type 12SR7-GT is electrically identical with type 6SR7 except for interelectrode capacitances. Type 12SR7 is used principally for renewal purposes. The 12SR7-GT is a DISCONTINUED type listed for reference only.

MEDIUM-MU TWIN TRIODE
12U7
Miniature type used as general-purpose amplifier tube in automobile-radio receivers operating directly from 12-volt storage-battery systems. Outline 4B, OUTLINES SECTION.
Tube requires miniature nine-contact socket and may be mounted in any position. Heater voltage range (ac/dc), 10.0 to 15.9; amperes (approx.) at 12.6 volts, 0.15. Maximum ratings (each unit) as class A: amplifier: plate volts, 30 max; cathode ma., 15 max; peak heater-cathode volts, 30 max. This type is used principally for renewal purposes.

BEAM POWER TUBE
12V6GT
Related types: 6V6GT, 6V6GT
Glass octal type used as output amplifier primarily in automobile radio receivers operating from a 12-volt storage battery. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 12.6; amperes, 0.225. Except for heater rating, this type is identical with glass octal type 6V6-GT.

BEAM POWER TUBE
12W6GT
Related type: 6W6GT
Glass octal type used in the audio output stages of television receivers employing series-connected heater strings. Triode-connected, this type is used as a vertical deflection amplifier. Outline 14C, OUTLINES SECTION. This type may be supplied with pin No.1 omitted. Heater volts (ac/dc), 12.6; amperes, 0.6; warm-up time (average), 11 seconds. Peak heater-cathode volts: heater negative with respect to cathode, 300 max (the dc component must not exceed 200 volts); heater positive with respect to cathode, 200 max (the dc component must not exceed 100 volts). Except for heater and heater-cathode ratings, this type is identical with glass octal type 6W6-GT.

FULL-WAVE VACUUM RECTIFIER
12X4
Related type: 6X4
Miniature type used in power supply of automobile radio receivers operating from a 12-volt storage battery. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 12.6; amperes, 0.3. Except for heater ratings, this type is identical with miniature type 6X4.

HALF-WAVE VACUUM RECTIFIER
12Z3
Glass types used in power supply of ac/dc receivers. Maximum dimensions: overall length, 43/16 inches; seated height, 3-9/16 inches; diameter, 1-9/16 inches. Tube requires four-contact socket. Heater volts (ac/dc), 12.6; amperes, 0.3. Maximum ratings as half-wave rectifier: peak inverse plate volts, 700 max; peak plate ma., 390 max; dc output max., 55 max; peak heater-cathode volts, 550 max. This is a DISCONTINUED type listed for reference only.

HIGH-MU TRIODE
13CW4
Related types: 2CW4, 6CW4
Nuvistor type used in booster amplifiers of antenna systems serving multiple television receiver installations. Outline 1, OUTLINES SECTION. Heater volts (ac/dc), 13.5; amperes, 0.06. Except for heater ratings, this type is identical with nuvistor type 6CW4.

DUAL TRIODE
13DE7
Related types: 6DE7, 10DE7
Miniature type used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers employing series-connected heater strings. 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 8D, OUTLINES SECTION. Heater volts (ac/dc), 13; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6DE7.

DUAL TRIODE
13DR7
Related types: 6DR7, 10DR7
Miniature type containing high-mu and low-mu triodes; used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 13; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6DR7.
**DUAL TRIODE**

**13EM7**

Glass octal type containing high-mu and high-perveance, low-mu triode; used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers employing series-connected heater strings. Outline 14B, OUTLINES SECTION. Heater volts (ac/dc), 15; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6EM7.

**13FD7**

Glass type containing high-mu and low-mu triode units used as combined vertical-deflection oscillator and vertical-deflection amplifier in television receivers employing series-connected heater strings. Heater volts (ac/dc), 15; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass type 6PD7.

**BEAM POWER TUBE**

**13GB5**

Neovolat type used as horizontal-deflection amplifier in television receivers. Maximum dimensions: overall length, 4-7/64 inches; seated height, 3-49/64 inches; diameter, 1-3/16 in. Tube requires neovolat nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 13.3; amperes, 0.6. Typical instantaneous characteristics (measured with recurrent waveform such that maximum ratings are not exceeded): plate volts, 75; grid-No.2 volts, 200; grid-No.1 volts, -19; plate ma., 440; grid-No.2 ma., 37.

**HORIZONTAL DEFLECTION AMPLIFIER**

For operation in a 555-line, 30-frame system

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage..........................</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage*.........</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage..............</td>
</tr>
<tr>
<td>Average Cathode Current........................</td>
</tr>
<tr>
<td>Plate Dissipation................................</td>
</tr>
<tr>
<td>Grid-No.2 Input................................</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:.................</td>
</tr>
<tr>
<td>Heater negative with respect to cathode...............</td>
</tr>
<tr>
<td>Heater positive with respect to cathode.........</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

Grid-No.1-Circuit Resistance: With drive into grid current (horizontal-deflection applications only) 2.3 ma megohms
Without grid current 0.5 ma megohms

*The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 555-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

*The dc component must not exceed 125 volts.

---

**DUAL TRIODE**

**13GF7**

Novo type containing high-mu and high-perveance, low-mu triode units used as combined vertical-deflection amplifier and vertical-deflection oscillator in television receivers employing series-connected heater strings. Outline 10A, OUTLINES SECTION. Heater volts (ac/dc), 15; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novo type 6GF7.

---

**POWER PENTODE—BEAM POWER TUBE**

**13J10**

Duodee type used in FM and television receivers employing series-connected heater strings. The pentode unit is used in audio power-output stages, and the beam power unit is used as a gated-beam discriminator in FM and television limiter and discriminator applications. Outline 12B, OUTLINES SECTION. Tube requires duodee twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 13.2; amperes, 0.45; warm-up time (average), 11 seconds.

**PENTODE UNIT AS CLASS A1 AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

| Plate Voltage:.............................| 215 ma max volts |
| Grid-No.2 Voltage:.........................| 275 ma max volts |
| Plate Dissipation:.........................| 10 ma max watts |
| Grid-No.2 Input:...........................| 2 ma max watts |
| Peak Heater-Cathode Voltage:..............|
| Heater negative with respect to cathode...............| 200 ma max volts |
| Heater positive with respect to cathode.........| 200 ma max volts |

**Characteristics and Typical Operation:**

Plate Voltage ..........................| 250 ma volts |
Grid-No.2 Voltage.........................| 250 ma volts |
Grid-No.1 Voltage........................| 8 ma volts |
Peak AP Grid-No.1 Voltage................| 8 ma volts |
Plate Resistance (Approx.) ................| 8.1 megohms |
Transconductance................................| 6500 µmhos |
Zero-Signal Plate Current ................| 35 ma |
Maximum-Signal Plate Current .................| 39 ma |
Zero-Signal Grid-No.2 Current ..............| 2.5 ma |
Maximum-Signal Grid-No.2 Current ............| 7 ma |
Load Resistance ................................| 5000 ohms |
Total Harmonic Distortion (Approx.) ..........| 10 per cent |
Maximum-Signal Power Output ..................| 4.2 watts |

**Maximum Circuit Values:**

Grid-No.1-Circuit Resistance: For fixed-bias operation, 0.25 ma megohms
For cathode-bias operation, 0.5 ma megohms

**BEAM POWER UNIT AS GATED-BEAM DISCRIMINATOR**

**Maximum Ratings, (Design-Maximum Values):**

| Plate Supply Voltage:.....................| 330 ma volts |
| Grid-No.2 (Accelerator-Grid) Voltage .......| 110 ma volts |
| Plate Voltage:............................| 60 ma volts |
| Grid-No.1 Voltage:.........................| 13 ma volts |
| Average Cathode Current:..................| 13 ma |
| Peak Heater-Cathode Voltage:.............|
| Heater negative with respect to cathode...............| 200 ma volts |
| Heater positive with respect to cathode.........| 200 ma volts |

*The dc component must not exceed 100 volts.
**MEDIUM-MU TRIODE**

Glass lock-in type used as detector, amplifier, or oscillator in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 12.6; amperes, 0.15. Except for heater ratings and capacitances, this type is electrically identical with lock-in type 7AF7 and metal type 687. Type 14AF7 is used principally for renewal purposes.

**BEAM POWER TUBE**

Glass lock-in type used as output amplifier in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 12.6; amperes, 0.15. Typical operation and ratings as class A amplifier; plate voltage and grid-No.2 voltage, 250 (300 max); plate dissipation, 7.5 watts; grid-No.2 input, 250 volts; grid-No.1 voltage, -12.6; plate ma., 32; grid-No.2 ma., 5.5; plate resistance, 7500 ohms; transconductance, 3000 amhos; load resistance, 7500 ohms; output watts, 2.8. This is a DISCONTINUED type listed for reference only.

**REMOTE-CUTOFF PENTODE**

Glass lock-in type used as r-f or if amplifier in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 12.6; amperes, 0.15. Except for heater rating and capacitances, this type is electrically identical with metal type 6S7GT and lock-in type 7AF7. Type 14AF7 is used principally for renewal purposes.

**TWIN DIODE—MEDIUM-MU TRIODE**

Glass lock-in type used as combined detector, amplifier, and ave tube in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is electrically identical with lock-in type 14E6. Type 14E6 is a DISCONTINUED type listed for reference only.

**TWIN DIODE—HIGH-MU TRIODE**

Glass lock-in type used as combined detector, amplifier, and ave tube in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is electrically identical with lock-in type 14F7. Type 14F7 is used principally for renewal purposes.

**PENTAGRID CONVERTER**

Glass lock-in type used as converter in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (ac/dc), 12.6; amperes, 0.15. Except for heater ratings and capacitances, this type is electrically identical with lock-in type 7AF7 and metal type 6A8. Type 14B8 is a DISCONTINUED type listed for reference only.
TWIN DIODE—HIGH-MU TRIODE

Miniature type used as combined detector and af voltage amplifier in radio receivers. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position.

**HEATER VOLTAGE (AC/DC)**
- 14 volts

**HEATER CURRENT**
- 0.15 amperes

**AMPLIFICATION FACTOR**
- 72

**PLATE RESISTANCE**
- 75,000 ohms

**TRANSCONDUCTANCE**
- 1,000 

* For triode unit: plate volts, 250; grid volts, -3; plate ma, 0.7.

**TRIODE UNIT AS CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

- **PLATE VOLTAGE**
  - 300 max volts

- **GRID VOLTAGE, Positive-bias value**
  - 50 max volts

- **PLATE DISSIPATION**
  - 1.1 max watts

- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode: 200 max volts
  - Heater positive with respect to cathode: 200 max volts

**DIODE UNITS (Each Unit)**

**Maximum Ratings, (Design-Maximum Values):**

- **PLATE CURRENT**
  - 5 max ma

- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode: 200 max volts
  - Heater positive with respect to cathode: 200 max volts

**Characteristics, Instantaneous Value:**

- Tube Voltage Drop for plate current of 18 ma: 5 volts

* The dc component must not exceed 100 volts.

**AVG. PLATE CHARACTERISTICS**

**SEMIREMOTE-CUTOFF PENTODE**

Glass lock-in type used as rf or if amplifier in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is electrically identical with lock-in type 7Q7. Type 14H7 is a DISCONTINUED type listed for reference only.

**14H7**

**14J7**

**TRIODE—HEPTODE CONVERTER**

Glass lock-in type used as combined triode oscillator and heptode mixer in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is electrically identical with lock-in type 7J7. Type 14J7 is a DISCONTINUED type listed for reference only.

**14N7**

**MEDIUM-MU TWIN TRIODE**

Glass lock-in type used as voltage amplifier or phase inverter in ac/dc radio equipment. Outline 13B, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 12.6; amperes, 0.63. Except for heater ratings and capacitances, this type is electrically identical with lock-in type 5N7 and glass-ceramic type 6SN7-GT. Type 14N7 is a DISCONTINUED type listed for reference only.

**14Q7**

**PENTAGRID CONVERTER**

Glass lock-in type used as converter in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings and capacitances, this type is electrically identical with metal type 6SN7 and lock-in type 7Q7. Type 14Q7 is used principally for renewal purposes.

**14R7**

**TWIN DIODE—REMOTE-CUTOFF PENTODE**

Glass lock-in type used as combined detector, amplifier, and afshe tube in ac/dc radio receivers. Outline 13A, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 12.6; amperes, 0.15. Except for heater ratings, this type is electrically identical with lock-in type 7K7. Type 14R7 is used principally for renewal purposes.

**15**

**SHARP-CUTOFF PENTODE**

Glass lock-in type used as rf amplifier in battery-operated receivers. Outline 24B, OUTLINES SECTION. Tube requires five-contact socket. Heater volts (dc), 2.0; amperes, 0.22. Typical operation as class A1 amplifier: plate volts, 135 ma; grid-No.2 (screen-grid) volts, 67.5 ma; grid-No.1 volts, 1.5; plate ma, 1.85; grid-No.2 ma, 0.3; plate resistance, 0.8 megohm; transconductance, 750 megohms. This is a DISCONTINUED type listed for reference only.

**15AF11**

**Related type:** 6AF11

**DUAL TRIODE—SHARP-CUTOFF PENTODE**

Duodecar type used in a variety of applications in television receivers employing series-connected heater strings. The high-mu triode unit is used in age-keyer applications, the low-mu triode unit in sync-separator applications, and the pentode unit in video-amplifier applications. Outline 12C, OUTLINES SECTION. Heater volts (ac/dc), 14.7; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is electrically identical with duodecar type 6AF11.
DUAL TRIODE

15FY7

Duodec-type triode used as combined vertical-deflection oscilator and vertical-deflection amplifier in television receivers employing series-connected heater strings. The high-mu triode unit No.1 is used as an oscillator, and the low-mu triode unit No.2 is used as an amplifier. Outline 12D, OUTLINES SECTION. Heater volts (ac/dc), 14.7; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodec-type 6FY7.

POWER PENTODE

15HB6

Miniature type used as vertical-deflection-amplifier tube in television receivers. Outline 9E, OUTLINES SECTION. Heater volts (ac/dc), 14.7; amperes, 0.3; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6HB6.

HIGH-MU TRIODE—BEAM POWER TUBE

15KY8

Novar type used in combined vertical-deflection-oscillator and vertical-deflection-amplifier applications in black-and-white television receivers having low-voltage "B" supplies and employing series-connected heater strings. Outline 10C, OUTLINES SECTION. Tube requires novar nine-contact socket and may be mounted in any position.

Technical Data

**Peak Positive-Pulse Grid-No.1 Voltage**: 
-400 max
**Peak Cathode Current**: 
77 max
**Averaage Cathode Current**: 
22 max
**Plate Disipation**: 
1.6 max
**Grid-No.2 Input**: 
-1.9 max
**Peak Heater-Cathode Voltage**: 
Heater negative with respect to cathode.
-200 max
**Heater Positive with respect to cathode**: 
-200 max

Maximum Ratings:

- Grid-No.1-Circuit Resistance: 
2.2 max
- Grid-No.2-Circuit Resistance: 
2.2 max
- Plate connection, grid No.2 connected to 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.
- The duration of the voltage pulse must not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 16 per cent of one vertical scanning cycle is 2.6 milliseconds.
- Under no conditions should this maximum value be exceeded.
- The dc component must not exceed 100 volts.

AVERAGE CHARACTERISTICS

**Beam Power Unit**

**Plate Voltage**: 
150V
**Heater Voltage (AC/DC)**: 
15 volts
**Heater Current**: 
0.45 amperes
**Heater Warm-up Time (Average)**: 
10 seconds

DEFECTIVE INTERELECTRODE CAPACITANCES (Approx.):

- Triode Unit:
  - Grid to Plate: 0.44 pf
  - Grid to Cathode and Heater: 15 pf
  - Plate to Cathode and Heater: 7 pf
- 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

**CLASS A AMPLIFIER**

**Characteristics**

<table>
<thead>
<tr>
<th>Triode Unit</th>
<th>Beam Power Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>-120</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>3</td>
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<tr>
<td>Amplification Factor</td>
<td>64</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>40000</td>
</tr>
<tr>
<td>Transconductance</td>
<td>1600</td>
</tr>
<tr>
<td>Plate Current</td>
<td>1.4</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>20</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 1 ma</td>
<td>-24</td>
</tr>
</tbody>
</table>

**VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER**

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

<table>
<thead>
<tr>
<th>Triode Unit</th>
<th>Beam Power Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>330 max</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage</td>
<td>2200 max</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>150 max</td>
</tr>
</tbody>
</table>
**DIODE**

Miniature type used as booster diode in line-time-base circuits of transformerless television receivers. Outline 9C, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 16.4, amperes, 0.6.

**Maximum Ratings, (Design-Center Values):**

- Supply Voltage at zero current: 550 max volts
- Supply Voltage: 250 max volts
- Peak Plate Current: 550 max ma
- Peak Plate Current: 250 max ma
- Plate Voltage: 5 max volts
- Peak Negative-Pulse Plate Voltage*: -6600 max volts
- Peak Heater-Cathode Voltage: 6600 max volts
- Heater negative with respect to cathode: 6600 max volts
- Heater positive with respect to cathode: 6600 max volts

* Under no conditions should an absolute maximum value of 7500 volts be exceeded.

**HALF-WAVE VACUUM RECTIFIER**

17AX3

Duodecar type used as damper tube in horizontal-deflection circuits of television receivers employing series-connected heater strings. Outline 12C, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodecar type 6AX3.

17AX4GT

HALF-WAVE VACUUM RECTIFIER

Glass octal types used as damper tubes in horizontal deflection circuits of television receivers employing series-connected heater strings. Outline 14C, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, these types are identical with glass octal types 6AX4-GT and 6AX4-GTB, respectively.

17AY3

HALF-WAVE VACUUM RECTIFIER

Novar type used as damper tube in horizontal-deflection circuits of black-and-white television receivers employing series-connected heater strings. Outline 17A, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6AY3.

17BH3

HALF-WAVE VACUUM RECTIFIER

Novar type used as damper tube in horizontal-deflection circuits of black-and-white television receivers employing series-connected heater strings. Outline 17A, OUTLINES SECTION. Heater volts (ac/dc), 17.0; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6BH3.

**BEAM POWER TUBE**

17BQ6GTB

Glass octal type used as horizontal deflection amplifier in television receivers employing series-connected heater strings. Outline 15C, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 6BQ6-GTB/6CUs.

17BS3

HALF-WAVE VACUUM RECTIFIER

Novar type used as damper tube in horizontal-deflection circuits of black-and-white television receivers employing series-connected heater strings. Outline 10D, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6BS3.

17C9

SHARP-CUTOFF DUAL TETRODE

Miniature type used as vhf rf amplifier and autodyne mixer tube. Outline 8B, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6C9.

17CU5

BEAM POWER TUBE

Miniature type used in the audio output stage of television receivers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CU5.

17D4

HALF-WAVE VACUUM RECTIFIER

Glass octal type used as damper tube in horizontal-deflection circuits of television receivers employing series-connected heater strings. Outline 14C, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 6DA4.
17DE4
HALF-WAVE VACUUM RECTIFIER
Glass octal type used as damper tube in horizontal-deflection circuits of television receivers employing series-connected heater strings. Outline 14F, OUTLINES SECTION. Heater volts (ac/dc), 17; amperes, 0.65; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 6DE4.

17DM4
HALF-WAVE VACUUM RECTIFIER
Glass octal type used as damper tube in horizontal-deflection circuits of television receivers employing series-connected heater strings. Outline 14F, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 6DM4.

17DQ6A
17DQ6B
BEAM POWER TUBE
Glass octal types used as horizontal-deflection amplifier in television receivers employing series-connected heater strings. Outline 21, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, these types are identical with glass octal types 6DQ6-A and 6DQ6-B.

17GE5
BEAM POWER TUBE
Duodecar type used as horizontal-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 20, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodecar type 6GE5.

17GJ5
BEAM POWER TUBE
Novar type used in horizontal-deflection-amplifier circuits of television receivers employing series-connected heater strings. Outline 18A, OUTLINES SECTION. Tube requires novar nine-contact socket and may be operated in any position. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with type 6GJ5.

17GT5
BEAM POWER TUBE
Novar type used in horizontal-deflection-amplifier circuits of television receivers employing series-connected heater strings. Outline 17A, OUTLINES SECTION. Tube requires novar nine-contact socket and may be operated in any position. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6GT5.

17GW5
BEAM POWER TUBE
Duodecar type used as horizontal-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 21, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with duodecar type 6GW5.

17GW6
BEAM POWER TUBE
Glass octal type used in horizontal-deflection-amplifier circuits of high-efficiency deflection circuits of television receivers employing series-connected heater strings. Outline 20, OUTLINES SECTION. Tube requires octal socket and may be operated in any position. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 6GW6.

17JB6
BEAM POWER TUBE
Novar type used as high-efficiency horizontal-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 18A, OUTLINES SECTION. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 6JB6.

17JZ8
MEDIUM-MU TRIODE—
POWER PENTODE
Duodecar type used as combined vertical-deflection-oscillator and vertical-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 20, OUTLINES SECTION. Tube requires duodecar twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 16.8; amperes, 0.45; warm-up time (average), 11 seconds.

CLASS A AMPLIFIER
Characteristics
Plate Voltage
Plate-No.2 (Screen-Grid) Voltage
Plate-No.1 (Control-Grid) Voltage
Amplification Factor
Plate Resistance (Approx.)
Transconductance
Plate Current
Grid-No.2 Current
Grid-No.1 Voltage (Approx.) for plate current of 100 µa
Grid-No.1 Voltage (Approx.) for plate current of 10 µa

Triode Unit
100 45 120
0 110 110
0 8 8
21.5
11000 11000
1900 7100
3 9 12 4
17 4
10

Pentode Unit
volts
volts
volts
µhos
µhos
µas
µas
µas
**RCA Receiving Tube Manual**

**VERTICAL-DEFLECTION OSCILLATOR AND AMPLIFIER**

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

<table>
<thead>
<tr>
<th>Tube</th>
<th>Plate</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Ratings:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC PLATE VOLTAGE</td>
<td>250 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td>PEAK POSITIVE-PULSE PLATE VOLTAGE</td>
<td>400 max</td>
<td>250 max</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE PLATE VOLTAGE</td>
<td>70 max</td>
<td>20 max</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>7 max</td>
<td>8 max</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>1.8 max watts</td>
<td></td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td></td>
<td>200 max</td>
</tr>
<tr>
<td><strong>PEAK HEATER-CATHODE VOLTAGE:</strong></td>
<td>200 max</td>
<td>200 max</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max</td>
<td></td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max</td>
<td></td>
</tr>
</tbody>
</table>

**MAXIMUM CIRCUIT VALUES:**

| **Grid-No.1 Circuit Resistance:** | 1 max ohm |
| **For fixed-bias operation:** | 2.2 max 2.9 max ohms |
| **For cathode-bias operation:** | 1 max ohm 1 max megohm |

*This value may be measured by a method involving a recurrent waveform such that the maximum ratings of the tube will not 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 horizontal scanning cycle is 25 milliseconds.*

**HALF-WAVE VACUUM RECTIFIER**

*Miniature type used as damper tube in horizontal-deflection circuits of television receivers employing series-connected heater strings. Outline 8D, OUTLINES SECTION. Tube requires miniature series-contact socket and may be mounted in any position. Socket terminals 2, 6, 7, and 9 should not be used as tie points. It is especially important that this tube, like other power-heating tubes, be adequately ventilated.*

Heater volts (ac/dc), 17.5; amperes, 0.3; warm-up time (average), 11 seconds. Maximum ratings for damper service (for operation in a 525-line, 30-frame system): peak inverse plate volts, 2000 max; plate ma., 450 ma; dc plate ma., 75 ma; plate dissipation, 8 watts; peak heater-cathode volts, 2000 max; heater negative with respect to cathode, 2000 max; the dc component must not exceed 500 volts; heater positive with respect to cathode, 200 max; the dc component must not exceed 100 volts. This type is used principally for renewal purposes.

**BEAM POWER TUBE**

*Glass octal type used as horizontal-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 14E, OUTLINES SECTION. Tube requires octal socket and may be operated in any position.*

Heater volts (ac/dc), 18.5; amperes, 0.3; warm-up time (average), 11 seconds. Characteristics as class A amplifier: plate volts, 300; grid-No.2 volts, 125; grid-No.1 volts, -17; plate ma., 40; grid-No.2 ma., 1.1; transconductance, 4000 ohms; plate resistance (approx.), 27000 ohms.

**HORIZONTAL-DEFLECTION AMPLIFIER**

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

<table>
<thead>
<tr>
<th>Tube</th>
<th>Plate</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Ratings:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC PLATE VOLTAGE</td>
<td>350 max</td>
<td>300 max</td>
</tr>
<tr>
<td>PEAK POSITIVE-PULSE PLATE VOLTAGE</td>
<td>600 max</td>
<td>450 max</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE PLATE VOLTAGE</td>
<td>150 max</td>
<td>100 max</td>
</tr>
<tr>
<td>PEAK NEGATIVE-PULSE GRID-No.1 (CONTROL-GRID) VOLTAGE</td>
<td>250 max</td>
<td>150 max</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>2.5 max</td>
<td>1.8 max</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>9 max watts</td>
<td></td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td></td>
<td>2.5 max</td>
</tr>
</tbody>
</table>

**Technical Data**

**PEAK HEATER-CATHODE VOLTAGE:**

| Heater negative with respect to cathode | 200 max volts |
| Heater positive with respect to cathode | 200 max volts |

**BULB TEMPERATURE (At hottest point):**

| 150 max | 190 max |

**MAXIMUM CIRCUIT VALUE:**

| Grid-No.1 Circuit Resistance | 1 max ohm |
| Grid-No.1-Circuit Resistance | 1 max ohm |

*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 25 milliseconds.*

*Under no circumstances should this absolute value be exceeded.*

*An adequate bias resistor or other means is required to limit the tube in the presence of excitation.*

*The dc component must not exceed 100 volts.*

**REMOTE-CUTOFF PENTODE**

*Miniature type used as rf- and if-amplifier tube in ac/dc radio receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 18; amperes, 0.1; warm-up time (average), 18-FW6-A, 20 seconds.*

**CLASS A, AMPLIFIER**

| **Maximum Ratings:** | | |
| Grid-No.2 (screen-grid) SUPPLY VOLTAGE | 150 max volts |
| Grid-No.3 SUPPLY VOLTAGE | 150 max volts |
| Grid-No.4 (CONTROL-GRID) VOLTAGE, Positive-bias value | 100 max volts |
| Grid-No.2 Input | 0.6 max watt |
| For grid-No.2 voltages up to 75 volts | See curve page 70 |
| For grid-No.2 voltages between 75 and 150 volts | See curve page 70 |
| PLATE DISSIPATION | 2.5 max watts |

**PENTAGRID CONVERTER**

*Miniature type used for converter applications in ac/dc radio receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 18; amperes, 0.1; warm-up time (average), 18-FX6-A, 20 seconds.*

**CONVERTER**

| **Maximum Ratings:** | | |
| Grid-No.5 AND Grid-No.6 (screen-grid) SUPPLY VOLTAGE | 150 max volts |
| Grid-No.5 AND Grid-No.6 SUPPLY VOLTAGE | 110 max volts |
| Grid-No.5 AND Grid-No.6 INPUT | 1.2 max watts |
TWIN DIODE—HIGH-MU TRIODE

Miniature type used for combined detector, amplifier, and valve tube in compact ac/dc radio receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 18; amperes, 0.1; warm-up time (average), 18FY6-A, 20 seconds.

TRIODE UNIT AS CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>150 ma volts</td>
</tr>
<tr>
<td>Grid Voltage, Positive-bias value</td>
<td>50 ma volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>0.5 ma volts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td>100 ma volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>100 ma volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>100 ma volts</td>
</tr>
</tbody>
</table>

Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>100 volts</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>100 volts</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>77000 ohms</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>1300 μmhos</td>
</tr>
<tr>
<td>Transconductance</td>
<td>6 ma</td>
</tr>
<tr>
<td>Plate Current</td>
<td>0 ma</td>
</tr>
</tbody>
</table>

DIODE UNITS (Each Unit):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Current</td>
<td>1 ma</td>
</tr>
</tbody>
</table>

SHARP-CUTTOFF PENTODE

Miniature type used in the if, rf, and converter stages of ac/dc AM radio receivers. Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be operated in any position.

HEATER VOLTAGE (ac/dc) | 18 volts
HEATER CURRENT | 0.1 ampere
WARM-UP TIME (average) | 20 seconds
BEAM POWER TUBE

19BG6G

19BG6GA

Related types: 8DG6G

Glass octal types used as output amplifiers in horizontal deflection circuits of television equipment of the "transformerless" type where high pulse voltages occur during short duty cycles. Type 19BG6GA, Outline 25A, OUTLINES SECTION. Tubes require octal socket. Vertical tube mounting is preferred but horizontal operation is permissible if pins No.2 and No.7 are in vertical planes. Heater volts (ac/dc), 18.9; amperes, 0.15. Except for heater rating and interelectrode capacitances, type 19BG6-GA is electrically identical with glass octal type 6BG6-G. Type 19BG6-G is a DISCONTINUED type listed for reference only. Type 19BG6-GA is used principally for renewal purposes.

MEDIUM-MU TRIODE—SHARP-CUTOFF TETRODE

19CL8A

Related types: 5CL8A, 6CL8A

Miniature type used as combined vhf oscillator and mixer in television receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 18.9; amperes, 0.15; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6CL8-A.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

19EA8

Related types: 2EA8, 6EA8

Miniature type used as combined oscillator and mixer in television receivers employing series-connected heater strings and using an intermediate frequency in the order of 40 megacycles per second. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 18.9; amperes, 0.15; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with miniature type 6EA8.

SEMIREMOTE-CUTOFF PENTODE

19HR6

Related type: 6HR6

Miniature type used as if-amplifier tube in FM receivers employing series-connected heater strings. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 18.9; amperes, 0.15; warm-up time (average), 17 seconds. Except for heater ratings, this type is identical with miniature type 6HR6.

SHARP-CUTOFF PENTODE

19HS6

Related type: 6HS6

Miniature type used as if-amplifier and limiter tube in FM receivers. Outline 7B, OUTLINES SECTION. Heater volts (ac/dc), 18.9; amperes, 0.15; warm-up time (average), 17 seconds. Except for heater ratings, this type is identical to miniature type 6HS6.

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

19HV8

19J6

Related types: 5J6, 6J6

Miniature type used as if-amplifier and af voltage-amplifier tube in radio receivers employing series-connected heater strings. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 18.9; amperes, 0.15.

MEDIUM-MU TWIN TRIODE

19J6

Related types: 5J6, 6J6

Miniature type used for converter service in ac/dc AM and FM receivers and as oscillator, amplifier, or mixer in television receivers of the "transformerless" type Outline 7B, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 18.9; amperes, 0.15. For direct interelectrode capacitances, ratings, and typical operation as a class A amplifier, and curves, refer to type 6J6. Maximum ratings and characteristics for mixer service (each unit): plate volts, 130 (300 ma); cathode-bias resistor, 810 ohms; peak oscillator voltage, 3; plate resistance, 10,200 ohms; conversion transconductance, 1900 amb, plate ma, 4.8; plate dissipation, 1.5 ma watts; peak heater-cathode volts, 90 ma. Type 19J6 is used principally for renewal purposes.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

19JN8

Miniature type used as FM converter and rf-amplifier tube in radio receivers. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 18.9; amperes, 0.15.
### Technical Data

#### DIODE—REMOTE-CUTOFF PENTODE

Miniature type used as combined if amplifier and AM detector in AM and AM/FM radio receivers. Outline 8D, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 20; amperes, 0.1. Except for heater ratings, this type is identical with miniature type 6EQ7.

- **20EQ7**
  - Related types: 6EQ7, 12EQ7

#### 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 8B, OUTLINES SECTION. For typical operation as resistance-coupled amplifier, refer to RESISTANCE-COUPLED AMPLIFIER SECTION. Tube requires miniature nine-contact socket and may be operated in any position.

- **20EZ7**
  - Related types: 6X8, 6X4

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### RCA Receiving Tube Manual

#### Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>TRIDEL</th>
<th>PENTODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>300 max volts</td>
<td>300 max volts</td>
</tr>
<tr>
<td>GRID-VOLTAGE</td>
<td>300 max volts</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>GRID-No.1 VOLTAGE</td>
<td>0 max volts</td>
<td>0 max volts</td>
</tr>
<tr>
<td>GRID-No.1 Plate Dissipation</td>
<td>10 max watts</td>
<td>10 max watts</td>
</tr>
<tr>
<td>GRID-No.2 Input</td>
<td>2.5 max volts</td>
<td>2.5 max watts</td>
</tr>
<tr>
<td>For grid-no.2 voltages up to 150 volts</td>
<td>2.5 max volts</td>
<td></td>
</tr>
<tr>
<td>For grid-no.2 voltages between 150 and 300 volts</td>
<td>2.5 max volts</td>
<td></td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE:</td>
<td>260 max volts</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>260 max volts</td>
<td></td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>260 max volts</td>
<td></td>
</tr>
</tbody>
</table>

#### Characteristics:

- Plate Voltage: 125 volts
- Grid-No.1 Voltage: -1 volt
- Amplification Factor: 46
- Plate Resistance (Approx.): 5400 ohms
- Transconductance: 1500 μmhos
- Plate Current: 15.5 ma
- Grid-No.2 Current: 4 ma
- Grid-No.1 Voltage (Approx.) for plate current of 10 μa: -8 volts

#### 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

* The dc component must not exceed 100 volts.

### TRIPLE DIODE—HIGH-MU TRIODE

**19T8**

Miniature type used as combined audio amplifier, AM detector, and FM detector in AM/FM receivers of the a/c or "transformer" type. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 18.5; amperes, 0.05. Except for heater ratings, this type is identical with miniature type 6T8-A. Type 19T8 is used principally for renewal purposes.

### MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE

**19X8**

Related types: 5X8, 6X4

Miniature type used as combined oscillator and mixer tube in "transformerless" AM/FM receivers. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 18.5; amperes, 0.15. Except for heater ratings, this type is identical with miniature type 6X8.

### POWER TRIODE

Glass type used as output amplifier in dry-battery operated receivers. Filament volts (dc), 3.3; amperes, 0.132. Characteristics as class A amplifier: plate volts, 35 max; grid voltage, -14.5 volts; plate ma, 6.5; plate resistance, 6000 ohms; amplification factor, 3.3; transconductance, 625 μmhos; load resistance, 6500 ohms; output ma, 110. This is a DISCONTINUED type listed for reference only.

---

#### Average Plate Characteristics

![Average Plate Characteristics](image)
**RCA Receiving Tube Manual**

**Characteristics:**
- Plate Voltage: 100 volts
- Grid Voltage: -1 volts
- Amplification Factor: 100
- Plate Resistance (Approx.): 80,000 ohms
- Transconductance: 1200 µhos
- Plate Current: 0.5 ma

* Without external shield.
* The dc component must not exceed 100 volts.

**BEAM POWER TUBE**

21EX6

Related type: 6X6

Glass octal type used as horizontal-deflection amplifier in television receivers employing series-connected heater strings. Outline 25A, OUTLINES SECTION. Tubes require octal socket and should be operated vertically (base down or up) or horizontally with pins 2 and 7 in a vertical plane. Heater volts (ac/dc), 21-5; amperes; warm-up time (average), 11 seconds. Except for heater ratings, this tube is identical with glass octal type 6X6.

**BEAM POWER TUBE**

21GY5

Duodecav tube used as horizontal-deflection-amplifier tube in television receivers employing series-connected heater strings. Outline 16C, OUTLINES SECTION. Tube requires duodecav twelve-contact socket and may be mounted in any position. Heater volts (ac/dc), 21; amperes, 0.45; warm-up time (average), 11 seconds.

**CLASS A, AMPLIFIER**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>60</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>130</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>0</td>
</tr>
<tr>
<td>Triode Amplification Factor*</td>
<td>4.7</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>11,000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>9100 µhos</td>
</tr>
<tr>
<td>Plate Current</td>
<td>50 ma</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>1.75 ma</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 1 ma</td>
<td>33 volts</td>
</tr>
</tbody>
</table>

* Triode connection, grid No. 2 connected to plate.
* This value can be met 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 325-line, 30-frame system

**Maximum Ratings:**

- DC PLATE SUPPLY VOLTAGE: 770 ma volts
- PEAK POSITIVE-PULSE PLATE VOLTAGES: 6500 ma volts
- PEAK NEGATIVE-PULSE PLATE VOLTAGE: 350 ma volts
- GRID NO.2 VOLTAGE: 220 ma volts
- PEAK NEGATIVE-PULSE GRID NO.1 VOLTAGE: 330 ma volts
- DC GRID NO.1 VOLTAGE: 800 ma volts
- PEAK CATHODE CURRENT: 230 ma
- AVERAGE CATHODE CURRENT: 18 ma
- PLATE DISSIPATION: 3.5 watts
- PEAK HRAPE-CATHODE VOLTAGE: 200 ma volts
- Heater negative with respect to cathode: 200 ma volts
- BULB Temperature (at hottest point): 220°C

**Technical Data**

**Maximum Circuit Values:**

- Grid-No.1 - Circuit Resistance: 1 m ohms

* The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 225-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.

* The dc component must not exceed 100 volts.

**SHARP-CUTOFF TETRODE**

Glass type used as rf amplifier in dry-battery-operated receivers. Maximum over-all length, 0.375 inches; maximum diameter, 1-13/16 inches. Filament volts (dc), 3.3; amperes, 0.132. Characteristics as class A1 amplifier: plate volts, 155 max; grid-No.5 (screen-grid) volts, 67.2 max; grid-No.1, 1.5; plate ma, 3.7; grid-No.2 ma, 1.3; plate resistance, 32500 ohms; transconductance, 560 µhos. This is a DI-CONTINUED type listed for reference only.

**HALF-WAVE VACUUM RECTIFIER**

Novar type used as damper tube in horizontal-deflection circuits of black-and-white television receivers employing series-connected heater strings. Outline 17A, OUTLINES SECTION. Heater volts (ac/dc), 22.4; amperes, 0.450; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 58H3.

**HALF-WAVE VACUUM RECTIFIER**

22BH3

Related types: 68M3, 17BH3

Heater volts (ac/dc), 22.4; amperes, 0.450; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with novar type 58H3.

**BEAM POWER TUBE**

22DE4

Related types: 68M4, 17DE4

Glass octal type used as damper tube in horizontal-deflection circuits of black-and-white television receivers employing series-connected heater strings. Outline 14F, OUTLINES SECTION. Heater volts (ac/dc), 22.4; amperes, 0.450; warm-up time (average), 11 seconds. Except for heater ratings, this type is identical with glass octal type 6DE4.

**BEAM POWER TUBE**

22G6

Novar type used as horizontal-deflection-amplifier tube in low-B+, black-and-white television receivers employing series-connected heater strings. Outline 17A, OUTLINES SECTION. Tube requires novar nine-contact socket and may be mounted in any position.

**Heater Voltage (ac/dc) ...**

22 volts

**Heater Current ...**

0.45 amperes

**Heater Warm-Up Time (Average) ...**

11 seconds

**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: 22 pf
- Plate to Cathode, Heater, Grid No.2, and Grid No.3: 9 pf

**CLASS A, AMPLIFIER**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.3 (Suppressor Grid)</td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>0</td>
</tr>
</tbody>
</table>

**Triodes**

<table>
<thead>
<tr>
<th>Connection</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected to cathode at socket</td>
<td>125</td>
</tr>
</tbody>
</table>

**Penodes**

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20</td>
</tr>
<tr>
<td>-20</td>
</tr>
</tbody>
</table>

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RCA Receiving Tube Manual

AVERAGE PLATE CHARACTERISTICS

<table>
<thead>
<tr>
<th>TYPE 22 JD6</th>
<th>6520 VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000 max volts</td>
<td></td>
</tr>
<tr>
<td>Grid No. 2 connected to cathode at socket. Grid No. 1 volts ± 1</td>
<td></td>
</tr>
</tbody>
</table>

Amplification Factor
Plate Resistance (Approx.)
Transconductance
Plate Current
Grid No. 2 Current
Grid No. 1 Voltage (Approx.), for plate current of 1 ma.

HORIZONTAL-DEFLECTION AMPLIFIER
For operation in a 555-line, 50-frame system

Maximum Ratings, (Design-Maximum Values):
DC PLATE SUPPLY VOLTAGE
PEAK NEGATIVE-PULSE PLATE VOLTAGE
DC GRID No. 2 VOLTAGE
DC NEGATIVE-Bias Voltage
PEAK CATHODE CURRENT
AVERAGE CATHODE CURRENT
PLATE DISSIPATION
GRID No. 2 INPUT

SHARP-CUTOFF TETRODE
Glass type used as rf amplifier or biased detector in ac-operated receivers. Maximum over-all length, 1-1/82 inches; maximum diameter, 1-15/16 inches. Tube requires five-contact socket. Heater volts (ac/dc), 2.5; anode, 1.75. Typical operation and maximum ratings as class A amplifier: plate volts, 250 (275 max); grid-No. 2 volts, 90; grid-No. 1 volts, -3; plate resistance, 0.6 megohms; transconductance, 1500 µmhos; plate ma. 4; grid-No. 2 ma., 1.7 max. This type is used principally for renewal purposes.

POWER PENTODE
Metal type 25A6 and glass octal type 25A6-GT used in output stage of ac/dc receivers. Outlines 5 and 14C, respectively. OUTLINES SECTION. Tubes require octal socket. Heater volts (ac/dc), 25; anode, 0.3. Maximum ratings as class A amplifier: plate volts, 100; grid-No. 2 volts, 135; plate dissipation, 5.3 watts; grid-No. 2 input, 1.9 watts. These are DISCONTINUED types listed for reference only.

RECTOR-POWER PENTODE
Glass octal type used as combined half-wave rectifier and power amplifier. Outline 14C, OUTLINES SECTION. Heater volts (ac/dc), 25; anode, 0.3. Typical operation of pentode unit as class A amplifier: plate volts and grid-No. 2 volts, 100 (117 max); grid-No. 1 volts, -15; plate ma., 20.5; grid-No. 2 ma., 4; plate resistance, 5000 ohms; transconductance, 1800 amper; load resistance, 4500 ohms; output watts, 0.77. Maximum ratings of rectifier unit: peak inverse plate volts, 850; peak plate ma., 450; dc output ma., 75; peak heater-cathode volts, 175. This is a DISCONTINUED type listed for reference only.

HIGH-MU POWER TRIODE
Glass octal type used in output stage of ac/dc receivers. Outline 14C, OUTLINES SECTION. Heater volts (ac/dc), 25; anode, 0.3. Maximum ratings: plate volts, 180 max; plate dissipation, 10 max watts. This is a DISCONTINUED type listed for reference only.
**BEAM POWER TUBE**

Glass octal types used as horizontal deflection amplifiers in television receivers employing either transformer coupling or direct coupling to the deflection yoke. Outline 19B, OUTLINES SECTION. Heater volts (ac/dc), 25; amperes, 0.3. Except for heater ratings, this type is identical with glass octal type 6AV5-GA.

**HALF-WAVE VACUUM RECTIFIER**

Glass octal type used as a damper tube in horizontal deflection circuits of television receivers. Outline 17C, OUTLINES SECTION. This type may be supplied with pin No.1 omitted. Heater volts (ac/dc), 25; amperes, 0.3. Except for heater ratings, this type is identical with glass octal type 6AX4-GT.

**DIRECT-COUPLED POWER AMPLIFIER**

Glass type used as a class A power amplifier. One triode, the driver, is directly connected with the tube to the second, or output, tube. Heater volts (ac/dc), 25; amperes, 0.3. Maximum ratings and characteristics are the same as for type 25N6-G. Type 25B5 is a DISCONTINUED type listed for reference only.

**TRIODE—PENTODE**

Glass octal type used as an amplifier. High- and triode unit and remote-cutout pentode unit are independent. Outline 14C, OUTLINES SECTION. Heater volts (ac/dc), 25; amperes, 0.15. Typical operation of pentode unit, as class A amplifier: plate and grid-No.2 volts, 100; grid-No.1 volts, -3; plate ma., 7.6; grid-No.2 ma., 2; plate resistance, 18000 ohms; transconductance, 2000 mhos. Triode unit: plate volts, 100; grid volts, -1; plate ma., 0.6; amplification factor, 112; plate resistance, 73000; transconductance, 1500 mhos. This is a DISCONTINUED type listed for reference only.

**POWER PENTODE**

Glass octal type used in output stage of ac/dc receivers. Outline 26, OUTLINES SECTION. Heater volts (ac/dc), 25; amperes, 0.3. Typical operation as class A amplifier: plate volts, 200 max; grid-No.2 volts, 155 max; grid-No.1 volts, -25; plate ma., 62; grid-No.2 ma., 1.8; plate resistance, 18000 ohms; transconductance, 5000 mhos; load resistance, 2500 ohms; output watts, 7.1. This is a DISCONTINUED type listed for reference only.

**BEAM POWER TUBE**

Miniature type used in audio output stages of television and radio receivers. Also used as video amplifier. Outline 8D, OUTLINES SECTION, Heater volts (ac/dc), 25; amperes, 0.3. Except for heater ratings, this type is identical with miniature type 6BK5.

**TECHNICAL DATA**

**25BQ6GT**

Glass octal types used as horizontal deflection amplifiers in circuits of television equipment. Outline 15C, OUTLINES SECTION. These types may be supplied with pin No.1 omitted. Tubes require octal socket and may be mounted in any position. Heater volts (ac/dc), 25; amperes, 0.3. Except for heater rating, these types are identical with glass octal types 6BQ6-GT and 6BQ6-GTB/6CU6, respectively. Type 25BQ6-GT is a DISCONTINUED type listed for reference only.

**25C5**

Miniature type used in the audio output stage of radio receivers. Because of its high power sensitivity and high efficiency at low plate and screen-grid voltages, it is capable of providing a relatively high power output. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 25; amperes, 0.3. Except for heater ratings, this type is identical with miniature type 50C5.

**25C6G**

Glass octal type used as output amplifier. Outline 26, OUTLINES SECTION. Heater volts (ac/dc), 25; amperes, 0.3. Refer to type 6Y6-G for typical operation as a class A amplifier. Type 25C6-G is a DISCONTINUED type listed for reference only.

**25CA5**

Miniature type used in audio-output stage of radio and television receivers. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 25; amperes, 0.3. Except for heater ratings, this type is identical with miniature type 12CA5.

**25CD6GA**

Glass octal types used as horizontal deflection amplifiers in television receivers employing series-connected heater strings. Type 25CD6-GA, Outline 25A, OUTLINES SECTION. Heater volts (ac/dc), 25; amperes, 0.6; warm-up time (average), 11 seconds. Except for heater ratings, these types are identical with glass octal types 6CD6-G and 6CD6-GA, respectively. Type 25CD6-GA is a DISCONTINUED type listed for reference only.

Refer to type 25BQ6GTB/25CU6
### RCA Receiving Tube Manual

#### BEAM POWER TUBE

**25DN6**

Glass octal type used as horizontal deflection amplifier in television receivers employing series-connected heater strings. Outline 25A, OUTLINES SECTION. Grid requires octal socket. Vertical tube mounting is preferred but horizontal operation is permissible if pins 1 and 3 are in vertical plane.

- **Heater Voltage (ac/dc)**: 25 volts
- **Heater Current**: 0.6 ampere
- **Heater Warm-Up Time (Average)**: 11 seconds
- **Plate Resistance (Absolute)**: 4000 ohms
- **Transconductance**: 8000 µhos

**HORIZONTAL DEFLECTION AMPLIFIER**

For operation in a 255-line, 30-frame system

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
</tr>
<tr>
<td>Peak Positive-Pulse Plate Voltage*</td>
</tr>
<tr>
<td>Peak Negative-Pulse Plate Voltage</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
</tr>
<tr>
<td>Peak Positive-Pulse Grid-No.1 Voltage</td>
</tr>
<tr>
<td>Peak Cathode Current</td>
</tr>
<tr>
<td>Average Cathode Current</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
</tr>
<tr>
<td>Plate Dissipation</td>
</tr>
</tbody>
</table>

**Peak Heater-Cathode Voltage**: Heater negative with respect to cathode.

- 200 ma watts
- Heater positive with respect to cathode: 20 ma watts
- Bulb Temperature (At hottest point): 225 max °C

**Maximum Circuit Values**: 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 355-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

---

### Technical Data

**441**

#### BEAM POWER TUBE

**25EC6**

Glass octal type used as horizontal deflection amplifier in television receivers employing series-connected heater strings. Outline 25A, OUTLINES SECTION, except vertical dimensions are 1/4 inch shorter. Tube requires octal socket and may be operated in any position.

- **Heater Voltage (ac/dc)**: 25 volts
- **Heater Current**: 0.6 ampere
- **Warm-Up Time (Average)**: 11 seconds

**Direct Inter-electrode Capacitances**: Grid No.1 to Plate, Grid No.1 to Cathode, Grid No.2, and Grid No.2:

- 0.6 pf
- 24 pf
- 10 pf

**CLASS A, AMPLIFIER**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Plate Voltage</th>
<th>Grid-No.2 (Screen-Grid) Voltage</th>
<th>Grid-No.1 (Control-Grid) Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>60</td>
<td>135 volts</td>
<td>0 volts</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid)</td>
<td>135</td>
<td>135 volts</td>
<td>0 volts</td>
</tr>
<tr>
<td>Triode Amplification Factor</td>
<td>-</td>
<td>3.8 volts</td>
<td>0 volts</td>
</tr>
</tbody>
</table>

---

### POWER PENTODE

**25EH5**

Miniature type used in the audio output stage of radio and television receivers and in phonographs. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 25; amperes, 0.3. Except for heater rating, this type is identical with miniature type 6EH5.

**BEAM POWER TUBE**

**25F5A**

Miniature type used in audio-output stage of ac/dc radio receivers employing series-connected heater strings. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position.

<table>
<thead>
<tr>
<th>Maximum Ratings (Design-Maximum Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
</tr>
<tr>
<td>Heater Voltage</td>
</tr>
<tr>
<td>Heater Warm-Up Time (Average)</td>
</tr>
<tr>
<td>Direct Inter-electrode Capacitances</td>
</tr>
<tr>
<td>Grid No.1 to Plate</td>
</tr>
<tr>
<td>Grid No.1 to Cathode</td>
</tr>
<tr>
<td>Plate to Plate</td>
</tr>
<tr>
<td>Plate to Cathode</td>
</tr>
<tr>
<td>Grid No.2 Input</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
</tr>
</tbody>
</table>
BEAM POWER TUBE

Metal type 25L6 and glass octal type 25L6-GT used in output stage of ac/dc receivers. Outlines 5 and 14C, respectively, Outlines Section.

These tubes require acot sleeve and may be mounted in any position. Type 25L6-GT may be supplied with pin No.1 omitted. Heater voltages (ac/dc), 25; amperes, 0.3. For maximum ratings and typical operation, refer to type 50L6-GT. Refer to miniature type 50C5 for curves, installation, and application information, but take into consideration the differences in heater ratings. Type 25L6 is used principally for renewal purposes.

DIRECT-COUPLED TWIN POWER AMPLIFIER

Glass octal type used as class A power amplifier. Heater voltage (ac/dc), 25; amperes, 0.3. Characteristics as class A amplifier—input triode: plate volts, 180 (100 max); grid volts, 70; peak grid voltage, 25; plate ma., 5.8; Output triode: plate volts, 180; plate ma., 46; load resistance, 4000 ohms; output watts, 3. This is a discontinued type listed for reference only.

HALF-WAVE VACUUM RECTIFIER

Glass octal type used as damper tube in magnetic-deflection circuits of television receivers. Outline 14C, Outline Section. This type may be supplied with pin No.1 omitted. Tube requires acot sleeve and may be mounted in any position. It is especially important that this tube, like other power-handling tubes, be adequately ventilated. Heater voltages (ac/dc), 25; amperes, 0.5. This type is used principally for renewal purposes.

DAMPER SERVICE

Maximum ratings (design-center values): For operation in a 525-line, 30-frame system

PEAK INVERSE PLATE VOLTAGE (Absolute Maximum) 3850 volts
PEAK PLATE CURRENT 750 ma
DC PLATE CURRENT 125 ma
PLATE DISSIPATION 3.6 watts
PEAK HEATER-CATHODE VOLTAGE:
Heater positive with respect to cathode (Absolute Maximum) 506 volts

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

VACUUM RECTIFIER-DOUBLER

Glass type used as half-wave rectifier or voltage doubler in ac/dc receivers. Maximum dimensions: over-all length, 4-9/16 inches; width, height, 3-9/16 inches; diameter, 1-9/16 inches. Heater voltages (ac/dc), 25; amperes, 0.3. Maximum ratings: peak inverse plate volts, 780; peak plate ma. per plate, 400; peak heater-cathode volts, 356; do output ma. per plate, 75. This is a discontinued type listed for reference only.
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VACUUM RECTIFIER-DOUBLER
Glass type used as half-wave rectifier or voltage doubler in ac/dc receivers. Maximum dimen-
sions: over-all length, 1-3/16 inches; diameter, 1-9/16 inches. Tube requires six-contact socket and may be mounted in any position. Heater voltages (ac/dc), 25; ampere, 0.3. This type is electrically identical with metal type 25Z6. Type 25Z6 is used principally for renewal purposes.

25Z5

VACUUM RECTIFIER-DOUBLER
Metal type 25Z6 and glass octal type 25Z6-GT used as half-wave rectifiers or voltage-
doublers in ac/dc receivers, particularly "transformerless" receivers. Outline 3 and 14C, respectively. OUTLINES SECTION. Type 25Z6-GT may be supplied with pin No.1 omitted. Tubes require octal socket. Heater voltages (ac/dc), 25; ampere, 0.3. Maximum ratings for half-
wave rectifier or voltage-doubler service: peak inverse plate volts, 700 ma; peak plate ma. (per plate), 450 ma; dc output ma. (per plate), 75 ma; peak heater-cathode volts, 360 ma. Typical operation as half-wave rectifier with filter-input capacitor of .06 mfd; ac plate-supply volts per plate (rms), 225; minimum total effective plate-supply impedance per plate, 100 ohms; dc output ma. per plate, 75; dc output volts at input to filter, 225 (at half-load current of 75 ma.); 200 (at full-load current of 150 ma.); voltage regulation, 55 volts; typical operation as voltage-
doubler: ac plate-supply volts per plate (rms), 117; filter-input capacitor, .06 mfd; minimum total ef-
fective plate-supply impedance per plate, 20 ohms (half-wave), 15 ohms (full-wave); dc output ma. 75. Type 25Z6 is a DISCONTINUED type listed for reference only. Type 25Z6-GT is used principally for renewal purposes.

MEDIUM-MU TRIODE
Glass type used as rf voltage amplifier in ac-operated receivers. Outline 27, OUTLINES SECT.
TION. Tube requires four-contact socket. Filament voltages (ac/dc), 1.5; ampere, 0.15. Typical operation as class A amplifier: plate volts, 180 ma; grid volts, -14.5; plate ma., 6.5; plate re-

distance, 700 ohms; transconductance, 1150 mhos; amplification factor, 8.3. This is a DIS-
CONTINUED type listed for reference only.

25Z6

LOW-MU TRIODE
Glass type used as voltage amplifier or detector in ac-operated receivers. Tube requires four-
contact socket. Heater voltages (ac/dc), 2.6; ampere, 1.75. Maximum ratings and character-
istics as class A amplifier: plate volts, 200 ma; grid volts, -21; amplification factor, 9; plate re-
distance, 9500 ohms; transconductance, 975 mhos; plate ma., 5.2. This type is used principally for renewal purposes.

25Z6GT

MEDIUM-MU TRIODE
Glass type used as voltage amplifier or detector in battery-operated receivers. Tube requires four-
contact socket. Filament voltages (dc), 2.6; ampere, 0.6. Except for interelectrode capacitances, this type is electrically identical with glass-octal type 1H4-G. Type 30 is a DISCON-

CONTINUED type listed for reference only.

30

POWER TRIODE
Glass type used in output stage of battery-
operated receivers. Tube requires four-contact socket. Filament voltages (dc), 2.0; ampere, 0.13. Typical operation as class A amplifier: plate volts, 180 ma; grid volts, -30; plate ma., 12.5; plate resistance, 3600 ohms; amplification factor, 3.5; transconductance, 1050 mhos; load resistance, 5700 ohms; output watts, 0.375. This is a DISCONTINUED type listed for reference only.

31

SHARP-CUTOFF TETRODE
Glass type used as rf amplifier or biased detector in battery-operated receivers. Maximum over-all length, 5-1/32 inches; maximum diameter, 1-11/16 inches. Tube requires four-
contact socket. Filament voltages (dc), 2.0; ampere, 0.6. Typical operation as class A amplifier: plate volts, 180 ma; grid-No.2 ma., 6.4 ma; plate resistance, greater than 1 megohm; plate ma., 1.7; transconductance, 650 mhos. This is a DISCONTINUED type listed for reference only.

32

POWER PENTODE
Miniature type used in audio output stage of compact ac/dc radio receivers. Outline 7C, OUTLINES SECT.
TION. Tube requires miniature seven-
contact socket and may be mounted in any position. Heater voltages (ac/dc), 32; ampere, 0.1; warm-up time (average) for type 32ET5A, 20 seconds.

32ET5

32ET5A

CLASS A, AMPLIFIER

Maximum Ratings, Design-Maximum Values:

<table>
<thead>
<tr>
<th>Maximum Ratings</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>150 ma volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>130 ma volts</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>1.2 ma watts</td>
</tr>
<tr>
<td>Plate Disipation</td>
<td>0.4 ma watts</td>
</tr>
</tbody>
</table>

Peak Heaters-Cathode Voltage:

- Heater negative with respect to cathode: 200 ma volts
- Heater positive with respect to cathode: 200 ma volts

Typical Operation and Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>110 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>110 volts</td>
</tr>
<tr>
<td>Peak AF Grid-No.1 Voltage</td>
<td>7.5 volts</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>7.5 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>2.8 ma</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>3500 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>3500 mhos</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>2800 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>19 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>1.2 watts</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Circuit Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1-Circuit Resistance</td>
<td>0.1 ma megohm</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>0.5 ma megohm</td>
</tr>
</tbody>
</table>

* The dc component must not exceed 100 volts.
**RECTIFIER—BEAM POWER TUBE**

Glass octal type used as combined halfwave rectifier and output amplifier in a/c-dc receivers. Outline 16A, OUTLINES SECTION. Tube requires octal socket. Heater voltages (a/c-dc), 32.5; amperes, 0.3. Maximum ratings for rectifier unit: plate voltages (a/c-dc), 125; plate current, 60; typical operation of beam power unit as class A amplifier: plate and grid-no.2 voltages, 100; plate current, 0.25 mA; plate resistance, 1750 ohms; transconductance, 4800 mhos; load resistance, 2600 ohms; maximum signal output power, 10. This is a DISCONTINUED type listed for reference only.

**POWER PENTODE**

Glass type used in output stage of batteryoperated receivers. Outline 25, OUTLINES SECTION. Tube requires five-contact socket. Filament voltages (a/c-dc), 20; amperes, 0.5. Typical operation as class A amplifier: plate and grid-no.2 voltages, 180; grid-no.1 voltages, -18; plate current, 22; grid-no.2 current, 5; plate resistance, 5000 ohms; transconductance, 1750 mhos; load resistance, 6000 ohms; output power, 1.4. This is a DISCONTINUED type listed for reference only.

**REMOTE-CUTOFF PENTODE**

Glass type used as rf or if amplifier in batteryoperated radio receivers, particularly those employing a/c-dc. Maximum over-all length, 5-1/8 inches; maximum diameter, 1-1/16 inches. Tube requires four-contact socket. Filament voltages (a/d-c), 20; amperes, 0.5. Characteristics as class A amplifier: plate voltages, 180; grid-no.2 voltages, 60; grid-no.1 voltages, -30; plate current, 2.8; grid-no.2 current, 0.1; plate resistance, 1.0; transconductance, 620 mhos. This is a DISCONTINUED type listed for reference only.

**BEAM POWER TUBE**

Miniature types used in audio output stages of compact a/c-dc radio receivers. Outline 7C, OUTLINES SECTION. Tubes require miniature seven-contact socket and may be operated in any position.

**Technical Data**

- **Typical Operation and Characteristics**
  - Plate Voltage: 110 volts
  - Grid-no.2 Voltage: 110 volts
  - Grid-no.1 Voltage: 7.5 volts
  - Peak A.F. Grid-no.1 Voltage: 7.5 volts
  - Zero Signal Plate Current: 35 ma
  - Zero Signal Grid-no.2 Current: 3 ma
  - Plate Resistance (Approx.): 13000 ohms
  - Transconductance: 5700 mhos
  - 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: 0.1 mohm
  - Grid-no.2-Circuit Resistance: 9.5 mohm

- *The de component must not exceed 100 volts.*

**AVERAGE CHARACTERISTICS**

**REMOTE-CUTOFF TETRODE**

Glass type used as rf or if amplifier in a/c receivers. Maximum over-all length, 5-1/8 inches; maximum diameter, 1-1/16 inches. Tube requires four-contact socket. Heater voltages (a/c-dc), 32.5; amperes, 1.75. Characteristics as class A amplifier: plate voltages, 250; grid-no.2 voltages, 90; plate current, 1.0; plate resistance, 1.0; transconductance, 1050 mhos. This is a DISCONTINUED type listed for reference only.

**BEAM POWER TUBE**

Glass lock-in type used in output stage of a/c-dc receivers. Outline 13B, OUTLINES SECTION. Tube requires lock-in socket. Heater voltages (a/c-dc), 32; amperes, 0.15. For maximum ratings and typical operation, refer to glass metal type 35A-A6. Type 35A5 is used principally for renewal purposes.
RCA Receiving Tube Manual

BEAM POWER TUBE

35B5

Miniature type used in output stage of compact, a/c-dc radio receivers. Because of its high power sensitivity at plate and screen-grid voltages available in a/c-dc receivers, it is capable of providing a relatively high power output. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket. To be mounted in any position. Within its maximum ratings, type 35B5 is equivalent in performance to glass-octal type 35L6-GT, and miniature type 35C5. Refer to type 35C5 for typical operation, maximum circuit values, installation, application information, and curves.

<table>
<thead>
<tr>
<th>HEATER VOLTAGE (AC/DC)</th>
<th>25 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER CURRENT</td>
<td>0.15 ampere</td>
</tr>
<tr>
<td>DIRECT INTERELECTRODE CAPACITANCES (Approx.)</td>
<td></td>
</tr>
<tr>
<td>Grid No. 1 to Plate</td>
<td>0.6 pf</td>
</tr>
<tr>
<td>Grid No. 1 to Cathode, Heater, Grid No. 2, and Grid No. 3</td>
<td>12 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, Grid No. 2, and Grid No. 3</td>
<td>9 pf</td>
</tr>
</tbody>
</table>

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Center Values):

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>117 max volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 (SCREEN-GRID) VOLTAGE</td>
<td>5.5 max volts</td>
</tr>
<tr>
<td>Grid-No.3 INPUT</td>
<td>2.5 max volts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>150 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>150 max volts</td>
</tr>
</tbody>
</table>

BEAM POWER TUBE

35C5

Miniature type used in output stage of compact, a/c-dc radio receivers. Because of its high power sensitivity and high efficiency at plate and screen-grid voltages available in a/c-dc receivers, the 35C5 is capable of providing a 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 35L6-GT. The basic arrangement of the 35C5 simplifies the problem of meeting Underwriters Laboratories requirements in the design of a/c-dc receivers.

<table>
<thead>
<tr>
<th>HEATER VOLTAGE (AC/DC)</th>
<th>25 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATER CURRENT</td>
<td>0.15 ampere</td>
</tr>
<tr>
<td>DIRECT INTERELECTRODE CAPACITANCES (Approx.)</td>
<td></td>
</tr>
<tr>
<td>Grid No. 1 to Plate</td>
<td>0.6 pf</td>
</tr>
<tr>
<td>Grid No. 1 to Cathode, Heater, Grid No. 2, and Grid No. 3</td>
<td>12 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater, Grid No. 2, and Grid No. 3</td>
<td>9 pf</td>
</tr>
</tbody>
</table>

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>PLATE VOLTAGE</th>
<th>150 max volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 (SCREEN-GRID) VOLTAGE</td>
<td>150 max volts</td>
</tr>
<tr>
<td>Grid-No.3 INPUT</td>
<td>200 max volts</td>
</tr>
<tr>
<td>PEAK HEATER-CATHODE VOLTAGE</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>BULB TEMPERATURE (At hottest point)</td>
<td>250 max °C</td>
</tr>
</tbody>
</table>

Typical Operation:

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>110 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>7.5 volts</td>
</tr>
<tr>
<td>Peak AP Grid-No.1 Voltage</td>
<td>7.5 volts</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>45 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>2 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.3 Current</td>
<td>1 ma</td>
</tr>
</tbody>
</table>

Technical Data

Plate Resistance (Approx.) | 13000 ohms |
Transconductance | 6000 μhos |
Load Resistance | 2000 ohms |
Total Harmonic Distortion | 10 per cent |
Maximum-Signal Power Output | 1.5 watts |

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:

For fixed-bias operation, 0.1 max meghom
For cathode-bias operation, 0.15 meghom

The dc component must not exceed 100 volts.

AVERAGE PLATE CHARACTERISTICS

INSTALLATION AND APPLICATION

Type 35C5 requires miniature seven-contact socket and may be mounted in any position. Outline 7C, OUTLINES SECTION. It is especially important that this tube, like other power-handling tubes, should be adequately ventilated.

The 95-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 amperes for the normal supply voltage.

HIGH-MU TRIODE—POWER PENTODE

35DZ8

Miniature type used as two-stage amplifier where plate supply voltage is obtained from single half-wave rectifier connected directly to 120-volt ac line. Outline 6E, OUTLINES SECTION, except maximum vertical dimensions are 1/16 inch greater than shown. Tube requires miniature seven-contact socket and may be operated in any position. Heater volts (ac/dc), 35; amperes, 0.15.

<table>
<thead>
<tr>
<th>Maximum Ratings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
</tr>
<tr>
<td>Grid-No.2 (SCREEN-GRID) VOLTAGE</td>
</tr>
<tr>
<td>Cathode Current</td>
</tr>
<tr>
<td>Grid-No.3 INPUT</td>
</tr>
</tbody>
</table>

CLASS A, AMPLIFIER

<table>
<thead>
<tr>
<th>Tritode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tritode Unit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plate Dissipation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.3 INPUT</td>
</tr>
</tbody>
</table>

| Tritode Unit     |
| Tritode Unit     |

448
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), 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.

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### Technical Data

![Graph of AVERAGE CHARACTERISTICS](image)

#### BEAM POWER TUBE

**35GL6**

Miniature type used in af power-output stage of radio receivers. Outline 7C, OUTLINES SECTION. Tube has heater tap which may be used for operating a 6.3-volt, 150-ma. panel lamp in equipment using semiconductor rectifiers. For dc output currents greater than 70 ma., a resistor shunting the panel lamp is required. Tube requires miniature seven-contact socket and may be operated in any position.

**HEATER VOLTAGE (AC/DC):**

| Entire Heater (Pins 3 and 4) | 55 | 32 | volts |
| PaneL Lamp Section (Pins 4 and 6) | 7 | 5.6 | volts |

**HEATER CURRENT:**

| Between Pins 3 and 4 | 0.15 | ampere |
| Between Pins 3 and 6 | 0.15 | ampere |

---

### POWER PENTODE

**35EH5**

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 screen-grid voltages with a low of grid-No.1 driving voltage. Outline 7C, 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 ampere

**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 | pf |

**CLASS A, AMPLIFIER**

**Maximum Ratings, (Design-Maximum Values):**

| PLATE VOLTAGE | 150 | volts |
| Grid-No.2 (SCREEN-GRID) VOLTAGE | 120 | volts |
| Grid-No.1 (CONTROL-GRID) VOLTAGE, Positive-bias value | 0 | volts |
| PLATE DISPERATION | 0 | watts |
| Grid-No.2 INPUT | 1.70 | max watts |

**PEAK HEATER-CATHODE VOLTAGE:**

| Heater negative with respect to cathode | 200 | volts |
| Heater positive with respect to cathode | 200 | volts |

**Maximum Circuit Values:**

| Grid-No.1-Circuit Resistance: | 0.1 max megohm |
| For fixed-bias operation | 0.1 max megohm |
| For cathode-bias operation | 0.5 max megohm |

*The dc component must not exceed 100 volts.*
RCA Receiving Tube Manual

CLASS A: AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS Heater-Tap Voltage, when panel lamp fails</td>
<td>14 max volts</td>
</tr>
<tr>
<td>Plate Voltage</td>
<td>100 max volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage (Screen-Grid) Voltage</td>
<td>130 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>5.5 max watts</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>1.1 max watts</td>
</tr>
<tr>
<td>Peak Heater-Tap Voltage</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>220 max volts</td>
</tr>
</tbody>
</table>

Typical Operation and Characteristics:

- **Plate Voltage**: 110 volts
- **Grid-No.2 Voltage**: 110 volts
- **Peak AF Grid-No.1 Voltage**: 75 volts
- **Zero-Signal Plate Current**: 45 ma
- **Maximum-Signal Plate Current**: 47 ma
- **Zero-Signal Grid-No.2 Current**: 3 ma
- **Maximum-Signal Grid-No.2 Current**: 9 ma
- **Plate Resistance (Approx.)**: 12000 ohms
- **Load Resistance**: 2590 ohms
- **Total Harmonic Distortion**: 8 per cent
- **Maximum-Signal Power Output**: 1.8 watts

Maximum Circuit Values:

- **Grid-No.1 Circuit Resistance**:
  - For fixed-bias operation: 0.6 max megohm
  - For cathode-bias operation: 9.5 max megohm

**BEAM POWER TUBE**

Glass octal type used in output stage of ac/dc radio receivers. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. This may be supplied with pin No.1 omitted. Refer to miniature type 35C6 for installation, application information, and curves.

**35L6GT**

**HEATER VOLTAGE (ac/dc)**

- 36 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: 13 pF
- Plate to Cathode, Heater, Grid-No.2, and Grid-No.3: 9.5 pF

**CLASS A: AMPLIFIER**

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>125 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>6.5 max watts</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>1.0 max watt</td>
</tr>
<tr>
<td>Peak Heater-Tap Voltage</td>
<td>90 max volts</td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>90 max volts</td>
</tr>
</tbody>
</table>

Typical Operation:

<table>
<thead>
<tr>
<th>Bias Type</th>
<th>Fixed Bias</th>
<th>Cathode Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>110 volts</td>
<td>110 volts</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>200 volts</td>
<td>200 volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>75 volts</td>
<td>75 volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>180 ohms</td>
<td>180 ohms</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>8 volts</td>
<td>8 volts</td>
</tr>
<tr>
<td>Peak AF Grid-No.1 Voltage</td>
<td>45 ma</td>
<td>45 ma</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>45 ma</td>
<td>45 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>47 ma</td>
<td>47 ma</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Voltage</td>
<td>3 ma</td>
<td>3 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Voltage</td>
<td>9 ma</td>
<td>9 ma</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>1400 ohms</td>
<td>1400 ohms</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>1000 ohms</td>
<td>1000 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>10 per cent</td>
<td>10 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>1.8 watts</td>
<td>1.8 watts</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

- **Grid-No.1 Circuit Resistance**:
  - For fixed-bias operation: 0.6 max megohm
  - For cathode-bias operation: 9.5 max megohm

Technical Data

**HALF-WAVE VACUUM RECTIFIER**

Miniature type used in power supply of ac/dc receivers. Equivalent in performance to glass-octal type 35Z5-GT. The heater is provided with a tap for operation of a panel lamp.

**35W4**

**HEATER VOLTAGE (ac/dc)**

- Entire Heater: 35 volts
- Between Pins 3 and 4: 32 volts
- Between Pins 4 and 6: 7.5 volts
- Between Pins 5 and 6: 5.5 volts

**Panel Lamp Section (Pins 4 and 6):**

- Without Lamp: 0.15 amperes
- With No.40 or No.47 panel lamp: 0.15 amperes

**HOLD-OFF VOLTAGE**

- With Panel Lamp: 66 ma
- Without Panel Lamp: 110 ma

**OPERATION CHARACTERISTICS**

- Plate Voltage: 360 max volts
- Plate Current: 660 max ma
- DC: 660 max ma
- With Panel Lamp and | No Shunting Resistor
  - Without Shunting Resistor: 100 ma
  - Without Panel Lamp: 110 ma
- Panel-Lamp Section Voltage (rms): 17 volts
- Peak Heater-Cathode Voltage:
  - Heater negative with respect to cathode: 360 volts
  - Heater positive with respect to cathode: 360 volts

**INSTALLATION AND APPLICATION**

Tube requires miniature seven-contact socket and may be mounted in any position. Outline 7C, OUTLINES SECTION. For heater considerations, refer to miniature type 35C6.

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 amperes. The shunting resistor R is required when dc output current exceeds 60 milliamperes. Values of R for dc output currents greater than 60 milliamperes are given in tabulated data.

**Typical Operation with Panel Lamp:**

- AC Plate-Supply Voltage (rms): 117 volts
- Filter-Input Capacitor: 40 µf
- Minimum Total Effective Plate-Supply Impedance: 18 ohms
- Panel-Lamp Shunting Resistor: 300 ma
- DC Output Current: 60 ma
- Other Heaters: 80 ma

**Typical Operation without Panel Lamp:**

- AC Plate-Supply Voltage (rms): 117 volts
- Filter-Input Capacitor: 40 µf
- Minimum Total Effective Plate-Supply Impedance: 18 ohms
- DC Output Current: 100 ma
**HALF-WAVE VACUUM RECTIFIER**

**35Y4**

Glass lock-in type used in power supply of a-c/d-c receivers. The heater is provided with tap for the operation of a panel lamp. Outline 13B, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (a-c/d-c), 35; amperes, 0.15. For maximum ratings and typical operation, refer to glass octal type 3525-GT. For typical operation and curves, refer to miniature type 35W4. Type 35Y4 is used principally for renewal purposes.

**35Z3**

Glass lock-in type used in power supply of a-c/d-c receivers. Outline 13B, OUTLINES SECTION. Tube requires lock-in socket. Heater voltage (a-c/d-c), 35; amperes, 0.15. For maximum ratings and typical operation, refer to glass octal type 3525-GT without panel lamp. Type 35Z3 is used principally for renewal purposes.

**35Z4GT**

Glass octal type used in power supply of a-c/d-c receivers. Outline 14C, OUTLINES SECTION. Tube requires octal socket. This type may be supplied with pin No.1 omitted. Heater voltage (a-c/d-c), 35; amperes, 0.15. For maximum ratings and typical operation, refer to glass octal type 3525-GT without panel lamp. Type 35Z4GT is used principally for renewal purposes.

**35Z5GT**

Glass octal type used in power supply of a-c/d-c receivers. The heater is provided with a tap for the operation of a panel lamp. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. This type may be supplied with pin No.1 omitted. For installation and application considerations, refer to miniature type 35W4.

**HEATER VOLTAGE (a-c/d-c):**

**ENTIRE HEATER (PINS 2 AND 7):**

**HEATER CURRENT**:

- BETWEEN PINS 2 AND 7: 0.15 amperes
- BETWEEN PINS 3 AND 7: 0.15 amperes

* Without panel lamp. **With No. 40 or No. 47 panel lamp.*

**SHARP-CUTOFF TETRODE**

Type 36

Glass type used as f.o. or if amplifier or as a biased or grid-resistor detector in radio receivers. Outline 4B, OUTLINES SECTION. Tube requires 5-contact socket. Heater voltage (a-c/d-c), 6.3; amperes, 0.5. Characteristics as class A; amplifier: plate volts, 250 ma.; grid-No.3 volts, 90 ma.; grid-No.1, volts, 3 plate ma.; 3.2; grid-No.2 ma., 1.7 ma.; plate resistance, 0.55 ohm; transconductance, 1980 amhos. This is a DISCONTINUED type listed only for reference.

**HALF-WAVE VACUUM RECTIFIER**

Type 36AM3

Miniature types used in power supply of a-c/d-c receivers. These types have 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 used as a panel-lamp shunt. Outline 7C, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be operated in any position. Type 36AM3 is a DISCONTINUED type listed for reference only.

**HEATER VOLTAGE (a-c/d-c):**

**ENTIRE HEATER (PINS 3 AND 4):**

**HEATER CURRENT**:

- BETWEEN PINS 3 AND 6: 0.1 amperes
- HEATER WARM-UP TIME (Average), For 36AM3-B: 20 seconds

**HALF-WAVE RECTIFIER**

Type 36AM3A

**Maximum Ratings, (Design-Maximum Values):**

- PEAK INVERSE PLATE VOLTAGE: 365 ma. volts
- PEAK PLATE CURRENT: 530 ma.
- DC OUTPUT CURRENT: 82 ma.
- PEAK HEATER-CATHODE VOLTAGE: 350 ma. volts
- Heater positive with respect to cathode: 250 ma. volts

**Technical Data**

**Panel-Lamp-Section Voltage**:

- When Panel Lamp Fails: 15 ma. volts

**Peak Heater-Cathode Voltage**:

- Heater positive with respect to cathode: 350 ma. volts

**Typical Operation with Panel Lamp**:

- AC Plate-Supply Voltage: 117 volts
- Filter-Input Capacitor: 40 and 40 ma.
- Minimum Total Effective Plate-Supply Impedance: 15 ohms
- DC Output Current: 60 ma.
- At full-load current (100 ma.): 120 volts

**Panel-Lamp Shunting Resistor:**

- 80 ma. ohms

**DC Output Current (Approx.):**

- At full-load current: 120 volts

**Maximum Circuit Values:**

- Panel-Lamp Shunting Resistor:
  - For dc output current of 80 ma. 800 ma. ohms
  - For 90 ma. 600 ma. ohms
  - For 100 ma. 300 ma. ohms

* Required when dc output current is greater than 60 milliamperes.
Typical Operation with Capacitor Input to Filter:
- AC Plate-Supply Voltage (ma) 123
- Filter-Input Capacitor 40
- Total Effective Plate Supply Resistance 118
- DC Output Current 75
- DC Output Voltage 105

Characteristics:
- Tube Voltage Drop for plate current of 150 ma 16
- The dc component must not exceed 150 volts.
- The ac component must not exceed 35 volts.

**MEDIUM-MU TRIODE**
Glass type used as voltage amplifier or detector in radio receivers. Tube requires five-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.3. Characteristics as class A; amplifier: plate volts, 220 max; grid volts, –18; plate ma, 7.5; plate resistance, 8400 ohms; amplification factor, 9; transconductance, 1150 mhos. This is a DISCONTINUED type listed for reference only.

**POWER PENTODE**
Glass type used in output stage of radio receivers. Outline 27, OUTLINES SECTION. Tube requires six-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.7. This type is electrically identical with type 6F6. Type 42 is used principally for renewal purposes.

**MEDIUM-MU TRIODE**
Glass type used as voltage amplifier or detector in radio receivers. Tube requires five-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.3. Characteristics as class A; amplifier: plate volts, 220 max; grid volts, –12; plate ma, 22; grid- No.2 ma, 3; plate resistance, 0.1 megohm; transconductance, 2500 mhos; load resistance, 10000 ohms; output watts, 2.5. This is a DISCONTINUED type listed for reference only.

**REMOTE-CUTOFF PENTODE**
Glass type used as rf or if amplifier in radio receivers, particularly those employing acv. Outline 248, OUTLINES SECTION. Tube requires five-contact socket. Heater volts (ac/dc), 6.3; amperes, 0.3. Characteristics as class A; amplifier: plate volts, 250 max; grid-No.2 volts, 85 max; grid-No.1 volts, –25; plate ma, 5.8; grid-No.2 ma, 1.4; plate resistance, 1.0 megohm; transconductance, 1050 mhos. This is a DISCONTINUED type listed for reference only.

**POWER PENTODE**
Glass type used in output stage of radio receivers. Outline 27, OUTLINES SECTION. Tube requires four-contact socket. Filament volts (ac/dc), 2.5; amperes, 1.5. Typical operation as class A; amplifier: plate supply volts, 375; grid volts, –34; cathode bias resistor, 2500 ohms; amplification factor, 5.5; plate resistance, 1700 ohms; transconductance, 2050 mhos; plate ma, 30; load resistance, 4000 ohms; undistorted power output, 2 watts. This is a DISCONTINUED type listed for reference only.

**HALF-WAVE VACUUM RECTIFIER**
Miniature type used in power supply of small, portable, ac/dc/battery receivers where small size and low heat dissipation are important. Outline 75, OUTLINES SECTION. Tube requires miniature seven-contact socket and may be mounted in any position. Heater volts (ac/dc), 45; amperes, 0.05. Maximum ratings: peak inverse plate volts, 350; peak plate ma, 350; dc output volts, 65; peak heater-cathode volts, 175; peak rectifier current, 250 ma; plate resistance, 1500 ohms; modulator, 45 mhos. This is a DISCONTINUED type listed for reference only.

**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 14C, OUTLINES SECTION. Tube requires octal socket. Without panel lamp, heater volts (ac/dc) of entire heater (pins 5 and 7), 45; amperes, 0.18. With panel lamp, heater volts (ac/dc) of panel-lamp section (pins 2 and 3 with 0.15 amperes between pins 2 and 3), 5.5. Except for difference in heater voltage, this type has the same ratings and typical operation values as glass octal type 5355-GT. Type 45Z5GT is a DISCONTINUED type listed for reference only.

**DUAL-GRID POWER AMPLIFIER**
Glass type used as class A or class B amplifier in radio equipment. Outline 28, OUTLINES SECTION. Tube requires five-contact socket. Filament volts (ac/dc), 2.5; amperes, 1.75. Typical operation as class A; amplifier (grid No.2 connected to plate at socket): plate volts, 250; grid volts, –35; plate ma, 22; plate resistance, 2200 ohms; amplification factor, 5.6; transconductance, 1200 mhos; load resistance for maximum undistorted power output, 6400 ohms; output watts, 1.25. This is a DISCONTINUED type listed for reference only.
**POWER PENTODE**

Glass type used in audio output stage of radio receivers. Outline 29, OUTLINES SECTION. Tube requires five-contact socket and should preferably be mounted in vertical position. Horizontal mounting is permissible if pins 1 and 5 are in vertical plane. Filament volts (ac/dc), 2.5; amperes, 1.75. Typical operation as class A1 amplifier: plate and grid-No.2 volts, 250 ma; cathode-bias resistor, 450 ohms; plate ma, 31; grid-No.2 ma, 8, plate resistance, 60,000 ohms; transconductance, 2500 μmhos; load resistance, 7000 ohms; power output, 2.7 watts. This type is used principally for renewal purposes.

**POWER TETRODE**

Glass type used in audio output stage of radio receivers designed to operate from dc powerlines. Outline 28, OUTLINES SECTION. Heater volts (dc), 30; amperes, 0.4. Typical operation as class A1 amplifier: plate volts, 125 ma; grid-No.2 volts, 100 ma; grid-No.1 volts, -50; plate ma, 55; grid-No.2 ma, 9.6; transconductance, 3000 μmhos; load resistance, 1500 ohms; output watts, 2.5. This is a DISCONTINUED type listed for reference only.

**DUAL-GRID POWER AMPLIFIER**

Glass type used in output stage of battery-operated receivers. Outline 27, OUTLINES SECTION. Tube requires five-contact socket. Filament volts (dc), 2.0; amperes, 0.12. Typical operation as class A1 amplifier: plate volts, 155 ma; grid, NO.2 volts, -20; plate ma, 5; plate resistance, 2570 ohms; amplification factor, 4.7; transconductance, 1155 μmhos; load resistance, 11000 ohms; output watts (approx.), 0.17. This is a DISCONTINUED type listed for reference only.

**POWER TRIODE**

Glass type used in output stage of af amplifiers employing transformer input coupling. Maximum over-all length, 6-1/4 inches; maximum diameter, 2.7/16 inches. Tube requires four-contact socket and should be mounted in vertical position with base down. Filament volts (ac/dc), 7.2; amperes, 1.25. Characteristics as class A1 amplifier: plate volts, 450 ma; grid volts, -84; cathode resistor, 1500 ohms; plate resistance, 1500 ohms; plate ma, 55; grid-No.1 ma, 40; grid-No.2 ma, 9.6. Power output, 6 watts. This is a DISCONTINUED type listed for reference only.

**BEAM POWER TUBE**

Glass lock-in type used in output stage of ac/dc receivers. Outline 13B, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 50; amperes, 0.15. For ratings and data, refer to glass-octal-type 50L6-GT. Type 50A5 is used principally for renewal purposes.

**50A5**

**BEAM POWER TUBE**

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 7C, OUTLINES SECTION.

**50B5**

**TECHNICAL DATA**

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**

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 50C5 is capable of providing a relatively high power output. Within its maximum ratings, type 50C5 is equivalent in performance to glass octal type 50L6-GT. The basing arrangement of the 50C5 simplifies the problem of meeting Underwriters' Laboratories requirements in the design of ac/dc receivers.

<table>
<thead>
<tr>
<th>Heater Voltage (ac/dc)</th>
<th>50 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Current (ac/dc)</td>
<td>0.15 amperes</td>
</tr>
<tr>
<td>Direct Inter-electrode Capacitances (Approx.)</td>
<td>0.6 pf</td>
</tr>
<tr>
<td>Plate to Grid No.1</td>
<td>13 pf</td>
</tr>
<tr>
<td>Plate to Cathode, Heater Grid No.2 and Grid No.3</td>
<td>8.5 pf</td>
</tr>
</tbody>
</table>

**CLASS A1 AMPLIFIER**

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>150 ma volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2 Voltage</td>
<td>100 ma volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage, Positive-bias Value</td>
<td>0 ma volts</td>
</tr>
<tr>
<td>Plate Current</td>
<td>7 ma watts</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>1.4 ma watts</td>
</tr>
</tbody>
</table>

**Peak Heater-Cathode Voltage**

| Heater negative with respect to cathode | 200 ma volts |
| Heater positive with respect to cathode | 200 ma volts |

**Bias Temperature (A hottest point)**

| 220°C |

* The dc component must not exceed 100 volts.

**Typical Operation**

Plate Voltage | 120 volts |
| Grid-No.2 Voltage | 110 volts |
| Grid-No.1 (Control-Grid) Voltage | 8 volts |
| Peak AF Grid-No.1 Voltage | 49 ma |
| Maximum-Signal Plate Current | 50 ma |
| Zero-Signal Grid-No.3 Current | 8.5 ma |
| Maximum-Signal Grid-No.3 Current | 10000 ohms |
| Transconductance | 1500 μmhos |

**AVERAGE PLATE CHARACTERISTICS**

| Type 50C5 | 4x 50 Volts |
| Grid-No.2 Volt | 110 |
| Plate Volt | 175 |
| Plate Volt | 200 |
| Plate Volt | 225 |
| Plate Volt | 250 |
| Plate Volt | 275 |
| Plate Volt | 300 |
| Plate Volt | 325 |
| Plate Volt | 350 |
| Plate Volt | 375 |
| Plate Volt | 400 |
| Plate Volt | 425 |
| Plate Volt | 450 |
| Plate Volt | 475 |
| Plate Volt | 500 |
| Plate Volt | 525 |
| Plate Volt | 550 |
| Plate Volt | 575 |
| Plate Volt | 600 |
| Plate Volt | 625 |
| Plate Volt | 650 |
| Plate Volt | 675 |
| Plate Volt | 700 |
| Plate Volt | 725 |
| Plate Volt | 750 |
| Plate Volt | 775 |
| Plate Volt | 800 |
| Plate Volt | 825 |
| Plate Volt | 850 |
| Plate Volt | 875 |
| Plate Volt | 900 |
| Plate Volt | 925 |
| Plate Volt | 950 |
| Plate Volt | 975 |
| Plate Volt | 1000 |
| Plate Volt | 1025 |
| Plate Volt | 1050 |
| Plate Volt | 1075 |
| Plate Volt | 1100 |
| Plate Volt | 1125 |
| Plate Volt | 1150 |
| Plate Volt | 1175 |
| Plate Volt | 1200 |
| Plate Volt | 1225 |
| Plate Volt | 1250 |
| Plate Volt | 1275 |
| Plate Volt | 1300 |
| Plate Volt | 1325 |
| Plate Volt | 1350 |
| Plate Volt | 1375 |
| Plate Volt | 1400 |
| Plate Volt | 1425 |
| Plate Volt | 1450 |
| Plate Volt | 1475 |
| Plate Volt | 1500 |
| Plate Volt | 1525 |
| Plate Volt | 1550 |
| Plate Volt | 1575 |
| Plate Volt | 1600 |
| Plate Volt | 1625 |
| Plate Volt | 1650 |
| Plate Volt | 1675 |
| Plate Volt | 1700 |
| Plate Volt | 1725 |
| Plate Volt | 1750 |
| Plate Volt | 1775 |
| Plate Volt | 1800 |
| Plate Volt | 1825 |
| Plate Volt | 1850 |
| Plate Volt | 1875 |
| Plate Volt | 1900 |
| Plate Volt | 1925 |
| Plate Volt | 1950 |
| Plate Volt | 1975 |
| Plate Volt | 2000 |

**GRID-NO.2 VOLTAGE**

| Plate Volt | 110 |
| Grid-No.2 Volt | 100 |
| Plate Volt | 50 |
| Grid-No.2 Volt | 0 |

**GRID-NO.1 VOLTAGE**

| Plate Volt | 8 |
| Grid-No.1 Volt | 0 |
| Plate Volt | -4 |

**GRID-NO.2 MA**

| Plate Volt | 13 |
| Grid-No.2 MA | 8 |
| Plate Volt | 5 |

**GRID-NO.1 MA**

| Plate Volt | 1 |
| Grid-No.1 MA | 0 |
| Plate Volt | -2 |

**DUAL-GRID POWER AMPLIFIER**

Glass type used in output stage of battery-operated receivers. Outline 27, OUTLINES SECTION. Tube requires five-contact socket. Filament volts (dc), 2.0; amperes, 0.12. Typical operation as class A1 amplifier: plate volts, 155 ma; grid, NO.2 volts, -20; plate ma, 5; plate resistance, 2570 ohms; amplification factor, 4.7; transconductance, 1155 μmhos; load resistance, 11000 ohms; output watts (approx.), 0.17. This is a DISCONTINUED type listed for reference only.
**RCA Receiving Tube Manual**

**Load Resistance**
- 2500 ohms

**Total Harmonic Distortion**
- 10 per cent

**Maximum-Signal Power Output**
- 2.3 watts

**Maximum Circuit Values:**
- Grid-No.1 Circuit Resistance: 0.1 mohm
- For fixed-bias operation: 0.5 mohm

**INSTALLATION AND APPLICATION**

Type 50C5 requires miniature seven-contact socket and may be mounted in any position. Outline 7C, 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 A1), 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.

**BEAM POWER TUBE**

50C6G

Glass octal type used in output stage of ac/dc receivers. Outline 28, OUTLINES SECTION. Heater volts (ac/dc), 50; amperes, 0.15. Except for heater rating, this type is identical with glass octal type 6Y6-G. Type 50C6-G is a DISCONTINUED type listed for reference only.

**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 7C, OUTLINES SECTION. Tube requires seven-contact socket and may be mounted in any position.

**HEATER VOLTAGE (AC/DC):**
- Entire heater (pins 3 and 4): 50 volts
- Between pins 3 and 4 (pins 4 and 6): 7.5 volts

**HEATER CURRENT:**
- Between pins 3 and 4: 0.15 miliampere
- Between pins 3 and 6: 0.15 miliampere

* Without panel lamp.
** With No. 49 or No. 47 panel lamp.

**Technical Data**

**HALF-WAVE RECTIFIER**

Maximun Ratings, (Design-Maximum Values): 230 maz volts

**PEAK INVERSE PLATE VOLTAGE:**
- 720 maz volts

**DC OUTPUT CURRENT:**
- With Panel Lamp and 1 No Shunting Resistor: 70 maz ma
- Without Panel Lamp: 110 maz mA

**PEAK HEATER-CATHODE VOLTAGE:**
- Heater negative with respect to cathode: 330 maz volts
- Heater positive with respect to cathode: 330 maz volts

**Typical Operation with Panel Lamp:**
- AC Plate-Supply Voltage (rms): 117 117 117 117 volts
- Filter-Input Capacitor: 40 40 40 40 μf
- Minimum Total Effective Plate-Supply Impedance: 15 15 15 15 ohms
- Panel-Lamp Shunting Resistor: 450 200 100 75 ohms
- DC Output Current: 70 80 90 100 maz ma

† No. 49 or No. 47 panel lamp used in circuit with capacitor-input filter given under type 35W4.

**Typical Operation without Panel Lamp:**
- AC Plate-Supply Voltage (rms): 117 volts
- Filter-Input Capacitor: 40 40 40 40 μf
- Minimum Total Effective Plate-Supply Impedance: 15 15 15 15 ohms
- DC Output Current: 110 maz ma
- DC Output Voltage at Input to Filter (Approx.) 180 volts
- At full-load current (110 maz): 110 volts
- Voltage Regulation (Approx.): 20 volts

* Required when dc output current is greater than 70 milliamperes.

**POWER PENTODE**

Miniature type used in the audio output stage of radio and television receivers and in phonographs. Outline 7C, OUTLINES SECTION. Heater volts (ac/dc), 50; amperes, 0.15. Except for heater rating, this type is identical with miniature type 6E5H.

**BEAM POWER TUBE**

Glass octal type used in audio-output stages of compact stereophonic and monophonic phonographs and radio and television receivers. Outline 14F, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 50; amperes, 0.15. Peak heater-cathode volts, heater negative with respect to cathode, 200 maz. Except for heater ratings and heater-cathode voltage, this type is identical with glass octal type 6F6S.

**50EH5**

Related types: 6EH5, 12EH5, 25EH5

**50FE5**

Related type: 6F5

**POWER PENTODE**

Miniature type used as audio output amplifier in ac/dc radio receivers. Outline 7C, OUTLINES SECTION. Tube requires seven-contact socket and may be operated in any position.

**50FK5**

Related type: 6F5
HEATER VOLTAGE (AC/DC) .......................... 50 volts
HEATER CURRENT .................................. 0.1 ampere
DIRECT INTERELECTRODE CAPACITANCES:
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 pf
For cathode bias: .................................

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
PEAK HEATER-CATHODE VOLTAGE WHEN PANEL LAMP FAILS: .......................... 14 max watts
PEAK HEATER-CATHODE VOLTAGE: ..........................
Heater negative with respect to cathode: .......................... 200 max volts
Heater positive with respect to cathode: .......................... 200 max volts

Typical Operation and Characteristics:
Plate Voltage .................................. 110 volts
Grid-No.2 Voltage .................................. 110 volts
Grid-No.1 (Control-Grid) Voltage .................. 110 volts
Peak A.F. Grid-No.1 Voltage .................. 7.5 volts
Zero-Signal Plate Current .................. 7.5 volts
Maximum-Signal Grid-No.2 Current .................. 49 ma
Maximum-Signal Grid-No.2 Current .................. 4 ma
Plate Resistance (Approx.) .................. 10000 ohms
Transconductance .................. 7500 ohms
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: .......................... 0.1 megohm
For fixed-bias operation: .......................... 0.5 megohm
For cathode bias: ..........................
* The dc component must not exceed 100 volts.

BEAM POWER TUBE

Glass octal type used in output stage of ac/dc radio receivers. Outline 14C, OUTLINESEC-TION. Tube requires octal socket and may be mounted in any position. This type may be supplied with pin No.1 omitted. Refer to miniature type 50C6 for installation and application information.

HEATER VOLTAGE (AC/DC) .................. 50 volts
HEATER CURRENT .................................. 0.15 ampere
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 .......................... 3.2 pf
Plate to Cathode, Heater, Grid No.2, and Grid No.3 .......................... 9.5 pf

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):
PLATE VOLTAGE .................................. 200 max volts
Grid-No.2 (Screen-Grid) Voltage .................. 150 max volts
PLATE DISSIPATION ................................. 10 max watts
Grid-No.2 INPUT .................................. 1.25 max watts
PEAK HEATER-CATHODE VOLTAGE: ..........................
Heater negative with respect to cathode: .......................... 90 max volts
Heater positive with respect to cathode: .......................... 90 max volts

Typical Operation:
Plate Supply Voltage .................. 110 volts
Grid-No.2 Supply Voltage .................. 110 volts
Grid-No.1 (Control-Grid) Voltage .................. – volts
Peak A.F. Grid-No.1 Voltage .................. – volts
Cathode-Bias Resistor: .......................... 180 ohms
Zero-Signal Plate Current .................. 49 ma
Zero-Signal Grid-No.2 Current .................. 4 ma
Maximum-Signal Grid-No.2 Current .................. 8.5 ma

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CLASS A, AMPLIFIER

50L6GT

50K6

Power Pentode

Miniature type used in audio-frequency power-output stage of radio receivers. Outline 7C, OUTLINESEC-TION. Tube requires miniature seven-contact socket and may be mounted in any position. The heater is provided with a tap for operation of a panel lamp. Heater volts (ac/dc), 50; amperes, 0.15; tap volts (without panel lamp), 7. 462
50X6

Vacuum Rectifier-Doubler

Lock-in type used as half-wave rectifier or voltage doubler in a.c./d.c. receivers. Outline 10C, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (a.c./d.c.), 50; amperes, 0.15. This type is electrically identical with glass octal type 506-GT and, except for heater rating, with glass octal type 5326-GT. Refer to type 5326-GT for maximum ratings, typical operation, and curves. Type 50X6 is used principally for renewal purposes.

50Y6GT

Vacuum Rectifier-Doubler

Glas octal type used as half-wave rectifier or voltage doubler in a.c./d.c. receivers. This type is used particularly in "transformerless" receivers of either the a.c./d.c. type or the voltage-doubling type. Outline 14C, OUTLINES SECTION. This type may be supplied with pin No.1 omitted. Tube requires octal socket. Heater volts (a.c./d.c.), 50; amperes, 0.15. Except for heater rating, this type is electrically identical with type 256-GT.

50Y7GT

Vacuum Rectifier-Doubler

Glass octal type used as half-wave rectifier or voltage doubler in a.c./d.c. receivers. This type is used particularly in "transformerless" receivers of either the a.c./d.c. type or the voltage-doubling type. The heater is provided with a tap for operation of a panel lamp. Outline 14C, OUTLINES SECTION. Tube requires octal socket. Without panel lamp, heater volts (a.c./d.c.) of entire heater (pins 2 and 7), 50; amperes, 0.15. With panel lamp, heater volts (a.c./d.c.) of panel-lamp section (pins 6 and 7 with 0.15 amperes between pins 2 and 7), 5.5. For maximum ratings and typical operation as half-wave rectifier or voltage doubler without panel lamp, refer to glass octal type 256-GT.

When operated with a panel lamp and 250-ohm panel-lamp shunting resistor, ratings and typical operation are the same as for type 256-GT, except that d.c. output current per plate is 65 ma. Type 50Y7-GT is used principally for renewal purposes.

50Z7G

Vacuum Rectifier-Doubler

Glass octal type used as half-wave rectifier or voltage doubler in a.c./d.c. receivers. Outline 22, OUTLINES SECTION. The heater is provided with a tap for operation of a panel lamp. Without panel lamp, heater volts (a.c./d.c.) of entire heater (pins 2 and 7), 50; amperes, 0.15. With panel lamp, heater volts (a.c./d.c.) of panel-lamp section (pins 6 and 7 with 0.15 amperes between pins 2 and 7), 2.5. Maximum ratings as rectifier or doubler: peak inverse plate volts, 700 ma; peak plate ma, per plate, 400 ma; d.c. output ma, per plate with panel lamp, 65 ma; peak heater-cathode volts, 550 ma; panel-lamp section volts (pins 6 and 7), 2.5 ma. This is a DISCONTINUED type listed for reference only.

HIGH-MU TWIN POWER TRIODE

Glass type used in output stage of a.e. operated receivers as a class B power amplifier. Outline 27, OUTLINES SECTION. Tube requires medium seven-contact (0.355-inch pin-circle diameter) socket. Heater volts (a.c./d.c.), 2.5; amperes, 2.0. Except for heater rating, this type is electrically identical with metal type 6N7. Type 53 is a DISCONTINUED type listed for reference only.

POWER PENTODE

Miniature type used in output stages of audio amplifiers, especially in two-tube series-string stereo systems. This type has extremely high power-sensitivity and can be driven to full output by a ceramic or crystal phonograph pickup. Outline 7C, OUTLINES SECTION. Tube requires seven-contact socket and may be mounted in any position.

HEATER VOLTAGE (A.C./D.C.)

60 volts

HEATER CURRENT

0.1 ampere

GRID NO. 1 (SCREEN-GRID) VOLTAGE

140 volts

GRID NO. 2 (VALVE GRID) VOLTAGE

160 volts

GRID NO. 3 (PLATE) VOLTAGE

90 volts

PEAK HEATER-CATHODE VOLTAGE:

Heater negative with respect to cathode

200 volts

Heater positive with respect to cathode

300 volts

LOAD RESISTANCE

9000 ohms

CIRCUIT VOLTAGE RANGES:

Grid No.1-Circuit Resistance

0.6 max megohm

For fixed-bias operation

Cathode-bias resistance

0.6 max megohm

For cathode-bias operation

AVERAGE CHARACTERISTICS

[Graphs and data plots]

Technical Data

60FX5

Related type: 13FX5

[Further data and specifications]
**RCA Receiving Tube Manual**

**VACUUM RECTIFIER-DOUBLER**

Glass octal-type tetrode as half-wave rectifier or voltage doubler in ac/dc receivers. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position.

117Z6GT

This type may be supplied with pin No.1 omitted. Heater volts (ac/dc), 117; amperes, 0.675.

Maximum ratings: peak inverse plate volts, 700 ma; peak plate ma, per plate, 360 ma; dc output ma, per plate, 60 ma; peak heater-cathode volts, 350 ma. Typical operation as half-wave rectifier with capacitor-input filter or as half-wave or full-wave voltage doubler: ac plate supply volts per plate (rms), 117; filter-input capacitor, 50 μf; minimum total effective plate-supply impedance per plate, 15 (80 for half-wave doubler service); dc output ma, per plate, 60. This type is used principally for renewal purposes.

**SHARP-CUTOFF PENTODE**

5879

Miniature type used as audio amplifier in applications requiring reduced microphones, leakage noise, and hum. Especially useful in the input stages of medium-gain public-address systems, home sound recorders, and general-purpose audio systems. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. For operation as resistance-coupled amplifier, refer to RESISTANCE-COUPLLED AMPLIFIER SECTION.

- **Heath Voltage (ac/dc)**: 6.3 volts
- **Heath Current**: 0.15 amperes
- **Diode Reverse-Capacitance**: 0.11 μf

**Pentode Connection**
- Grid No.1 to Plate: 0.11 μf
- Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3: 1.4 μf
- Plate to Cathode, Heater, Grid No.2, and Grid No.3: 2.7 μf

**Triode Connection**
- Grid No.1 to Plate: 0.11 μf
- Grid No.1 to Cathode and Heater: 0.85 μf
- Plate to Cathode and Heater: 2.4 μf

* Grid No.2 and grid No.3 connected to plate.

**CLASS A: AMPLIFIER**

Maximum Ratings, (Design-Maximum Values):
- **Plate Voltage**: 275 ma; 380 ma

**AVERAGE CHARACTERISTICS**

**PENTODE CONNECTION**

- **Triode Connection**: 275 ma
- **Pentode Connection**: 380 ma

**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.

Maximum dimensions: over-all length, 3-15/32 inches; seated height, 2-29/32 inches; diameter, 1-7/16 inches. Tube requires octal socket and may be mounted in any position. For typical operation as push-pull class A, class AB1 (within maximum ratings), and class AB1 amplifier, and for curves of average plate characteristics, refer to type 6L6-GC. Heater volts (ac/dc), 6.3; amperes, 0.9.
CLASS A: AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>400 max</td>
<td>400 max</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>25 max</td>
<td>25 max</td>
</tr>
<tr>
<td>Grid-No.3 Input</td>
<td>3 max</td>
<td></td>
</tr>
</tbody>
</table>
| Typical Operation and Characteristics:
  | Plate Voltage                | 250     | 250     |
  | Grid-No.2 Voltage            | 920     | 920     |
  | Grid-No.3 (Control-Grid) Voltage| -30     | -30     |
  | Peak A.F. Grid-No.1 Voltage  | 18      | 18      |
  | Zero-Signal Plate Current     | 125     | 125     |
  | Maximum Signal Plate Current  | 50      | 50      |
  | Zero-Signal Grid-No.2 Current | 12      | 12      |
  | Maximum-Signal Grid-No.3 Current | 12      | 12      |
  | Amplification Factor          | 9       | 9       |
  | Plate Resistance (Approx.)    | 123     | 123     |
  | Transformer Resistance        | 30000   | 30000   |
  | Transformer Resistance (ohms) | 12000   |         |
  | Load Resistance               | 4000    | 4000    |
  | Total Harmonic Distortion     | 0.5     | 0.5     |
  | Maximum-Signal Power Output   | 1.4     | 1.4     |

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1-Circuit Resistance</td>
<td>0.1 max</td>
<td>0.1 max</td>
</tr>
<tr>
<td>Grid-No.2-Circuit Resistance</td>
<td>0.5 max</td>
<td>0.5 max</td>
</tr>
</tbody>
</table>

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 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 SE, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position.

HEATER VOLTAGE (60/100): 6.3 volts
HEATER CURRENT: 0.46 ampere
DIRECT INTERESTED CAPACITANCES:
  Grid-No.1 to Plate 0.04 max pf
  Grid-No.1 to Cathode, Grid-No.3 9 pf
  Plate to Cathode, Grid-No.2, and Grid-No.3 6 pf

Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Grid-No.2 (Screen-Grid) Voltage</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Grid-No.3 (Control-Grid) Voltage</td>
<td>-15</td>
<td>-15</td>
</tr>
<tr>
<td>Transconductance (Approx.)</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Plate Current</td>
<td>35000</td>
<td>35000</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.)</td>
<td>3.5</td>
<td>3.5</td>
</tr>
</tbody>
</table>

PUSH-PULL CLASS AB: AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>440 max</td>
<td>440 max</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>330 max</td>
<td>330 max</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>12 max</td>
<td>12 max</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>2 max</td>
<td>2 max</td>
</tr>
</tbody>
</table>
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):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate and Grid-No. 2 Supply Voltage</td>
<td>410 max volts</td>
</tr>
<tr>
<td>Plate Disipation</td>
<td>12 max watts</td>
</tr>
<tr>
<td>Grid-No. 2 Input</td>
<td>1.75 max watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>250 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Build Temperature (At hottest point)</td>
<td>250°C</td>
</tr>
</tbody>
</table>

**Typical Operation, (Values are for two tubes):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>375 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Supply Voltage</td>
<td>74 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>33.5 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>50 ohms</td>
</tr>
<tr>
<td>Peak A.F. Grid-No. 1 to Grid-No. 1 Voltage</td>
<td>12500 ohms</td>
</tr>
<tr>
<td>Zero-Signal Cathode Current</td>
<td>6.5 ma</td>
</tr>
<tr>
<td>Maximum-Signal Cathode Current</td>
<td>35 ma</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-plate)</td>
<td>1.5 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>1.5</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>15 watts</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No. 1-Circuit Resistance</td>
<td>0.5 ma</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>1 ma</td>
</tr>
</tbody>
</table>

*The cathode component must not exceed 100 volts.
*Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the center tap (G) so as to apply 60 per cent of the plate 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 (G) so as to apply 60 per cent of the plate voltage to grid-No. 2 of each output tube.

**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 8B, OUTLINES SECTION. This type is identical with miniature type 12AX7 except that it has a controlled equivalent noise and hum characteristic. For operation as a resistance-coupled amplifier, RESISTANCE-COUPLED AMPLIFIER SECTION.

**Equivalent-Noise and Hum Voltage Referenced to Grid, (Each Unit):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Value (rms)†</td>
<td>1.8 µvolts</td>
</tr>
<tr>
<td>Maximum Value (rms)‡</td>
<td>7 µvolts</td>
</tr>
</tbody>
</table>

† Measured in "true rms" units under following conditions: heater volts (ac), 6.3; center tap of heater transformer connected to ground; plate supply volts, 250; plate load resistor, 2700 ohms; cathode bypass capacitor, 100 µf; grid resistor, 6 ohms; and amplifier covering frequency range between 25 to 15000 cycles per second.
‡ Same conditions as for "Average Value" except: cathode resistor is unby-passed and grid resistor, 0.06 megohm.

**BEAM POWER TUBE**

Glass octal types used in push-pull power amplifier circuits of high-fidelity audio equipment. Tubes provide high powersensitivity and highstability and are capable of delivering high power output at low distortion. Double base-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 19D, OUT.

**LINES SECTION**, except diameter is 1-5/8 inches max. Tubes require 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 7027 is a DISCONTINUED type listed for reference only.

**Heater Voltage (ac/dc):**

<table>
<thead>
<tr>
<th>Value</th>
<th>Type 7027-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.3</td>
<td>volts</td>
</tr>
</tbody>
</table>

**Heater Current:**

<table>
<thead>
<tr>
<th>Value</th>
<th>Type 7027-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>amperes</td>
</tr>
</tbody>
</table>

**Direct Interelectrode Capacitances (Approx.):**

<table>
<thead>
<tr>
<th>Value</th>
<th>Type 7027-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>pf</td>
</tr>
</tbody>
</table>

**Grid No. 1 to Cathode, Heater, Grid No. 2, and Grid No. 3:**

<table>
<thead>
<tr>
<th>Value</th>
<th>Type 7027-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>pf</td>
</tr>
</tbody>
</table>

**Plate to Cathode, Heater, Grid No. 2, and Grid No. 3:**

<table>
<thead>
<tr>
<th>Value</th>
<th>Type 7027-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5</td>
<td>pf</td>
</tr>
</tbody>
</table>

**CLASS A1 AMPLIFIER**

**Maximum Ratings for 7027-A, (Design-Maximum Values):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>600 max volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>500 max volts</td>
</tr>
<tr>
<td>Plate Disipation</td>
<td>35 max watts</td>
</tr>
<tr>
<td>Grid-No. 2 Input</td>
<td>5 max watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>200 max watts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200*</td>
</tr>
</tbody>
</table>

**Typical Operation for 7027-A, (Values are for two tubes):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>400 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Supply Voltage</td>
<td>300 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>200 ohms</td>
</tr>
<tr>
<td>Peak A.F. Grid-No. 1 to Grid-No. 1 Voltage</td>
<td>1000 ohms</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>113 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>175 ma</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-Plate)</td>
<td>1500 ohms</td>
</tr>
</tbody>
</table>

**AVERAGE PLATE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 7027-A</td>
<td>500</td>
</tr>
<tr>
<td>E = 6.3 volts, G = 63 volts, V = 190 volts</td>
<td>1000</td>
</tr>
</tbody>
</table>

**TYPICAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>600 max volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Plate Disipation</td>
<td>5 max watts</td>
</tr>
<tr>
<td>Grid-No. 2 Input</td>
<td>5 max watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>200 max watts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200*</td>
</tr>
</tbody>
</table>

**Typical Operation for 7027-A, (Values are for two tubes):**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>400 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Supply Voltage</td>
<td>300 volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>200 ohms</td>
</tr>
<tr>
<td>Peak A.F. Grid-No. 1 to Grid-No. 1 Voltage</td>
<td>1000 ohms</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>112 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>175 ma</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-Plate)</td>
<td>1500 ohms</td>
</tr>
</tbody>
</table>

**AVERAGE PLATE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 7027-A</td>
<td>500</td>
</tr>
<tr>
<td>E = 6.3 volts, G = 63 volts, V = 190 volts</td>
<td>1000</td>
</tr>
</tbody>
</table>

**TYPICAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>600 max volts</td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Plate Disipation</td>
<td>5 max watts</td>
</tr>
<tr>
<td>Grid-No. 2 Input</td>
<td>5 max watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td>200 max watts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200*</td>
</tr>
</tbody>
</table>
**RCA Receiving Tube Manual**

**Total Harmonic Distortion**........... 2 1.5 2 2 3.5 4 per cent

**Maximum Signal Power Output**........ 34 50 76 32 36 44 watts

**Maximum Circuit Values:**

- Grid-No.1 Circuit Resistance:
  - For fixed-bias operation*.............. 0.1 max. mhos
  - For cathode-bias operation............. 0.5 max. mhos

* The d.c. component must not exceed 100 volts.

* 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 Top on Plate Winding of Output Transformer

**Maximum Ratings,** for 7027-A, (Design-Maximum Values):

- **PLATE AND GRID-NO.2 SUPPLY VOLTAGE:**........ 600 max. volts
- **PLATE DISSIPATION:**.............. 35 max. watts
- **GRID-NO.2 SUPPLY VOLTAGE:**........ 4.5 max. volts
- **GRID-NO.2 INPUT:**................. 1.5 max. volts
- **PEAK HEATER-CATHODE VOLTAGE:**
  - Heater negative with respect to cathode........ 220 max. volts
  - Heater positive with respect to cathode........ 200 max. volts

**Typical Operation** (Values are for two tubes):

- **Plate Supply Voltage:**........ 410 volts
- **Grid-No.2 Supply Voltage:**........ 4 volts
- **Cathode-Bias Resistor:**........ 220 ohms
- **Peak AP Grid-No.1 to Grid-No.2 Voltage:**........ 28 volts
- **Zero-Signal Cathode Current:**........ 134 ma
- **Maximum-Signal Cathode Current:**........ 155 ma
- **Effective Load Resistance** (Plate to plate):........ 800 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. mhos

* The d.c. component must not exceed 100 volts.

* 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 48 per cent of the plate signal voltage to grid No.2 of each output tube.

**AVG. CHARACTERISTICS**

- **0.25** 3500 VOLS. 3000 VOLS. 2000 VOLS. 1000 VOLS. 500 VOLS. 250 VOLS.

**POWER PENTODE**

Miniature type used as power amplifier tube in high-fidelity audio equipment. Outline 8E, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. Heaters volts (ac/dc), 6.3; amperes, 0.76.

**MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE**

Miniature type used in a wide variety of applications in high-quality, high-fidelity audio equipment, particularly in phase-splitters, tone-control amplifiers, and high-gain voltage amplifiers in which low hum and reduced noise are required. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be mounted in any position. For operation as resistance-coupled amplifier, refer to RESISTANCE-COUPLING AMPLIFIER SECTION. In direct-coupled voltage-amplifier phase-splitter circuits, the pentode unit should drive the triode unit.

**HEATER VOLTAGE** (ac/dc).............. 6.3 volts

**HEATER CURRENT**.................. 0.45 ampere

**CLASS A, AMPLIFIER**

**Grid-No.2**

**Maximum Ratings,** for 7027-A, (Design-Maximum Values):

- **PLATE VOLTAGE:**.............. 400 max. volts
- **GRID-NO.2 VOLTAGE:**.............. 300 max. volts
- **CATHODE CURRENT:**.............. 65 max. ma
- **PLATE DISSIPATION:**.............. 12 max. watts
- **ZERO-SIGNAL GRID-NO.2 INPUT:**.............. 2 ma
- **MAXIMUM-SIGNAL GRID-NO.2 INPUT:**.............. 4 ma
- **PEAK HEATER-CATHODE VOLTAGE:**
  - Heater negative with respect to cathode........ 100 max. volts
  - Heater positive with respect to cathode........ 100 max. volts

**Typical Operation** (Values are for two tubes):

- **Plate Supply Voltage:**........ 375 volts
- **Plate Voltage:**.............. 400 volts
- **Grid-No.2 Supply Voltage:**........ 300 volts
- **Grid-No.2 Voltage:**............. 15 volts
- **Cathode-Bias Resistor:**........ 220 ohms
- **Peak AP Grid-No.1 Voltage:**........ 14.8 volts
- **Zero-Signal Plate Current:**........ 15 ma
- **Maximum-Signal Plate Current:**........ 105 ma
- **Zero-Signal Grid-No.2 Current:**........ 1.6 ma
- **Maximum-Signal Grid-No.2 Current:**........ 25 ma
- **Effective Load Resistance** (Plate-to-plate):........ 1100 ohms
- **Total Harmonic Distortion:**........ 4.3 per cent
- **Maximum Signal Power Output:**........ 34 watts

**Medium-Mu Triode**

**Fixed Bias**

Grid-No.1 Circuit Resistance:

- 0.3 max. mhos
- 1 max. mhos

* 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 apply 48 per cent of the plate signal voltage to grid No.2 of each output tube.
DIRECT INTERELECTRODE CAPACITANCES:

Triode Unit:
- Grid to Plate: 2 pf
- Grid to Cathode and Heater: 2.5 pf
- Plate to Cathode and Heater: 0.3 pf
- Penode Unit:
  - Grid No.1 to Plate: 0.06 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: 2 pf

Equivalent-Noise and Hum Voltage Referenced to Grid:

Triode Unit
- Median Value (rms): 10 μV
- Maximum Value (rms): 150 μV

Penode Unit
- Median Value (rms): 30 μV
- Maximum Value (rms): 160 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, 1000 ohms; grid resistor, 0.05 megohm; and amplifier covering frequency range between 25 and 10000 cycles per second.

*Some conditions as for triode unit except: grid-No.2 supply volts, 250; grid-No.2 resistor, 0.33 megohm; grid-No.2 by-pass capacitor, 0.22 μF; cathode resistor, 1200 ohms; and grid-No.1 resistor, 0.05 megohm.

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Triode Unit</th>
<th>Penode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>300 max</td>
</tr>
<tr>
<td>Grid-No.2 Screen-Grid Voltage</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>300 max</td>
</tr>
<tr>
<td>Grid-No.1 Control-Grid Voltage, Positive-bias value</td>
<td>0 max</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>2500 max</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>0.6 mA</td>
</tr>
<tr>
<td>For grid-No.2 voltages up to 165 volts</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>For grid-No.2 voltages between 165 and 330 volts</td>
<td>See curve page 70</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage: Heatex positive with respect to cathode</td>
<td>200 max</td>
</tr>
<tr>
<td>Heatex positive with respect to cathode</td>
<td>200 max</td>
</tr>
<tr>
<td>Characteristics: Plate Supply Voltage</td>
<td>215</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>-50</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>-8.5</td>
</tr>
<tr>
<td>Cathode-Bias Resistor</td>
<td>62 ohms</td>
</tr>
<tr>
<td>Amplitude Factor</td>
<td>17</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>0.0053</td>
</tr>
<tr>
<td>Transconductance</td>
<td>2100</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.) for plate current of 10 ma</td>
<td>40</td>
</tr>
<tr>
<td>Plate Current</td>
<td>9</td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>0.36</td>
</tr>
</tbody>
</table>

AVG VOLTAGE CHARS. TRIPDE UNIT

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Triode Unit</th>
<th>Penode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1 Circuit Resistance: For fixed-bias operation</td>
<td>0.5 max</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>1.0 max</td>
</tr>
</tbody>
</table>

*The dc component must not exceed 100 volts.

+ If either unit is operated at maximum rated conditions, grid-No.1-circuit resistance for both units should not exceed the stated values.

DUAL TRIODE

Miniature type used for combined first- and second-stage audio preamplification in high-fidelity phonograph or tape equipment. Tube has high-mu unit and medium-mu unit. Outline 8B, OUTLINES SECTION. Tube requires miniature nine-contact socket and may be operated in any position. Heater volts (ac/dc), 12.6 (series), 6.3 (parallel); amperes, 0.15 (series), 0.3 (parallel).

CLASS A, AMPLIFIER

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Unit</th>
<th>No.1</th>
<th>No.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>330 max</td>
<td>330 max</td>
</tr>
<tr>
<td>Grid Voltage: Negative-bias value</td>
<td>55 max</td>
<td>55 max</td>
</tr>
<tr>
<td>Positive-bias value</td>
<td>0 max</td>
<td>0 max</td>
</tr>
<tr>
<td>Cathode Current</td>
<td>22 max</td>
<td></td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>1.2 max</td>
<td>3 max</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage: Heatex negative with respect to cathode</td>
<td>200 max</td>
<td></td>
</tr>
<tr>
<td>Heatex positive with respect to cathode</td>
<td>200 max</td>
<td></td>
</tr>
<tr>
<td>Characteristics: Plate Voltage</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Grid Voltage</td>
<td>-1</td>
<td>-2</td>
</tr>
<tr>
<td>Amplification Factor</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>800 ohms</td>
<td>6250 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>1200</td>
<td>1600</td>
</tr>
<tr>
<td>Grid Voltage (Approx.) for plate current of 10 ma</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>Maximum Circuit Values: Grid-Circuit Resistance: For fixed-bias operation</td>
<td>0.5 max</td>
<td></td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>1 max</td>
<td>0.5 max</td>
</tr>
</tbody>
</table>

7247
**POWER PENTODE**

Glass octal type used in the power-output stage of high-fidelity audio-frequency amplifier systems. Outline 14E, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.8.

**7355**

Maximum Ratings, (Design-Maximum Values):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>500 max volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>400 max volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>0 max volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>18 max watts</td>
</tr>
<tr>
<td>DC Grid-No.2 Input</td>
<td>3.8 max volts</td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>100 max ma</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 max volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 max volts</td>
</tr>
</tbody>
</table>

Typical Operation and Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>225 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>15 volts</td>
</tr>
<tr>
<td>Peak AF Grid-No.1 Voltage</td>
<td>24 volts</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>42000 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>7600 (\mu)s/hce</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>74 ma</td>
</tr>
<tr>
<td>Maximum Signal Plate Current</td>
<td>16.5 ma</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>2500 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion (Approx.)</td>
<td>25 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>9 watts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Approx.)</td>
<td>-55 volts</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1-Circuit Resistance:</td>
<td></td>
</tr>
<tr>
<td>For fixed-bias operation</td>
<td>0.3 max megohm</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>1 max megohm</td>
</tr>
</tbody>
</table>

**SHARP-CUTOFF PENTODE**

Miniature type used in compact audio equipment, especially in low-lum, low-microphonic, high-gain, resistance-coupled-amplifier applications. Outline 7B, OUTLINES SECTION. This type is identical with miniature type 6AU6 except that it has a controlled hum characteristic.

**Ham Output Voltage:**

Average Value (rms, cathode bypassed) 1.21 millivolts

Average Value (rms, cathode unbypassed) 0.98 millivolts

* The dc component must not exceed 100 volts.

**BEAM POWER TUBE**

Glass octal type used as output amplifier in high-quality sound systems. Outline 14C, OUTLINES SECTION. Tube requires octal socket and may be mounted in any position. Heater volts (ac/dc), 5.3; amperes, 0.45.

**7408**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>350 ma volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>250 ma volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>0 ma volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>14 ma watts</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>200 ma volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>200 ma volts</td>
</tr>
</tbody>
</table>

Typical Operation and Characteristics:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>60 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>0 volts</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>5 ma</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>4000 ohms</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>5000 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>25 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>4.5 watts</td>
</tr>
</tbody>
</table>

Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1-Circuit Resistance:</td>
<td></td>
</tr>
<tr>
<td>For fixed-bias operation</td>
<td>0.1 max megohm</td>
</tr>
<tr>
<td>For cathode-bias operation</td>
<td>0.5 max megohm</td>
</tr>
</tbody>
</table>

* The dc component must not exceed 100 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.
POWER PENTODE
Glass octal type used as audio-frequency power-output tube in high-quality audio applications. Outline 14C, OUTLINES SECTION. Tubecases and socket may be mounted in any position. Heater volts (ac/dc), 6.3; amperes, 0.8.

CLASS A, AMPLIFIER

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th>Fixed</th>
<th>Cathode</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>550 mV</td>
<td>volts</td>
</tr>
<tr>
<td>GRID-No.2 VOLTAGE</td>
<td>140 mV</td>
<td>volts</td>
</tr>
<tr>
<td>CATHODE CURRENT</td>
<td>85 mV</td>
<td>ma</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>19 ma</td>
<td>watts</td>
</tr>
<tr>
<td>GRID-No.2 INPUT</td>
<td>3.3 mV</td>
<td>watts</td>
</tr>
</tbody>
</table>

HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode...

Typical Operation and Characteristics:
Plate Voltage...
Grid-No.2 Voltage...
Cathode Current...
Zero-Signal Plate Current...
Maximum Signal Grid-No.2 Current...
Triode Amplification Factor...
Plate Resistance (Approx.)...
Transconductance...
Load Resistance...
Total Harmonic Distortion...
Maximum-Signal Power Output...

Maximum Circuit Values:
Grid-No.1 Circuit Resistance...
For fixed-bias operation...
For cathode-bias operation...

PUSH-PULL CLASS AB, AMPLIFIER

<table>
<thead>
<tr>
<th>Maximum Ratings (Same as for Class A, Amplifier):</th>
<th>Fixed</th>
<th>Cathode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Operation, (Values are for two tubes):</td>
<td>Bias</td>
<td>Bias</td>
</tr>
<tr>
<td>Plate Supply Voltage</td>
<td>350</td>
<td>450</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>350</td>
<td>450</td>
</tr>
<tr>
<td>CATHODE-BIAS RESISTOR (COMMON TO BOTH CATHODES)</td>
<td>-15</td>
<td>-15</td>
</tr>
<tr>
<td>Peak AF Grid-No.1-to-Grid-No.2 Voltage</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-plate)</td>
<td>600</td>
<td>600</td>
</tr>
</tbody>
</table>

Total Harmonic Distortion...
Maximum-Signal Power Output...

PUSH-PULL CLASS AB, AMPLIFIER

<table>
<thead>
<tr>
<th>Maximum Ratings, (Design-Maximum Values):</th>
<th>Fixed</th>
<th>Cathode</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>150 mV</td>
<td>volts</td>
</tr>
<tr>
<td>GRID-No.2 VOLTAGE</td>
<td>150 mV</td>
<td>volts</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>16 mV</td>
<td>watts</td>
</tr>
</tbody>
</table>

HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode...

Typical Operation and Characteristics:
Plate Supply Voltage...
Grid-No.2 Supply Voltage...
Cathode Current...
Zero-Signal Plate Current...
Maximum-Signal Grid-No.2 Current...
Triode Amplification Factor...
Plate Resistance (Approx.)...
Transconductance...
Load Resistance...
Total Harmonic Distortion...
Maximum-Signal Power Output...

Maximum Circuit Values:
Grid-No.1 Circuit Resistance...
For fixed-bias operation...
For cathode-bias operation...

* The dc component must not exceed 100 volts.

BEAM POWER TUBE
Neonval type used as of poweramplifier tube. Outline 14C, OUTLINES SECTION. Tube requires neonval nine-contact socket and may be mounted in any position. Heater volts (ac/dc), 60 volts; amperes, 0.15.

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 10C, OUTLINES SECTION. Tube requires novar nine-contact socket and may be operated in any position. It is especially important that this tube, like other power-handling tubes, be adequately ventilated.
### RCA Receiving Tube Manual

#### Class A Amplifier

**Maximum Ratings (Dc-Rated-Maximum System):**
- **Plate Voltage:** 550 max volts
- **Grid No. 2 (Screen-Grid) Voltage:** 430 max volts
- **Plate Dissipation:** 14 max watts
- **Grid-No.2 Input:** 8.2 max watts
- **DC Cathode Current:** 80 ma
- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode: 290 volts
  - Heater positive with respect to cathode: 290 max volts
- **Bulb Temperature (At hottest point):** 340 max °C

#### Typical Operation and Characteristics:
- **Plate Supply Voltage:** 300 volts
- **Grid-No.2 Supply Voltage:** 300 volts
- **Grid-No.1 (Control-Grid) Voltage:** 300 volts
- **Peak AP Grid-No.1 Voltage:** 81 volts
- **Zero-Signal Plate Current:** 18 ma
- **Maximum-Signal Plate Current:** 18 ma
- **Maximum-Signal Grid-No.2 Current:** 14 ma
- **Plate Resistance (Approx.):** 2900 ohms
- **Transconductance:** 10200 mhos
- **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 m ohm
  - For cathode-bias operation: 1 m ohm

---

#### Push-Pull Class AB Amplifier

**Maximum Ratings (Same as for Class A Amplifier):**

#### Typical Operation (Values for two tubes):

<table>
<thead>
<tr>
<th></th>
<th>Fixed Bias</th>
<th>Cathode Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Peak AP Grid-No.1 Voltage</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>18 ma</td>
<td>18 ma</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>18 ma</td>
<td>18 ma</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>14 ma</td>
<td>14 ma</td>
</tr>
<tr>
<td>Plate Resistance (Approx.)</td>
<td>2900 ohms</td>
<td>2900 ohms</td>
</tr>
<tr>
<td>Transconductance</td>
<td>10200 mhos</td>
<td>10200 mhos</td>
</tr>
<tr>
<td>Effective Load Resistance</td>
<td>3000 ohms</td>
<td>3000 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>13 per cent</td>
<td>13 per cent</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>11 watts</td>
<td>11 watts</td>
</tr>
</tbody>
</table>

---

#### Push-Pull Class AB Amplifier

**Maximum Ratings (Same as for Class A Amplifier):**

#### Typical Operation (Values for two tubes):

<table>
<thead>
<tr>
<th></th>
<th>Fixed</th>
<th>Cathode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Supply Voltage</td>
<td>400</td>
<td>425</td>
</tr>
<tr>
<td>Grid-No.2 Supply Voltage</td>
<td>400</td>
<td>425</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>20.5</td>
<td>20.5</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (Common to both cathodes)</td>
<td>185</td>
<td>185</td>
</tr>
<tr>
<td>Peak AP Grid-No.1 Grid-No.1 Voltage</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Maximum-Signal Plate Current</td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td>Zero-Signal Grid-No.2 Current</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Maximum-Signal Grid-No.2 Current</td>
<td>18 ma</td>
<td>18 ma</td>
</tr>
<tr>
<td>Effective Load Resistance (Plate-to-plate)</td>
<td>6600 ohms</td>
<td>6600 ohms</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>23</td>
<td>23</td>
</tr>
</tbody>
</table>

* 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 400 volts.

---

### Technical Data

#### Electron-Ray Tube

Miniature type with triode unit used to indicate visually by means of a fluorescent target the effects of changes in a controlling voltage. Tube is used for accurate tuning or modulation control. Maximum dimensions: over-all length, 2.27-32 inches; seated height, 2.13-32 inches; diameter, 7.8 inch. Tube requires nine-contact socket and may be mounted in any position. Heater voltage (ac/dc), 63.6; amperes, 0.27. For additional considerations, refer to Tuning Indication with Electron-Ray Tubes in ELECTRON TUBE APPLICATIONS SECTION.

#### Indicator Service

<table>
<thead>
<tr>
<th>Maximum and Minimum Ratings, (Design-Center Values):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ray-Control-Electrode Voltage:</strong></td>
</tr>
<tr>
<td>Without current flowing through series triode-plate resistor</td>
</tr>
<tr>
<td>With current flowing through series triode-plate resistor</td>
</tr>
<tr>
<td><strong>Fluorescent-Target Voltage:</strong></td>
</tr>
<tr>
<td>Without current flowing through series triode-plate resistor</td>
</tr>
<tr>
<td>With current flowing through series triode-plate resistor</td>
</tr>
<tr>
<td><strong>Cathode Current:</strong></td>
</tr>
<tr>
<td>3 ma max ma</td>
</tr>
<tr>
<td><strong>Triode-Plate Dissipation:</strong></td>
</tr>
<tr>
<td>3 ma max ma</td>
</tr>
<tr>
<td><strong>Peak Heater-Cathode Voltage:</strong></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
</tr>
<tr>
<td><strong>Bulb Temperature (At hottest point):</strong></td>
</tr>
<tr>
<td>120 ma max ma</td>
</tr>
</tbody>
</table>

#### Typical Operation with Ray-Control Electrode Connected to Triode Plate:

| Triode-Plate Supply Voltage | 250 volts |
| Fluorescent-Target Voltage | 250 volts |
| Series Triode-Plate Resistor | 0.47 ma |
| Triode-Grid Supply Voltage | 0 ma |
| Triode-Grid Resistor | 3 ma |
| Triode-Plate Current | 0.45 ma |
| Fluorescent-Target Current | 1.1 ma |
| Length of Dark Part of Fluorescent Target | 0.83 ± 0.23 inch |
| Length of Dark Part of Fluorescent Target when triode-grid resistor is 0 ohms | 0.94 ± 0.26 inch |

#### Maximum Circuit Values:

| Triode-Grid-Circuit Resistance | 3 ma max ma |
Electron Tube Testing

The 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 tube-tester 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 short-circuit tester is shown in Fig. 99. Although this circuit is suitable for tetrodes 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 shortsed 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 short-circuits in a tube may sometimes occur only when the electrodes are heated. However, a short-circuit tester having too high a sensitivity may indicate very-high-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, ELECTRONELETS, 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. 100 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 constant 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.

**Fig. 100**

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. 101 giving a fundamental circuit with a tetrode under test), appropriate operating voltages are applied to the electrodes of the tube. A plate current divided by the input-signal voltage, if a one-volt rms signal is applied, gives the plate-current 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 much complicated to set up, the power-output test will give closer correlation with actual performance than any other single test.

**Fig. 101**

**Electron Tube Testing**

The 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. 102 gives a fundamental circuit with a tetrode under test. This method is superior to the static transconductance test in that ac voltage 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 dynomometer type. The transconductance of the tube is equal to the current reading and known load resistance. In this way, it is possible to determine the operating condition of the tube quite accurately.

Fig. 102 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:

\[ P_o = (V_o \times I_o) \times 0.465 \]

where \( P_o \) is the power output in watts, \( I_o \) is the dc current in amperes, and \( R_L \) is the load resistance in ohms.

**Fig. 102**

**Essential Tube-Tester Requirements**

1. The tester should provide for making a short-circuit test before measurement of the tube's characteristics.
2. 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 con-
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, audio-frequency 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 50 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 screen-grid 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 power-supply unit of conventional design without encountering any difficulties due to coupling.

**Key to Charts**

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T = Triode Unit or Triode Connection
P = Pentode Unit or Pentode Connection
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 (\( \mu \)fd).
- \( C_{kB} \) = Cathode Bypass Capacitor (\( \mu \)fd).
- \( C_{g x} \) = Screen-Grid Bypass Capacitor (\( \mu \)fd).
- \( E_{b} \) = Plate-Supply Voltage (volts).
- \( V.G. \) = Plate-supply voltage minus drop in \( R_{P} \) and \( R_{S} \).
- \( R_{S} \) = Cathode Resistor (ohms).
- \( R_{cK} \) = Screen Grid Resistor (megohms).
- \( R_{g} \) = Grid Resistor (megohms) for following stage.
- \( R_{P} \) = Plate Resistor (megohms).

The frequency (f) 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 performance. One-half-watt resistors are usually suitable for \( R_{P} \), \( R_{c} \), \( E_{b} \), and \( R_{g} \) resistors. Capacitors \( C \) and \( C_{g x} \) should have a working voltage equal to or greater than \( E_{b} \). 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 \( E_{b} \) for a frequency (f) of 100 cycles. For any other value of \( f \), multiply values of \( C \) and \( C_{K} \) by 100/\( f \). The voltage output at \( f \) for "n" like stages equals \( 0.8 \times E_{b} \) where \( E_{b} \) 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 \( R_{g} \) are 20000, 10000, and 5000 cycles, respectively. Note: The values of input-coupling capacitor in microfarads and of grid resistor in megohms should be such that their product lies between 0.02 and 0.1. Values commonly used are 0.005 \( \mu \)fd and 10 megohms.

Pentode Amplifier

Heater-Cathode Type

Capacitors \( C \), \( C_{K} \), and \( C_{g x} \) have been chosen to give an output voltage equal to 0.7 \( E_{b} \) for a frequency (f) of 100 cycles. For any other value of \( f \), multiply values of \( C \), \( C_{K} \), and \( C_{g x} \) by 100/\( f \). 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 \( f \), it may be necessary to increase the value of \( C_{K} \) 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 \( f \) for "n" like stages equals \( 0.7 \times E_{b} \) where \( E_{b} \) 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 \( R_{g} \) are 20000, 10000, and 5000 cycles, respectively.

General Circuit Considerations

In the discussions which follow, the frequency (f) is that value at which the high-frequency response begins to fall off.
### RCA Receiving Tube Manual

(See page 192 for explanation of column headings)

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| 1.0 | 1.00 | 6300 | 0.17 | 2.8 | 0.0019 | 25 | 161 |

| 2.2 | 1.00 | 10800 | 0.17 | 1.7 | 0.0025 | 10 | 139 |
| 1.0 | 2.00 | 13100 | 0.17 | 1.7 | 0.0025 | 10 | 139 |

| 180 | 0.22 | 0.520 | 1340 | 0.059 | 8.8 | 0.0081 | 31 | 143 |
| 1.0 | 0.520 | 1420 | 0.059 | 8.6 | 0.0038 | 25 | 223 |

| 0.47 | 1.05 | 2700 | 0.039 | 5.5 | 0.0441 | 14 | 189 |
| 1.0 | 1.55 | 2800 | 0.037 | 5.4 | 0.0277 | 43 | 249 |

| 2.2 | 1.20 | 2950 | 0.036 | 5.4 | 0.0199 | 50 | 294 |
| 1.0 | 2.40 | 5500 | 0.028 | 3.2 | 0.0023 | 33 | 230 |

| 0.01 | 0.530 | 780 | 0.077 | 13.3 | 0.0883 | 53 | 200 |
| 1.0 | 0.540 | 800 | 0.077 | 13.1 | 0.0372 | 24 | 316 |

| 0.47 | 1.15 | 1590 | 0.067 | 8.4 | 0.0445 | 56 | 275 |
| 1.0 | 1.22 | 1650 | 0.067 | 8.4 | 0.0277 | 72 | 357 |

| 2.2 | 1.31 | 1720 | 0.045 | 7.2 | 0.0017 | 87 | 418 |
| 1.0 | 2.50 | 3300 | 0.036 | 5.3 | 0.0022 | 57 | 352 |

### Resistance-Coupled Amplifiers

(See page 192 for explanation of column headings)

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| 1.0 | 6500 | 0.92 | 0.0083 | 13 | 28 |

| 0.47 | 1.00 | 12500 | 0.52 | 0.0043 | 14 | 28 |
| 2.2 | 13500 | 0.47 | 0.0031 | 18 | 28 |

| 6AB4 | 12AT7* |
| See Circuit Diagram 1 |

| 6C4 | 7AU7* |
| See Circuit Diagram 1 |

### Resistance-Coupled Amplifiers

(See page 192 for explanation of column headings)

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| 1.0 | 8100 | 1.1 | 0.0035 | 12 | 37 |

| 0.47 | 12000 | 0.83 | 0.0096 | 10 | 36 |
| 1.0 | 14000 | 0.7 | 0.0035 | 14 | 39 |
| 2.2 | 15000 | 0.6 | 0.0012 | 16 | 41 |

| 0.1 | 1900 | 3.6 | 0.0277 | 19 | 30 |
| 0.22 | 2200 | 3.1 | 0.014 | 15 | 30 |
| 0.47 | 2500 | 2.8 | 0.0065 | 32 | 37 |

| 0.22 | 3400 | 2.2 | 0.014 | 24 | 38 |
| 1.0 | 4100 | 1.7 | 0.0065 | 34 | 42 |
| 2.2 | 9100 | 0.8 | 0.0022 | 43 | 47 |

| 0.47 | 6500 | 1.1 | 0.0065 | 39 | 44 |
| 1.0 | 8100 | 0.9 | 0.0035 | 38 | 44 |
| 2.2 | 9100 | 0.8 | 0.0022 | 43 | 47 |

| 0.22 | 2600 | 2.5 | 0.013 | 53 | 46 |
| 0.47 | 2100 | 3.0 | 0.0065 | 63 | 47 |
| 0.1 | 3700 | 1.6 | 0.0035 | 77 | 48 |
| 0.22 | 3200 | 1.9 | 0.0065 | 65 | 36 |
| 0.47 | 5200 | 1.2 | 0.0066 | 61 | 48 |

| 2.2 | 7200 | 0.9 | 0.0022 | 85 | 51 |

*One triode unit. *Peak volts.
### Resistance-Coupled Amplifiers

(See page 192 for explanation of column headings)

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(See page 192 for explanation of column headings)

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* Peak volts.

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* One triode unit. * Peak volts.
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 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 oscillographs are the minimum of 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.

Information on the characteristics and application features of each tube type are given in the TECHNICAL DATA FOR RCA RECEIVING TUBES SECTION. This information should be helpful in the understanding and utilization of the circuits.

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<td>144-Mc Superregenerative Receiver</td>
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<td>Citizens-Band Transceiver</td>
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<tr>
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<td>High-Fidelity Audio Amplifier (class AB; power output, 15 watts)</td>
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<td>22-14</td>
<td>High-Fidelity Audio Amplifier (class AB; power output, 30 watts)</td>
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<td>High-Fidelity Audio Amplifier (class AB; power output, 50 watts)</td>
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<td>Two-Channel Sterophonic Amplifier With Tone Control (power output, 1 watt each channel)</td>
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<td>22-18</td>
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<td>Phonograph Amplifier (power output, 1 watt)</td>
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<td>Preamplifier for Magnetic Phonograph Pickup (with RIAA equalization)</td>
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<td>Preamplifier for Ceramic Phonograph Pickup (cathode-follower, low-impedance output)</td>
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<td>Low-Distortion Preamplifier (for low-output, high-impedance microphones)</td>
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<td>Two-Stage Input Amplifier (cathode-follower, low-impedance output)</td>
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<td>22-26</td>
<td>Bass and Treble Tone-Control Amplifier Stage</td>
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<td>22-27</td>
<td>Audio Control Unit (with volume and tone controls)</td>
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<td>22-28</td>
<td>Code-Practice Oscillator</td>
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<td>Intercommunication Set (with master unit and two or more remote units)</td>
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<td>All-Purpose Power Supply</td>
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<td>Cathode-Ray Oscilloscope</td>
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<td>22-32</td>
<td>Audio-Signal Generator</td>
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<tr>
<td>22-33</td>
<td>Electronic Volt-Ohm Meter</td>
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</table>
PORTABLE BATTERY-OPERATED SUPERHETERODYNE RECEIVER

C = 0.0002 μF, paper, 600 V
L = Loop antenna or ferrite-rod antenna, 540-1600 Kc (with specified values of capacitance for C and C1)
R1 = 0.1 megohm, 0.25 watt
R2 = 1500 ohms, 0.25 watt
R3 = 3.3 megohms, 0.25 watt
R4 = 680 megohms, 0.25 watt
R5 = Volume control, potentiometer, 2 megohms
R6 = 10 megohms, 0.25 watt
R7 = 4.7 megohms, 0.25 watt
R8 = 1 megohm, 0.25 watt
R9 = 280 ohms, 0.25 watt
S = Switch, double-pole, single-throw
T1 = Oscillator coil for use with tuning capacitor of 7.5-124.5 μF, and 455 Kc if transformer
T2 = Transformer
T3 = Intermediate-frequency transformer, 455 Kc
T4 = Output transformer for matching impedance of voice coil to 10000-ohm tube load

Cs, Cb, C4 = Ganged tuning capacitors, 20-450 pf
Ca, Cb = Trimmer capacitors, 2-15 pf
Cg = 56 pf, ceramic
Ct, Cs, C4 = Trimmer capacitors for if transformers
CA = 0.0002 μF, paper, 50 V
C1, C2 = 0.002 μF, paper, 100 V
C3 = 0.02 μF, ceramic
C5 = 0.002 μF, paper, 150 V
C6 = 35 pf, ceramic
C7 = 10 μF, electrolytic, 100 V

PORTABLE 3-WAY SUPERHETERODYNE RECEIVER

C5, C6, C7 = Ganged tuning capacitors, 20-450 pf
C8, C9, C10 = Trimmer capacitors, 2-15 pf
C11, C12 = 0.002 μF, paper, 400 V
C13 = 0.1 μF, paper, 400 V
C14 = 0.001 μF, paper, 400 V
C15 = 0.005 μF, paper, 400 V
C16 = 6.1 μF, paper, 400 V
C17 = 0.05 μF, paper, 400 V
C18 = 0.05 μF, paper, 50 V
C19 = 0.05 μF, paper, 400 V
C20 = 40 μF, electrolytic, 25 V
C21 = 100 μF, electrolytic, 25 V
C22 = 20 μF, electrolytic, 150 V
L1 = Loop antenna or ferrite-rod antenna, 540-1600 Kc (with specified values of capacitance for C and C1)
R11 = R12 = 4.7 megohms, 0.25 watt
R13 = 2.2 megohms, 0.25 watt
R14 = 0.1 megohm, 0.25 watt
R15 = Volume control, potentiometer, 2 megohms
R16 = 10 megohms, 0.25 watt
R17 = 0.22 megohm, 0.25 watt
R18 = 1 megohm, 0.25 watt
R19 = 1800 ohms, 0.25 watt
R20 = 27000 ohms, 0.25 watt
S = Switch, 4-pole double-throw
T1 = HF transformer, 540-1600 Kc
T2 = Oscillator coil for use with a 560-μF condenser, 20-450 pf
T3 = Intermediate-frequency transformers, 455 Kc
T4 = Output transformer for matching impedance of voice coil to 10000-ohm tube load
(22-3)

**AC-OPERATED SUPERHETERODYNE RECEIVER**

- **RF AMPLIFIER**
  - Type 2BG6
  - Components:
    - $C_1, C_2, C_3$: Ganged tuning capacitors, 10-365 pf
    - $C_4, C_5$: Trimmer capacitors, 4-40 pf
    - $C_6, C_7$: Loop antenna or ferrite-rod antenna, 500-1600 Kc, with specified values of capacitance for $C_1$ and $C_2$
    - $R_1$: 12000 ohms, 0.5 watt
    - $R_2$: 20000 ohms, 0.5 watt
    - $R_3$: 2.5 megohms, 0.5 watt
    - $R_4$: 0.5 megohm, 0.5 watt
    - $R_5$: Volume control, potentiometer, 1 megohm
    - $R_6$: 10 megohms, 0.5 watt
    - $R_7$: 20000 ohms, 0.5 watt
    - $R_8$: 0.5 megohm, 0.5 watt
    - $R_9$: 470000 ohms, 0.5 watt
    - $R_{10}$: Matching impedance of voice coil to a 1000-ohm plate-to-plate tube load

- **CONVERTER**
  - Type 2CQ6
  - Components:
    - $C_{10}$, $C_{11}$: 0.05 µf, paper, 600 v
    - $C_{12}$, $C_{13}$: Electrolytic, 450 v
    - $C_{14}$: 20 µf, electrolytic, 60 v
    - $C_{15}$: 0.09 µf, paper, 600 v

- **IF AMPLIFIER**
  - Type 2BA6
  - Components:
    - $C_{16}$: 25 µf, electrolytic, 150 v
    - $C_{17}$: Loop antenna or ferrite-rod antenna, 540-1600 Kc, with specified values of capacitance for $C_1$ and $C_2$
    - $R_1$: 0.05 µf, paper, 50 v
    - $R_2$: 0.05 µf, paper, 600 v
    - $C_{18}$: Oscillator padding capacitor—follow oscillator-coil manufacturer's recommendations
    - $C_{19}$: 35 µf, mica
    - $C_{20}$: 47 µf, mica
    - $C_{21}$: Trimmer capacitors for if transformers
    - $C_{22}$: 180 µf, mica
    - $C_{23}$: 0.01 µf, paper, 400 v
    - $C_{24}$: 20 µf, electrolytic, 450 v
    - $C_{25}$: 120 µf, mica
    - $C_{26}$: 0.02 µf, paper, 400 v
    - $R_{16}$: 15000 ohms, 1 watt

- **DIODE DETECTOR**
  - Type 2BA6
  - Components:
    - $C_{27}$: 50 µf, electrolytic, 150 v
    - $C_{28}$: Loop antenna or ferrite-rod antenna, 540-1600 Kc, with specified values of capacitance for $C_1$ and $C_2$
    - $R_1$: 0.05 µf, paper, 50 v
    - $R_2$: 0.05 µf, paper, 600 v
    - $C_{29}$: 0.01 µf, paper, 400 v
    - $C_{30}$: 20 µf, electrolytic, 450 v
    - $C_{31}$: 120 µf, mica
    - $C_{32}$: 0.02 µf, paper, 400 v
    - $R_{16}$: 15000 ohms, 1 watt

(22-4)

**AC/DC SUPERHETERODYNE RECEIVER**

- **PENTAGRID CONVERTER**
  - Type 2B66
  - Components:
    - $C_{33}$: 100 µf, electrolytic, 150 v
    - $C_{34}$: Loop antenna or ferrite-rod antenna, 540-1600 Kc, with specified values of capacitance for $C_1$ and $C_2$
    - $R_1$: 0.05 µf, paper, 50 v
    - $R_2$: 0.05 µf, paper, 600 v
    - $C_{35}$: 0.01 µf, paper, 400 v
    - $C_{36}$: 20 µf, electrolytic, 450 v
    - $C_{37}$: 120 µf, mica
    - $C_{38}$: 0.02 µf, paper, 400 v
    - $C_{39}$: 0.05 µf, paper, 400 v
    - $R_{16}$: 15000 ohms, 1 watt

- **IF AMPLIFIER**
  - Type 2BA6
  - Components:
    - $C_{40}$: 50 µf, electrolytic, 150 v
    - $C_{41}$: Loop antenna or ferrite-rod antenna, 540-1600 Kc, with specified values of capacitance for $C_1$ and $C_2$
    - $R_1$: 0.05 µf, paper, 50 v
    - $R_2$: 0.05 µf, paper, 600 v
    - $C_{42}$: 0.01 µf, paper, 400 v
    - $C_{43}$: 20 µf, electrolytic, 450 v
    - $C_{44}$: 120 µf, mica
    - $C_{45}$: 0.02 µf, paper, 400 v
    - $C_{46}$: 0.05 µf, paper, 400 v
    - $R_{16}$: 15000 ohms, 1 watt

- **DIODE DETECTOR**
  - Type 2BA6
  - Components:
    - $C_{47}$: 50 µf, electrolytic, 150 v
    - $C_{48}$: Loop antenna or ferrite-rod antenna, 540-1600 Kc, with specified values of capacitance for $C_1$ and $C_2$
    - $R_1$: 0.05 µf, paper, 50 v
    - $R_2$: 0.05 µf, paper, 600 v
    - $C_{49}$: 0.01 µf, paper, 400 v
    - $C_{50}$: 20 µf, electrolytic, 450 v
    - $C_{51}$: 120 µf, mica
    - $C_{52}$: 0.02 µf, paper, 400 v
    - $C_{53}$: 0.05 µf, paper, 400 v
    - $R_{16}$: 15000 ohms, 1 watt

- **POWER AMPLIFIER**
  - Type 50C5

**NOTE 1:** The following tube types are recommended for a 100-ma-heater tube complement: 18FX6A converter, 18FW6A if amplifier, 18FY6A detector and audio amplifier, 34GD5A power amplifier, and 36AM38 rectifier.
(22-5)

AUTOMOBILE RECEIVER

C1, C4, C6= Ganged tuning capacitors; C7= 7-100 pf; C2, C3= 80-460 pf
C5, C8, C9, C10, C11= 106 pf, mica
C3= 27 pf, mica
C7= 0.067 pf, paper, 100 volts
C1= 0.1 mfd, paper, 100 volts
C10, C11= Trimmer capacitors for IF transformers
C12= 330 pf, mica
C13= 125 pf, mica
C14= 150 pf, mica
C15= 1500 pf, mica
C16= 0.055 mf, paper, 100 volts
C17= 0.01 mf, paper, 100 volts
C18= 0.47 pf, paper, 100 volts
C19= 350 pf, mica
C20= 550 pf, electrolytic, 25 v
C21= 250 pf, electrolytic, 25 v
C22= 550 pf, electrolytic, 3 v
P=Fuse, 5 a.
L= Antenna coil for use with C1
L1= RF coil for use with C1
L2= Oscillator coil, tapped for use with C4, and 302.5-Kc IF transformer
L3= RF choke, 5 a.
L4= Filter choke, 10 mh., 5 a
R1= 0.5 megohm, 0.5 watt
R2= 0.47 megohm, 0.5 watt
R3, R4= 2.2 megohm, 0.5 watt
R5= 150 ohms, 8.5 watt
R6= 1 megohm, 0.5 watt
R7= 3500 ohms, 0.5 watt
R8= 100 ohms, 0.5 watt
R9, R10, R11= 4.7 megohms, 0.5 watt
R12= 22 megohms, 0.5 watt
R13= 47000 ohms, 0.5 watt
R14= 10 megohms, 0.5 watt
R15= 32000 ohms, 0.5 watt
R16= Volume control, potentiometer, 1 megohm, tapped at 0.5 megohm
R17= Tone control, potentiometer, 1 megohm
R18= 47 ohms, 1 watt
R19= 220 ohms, 1 watt
R20= 16 ohms, 0.5 watt
R21= 1 ohm, 1 watt
B= Speaker, 3.3-ohm voice coil
T1= IF input transformer, 302.5 Kc
T2= IF output transformer, 302.5 Kc
C= Audio driver transformer: impedance of primary, 2200 ohms; of secondary, 10 ohms; dc resistance of primary, 180 ohms; of secondary, 1.6 ohms; primary current, 15 ma. dc.
T1= Audio output transformer: impedance of primary, 20 ohms, of secondary, 4 ohms; dc resistance of primary, 0.6 amperes dc.

(22-6)

144-Mc SUPERREGENERATIVE RECEIVER

C1= 0.1 pf, paper, 400 v
C2= 100 pf, mica, 500 v
C3, C4= 20 pf, electrolytic, 450 v
C5= 0.01 mf, electrolytic, 50 v
C6= 0.005 mf, paper, 400 v
C7= 50 pf, silver mica, 300 v
C8= Ganged or split-stator tuning capacitor, 10 pf max. per section
R1= Potentiometer, 50000 ohms, 1 watt, wire wound
R2= 47000 ohms, 0.5 watt
R3= 27000 ohms, 1 watt
R4= 2700 ohms, 1 watt
R5= 0.1 megohm, 0.5 watt
R6= 270 ohms, 1 watt
R7= Volume control, potentiometer, 0.5 megohm
R8= 4.7 megohms, 0.5 watt
R10= One-quarter wavelength (20.5 inches at 144 Mc) of No. 22 Enam. copper wire on a 3/4" I.D. form (144 Mc): adjust so as to set band.
R11= Filter choke, 12 henries, 70 ma.
R12= Rectifier, 56000 ohms, 0 volt, 1.5 amperes
T1= Power transformer, 300-6-300 volts rms, 70 ma.; 6.5 volts, 1.5 amperes
T2= Output transformer for matching impedance of voice coil to 5000-ohm tube load

NOTE: The use of an rf amplifier is recommended to minimize radiation from the superregenerative detector.
CITIZENS-BAND TRANSCEIVER

CITIZENS-BAND TRANSCEIVER (Cont’d)

NOTE: See general considerations for construction of high-frequency and broadband circuits on page 504.
**RCA Receiving Tube Manual**

(22-8)

**AM/FM RECEIVER**

**Circuits**

(22-9)

**TRF AM TUNER**

For High-Fidelity
Local Broadcast Reception

![Circuit Diagram]

Parts List for AM/FM RECEIVER

- **C** = Part of **Ri**
- **Cg** = 36 pf, ceramic, 500 v.
- **Cw** = Ganged tuning capacitor, tune **L2** and **T2** to 88-100 Mc.
- **Ct** = Trimmer capacitors, 1.7 pf.
- **Cg** = 0.008 pf, ceramic, 500 v., N228
- **Cw** = 1600 pf, feed-through, 500 v.
- **Ct** = 11 pf, ceramic, 500 v.
- **Cw** = 6.0 pf, ceramic, 500 v.
- **Ct** = 500 pf, feed-through, 500 v.
- **Ct** = 3.22 pf, ceramic disc, 500 v.
- **Cw** = 2000 pf, feed-through, 500 v.
- **Ct** = 0.1 pf, air, 200 v.
- **Cw** = 0.1 pf, feed-through, 500 v.
- **Ct** = Tuning capacitor; value, with cable capacitance, tunes **T2** to 16.7 Mc.
- **Cw** = 4700 pf, ceramic, 500 v.
- **Ct** = 2700 pf, ceramic, 500 v.
- **Cw** = Part of **T2**
- **Ct** = Part of **T2**
- **Cw** = 100 pf, ceramic, 500 v., NPO
- **Ct** = Part of **T2**
- **Cw** = 1000 pf, ceramic, 500 v.

*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.*

NOTE: See general considerations for construction of high-frequency and broadband circuits on page 504.

514
FM STEREO MULTIPLEX ADAPTER

NOTE: See general considerations for construction of high-frequency and broadband circuits on page 504.
TWO-CHANNEL STEREOPHONIC AMPLIFIER
Power Output, 1 Watt Each Channel

C1, C2=0.047 μf, paper, 150 v.
C3, C4=0.1 μf, 400 v., paper
C5, C6=60 μf, 25 v., electrolytic
C7, C8=60 μf, 150 v., electrolytic
F=Fuse, 3 amperes

R1, R2=Volume control, potentiometer, 1.5 megohms, ganged
R5, R6=47000 ohms, 0.5 watt
R7, R8=Balance control, potentiometer, 2 megohms
R9, R10=60 ohms, 1 watt

R1=2200 ohms, 2 watts
R2=280 ohms, 2 watts
R3=15 ohms, 1 watt
R4=0.22 megohm, 0.5 watt
T1, T2=Output transformer for matching impedance of voice coil to 8000-ohm tube load.

TWO-CHANNEL STEREOPHONIC AMPLIFIER
With Tone Control
Power Output, 1 Watt Each Channel

C1, C2=0.047 μf, paper, 150 v.
C3, C4=0.1 μf, paper, 150 v.
C5, C6=0.022 μf, paper, 150 v.
C7=9 μf, electrolytic, 150 v.
C8=680 μuf, ceramic or mica, 400 v.
C9=80 μf, electrolytic, 25 v.
C10=0.068 μf, paper, 150 v.
C11=200 μf, electrolytic, 150 v.
C12=100 μf, electrolytic, 150 v.
F=Fuse, 3 amperes

R1, R2=Volume control, potentiometer, 2 megohms, ganged.
R3, R4=10 megohms, 0.5 watt
R5, R6=0.22 megohm, 1 watt
R7, R8=0.022 megohm, 2 watts
R9, R10=4000 ohms, 10 watts
R11, R12=Output transformer for matching impedance of voice coil to 1000-ohm plate tube load. Turns ratio 20 to 1:
primary current 80 ma.; de-power-handling capacity, 3.6 watts minimum.
(22-18)

TWO-CHANNEL AUDIO MIXER
Voltage Gain From Each Grid of 6EU7 to Output is Approximately 20

(22-19)

PHONOGRAPH AMPLIFIER
Power Output, 1 Watt

(22-20)

MICROPHONE AND PHONOGRAPH AMPLIFIER
Power Output, 8 Watts

C1 = 10 μF, electrolytic, 25 v.
C2 = 0.008 μF, paper, 400 v.
R1, R2, R3 = 1 megohm, 0.5 watt
R4, R5 = 0.1 megohm, 0.5 watt
R6 = Potentiometer, 0.1 megohm, audio taper
R7 = 1200 ohms, 0.5 watt

C1 = 0.02 μF, paper, 400 v.
C2 = 0.008 μF, paper, 400 v.
C3, C4 = 40 μF, electrolytic 160 v.
F = Fuse, 1 ampere
J = Input connector, shielded, for crystal phonograph pickup.
R5 = Volume control, potentiometer, 0.5 megohm, audio taper
R6 = 10000 ohms, 0.5 watt
R7 = 220 ohms, 0.5 watt
R8 = 22 ohms, 0.5 watt

C1 = 100 μF, disc-ceramic, 300 v.
C2 = 0.05 μF, paper, 200 v.
C3 = 8 μF, electrolytic, 450 v.
C4 = 16 μF, electrolytic, 450 v.
C5 = 25 μF, electrolytic, 450 v.
C6 = 0.1 μF, paper, 200 v.
C7 = 0.002 μF, disc-ceramic, 300 v.
C8 = 0.01 μF, disc-ceramic, 300 v.
C9 = 4700 μF, disc-ceramic, 300 v.
C10 = 47000 μF, disc-ceramic, 300 v.
C11 = 47 μF, electrolytic, 450 v.
C12 = 0.05 μF, paper, 400 v.
C13 = 20 μF, electrolytic, 25 v.
C14, C15, C16 = 20 μF, electrolytic, 450 v.
C17 = 0.05 μF, paper, 400 v.
C18 = 200000 μF, 0.5 watt
R1, R2 = 12000 ohms, 0.5 watt
R3, R4 = 0.15 megohm, 0.5 watt
R5, R6 = 47000 ohms, 1 watt
R7 = 50 k ohms, 10 watts
R8 = 8200 ohms, 2 watts
R9 = Switch, SPST
R10 = 22000 ohms, 0.5 watt
R11 = 12000 ohms, 0.5 watt
R12 = 1200 ohms, 0.5 watt
R13 = 0.1 megohm, 0.5 watt
R14 = Tone control, potentiometer, 0.5 megohm
R15 = 22000 ohms, 0.5 watt
R16 = 12000 ohms, 0.5 watt
R17 = 1200 ohms, 0.5 watt
R18 = 0.1 megohm, 0.5 watt
R19 = Tone control, potentiometer, 0.5 megohm
R20 = 22000 ohms, 0.5 watt
R21 = 12000 ohms, 0.5 watt
R22 = 1200 ohms, 0.5 watt
R23 = 0.15 megohm, 0.5 watt
R24 = 47000 ohms, 1 watt
R25 = 50 k ohms, 10 watts
R26 = 8200 ohms, 2 watts
S = Switch, SPST
T = Transformer, 300-0-300 v, 96 ma, 6.3 v, 1.5 a.
T1 = Transformer, 300-0-300 v, 96 ma, 6.3 v, 1.5 a.
T2 = Transformer, 300-0-300 v, 96 ma, 6.3 v, 1.5 a.
(22-21)

PREAMPLIFIER FOR AMATEUR RECEIVER FOR 10-METER (30-MEGACYCLE) BAND

Power Gain, 25 to 35 db

\[ C_5 = 0.001 \mu\text{F}, \text{500 v, ceramic} \]
\[ L_1 = 12 \text{ turns of No. 32 Enam. copper wire wound} \]
\[ L_2 = \frac{1}{4} \text{" I.D. slug-tuned form.} \]
\[ L_3 = \text{tuned to 32 Me; } L_4 = \text{to} \]
\[ 29.5 \text{Mc. Input and output} \]
\[ \text{link, 1/4 turns. Input and output impedance, 75 ohms.} \]

\[ R_1, R_2 = 100 \text{ ohms, 0.5 watt} \]
\[ R_3 = 0.47 \text{ megohm, 0.5 watt} \]
\[ R_4 = 1000 \text{ ohms, 0.5 watt} \]

(22-22)

PREAMPLIFIER FOR MAGNETIC PHONOGRAPH PICKUP

With RIAA Equalization

\[ C_2 = 0.1 \mu\text{F, paper, 400 v} \]
\[ C_3 = 5 \mu\text{F, electrolytic, 25 v} \]
\[ C_4 = 0.0033 \mu\text{F, 8 per cent, paper, 600 v} \]
\[ C_5 = 0.61 \mu\text{F, 8 per cent, paper, 600 v} \]
\[ C_6 = 189 \mu\text{F, 6 per cent, ceramic or mica, 500 v} \]
\[ \text{(includes capacitance of output cable)} \]

\[ R_1 \text{ to } R_7 = \text{2700 ohms, 0.5 watt} \]
\[ R_8 = 0.1 \text{ megohm, 0.5 watt} \]
\[ R_9 = 39000 \text{ ohms, 0.5 watt} \]
\[ R_{10} = 0.67 \text{ megohm, 0.6 watt} \]
\[ R_{11} = 15000 \text{ ohms, 0.5 watt} \]
\[ R_{12} = 122000 \text{ ohms, 0.5 watt} \]

(22-23)

PREAMPLIFIER FOR CERAMIC PHONOGRAPH PICKUP

Cathode-Follower (Low-Impedance) Output

\[ C_1 = 0.1 \mu\text{F, paper, 400 v} \]
\[ C_2 = 0.01 \mu\text{F, paper, 400 v} \]
\[ C_3 = 20 \mu\text{F, electrolytic, 400 v} \]
\[ C_4 = 0.025 \mu\text{F, paper, 400 v} \]
\[ C_5 = 0.22 \mu\text{F, paper, 600 v} \]
\[ J = \text{Input connector, shielded, for high-impedance ceramic} \]
\[ \text{phonograph pickup (0.5 v, output)} \]
\[ R_1 = 1.8 \text{ megohm, 0.5 watt} \]
\[ R_2 = 4700 \text{ ohms, 0.5 watt} \]
\[ R_3 = 1 \text{ megohm, 0.5 watt} \]
\[ R_4 = 1800 \text{ ohms, 0.5 watt} \]

(22-24)

LOW-DISTORTION PREAMPLIFIER

For Low-Output High-Impedance Microphones

\[ C_1 = 20 \mu\text{F, electrolytic, 25 v} \]
\[ C_2 = 0.047 \mu\text{F, paper, 400 v} \]
\[ C_3 = 0.025 \mu\text{F, paper, 400 v} \]
\[ R_1 = 0.1 \text{ megohm, 0.5 watt} \]
\[ R_2 = 1000 \text{ ohms, 0.5 watt} \]

\[ \text{Sensitivity=3 millivolts for output of 220 millivolts} \]
(22-25)

TWO-STAGE INPUT AMPLIFIER
Cathode-Follower (Low-Impedance) Output

\[ +300 \text{ V} \]

\[ \text{C}_1, \text{C}_2=0.1 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{C}_3=25 \mu\text{F}, \text{electrolytic, 25 V} \]
\[ \text{C}_4=0.5 \mu\text{F}, \text{paper, 200 V} \]
\[ R_1, R_2=5500 \Omega, 0.5 \text{ watt} \]
\[ R_3, R_4=57000 \Omega, 0.5 \text{ watt} \]

(22-26)

BASS AND TREBLE TONE-CONTROL AMPLIFIER STAGE

\[ +250-300 \text{ V} \]

\[ \text{C}_1, \text{C}_2=0.01 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{C}_3=0.01 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{C}_4=0.01 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{C}_5=0.01 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{C}_6=0.01 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{C}_7=0.01 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{C}_8=0.01 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{R}_1, \text{R}_2=0.22 \text{ M\Omega}, 0.5 \text{ watt} \]

(22-27)

AUDIO CONTROL UNIT
With Volume and Tone Controls

(22-28)

CODE-PRACTICE OSCILLATOR

\[ 117 \text{ V AC} \]

\[ \text{C}_1, \text{C}_2=20 \mu\text{F}, \text{electrolytic, 150 V} \]
\[ \text{C}_3=0.0022 \mu\text{F}, \text{paper, 400 V} \]
\[ \text{R}_1=0.47 \text{ M\Omega}, 0.5 \text{ watt} \]
\[ \text{R}_2=1000 \Omega, 0.5 \text{ watt} \]
\[ \text{R}_3, \text{R}_4\text{= T} 0 \mu\text{F, ceramic or mica, } 500 \text{ V} \]

Sensitivity = 0.5 volt rms for output of 1.25 volts with controls set for flat response.

NOTE: Select any two terminals of secondary of \( T_2 \) to give desired tone.

voltage rms, 16 ma; 6.3 volts, 0.6 amperes

\( T_2 \) = Output transformer, universal
(22-29)

**INTERCOMMUNICATION SET**

With Master Unit and Two or More Remote Units

![Circuit Diagram]

- **C1, C2 = 0.0022 μF, paper, 200 v.**
- **R1, R2 = 68 ohms, 0.5 watt**
- **R3, R4 = 2200 ohms, 1 watt**
- **R5, R6 = 5600 ohms, 0.5 watt**
- **R7, R8 = 10000 ohms, 0.5 watt**
- **C3, C4, C5 = 0.005 μF, paper, 300 v.**
- **C6 = 0.005 μF, electrolytic, 150 v.**
- **F = Fuse, 1 ampere**

**NOTE:** The leads from the LISTEN-TALK switch to T1 and T3 should be kept as far apart as possible to prevent undesirable regeneration effects. Connections to the remote speaker units should be made with low-resistance wire, preferably shielded "intercom" cable.

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(22-30)

**ALL-PURPOSE POWER SUPPLY**

![Circuit Diagram]

**POWER SUPPLY TRANSFORMER**

<table>
<thead>
<tr>
<th>Transformer Type</th>
<th>Choke (L)</th>
<th>R1 (Ω)</th>
<th>R2 (Ω)</th>
<th>C1 (μF)</th>
<th>C2 (μF)</th>
<th>Output Volts</th>
<th>Output MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stancor 149 ma, 7b, 165 ohms</td>
<td>33 ohms</td>
<td>40 μF</td>
<td>40 μF</td>
<td>360</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>(6BC6)</td>
<td>or equiv. 5W</td>
<td>450 Vdc</td>
<td>450 Vdc</td>
<td>340</td>
<td>40</td>
<td>320</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Stancor 200 ma, 4b, 156 ohms</td>
<td>56 ohms</td>
<td>40 μF</td>
<td>40 μF</td>
<td>450</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>(6X4)</td>
<td>or equiv. 10W</td>
<td>600 Vdc</td>
<td>600 Vdc</td>
<td>420</td>
<td>60</td>
<td>410</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>Stancor 60 ma, 12b, 500 ohms</td>
<td>500 ohms</td>
<td>40 μF</td>
<td>40 μF</td>
<td>350</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>(P-6S58)</td>
<td>or equiv. 5W</td>
<td>450 Vdc</td>
<td>450 Vdc</td>
<td>320</td>
<td>40</td>
<td>250</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Stancor 80 ma, 12b, 500 ohms</td>
<td>500 ohms</td>
<td>40 μF</td>
<td>40 μF</td>
<td>345</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>(P-6S59)</td>
<td>or equiv. 5W</td>
<td>450 Vdc</td>
<td>450 Vdc</td>
<td>320</td>
<td>40</td>
<td>250</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Stancor 80 ma, 12b, 500 ohms</td>
<td>500 ohms</td>
<td>40 μF</td>
<td>40 μF</td>
<td>260</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>(6X4)</td>
<td>or equiv. 5W</td>
<td>450 Vdc</td>
<td>450 Vdc</td>
<td>225</td>
<td>40</td>
<td>190</td>
<td>60</td>
</tr>
</tbody>
</table>

**NOTE:** Bleeder Rs 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.
NOTE: For home construction of this circuit, the complete Kit RCA-WO-33A (K) is recommended because of the large number of special components used. This circuit is also available in wired form as the RCA-WO-33A.
(22-32)

**AUDIO SIGNAL GENERATOR**

**CIRCUITS**

**AUDIO SIGNAL GENERATOR (Cont'd)**

**ELECTRONIC VOLT-OHM METER**

**NOTE:** Switches are shown in their maximum counterclockwise positions (S1 = 1.5 V, R X 1; S2 = "OFF"). For home construction of this or a similar circuit, the complete Kit RCA-WV-77E (K) or RCA-WV-98C (K) is recommended because of the large number of special components used.
RCA Technical Publications

on Electron Tubes, Semiconductor Products, Batteries, and Test and Measuring Equipment

Copies of the publications listed below may be obtained from your RCA distributor or from Commercial Engineering, Radio Corporation of America, Harrison, New Jersey.

Electron Tubes
- RCA ELECTRON TUBE HANDBOOK — III-3. Fivebinders, each 73/4" x 53/4" x 23/4." D, having gold-imprinted black covers. The "bible" of the industry — contains over 6000 pages of loose-leaf data and curves on RCA receiving tubes, transmitting tubes, cathode-ray tubes, picture tubes, photocells, phototubes, camera tubes, ignitrons, vacuum and gas rectifiers, magnetrons, traveling-wave tubes, vacuum tubes, and other miscellaneous types for special applications. Available on subscription basis. Price $20.00* including service for first year. Also available with RCA Semiconductor Products Handbook HB-10 at special combination price of $25.00.* Write to Commercial Engineering for descriptive flyer and order form.


- RCA TRANSMITTING TUBES — TT-5 (8¼" x 5¼") — 20 pages. Gives data on over 100 power tubes having plate-input ratings up to 5 kV and on associated rectifier tubes. Provides basic information on generic types, parts and materials, installation and application, and interpretation of data. Contains circuit diagrams for transmitting and industrial applications. Features lie-flat binding. Price $1.00.*

- RCA MAGNETRONS AND TRAVELING-WAVE TUBES — MT-301A (8½" x 8½") — 28 pages. Operating theory for magnetrons and traveling-wave tubes, application considerations, and techniques for measurement of electrical parameters. Price 60 cents.*

- RCA INTERCHANGEABILITY DIRECTORY OF FOREIGN VS. U.S.A. RECEIVING-TYPE ELECTRON TUBES — 1CE-197B (8½" x 10½") — 8 pages. Covers approximately 600 foreign tube types used principally in AM and FM radios, TV receivers, and audio amplifiers. Indicates U.S.A. direct replacement type or similar type if available. Price 10 cents.*

- RCA POWER TUBES — PM-301E (10¼" x 8½") — 46 pages. Technical information on 200 RCA vacuum power tubes, rectifier tubes, thyratrons, and ignitrons. Includes terminal connections. Price 75 cents.*

- RCA RECEIVING-TYPE TUBES FOR INDUSTRY AND COMMUNICATIONS — 1RC-104C (8½" x 8½") — 44 pages. Technical information on over 150 RCA "special red" tubes, premium tubes, vacuum tubes, photograph tubes, small thyratrons, low-microphone amplifier tubes, vacuum gauge tubes, mobile communications tubes, and other special types. Includes socket-connection diagrams. Price 35 cents.*

- RCA RECEIVING TUBES AND PICTURE TUBES — 1275-K (10¼" x 8¼") — 56 pages. New booklet contains classification chart, characteristics chart, and base and envelope connection diagrams on more than 1500 entertainment receiving tubes and picture tubes. Price 50 cents.*

- RCA INTERCHANGEABILITY DIRECTORY OF INDUSTRIAL-TYPE ELECTRON TUBES — ID-1024D (8½" x 9½") — 12 pages. Lists more than 1500 basic type designations for 20 classes of industrial tube types; shows the RCA Direct Replacement Type or the RCA Similar Type, when available. Price 35 cents.*

- RCA NUVISITOR TUBES FOR INDUSTRIAL AND MILITARY APPLICATIONS — 1CE-280 (8½" x 8½") — 16 pages. Describes unique features of nuvistors and includes tabular data, dimensional outlines, curves, terminal diagrams, and socket information. Price 25 cents.*

- RCA PHOTO AND IMAGE TUBES — 1CE-260 (10¼" x 8½") — 6 pages. Includes revised data on RCA multiplier phototubes, gas and vacuum photodiodes, and image-converter tubes. Features recommended multiplier phototubes and image-converter tubes and quick selection charts for phototubes. Includes response curves for photo and image tubes, sockets, and shields for phototubes, and dimensional outlines for photo and image tubes. Price 60 cents.*

- RCA STORAGE AND CATHODE-RAY TUBES — 1CE-270 (10¼" x 8½") — 12 pages. Includes technical data on RCA display-storage tubes, computer-storage tubes, scan-converter, radomes, oscillograph-type cathode-ray tubes, and special-purpose kinescopes including monoscopes, dissector types, monitor types, fly!-spot types, and view-finder types. Includes latest JEDEC "Kelley Chart" and descriptive material on the characteristics of phosphors used in RCA industrial tubes. Price 20 cents.*

- RCA MICROVACUUM TUBES AND PACKAGED SOLID-STATE DEVICES — 1CE-180E (10¼" x 8½") — 16 pages. Includes technical data on RCA solid-state devices, traveling-wave tubes, pencil tubes, integral-cavity pencil tubes, magnetrons, and solenoids for traveling-wave tubes. Single copy free on request.

- RCA PENCIL TUBES — 1CE-219 (10¼" x 8½") — 20 pages. Contains operating data for 15 different industrial tubes and phospor, spectral-energy emission curves, persistence curves, and quick-reference classification charts. Price 50 cents.*

- RCA PHOSPHORS — TPM-1506A (10¼" x 8½") — 48 pages. Contains instructions for the use of over 150 different industrial phosphors, spectral-energy emission curves, persistence curves, and quick-reference classification charts. Price 75 cents.*

- TECHNICAL BULLETINS — Authorized information on RCA transmitting tubes and other tubes for communications and industry. Be sure to mention tube-type bulletin desired. Single copy on any request free on request.

- TV SERVICING. Bulletin TVS-1080 (10¼" x 8½") — 48 pages. Contains articles on TV trouble shooting, TV tuner alignment, and TV circuit analysis by RCA's expert in the field of TV servicing and test equipment — John R. Meagher. Price 85 cents.*

- TV SERVICING, SUPPLEMENT 1. Bulletin TVS-1081 (10¼" x 8½") — 12-page booklet by John R. Meagher on solving trouble shooting problems in those hard-to-service television receivers known to service technicians as "ugly" sets or "dogs." Price 15 cents.*

Semiconductor Products
- RCA SEMICONDUCTOR PRODUCTS HANDBOOK — HB-10. Tubefinders, each 7¼" x 5½" x 2¼." D, having gold-imprinted red covers. Contains over 1000 pages of loose-leaf data and curves on RCA semiconductor devices such as transistors, silicon rectifiers, silicon controlled rectifiers, tunnel diodes, and tunnel rectifiers. Available on subscription basis. Price $10.00* including service for first year. Also available with RCA Electron Tube Handbook HB-3 at special combination price of $25.00.* Write to Commercial Engineering for descriptive flyer and order form.
RCA TRANSISTOR MANUAL—SC-10 (8¾" x 11¾")—304 pages. Contains detailed technical data on RCA semiconductor devices. Easy-to-read text includes basic theory, application, and installation of transistors, silicon rectifiers, and semiconductor diodes. Includes circuit diagrams and parts lists for many typical applications. Features lie-flat binding. Price $1.50.

RCA TUNNEL DIODE MANUAL—TD-30 (8¾" x 11¾")—60 pages. Describes the microwave and switching capabilities of tunnel diodes. Contains information on theory and characteristics, and on tunnel-diode applications in switching circuits and in microwave oscillator, converter, and amplifier circuits. Includes data for over 40 RCA germanium and gallium arsenide tunnel diodes and tunnel rectifiers. Price $1.50.

RCA SEMICONDUCTOR PRODUCTS GUIDE—60-S-16R5 (8¾" x 11¾")—12 pages. Contains application guide, index, and ratings and characteristics arranged for easy access to RCA's entire line of semiconductor products, as well as for microcircuits, memory products, and photocells. Single copy free on request.

RCA TRANSISTOR REPLACEMENT GUIDE—11L1115 (8¾" x 11¾")—36 pages. Contains RCA transistor and rectifier replacement data for more than 1000 portable radio receivers, tape recorders, and portable equipment of 145 manufacturers. Price 35 cents.

RCA SILICON RECTIFIER INTERCHANGEABILITY DIRECTORY—ICE-229A (10¾" x 8¼")—16 pages. Contains replacement information, ratings, characteristics, and physical dimensions for more than 400 silicon and selenium rectifiers. Price 25 cents.


RCA SILICON POWER TRANSISTORS APPLICATION GUIDE—ICE-215 (10¾" x 8¼")—28 pages. Describes outstanding features of RCA silicon power transistors and their use in many critical industrial and military applications. Includes construction details, discussion of voltage ratings, thermal stability conditions, and equivalent circuits for these transistors. Price 50 cents.

RCA SILICON VHF TRANSISTORS APPLICATION GUIDE—ICE-228 (10¾" x 8¼")—20 pages. Describes unique capabilities of RCA silicon vhf transistors and their use in military applications up to 300 Mc. Price 50 cents.

TECHNICAL BULLETINS—Authorized information on RCA semiconductor products. Be sure to mention type-number bulletin desired. Single copy on any type free on request.

Batteries

RCA BATTERIES—BAT-134F (10¾" x 8¼")—24 pages. Technical data on 113 Leclanché, alkaline, and mercury-type dry batteries, for radios, industrial applications, flashlights, lanterns, electronic toys, and for photoflash service. Price 35 cents.

RCA BATTERY MANUAL—BDG-111 (10¾" x 8¼")—64 pages. Contains information for the designer, application engineer, experimenter, and student 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 outlines, and terminal connections for each battery type. Price 50 cents.

RCA ALKALINE BATTERIES—ICE-237 (10¾" x 8¼")—2 pages. Contains technical data, curves, and dimensional outlines for 4 alkaline batteries in applications having a wide range of current drain requirements. No recovery period required; batteries have exceptionally long shelf life. Single copy free on request.

Test and Measuring Equipment

INSTRUCTION BOOKLETS—Illustrated instruction booklets, containing specifications, operating and maintenance data, application information, schematic diagrams, and replacement parts lists, are available for all RCA test instruments. Booklets for the following popular instruments are available at the prices indicated. Prices for booklets on other instruments are available on request.

WA-44A (Audio Signal Generator) .................. $0.50
WA-44C (Audio Oscillator) .................. 1.00
WE-93A ('Transistor Radio Dynamic Demonstrator Kit') .................. 0.25
WE-95A (VOM Dynamic Demonstrator Kit) .................. 0.10
WO-33A (Super-Portable Oscilloscope) ......... 1.00
WO-88A (5-in. Oscilloscope) .................. 0.50
WO-91A (5-in. Oscilloscope) .................. 1.00
WR-36A (Dot-Bar Generator) .................. 0.50
WR-46A (Video Dot/Crosshatch Generator) .................. 0.75
WR-49A (RF Signal Generator) .................. 0.50
WR-49B (RF Signal Generator) .................. 1.00
WR-50A (RF Signal Generator) .................. 1.00
WR-51A (Stereo FM Signal Simulator) .................. 1.00
WR-61B (Color-Bar Generator) .................. 1.00
WR-64A (Color-Bar/Color-Bar/Dot/ Crosshatch Generator) .................. 1.00
WR-67A (Test-Oscillator) .................. 0.25
WR-69A (Audio-FM Sweep Generator) .................. 1.00

WR-70A (RF-IF-VF Marker Adder) .................. 0.75
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19S-A (Volt-Ohm-Milliammeter) .................. 0.25
WT-100A (Electron-Tube MicroMinoMeter, Ser. No. 1001 and over) .................. 2.00
WT-100A (Tube Chart 1CE-168) .................. 3.00
WT-110A (Automatic Electron-Tube Tester) .................. 1.00
WT-110A (ICE-174 Card Punch Data) .................. 0.25
WT-110A (ICE-234 Card Punch Data) .................. 1.00

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*Optional List Price.