



RCA MANUFACTURING COMPANY, INC.

A RADIO CORPORATION OF AMERICA SUBSIDIARY

Harrison, New Jersey

RCA RADIOTRON
D I V I S I O N

APPLICATION NOTE No.58
April 15, 1936.

APPLICATION NOTE ON RECEIVER DESIGN

This note discusses briefly a variety of topics that relate to radio-receiver design. The material contains information on the characteristics of tubes and circuits; suggestions for the improvement of receiver performance are also offered.

Power Output Characteristics of the 6R7

(a) When the triode section of the 6R7 is operated as a Class A amplifier, an output of about 300 milliwatts at 6 per cent distortion can be obtained. This output was measured under the following conditions: Plate voltage, 250 volts; grid bias, -9 volts; a-c plate load, 8500 ohms; d-c plate load, nearly zero. These conditions are easily satisfied in practice, since the low plate impedance of this tube permits coupling it to the following tube by a transformer. Another desirable characteristic of the 6R7 is that power output and distortion are not critically dependent on plate load. Output measurements show that a decrease in load impedance from 20000 ohms to 6000 ohms produces an increase in power output from 260 to 275 milliwatts, respectively; the maximum output of about 300 milliwatts is obtained with a load of 8500 ohms. The distortion, which increases with decreasing load impedance, is 3 per cent with a 20000-ohm load and 8 per cent with a 6000-ohm load.

Voltage Rating of Tubes

(b) It is common practice to design the power-supply system of a radio receiver to deliver recommended maximum voltages to the plates and screens of the tubes at a specified line voltage. When the line voltage exceeds the specified value, the electrode voltages may rise high enough to shorten tube life appreciably. As a remedy, it is suggested that the equipment provide

Copyright, 1936, by
RCA Manufacturing Co., Inc.

AN-58-3-31-36



recommended heater voltage for a line voltage of 117 volts and maximum plate and screen voltages for a line voltage of 125 volts. The design of heaters is such that a rise in line voltage from 117 to 125 volts does not seriously reduce tube life.

Series-Filament Operation of 2-Volt Tubes

(c) Series-filament operation of the 2-volt series is recommended, provided certain precautions are taken to insure normal life performance. First, the filament circuit should be arranged so that removal of a single tube does not cause excessive rise in the filament voltage of the remaining tubes. Second, shunt resistors should be employed across certain filaments in order to by-pass the plate current flowing in the filament circuit.

(d) Some six-volt, series-filament receivers that employ mechanical B-supply units use a separate rectifier tube to obtain bias voltage for the output tube. When such a circuit arrangement is used, it is suggested that the filament of this rectifier be connected in series with that of the output tube. This arrangement insures that the output tube is inoperative when the rectifier is removed from the circuit. If this precaution is not observed, the plate current of the output tube may rise to an abnormally high value when the rectifier is removed from the circuit.

(e) The grid biases for certain tubes in most six-volt, series-filament receivers are obtained by connecting grid-return leads to appropriate points in the filament circuit. If the comparatively large plate current of the output tube flows through a filament circuit to which grid-return leads are connected, the potential of all these grid-return leads will vary in accordance with the plate current of the output tube. Thus, regeneration or degeneration may be present. To minimize the effects of this condition, the filament of the output tube should be connected in series with that of another tube whose input signal is large compared to the possible variation in bias. For example, the filament of the output tube should be connected in series with that of the final i-f amplifier tube. The filament of the second detector should be connected in series with that of the oscillator-mixer tube.

(f) By means of a suitable switching scheme, a receiver that employs the two-volt series of tubes can be designed to operate from several types of A- and B-voltage sources. For example, the switching scheme can easily permit series-filament operation from a six-volt storage battery or parallel-filament operation from a two-volt air cell. If B voltage is furnished by a mechanical B-supply unit, the switching scheme can also connect the grid-return leads to the proper points in the filament circuit in order to obtain bias. Thus, a single switching arrangement can provide for the operation of a receiver from either a six-volt storage battery and mechanical B-supply unit or a two-volt air cell and dry B and C batteries. Fig. 1 shows a plug-in switching scheme that has been installed in several receivers in order to facilitate operation from these typical voltage sources. The exclusive use of filament-type tubes will insure low power consumption, regardless of the source of filament power.

(g) Fig. 2 is the diagram of a simple a-v-c circuit that delays a-v-c action until the carrier voltage at the detector exceeds a certain value. This circuit uses the filament voltage of the 1B5 as the delay voltage; hence, no separate battery is required for delay purposes. When no signal is received, diode D_2 is positive with respect to the negative side of the filament; therefore, current flows through R_1 , R_2 , and the D_2 -filament circuit. When the carrier voltage at the detector exceeds $(E_1 + E_2)$, the a-v-c diode (D_2) does not conduct; the full a-v-c voltage is then applied to the controlled tubes. No a-v-c action occurs until the carrier voltage at the detector equals $(E_1 + E_2)$. The voltage drops across R_1 and R_2 must be considered when the bias applied to the controlled tubes is determined.

Rectifier-Tube Sputter

(h) If a close-spaced rectifier tube is connected between a power-supply line of low impedance and a condenser-input filter, the initial charging current of the first filter condenser may be high enough to damage the cathode of the tube. This effect is also present when plate voltage is applied repeatedly while the cathode is emitting electrons. To remedy this condition, it is necessary to limit the initial charging current to a safe value. A receiver that employs a power transformer is not subject to such rectifier-tube failures, because the leakage inductance and resistance of the usual power transformer is great enough to limit the initial charging current to a safe value. However, the effect is prevalent in 220-volt receivers that do not use transformers. The remedy in this case is to insert a 100-ohm resistor in series with each plate of the rectifier tube. This connection has the advantage of retaining the current-limiting action of 100 ohms of resistance for each half of the rectifier; yet, it produces the same line-voltage drop as only 50 ohms connected in a circuit that is common to both rectifier plates.

Increased Current Rating of the 6H6

(i) The direct-current output rating of the 6H6 has been increased to 4 milliamperes, maximum, for either full- or half-wave operation. The a-c voltage per plate remains at 100 volts (RMS), maximum. This higher current rating permits the use of the 6H6 in a wider variety of circuits than was heretofore possible. The use of this tube as a power rectifier to furnish a fixed C bias to a power amplifier is suggested.

SCHEMATIC CIRCUIT OF "UNIVERSAL" RECEIVER

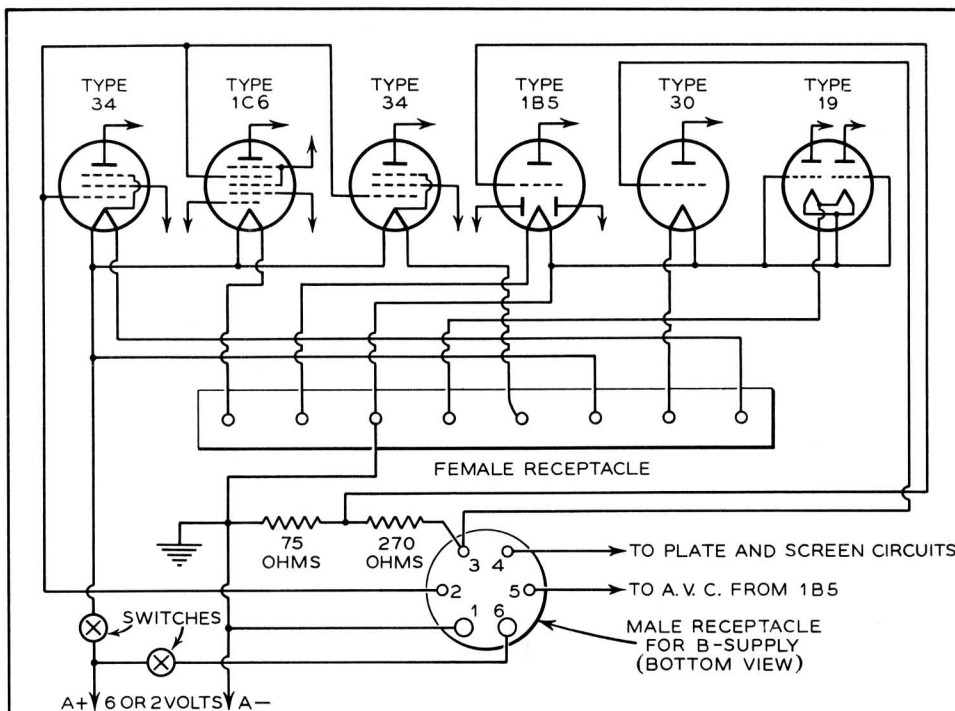
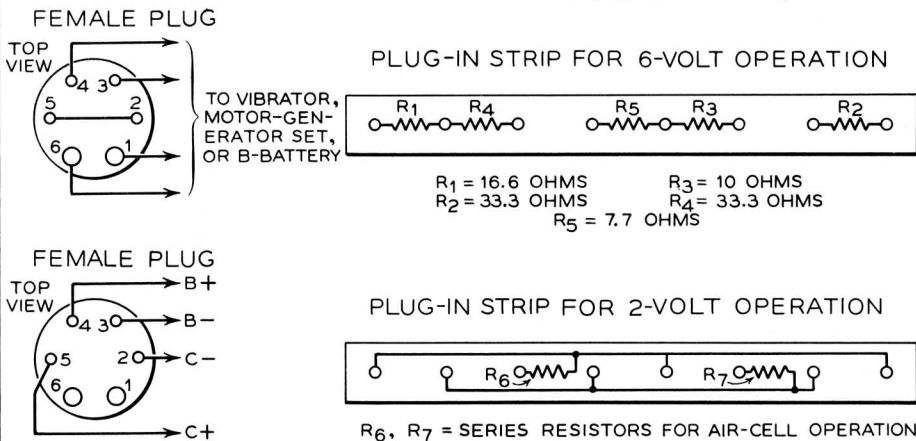


FIG. 1



DELAYED A.V.C. CIRCUIT USING TYPE 1B5

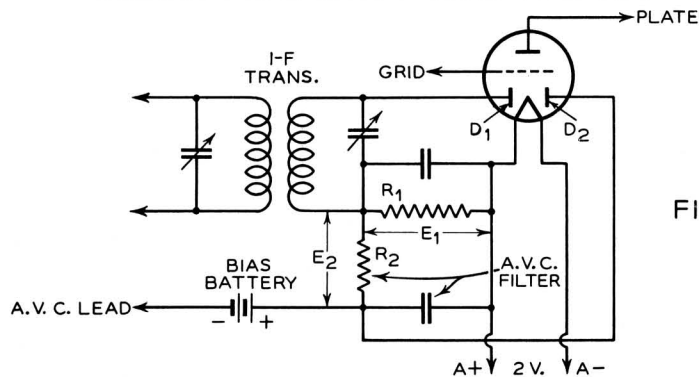


FIG. 2

The license extended to the purchaser of tubes appears in the License Notice accompanying them. Information contained herein is furnished without assuming any obligations.