RADIOTRONICS

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

BOX No. 2516BB, G.P.O., SYDNEY

TECHNICAL BULLETIN No. 95 15th FEBRUARY, 1939

In this issue:—

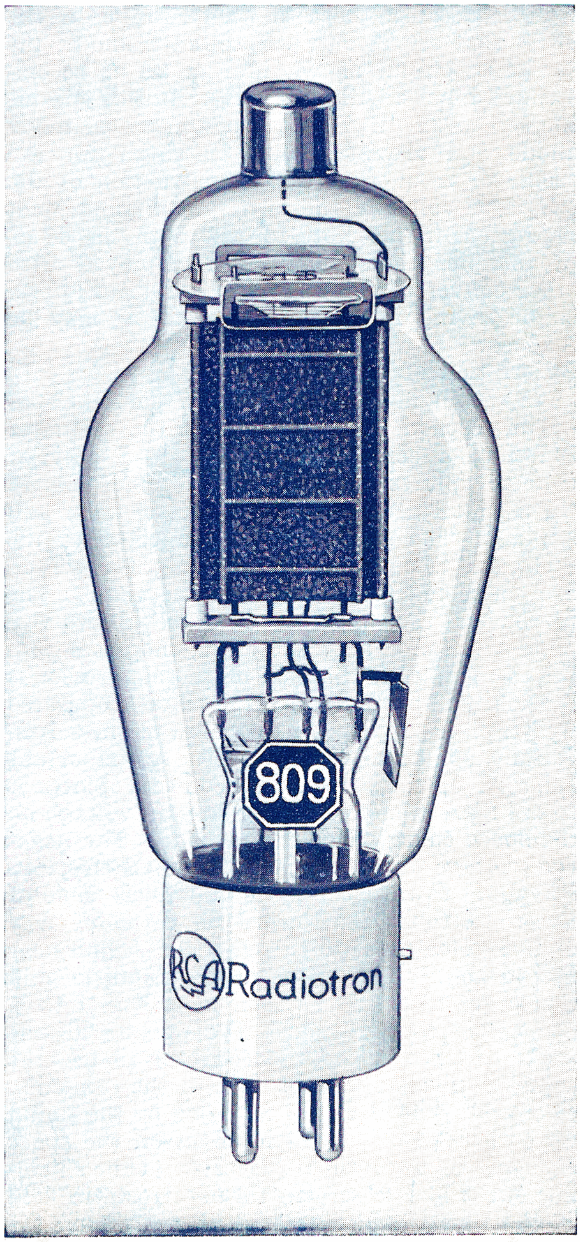
RADIOTRONS 809 AND 1623 TRANSMITTING TRIODES

25 WATTS PLATE DISSIPATION

The illustration in the adjoining column is of one of the most popular types for Experimental Transmitters. Since its initial release just over 12 months ago Radiotron 809 has been very widely applied and has proved its value by consistent service. Although suitable for use as a Class B audio amplifier with an output of up to 100 watts (2 valves), or as a linear Class B.R.F. amplifier with an output of 12.5 watts, or as a Class C amplifier with an output of 55 watts, the most popular application of the 809 is as a plate-modulated amplifier. In this service the 809 is particularly suited to transmitters operating with a plate input which is limited to 50 watts. An output of 38 watts is obtainable under these conditions with 600 volts on the plate.

Alternatively the 809 may be used with series modulation, 4 type 50 valves in parallel forming the modulator. The plate supply should be 1350 volts, the plate current 100 mA. and the cathode bias resistor 1700 ohms. The voltage across the 809 should then be 500 volts, giving a power input of 50 watts to the final stage, and a power output of 30 watts.

Radiotron 1623 is identical to type 809 except that the amplification factor is lower (20 in place of 50).



RCA APPLICATION NOTE

OPERATION OF RADIOTRON 6SA7

New Type of Converter Valve

The 6SA7 is a single-ended pentagrid converter designed to perform the functions of oscillator and mixer in all-wave receivers. Structurally, the 6SA7 differs from other converter valves in two important respects: (1) all electrodes including the signal grid terminate at base pins, and (2) there is no electrode which functions only as oscillator anode.

The single-ended construction employed in the 6SA7 effects an appreciable saving in installation cost because a flexible grid lead and top-cap connector are not required; in addition, the lead connecting to the signal-grid terminal of the socket can be made short and rigid. Because there is no electrode in the 6SA7 that serves only as oscillator anode, the oscillator circuit shown in Fig. 2A is recommended for use with this valve. In this circuit, the screen and the plate function as oscillator anode and are at ground potential for the oscillator frequency. The construction of the oscillator coil and the switching arrangement suggested in this Note for use with the 6SA7 are simpler than those often employed with other converter valves. As a result, an appreciable saving in coil and circuit cost may be realized.

Description of the 6SA7.

As shown in Fig. 1, the 6SA7 consists of a heater, cathode, a grid (G_1) for the oscillator function, a screen (G_2 and G_4), a pair of collector plates mounted on the side rods of G_2, a signal grid (G_3), a suppressor (G_5) and a plate. The suppressor is connected to the shell, and the two grids forming the screen are connected together inside the valve. The presence of the suppressor increases the valve's plate resistance and, therefore, increases conversion gain. This action of the suppressor is especially important when the valve is operated with a plate-supply voltage as low as the screen voltage, as in an ac-dc receiver. An important function of the screen and collector plates is to minimize the effect of signal-grid voltage on the space charge near the cathode. The negative voltage on the signal grid repels electrons travelling toward the plate and turns some of these electrons back toward the cathode. Any of these electrons which reach the region near the cathode affect space-charge conditions in this region. It can be seen from Fig. 1 that, because of the position of the signal-grid side rods with respect to the collector plates, the collector plates intercept most of the returning electrons. The electrons returned by the signal grid, therefore, have little effect on the space charge near the cathode. Because of the shielding effect of the screen, the electrostatic field of the signal grid also has little effect on the space charge. Thus, the collector plates and the screen serve to isolate the cathode space charge from the signal grid.

The result is that a change in signal-grid voltage produces little change in cathode current. Although a change in signal-grid voltage produces a change in plate current, this change is accompanied by an opposite and almost equal change in screen current. An r-f voltage on the signal grid, therefore, 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 little effect on the space charge near the cathode, changes in A.V.C. bias produce little change in oscillator transconductance and in the input capacitance of the No. 1 grid. There is, therefore, little detuning of the oscillator by A.V.C. bias.

Adjustment of the Oscillator Circuit.

In the circuit of Fig. 2A, the oscillator circuit provides peak plate current at the time when the oscillating voltage (E_k) on the cathode (with respect to ground) and the oscillating voltage (E_g) on the No. 1 grid are at their peak positive values. For maximum conversion transconductance, this peak value of plate current should be as large as possible. The effect on plate current of the positive voltage on the cathode is approximately the same as would be produced by an equal voltage, of negative sign, applied to the signal grid. Hence, the amplitude of oscillating voltage on the cathode limits the peak plate current. This amplitude should, therefore, be small.

During the negative portion of an oscillation cycle, the cathode may swing more negative than the signal grid. If this occurs, the signal grid will draw current unless the oscillator grid is sufficiently negative to cut off cathode current. This signal-grid current will develop a negative bias on the signal grid and may also cause a negative bias to be applied to the r-f and i-f stages through the A.V.C. system. As a result, sensitivity will be decreased. In order that signal-grid current should be prevented, the d-c bias developed on the oscillator grid should be not less than its cut-off value.

Because the peak plate current depends on how far positive the oscillator grid swings with respect to cathode, it is desirable that this positive swing be as large as possible. It follows that the oscillator grid-leak resistance should be low. This resistance, however, should not be so low as to cause excessive damping of the tank circuit. It has been found, for operation in frequency bands lower than approximately 6 megacycles, that all these requirements are generally best satisfied when the oscillator circuit is adjusted to provide, with recommended values of plate and screen voltage, a value of

RADIOTRON 6SA7 (Continued)

STRUCTURE AND SOCKET CONNECTIONS

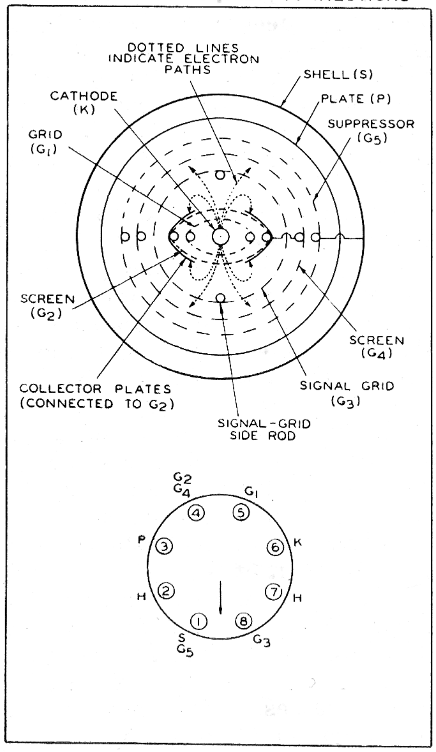


FIG. 1

CIRCUITS

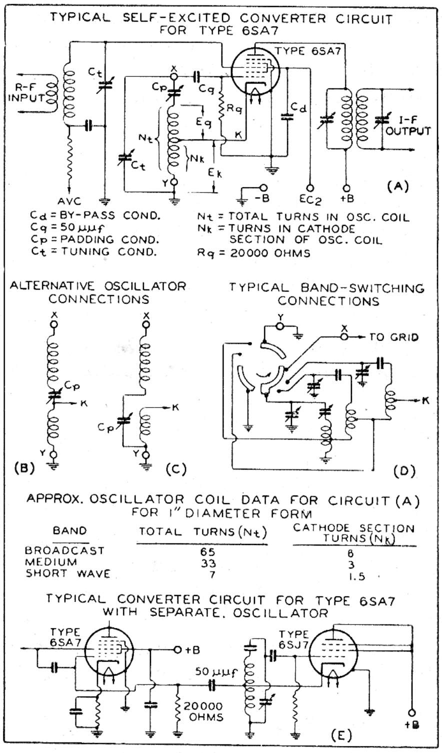


FIG. 2

OPERATION CHARACTERISTICS WITH SELF-EXCITATION

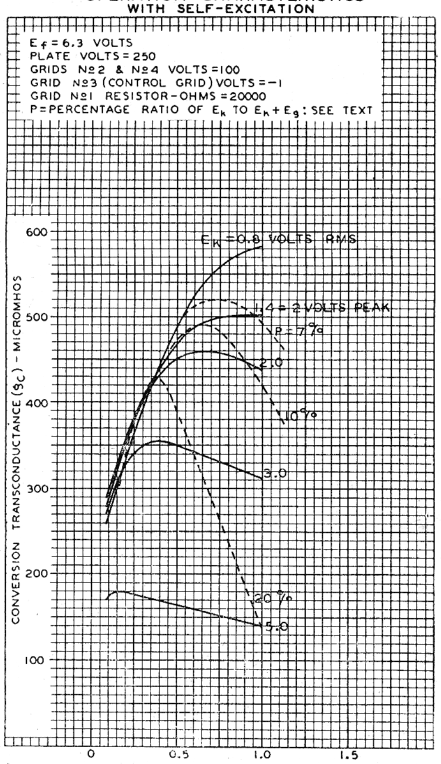


FIG. 3

OPERATION CHARACTERISTICS WITH SELF-EXCITATION

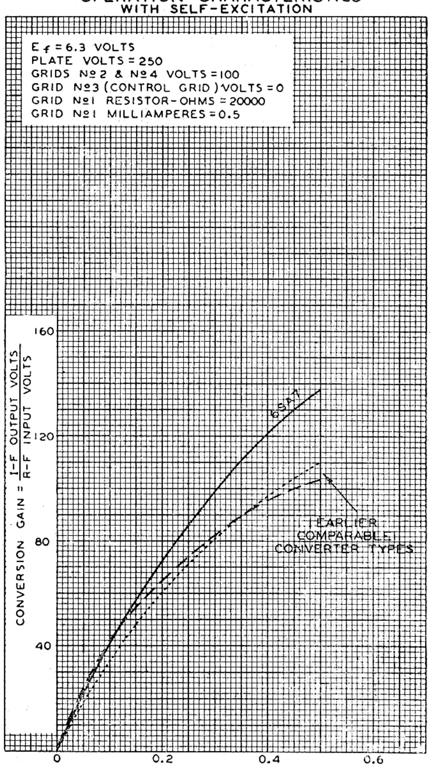


FIG. 4

RADIOTRON 6SA7 (Continued)

E_k of approximately 2 volts peak, and an oscillator-grid current of 0.5 milliampere through a grid-leak resistance (R_g) of 20000 ohms. With a 20000-ohm grid-leak resistance, the rectification efficiency of the No. 1 grid is approximately 0.7. Since the bias on this grid is 10 volts (0.5 milliampere x 20000 ohms), the peak value of E_g is approximately $10/0.7 = 14$ volts. With a 10-volt bias and a peak oscillator-grid voltage of 14 volts, the peak positive voltage of the oscillator grid with respect to cathode is 4 volts. If a higher value of R_g were used, the rectification efficiency would be higher; hence for the same value of E_g, the peak positive voltage of the oscillator grid with respect to cathode would be lower, and, therefore, the conversion transconductance would be lower.

In the low- and medium-frequency bands, the recommended oscillator conditions can be readily obtained. However, in the frequency band covering frequencies higher than approximately 6 megacycles, the tank-circuit impedance is generally so low that it is not easy to obtain these oscillator conditions, especially at the low-frequency end of the band. For optimum performance in this band, it is generally best to adjust the oscillator circuit for maximum conversion gain at the low-frequency end of the band. This method of adjustment has the disadvantage that, when the oscillator is tuned to the high-frequency end of the band, E_k will be greater than 2 volts peak and conversion gain will, therefore, be less than the maximum obtainable. However, this disadvantage is usually outweighed by the considerations that overexcitation at the high-frequency end of the band improves frequency stability, that some decrease in conversion gain at the high end of the band can be tolerated because the r-f tuned circuits have higher impedance at this end of the band, and that a good factor of safety is provided against the possibility of oscillation being stopped by a decrease in line voltage.

Maximum conversion gain at the low-frequency end of the high-frequency band is usually obtained by adjustment of the oscillator circuit to give a value of E_k of approximately 2 volts peak and an oscillator-grid current of 0.20 to 0.25 milliampere, with a grid leak of 20000 ohms. Because the oscillator-grid bias voltage developed under these conditions is less than the cut-off value, some signal-grid current may be observed. In tests which have been made on typical receivers, this signal-grid current and the resultant signal-grid bias have been small and have caused no difficulty.

The use of a valve voltmeter connected across the cathode coil is suggested as the simplest method of obtaining approximately optimum oscillator adjustments in all bands. Since the impedance of the 6SA7 cathode circuit is never very high, the requirements with respect to voltmeter input conductance and capacitance are not very severe; a diode with a 100000-ohm resistor and a microammeter would be satisfactory. Adjustment should be made for approximately 1.5 volts RMS at the low-frequency end of each band; when push-button circuits are used, the cathode voltage for each push-button position should be in the range from approximately 1 volt to 3 volts RMS for best results.

The curves of Fig. 3 show how conversion transconductance varies when oscillator-grid current changes with tuning or with circuit adjustment. The solid-line curves were taken with a-c voltages applied to the cathode (with reference to ground) and to the No. 1 grid (with reference to cathode) from an external generator. With the amplitude of cathode voltage fixed, the amplitude of voltage on the No. 1 grid was varied. The No. 1 grid voltage and cathode voltage were in phase, as they are in a self-excited oscillator circuit. The solid-line curves show conversion transconductance plotted against No. 1 grid (oscillator-grid) current for different fixed values of cathode voltage. These curves illustrate the desirability of having E_k not larger than about 2 volts peak. Larger values of E_k give reduced conversion transconductance. With lower values of E_k it is difficult to obtain strong oscillation. The dashed-line curves of Fig. 3 show conversion transconductance for different fixed values of $P = E_k/(E_k + E_g)$. Hence, the dashed-line curves show how conversion transconductance varies with grid current when the oscillator is self-excited with a fixed position of the cathode tap on the tank coil.

It should be noted that the curves of Fig. 3 obtain for $E_{c_3} = -1$ volt. An A.V.C. circuit applies approximately this value of bias to the signal grid at zero signal because of contact potentials. In a receiver, no other residual bias need be used.

Space-charge coupling between the No. 1 grid and signal grid is present in the 6SA7, as in other converter types. This coupling is due to the effect of No. 1 grid voltage on the space charge in the region of the signal grid. An important effect of space-charge coupling is to cause a voltage of oscillator frequency (f_o) to appear across the signal-grid circuit. This voltage is 180 degrees out of phase with the No. 1 grid voltage when f_o is greater than the signal frequency (f_s). Thus, in the usual receiver in which f_o is greater than f_s, the effective modulation of the signal-grid-to-plate transconductance by a voltage of oscillator frequency is reduced; the value of conversion transconductance, which is proportional to this modulation, is also reduced.

In many converter valve types, the effects of space-charge coupling can be reduced by connecting a small condenser between No. 1 grid and signal grid. Although this scheme

RADIOTRON 6SA7 (Continued)

FREQUENCY SHIFT IN TYPICAL RECEIVER
AT 18 MC-250 VOLT OPERATING CONDITIONS-
SELF-EXCITATION

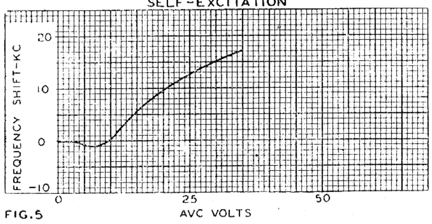


FIG.5

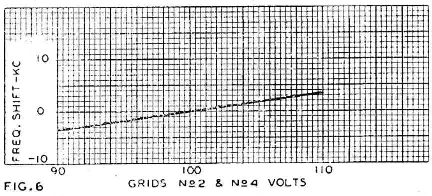


FIG.6

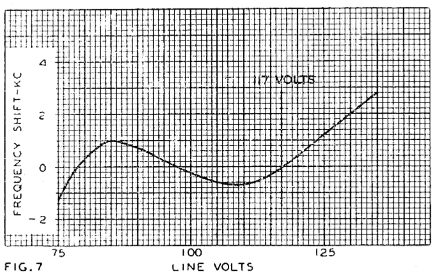


FIG.7

FREQUENCY SHIFT IN TYPICAL RECEIVER—
250-VOLT OPERATING CONDITIONS-
SELF-EXCITATION

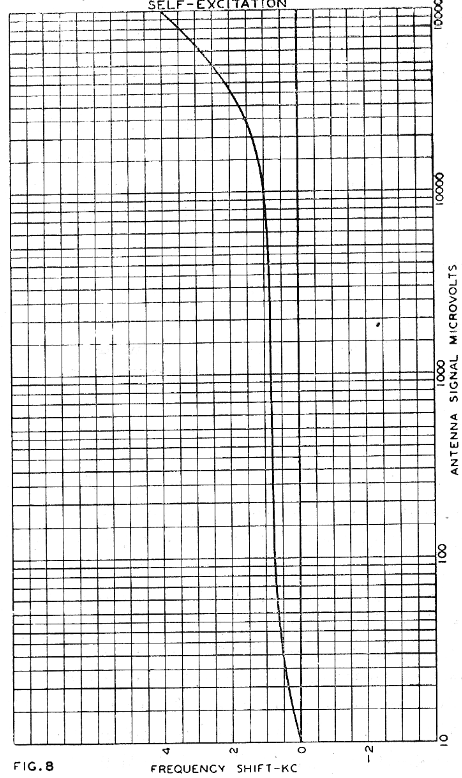


FIG.8

OPERATION CHARACTERISTIC
WITH SEPARATE OSCILLATOR EXCITATION

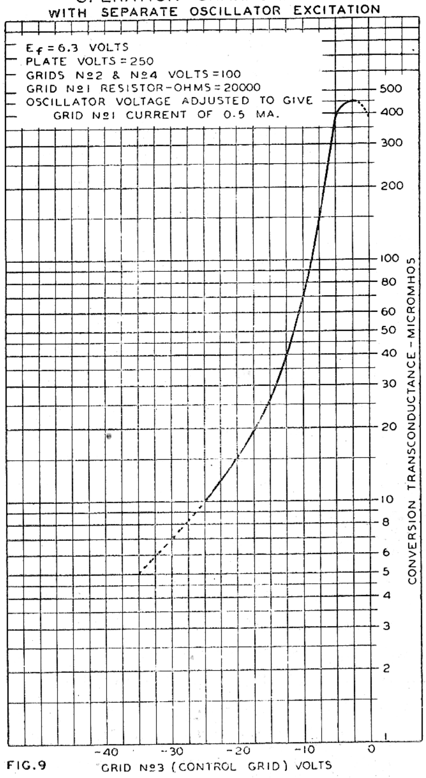


FIG.9

OPERATION CHARACTERISTICS
WITH SEPARATE OSCILLATOR EXCITATION

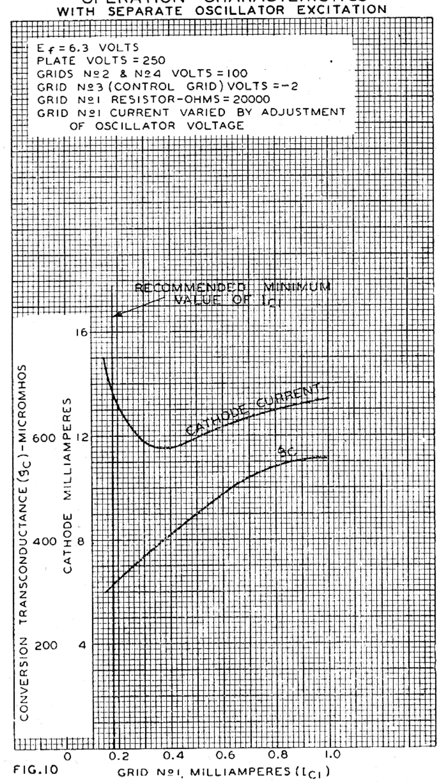


FIG.10

RADIOTRON 6SA7 (Continued)

reduces the voltage of oscillator frequency that appears across the signal-grid circuit, it is not recommended for use in self-excited circuits using the 6SA7. Tests in receivers with such a condenser show that: (1) sensitivity at frequencies in the region of 18 megacycles is not greatly improved, (2) the tendency to flutter increases, (3) frequency stability decreases, and (4) pull-in between signal and oscillator circuits increases. Because these undesirable effects are produced in self-excited circuits by capacitance between the No. 1 grid and signal grid, the direct interelectrode capacitance between these grids has been made small. The base pins are arranged so that stray circuit capacitance between these grids can also be made small.

When the oscillator frequency is higher than the signal frequency and intermediate frequency, as is usually the case, the impedance between cathode and ground has inductive reactance at signal frequency and at intermediate frequency. Any signal-frequency and intermediate-frequency components of cathode current, therefore, produce degenerative voltages across the cathode impedance. The signal-frequency and intermediate-frequency components of electron current in the cathode circuit are minimized by the screen and the collector plates, as previously explained. The intermediate-frequency charging current which flows through the plate-to-cathode capacitance is small because this capacitance has a low value. Similarly, the signal-frequency charging current which flows through the capacitance between signal grid and cathode is small. Hence, the total signal-frequency and intermediate-frequency currents flowing in the cathode circuit are small. Because the impedance between cathode and ground is not large, there is little degenerative voltage built up across this impedance. The slight amount of degeneration that does exist adds small values of positive conductance to the r-f input circuit and to the i-f output circuit. The total input conductance of the signal grid is the sum of this small positive conductance and the negative conductance due to transit-time effects.

The conversion transconductance of the 6SA7 for the 250-volt operating conditions is approximately 450 micromhos; the valve's plate resistance is approximately 0.8 megohm. The conversion gain, which is the ratio of i-f voltage across the plate load to r-f voltage input, is given by:

$$\text{Conversion Gain} = \frac{g_c r_p R_L}{r_p + R_L}$$

where g_c is the conversion transconductance of the valve, r_p is the plate resistance of the valve, and R_L is the resonant impedance of the i-f transformer measured across the primary terminals. The conversion gain for different values of R_L is shown by the solid-line curve of Fig. 4; conversion-gain curves of two earlier comparable converter types are also shown.

Frequency Shift.

In a converter valve used at high frequencies, it is desirable that changes in electrode voltages should not produce much effect on oscillator frequency. The curve of Fig. 5 shows the frequency shift produced in a 6SA7 at 18 megacycles by changes in A.V.C. voltage; the frequency shift is only about 5 kc for an A.V.C. voltage of 15 volts. Variations in screen voltage also produce only small effects on oscillator frequency, as shown by the curve of Fig. 6. In operation of a receiver, an observed value of frequency shift is due to simultaneous changes in a number of electrode voltages. Such changes occur, for example, when line voltage or when signal strength is changed. The relation between frequency shift and line voltage at 18 megacycles is shown by the curve of Fig. 7; the curve of Fig. 8 shows the relation between frequency shift and r-f input voltage at 18 megacycles. The data for Figs. 5 to 8 were taken in a commercial receiver of typical design. These curves may not apply to other receivers, but show that frequency shift is small for reasonable changes in line voltage or signal input.

Operation of the 6SA7 with a Separate Oscillator.

The 6SA7 may be used with a separate oscillator. A typical circuit for such operation is shown in Fig. 2E. With separate excitation, there is no oscillating voltage on the cathode. The amplitude of oscillation, therefore, can well be made higher than the amplitude used in self-excitation. As a result, somewhat higher conversion transconductance can be obtained with separate excitation than with self-excitation. When separate excitation is used, it may be desirable to neutralize the effects of space-charge coupling by connecting a small capacitance between the No. 1 grid and No. 3 grid, as shown in Fig. 2E.

The curves of Fig. 10 show conversion transconductance and cathode current vs. No. 1 grid current under separately excited conditions. The recommended minimum value of $I_{c_1} = 0.18$ milliampere is that at which the recommended maximum value of cathode current (14ma.) flows. The cut-off characteristic for separate excitation with 0.5 milliampere of No. 1 grid current is shown in Fig. 9. It can be seen from Fig. 9 that a –2 volt bias on the signal-grid gives greatest conversion transconductance under the conditions for which the curve was taken. Hence, when the 6SA7 is operated with separate excitation under these conditions, it is recommended that a minimum signal-grid bias of –2 volts be used. If the curve of Fig. 9 is moved 2 volts in the positive direction along the horizontal axis, the curve is very nearly

(continued on page 14)

RADIOTRON 6SA7 (Continued)

Tentative Characteristics and Ratings.

HEATER VOLTAGE (A.C. or D.C.)	6.3	Volts
HEATER CURRENT	0.3	Ampere
DIRECT INTERELECTRODE CAPACITANCES:—		
Grid #3 to All Other Electrodes (R–F Input) †	9.5	μμf
Plate to All Other Electrodes (Mixer Output) †	12	μμf
Grid #1 to All Other Electrodes †	7	μμf
Grid #3 to Plate †	0.13 max.	μμf
Grid #1 to Grid #3 †	0.15 max.	μμf
Grid #1 to Plate †	0.06 max.	μμf
Grid #1 to All Other Electrodes except Cathode	4.4	μμf
Grid #1 to Cathode	2.6	μμf
Cathode to All Other Electrodes except Grid #1	5	μμf
MAXIMUM OVERALL LENGTH	2–5/8"	
MAXIMUM DIAMETER	1–5/16"	
BASE	Small Wafer Octal 8-Pin	

Converter Service.

PLATE VOLTAGE	250 max.	Volts
GRIDS #2 & #4 VOLTAGE	100 max.	Volts
TOTAL CATHODE CURRENT	14 max.	Milliamperes

TYPICAL OPERATION:—

	Self-Excitation *		*Separate Excitation*		
Heater Voltage ‡	6.3	6.3	6.3	6.3	Volts
Plate Voltage	100	250	100	250	Volts
Grids #2 & #4 Voltage	100	100	100	100	Volts
Grid #3 (Control Grid) Voltage	0	0	–2	–2	Volts
Shell & Grid #5 Voltage	0	0	0	0	Volts
Grid #1 Resistor	20000	20000	20000	20000	Ohms
Plate Resistance (Approx.)	0.5	0.8	0.5	0.8	Megohm
Conversion Transcond.	425	450	425	450	Micromhos
Grid #3 Bias (Approx.) for Conversion Transconductance = 5 micromhos	–35	–35	–35	–35	Volts
Plate Current	3.2	3.4	3.2	3.4	Milliamperes
Grids #2 & #4 Current	8	8	8	8	Milliamperes
Grid #1 Current	0.5	0.5	0.5	0.5	Milliamperes

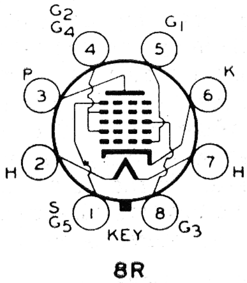
NOTE: The transconductance between Grid #1 and Grids #2 & #4 tied to plate (not oscillating) is approximately 4500 micromhos under the following conditions:

Grid #1, Grid #3, Grid #5 & Shell } at 0 volts

Grid #2 & #4, Plate } at 100 volts

† With shell connected to cathode.
* Characteristics values are approximate only and are shown for a Hartley circuit with a feedback of approximately 2 volts peak in the cathode circuit.
‡ In circuits where the cathode is not directly connected to the heater, the potential difference between heater and cathode should be kept as low as possible.

BOTTOM VIEW OF SOCKET CONNECTIONS FOR 6SA7



8R

Pin Connections.

Pin 1—Shell & Grid #5.
Pin 2—Heater.
Pin 3—Plate.
Pin 4—Grids #2 & #4.
Pin 5—Grid #1.
Pin 6—Cathode.
Pin 7—Heater.
Pin 8—Grid #3.

(Pin numbers are according to RMA system).

Mounting Position.

Vertical or Horizontal — No restrictions.

CATHODE RAY TUBES
DIRECTLY REPLACEABLE TYPES

Certain types of Cathode Ray Tubes differ only in the "Phosphor" material for the screen, and may be interchanged in an oscillograph or other equipment without any alteration. For general oscillographic purposes any Phosphor except No. 2 may be used. For long persistence images Phosphor No. 2 is required.

The following types are directly interchangeable, apart from the screen material:—

3in. electrostatic deflection: 906, 906-P4, 908, 910.

5in. electrostatic deflection: 905, 907, 909.

Special Reduced Prices.

Special reduced prices have been announced for the following types:—

	Australian Price
Radiotron 904	£15 0 0 nett
Radiotron 907	£15 0 0 nett
Radiotron 908	£5 0 0 nett
Radiotron 909	£15 0 0 nett

RADIOTRON 6SA7 (continued)

correct for the recommended self-excited conditions.

Suggested Circuits.

Alternative oscillator connections for the circuit of Fig. 2A are shown in Figs. 2B and 2C. In Fig. 2B, the tank current of the oscillator circuit flows through the cathode coil and contributes to grid-plate coupling; this contribution is not present in the circuit of Fig. 2C. These circuits are recommended when the series padding condenser is to be adjustable. Fig. 2B places this condenser at a small r-f potential, and is satisfactory in most cases. Fig. 2C permits grounding one side of the condenser. Typical wave-band switching connections for the oscillator circuit are shown in Fig. 2D. The optimum oscillator conditions for these circuits are approximately the same as those for Fig. 2A.

Operation of the 6SA7 with Reduced Screen Voltages.

In some applications, it may be desirable to operate the 6SA7 with a screen voltage less than 100 volts. Screen voltage can be made considerably less than 100 volts without excessive loss of conversion gain. For example, measurements on a typical receiver show that sensitivity is reduced only about 25% when the screen voltage of the 6SA7 is reduced from 100 volts to 70 volts. When the 6SA7 is operated with self-excitation and reduced screen voltage, the adjustment of feedback voltage on the cathode should be made so as to insure that oscillation will continue when line voltage is low.

RADIOTRON NEWS

Radiotron 2V3-G is a High Voltage Half-Wave Rectifier intended for use in equipment supplying high D-C voltages to cathode ray tubes and kinescopes. The filament is of tungsten, operating at 2.5 volts 5 amperes. The peak plate current is 12 mA. max., and the average plate current is 2 mA. max. The peak inverse voltage is 16,500 volts max. The 2V3-G is fitted with a medium metal cap and a small shell octal 6 pin base. Further information is available on request. Small quantities are expected to be available in March.

Radiotron 6SA7: See data elsewhere in this issue.

Radiotron 6SC7: See data elsewhere in this issue.

Radiotron 1803-P4 is a 12in. Kinescope* with electromagnetic deflection and producing a black and white picture.

Radiotron 1804-P4 is a 9in. Kinescope* with electromagnetic deflection and producing a black and white picture.

*A Kinescope is a Cathode Ray Tube suitable for use in Television reception. Both these Kinescopes may also be used for oscillographic purposes if so desired. These types are not normally available from stock. Additional technical information is available on request.

RADIOTRON 6SC7
SINGLE-ENDED TWIN TRIODE

Radiotron 6SC7 is a single-ended metal Twin-Triode intended primarily for phase inverter service. Inter-lead shielding between grid and heater within the base reduces hum voltage picked up by the grid lead from the heater leads.

The heater is rated at 6.3 V., 0.3 A. The maximum plate voltage is 250 volts, the amplification factor 70, plate resistance 53,000 ohms and mutual conductance 1325 μmhos, with a bias of –2 volts and plate current of 2 mA. for each unit.

As a resistance coupled amplifier each unit may be used to give a stage gain of 42 times at 5 volts R.M.S. output under the following conditions:—

Plate-Voltage Supply ..	300 volts
Plate Load Resistor ...	250,000 ohms
Following Grid Resistor	500,000 ohms
Cathode Resistor	1,675 ohms

The peak output when excited to the grid-current point is 55 volts.

A common cathode for both units is used in the 6SC7, as in its nearest equivalent, which is the 6N7 in the metal series or the 6N7-G in the G series. The amplification factor of the 6N7 or 6N7-G is, however, 35, compared with 70 for the 6SC7.

Published by The Wireless Press for Amalgamated Wireless Valve Co. Pty. Ltd.

RADIOTRON
OPERATING POSITION CHART

VALVE TYPE	RECOMMENDED OPERATING POSITION V = Vertical H = Horizontal	PIN POSITIONS FOR HORIZONTAL OPERATION (RMA Base-Pin Numbering)	
		V-Plane	H-Plane
* 00-A, 01-A	V	—	—
• OA4-G	V and H	No restrictions	No restrictions
* 1A4-P	V and H	Pins 1 and 4	—
* 1A5-G, 1A7-G	V	—	—
* 1A6	V and H	Pins 1 and 6	—
* 1B4-P	V and H	Pins 1 and 4	—
* 1B5/25S	V and H	Pins 1 and 6	—
* 1C4	V and H	Pins 1 and 4	—
* 1C5-G	V	—	—
* 1C6	V and H	Pins 1 and 6	—
* 1C7-G	V and H	Pins 2 and 7	—
* 1D4	V and H	Pins 1 and 5	—
* 1D5-GP, 1D7-G, 1E5-GP, 1E7-G	V and H	Pins 2 and 7	—
* 1F4	V and H	Pins 1 and 5	—
* 1F5-G	V and H	Pins 2 and 7	—
* 1F6	V and H	Pins 1 and 6	—
* 1F7-GV, 1G5-G, 1H4-G	V and H	Pins 2 and 7	—
* 1H5-G	V	—	—
* 1H6-G	V and H	Pins 2 and 7	—
* 1J6-G	V and H	Pins 1 and 4	—
* 1K4	V and H	Pins 1 and 4	—
* 1K5-G	V and H	Pins 2 and 7	—
* 1K6	V and H	Pins 1 and 6	—
* 1K7-G, 1L5-G, 1M5-G	V and H	Pins 2 and 7	—
* 1N5-G	V	—	—
1-V	V and H	No restrictions	No restrictions
* 2A3	V and H	—	Pins 1 and 4 (in new equipment)
2A5, 2A6, 2A7, 2B7	V and H	No restrictions	No restrictions
* 2V3-G	V	—	—
* 5T4	V and H	Pins 2 and 4	—
* 5U4-G	V and H	—	Pins 2 and 7
5V4-G	V and H	No restrictions	No restrictions
* 5W4	V and H	Pins 2 and 8	—
* 5X4-G, 5Y3-G, 5Y4-G	V and H	—	Pins 2 and 7
* 5Z3	V and H	—	Pins 1 and 4
5Z4	V and H	No restrictions	No restrictions

Issued by Amalgamated Wireless Valve Co. Pty. Ltd.

RADIOTRON OPERATING POSITION CHART (Continued)

VALVE TYPE	RECOMMENDED OPERATING POSITION V = Vertical H = Horizontal	PIN POSITIONS FOR HORIZONTAL OPERATION (RMA Base-Pin Numbering)	
		V-Plane	H-Plane
* 6A4	V and H	Pins 1 and 5	—
6A6, 6A7, 6A8, 6A8-G, 6AC5-G, 6AF6-G, 6B7, 6B7S, 6B8, 6B8-G, 6C5, 6C5-G, 6C6, 6C8-G, 6D6, 6D8-G, 6E5, 6F5, 6F5-G, 6F6, 6F6-G, 6F7, 6F8-G, 6G5, 6G6-G, 6G8-G, 6H6, 6H6-G, 6J5, 6J5-G, 6J7, 6J7-G, 6J8-G, 6K5-G, 6K6-G, 6K7, 6K7-G, 6K8, 6L5-G, 6L6, 6L6-G, 6L7, 6L7-G, 6N5, 6N7, 6N7-G, 6Q7, 6Q7-G, 6R7, 6R7-G, 6S7, 6S7-G, 6SA7, 6SC7, 6SF5, 6SJ7, 6SK7, 6SQ7, 6T7-G, 6U5, 6U5/6G5, 6U7-G, 6V6, 6V6-G	V and H	No restrictions	No restrictions
6X5	V and H	—	Pins 3 and 5
6X5-G	V and H	No restrictions	No restrictions
6Y6-G	V and H	Pins 2 and 7	—
6Z7-G, 6ZY5-G	V and H	No restrictions	No restrictions
* 10, 11, 12	V	—	—
12A7, 12Z3	V and H	No restrictions	No restrictions
15	V and H	No restrictions	No restrictions
* 19	V and H	—	Pins 1 and 6
* 20, 22	V	—	—
24-A	V and H	No restrictions	No restrictions
25A6, 25A6-G, 25A7-G, 25B6-G, 25L6, 25L6-G, 25Z5, 25Z6, 25Z6-G	V and H	No restrictions	No restrictions
* 26	V	—	—
27	V and H	No restrictions	No restrictions
* 30, 31, 32	V and H	Pins 1 and 4	—
* 33	V	—	—
* 34	V and H	Pins 1 and 4	—
35, 36, 37, 38, 39/44	V and H	No restrictions	No restrictions
* 40	V	—	—
41, 42, 43	V and H	No restrictions	No restrictions
* 45	V and H	Pins 1 and 4	—
* 46, 47	V and H	Pins 1 and 5	—
48	V and H	Pins 2 and 5	—
* 49, 50	V	—	—
53, 55, 56, 57, 58, 59	V and H	No restrictions	No restrictions
* 71-A	V	—	—
75, 76, 77, 78, 79	V and H	No restrictions	No restrictions
* 80	V and H	—	Pins 1 and 4
* 81, 82, 83	V	—	—
83-V, 84/6Z4, 85, 89	V and H	No restrictions	No restrictions
* 99, 112-A	V	—	—

* Indicates that valves have a filament; no asterisk indicates that valves have heater and cathode.
● Cold cathode, gas type.
Bantam valves carry the suffix -GT, but have the same operating positions as the -G types
Vertical includes the up-side-down position.

THE NATIONAL ELECTRICAL & ENGINEERING CO. LTD.

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RADIO

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