NUMBER 135

Radiotronics

JANUARY-FEBRUARY 1949

Illustrating one stage during the exhausting of an Australian-made type 833-A Radiotron transmitting valve. The electrodes are being heated to incandescence by passing radio frequency current through a coil which is placed around the valve.

It is joined by means of an exhaust tube to high vacuum pumps which remove gases driven off by the high temperature treatment. The operator is shown reading electrode temperatures with an optical pyrometer.

CIRCUIT DESIGN PRECAUTIONS TO PREVENT INTERNAL ARCS FROM DAMAGING KINESCOPES

R.C.A. application note AN-128; reprinted by courtesy of the Radio Corporation of America.

Because kinescopes operate at relatively high voltages and low currents, they are most efficiently used with highly specialized power supplies usually having limited current capabilities. For this reason, it is generally feasible to design television cathode-ray tubes with a lower factor of safety against surges and over-voltages than is required in other high-voltage apparatus. When the stored energy available is low and the peak current is adequately limited, an internal arc in a cathode-ray tube clears quickly and does not damage the tube. When the current and energy of the power supply are not limited, the desired protection may be provided either by utilizing a series resistor which limits the maximum possible peak current to a safe value, or by restricting the storage of energy in the bypass or filter circuit to a maximum value of 250 microcoulombs.

If the stored energy in the filter capacitance of the power supply exceeds 250 microcoulombs, it is recommended that the power supply be designed to limit the peak instantaneous short-circuit current to one ampere. The stored energy or change is given by the relation Q = CE where Q is the charge in microcoulombs, C is the capacitance in microfarads, and E is the voltage in volts. In order to limit the peak electrode current to one ampere, it is recommended that the resistance in the circuit between each electrode (grid No. 1, grid No. 2, anode No. 1, and anode No. 2) and the output capacitor of the power supply be not less than the minimum value given in Table I. If CE is 250 microcoulombs or less, the limiting resistance may be omitted, although the use of such a resistance provides an additional safety factor.

To prevent damage to the heater and cathode when the tube arcs internally a further precaution is necessary. An arc in a cathode-ray tube is usually initiated between the high-voltage anode and an adjacent electrode which is exposed to a high voltage gradient. This arc may then transfer to other electrodes because of ionized gas. Electrodes with high impedances in their external circuits may not sustain the arc because the voltage drop is transferred to the impedance; but, nevertheless, a voltage high enough to break down internal insulation may be produced. The heater insulation is particularly subject to this type of failure. Furthermore, when an arc forms between heater and cathode, the added heat due to the arc may cause the heater to burn out or short to the cathode.

In order to minimize the possibility of burning out the heater or of causing a short circuit, it is recommended that the heater be connected directly to the cathode whenever possible. If it is not possible to

(Continued on next column)

Radiotronics

NUMBER 135 **JAN.-FEB. 1949**

A Radiotron technical release published in Sydney, N.S.W., by Amalgamated Wireless Valve Company Pty. Ltd.

Technical Editor
F. Langford-Smith, B.Sc., B.E., Senior Member IRE
Asst. Tech. Editor
I. C. Hansen, Member IRE

All communications should be directed in Australia to Amalgamated Wireless Valve Co. Pty. Ltd., (Sales Promotion Department), 47 York Street, Sydney, N.S.W.
In New Zealand to — Amalgamated Wireless (Australasia) Ltd., P.O. Box 830, Wellington, C1, N.Z.

CONTENTS of this ISSUE

Radiotronics is published six times a year as part of "Radiotron technical publishing Service" for which the annual (January-December) mailing fee is 6/-.

Wholly set up and printed by Cloister Press (D. & W. Short), Redfern, N. S. W.

connect the heater and cathode because of circuit design considerations, precautions must be taken to make sure that heater-cathode voltage does not exceed the maximum value shown in the tube data even for the condition of arc-over between anode and cathode.

TABLE I.—Minimum Values of Resistance Between Indicated Electrode and Output Capacitor.

Electrode	5TP4	7DP4	7JP4	10BP4
Grid No. 1	180	150	220	150 ohms
Grid No. 2	390	450	—	470 ohms
Anode No. 1	6800	2700	3000	11000 ohms
Anode No. 2	30000	9100	6800	— ohms

Two Dual Wave Receivers Using A.C. Miniature Valves — Radiotron Receivers RC43 and RC54

By G. THORNE (Applications Laboratory)

The new range of miniature A.C. valves permits several useful design features. An appreciable reduction in chassis size can be made, particularly if associated components of miniature design are available. This feature is a real advantage in the manufacture of mantel and car-radio receivers.

In the article we describe two receiver circuits designed around the miniature A.C. series, which may be taken as illustrative of good commercial practice.

Because of the high mutual conductance of these valves it is necessary to use low dynamic impedance I.F. transformers to obtain the maximum stage gain consistent with stability. As a consequence of the high mutual conductance, there is a considerable variation in input capacitance, the effects of which can be made negligible by the use of a high tuning capacitance in the first I.F. transformer. Both these requirements can be satisfied easily and economically with the use of low LC ratio I.F. transformers.

Such transformers are attractive from the viewpoint of manufacturing cost, requiring approximately half the number of turns used on a standard I.F. transformer tuned with 80 μμF tuning capacitance.

The transformers finally selected were tuned with 200 μμF capacitors and were of the type having pies two per winding. Full details are shown in the coil data section.

In passing we would mention that two other types of I.F. transformers were tested with the miniature valves and discarded because of the disadvantages noted below.

The first of these was the use of standard cheap I.F. transformers, i.e. those having a high impedance but low Q of the order of 70. This type produced reasonable stage gain, but poor selectivity.

The second type was the better class of standard I.F. transformer which possessed high Q values (greater than 100) and high impedance. Whilst the higher Q corrected the selectivity disadvantage of the previous type, it was found impossible to reduce the stage gain within useable limits. Regeneration made itself apparent in the asymmetrical selectivity response curve and would have necessitated the use of special methods involving neutralization and negative feedback in order to correct this fault.

Description of Circuit

Reduced gain and plate current in the R.F. stage of the receiver are obtained by means of a 500 ohm cathode bias, resistor, suitably bypassed.

A trace of flutter at the extreme high frequency end of the short wave band was eliminated by feeding the 6BE6 screen directly from the cathode of the rectifier and stabilizing the screen voltage with an 8 μF capacitor. The .05 μF screen bypass capacitance was retained to ensure efficient bypassing for radio frequencies.

The *oscillator coil* used for the broadcast band is one commercially available for use with the 6SA7-GT valve. In order to determine optimum *oscillator* operation, the oscillator voltage between cathode and earth, and also the oscillator grid current at the earthed end of the oscillator grid resistor, were measured. It was found necessary to remove turns from the earthy end of the coil to secure correct operating conditions for the 6BE6.

Shielding provided by the internal shields of the 6BA6 and 6BE6 valves was found to be quite adequate in both receivers when a type of socket having a short attached shield was used. Note that the tubular metal insert in the miniature socket should always be earthed, as it forms part of the shielding system.

It will be noted that the A.V.C. diode is connected by a small capacitor to the detector diode in these circuits. This was used rather than the alternative connection from the plate of the I.F. amplifier because of the undesirable increase of coupling factor introduced by "top capacitance" coupling from primary to secondary through the high value of capacitance between the two diodes.

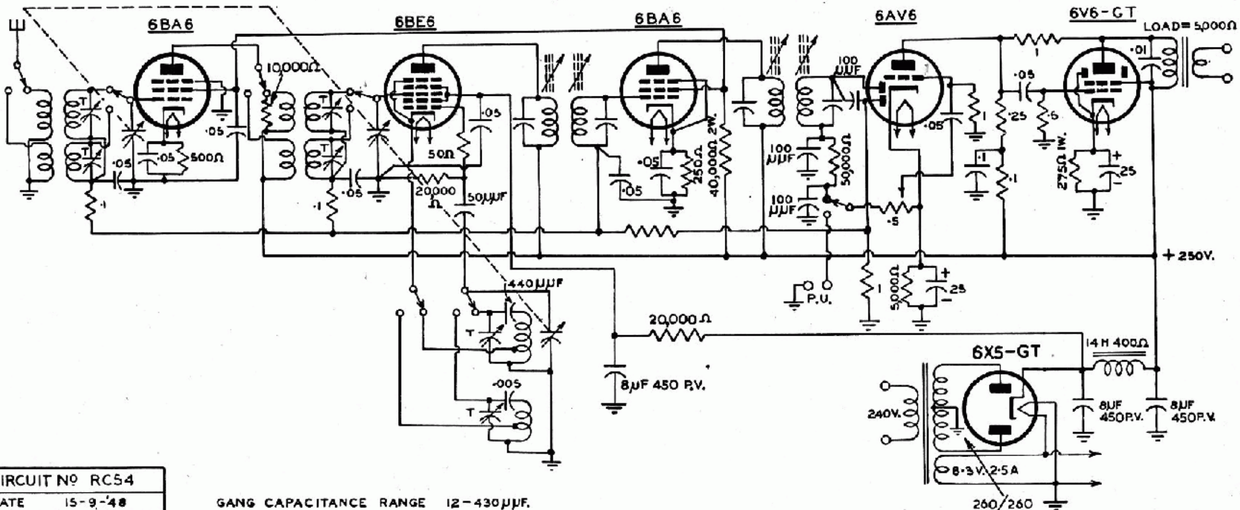
A simple arrangement is used to provide about 7 db of negative feedback in the audio section of the six valve receiver. This gives a useful improvement in audio frequency response which can be observed from the performance figures.

Full gain of the I.F. amplifier is not utilized in the six valve version, the cathode resistor of 250 ohms producing a bias voltage of 1.85 V with 85V applied to the screen; the I.F. sensitivity of 34μV into the converter grid was considered ample. With both 6BA6's operating under these conditions, the reduction in total current permits the use of a 6X5-GT rectifier, which in turn permits a simplified power transformer construction, a separate heater winding for the rectifier being unnecessary.

R.F. Amplifier

With the use of a standard B/C R.F. transformer having a high impedance primary, it was found necessary to shunt this winding with a 10,000 ohm resistor to provide the desired stage gain of about 40. This of course has an adverse effect on the R.F. selectivity but the overall selectivity response curves are representative of normal commercial

RADIOTRONIC 6 VALVE DUAL-WAVE RECEIVER RC54.



CIRCUIT Nº RC54	
DATE	15-9-'48
DRAWN	J.C.M.
CHECK	R.a.

GANG CAPACITANCE RANGE 12–430μμF.
TRIMMER CAPACITANCE RANGE 1–25μμF.
ALL RESISTORS 1/3 WATT UNLESS OTHERWISE MARKED.

practice. This damping method, in addition to permitting the use of standard coils, has another advantage in that it damps down the primary coil resonance.

On the broadcast band in the RC54, the "sensitivity" varies from 0.2 to 0.25 μV, but for equal signal and noise outputs, the useful sensitivity is slightly over 1μV. The high sensitivity on the broadcast band, although causing noise when tuning between stations with no signal input, does not affect the noise level when tuned to a carrier under normal conditions. Under these conditions the noise level is quite low, as would be expected from the high gain R.F. stage ahead of the converter. In any case the full sensitivity of the receiver on the broadcast band is rarely reached, owing to the close frequency spacing of stations and the operation of the A.V.C. which commences to function considerably off resonance with any powerful station.

On the short-wave band the full sensitivity of this receiver may be utilized and it varies from 0.7 to 2.1 μV over the band.

Oscillator Drift with change of signal input is negligible on the broadcast band and within commercial practice limits on the short-wave band. As can be observed from the figures given, even a large fluctuation in a short wave signal would not produce a frequency shift in excess of 2 Kc/s.

Coil Data RC43 and RC54

Intermediate Frequency Transformers
Each winding (primary and secondary):
7/16" former, two pie windings, slug tuned.
9/41 litz wire, honeycomb wound.
92 turns on each pie, i.e. 184 turns per winding.
Tuned with 200 μμF capacitor
Q of each winding = 117 approx. (unloaded).
$R_D = \omega_0 LQ = 200{,}000$ ohms.
$K_{crit} = 1/Q = .00854$.
(Coupling of transformer external to receiver will be referred to as K')

$$K' \; IF_1 = 80\% \; K_{crit} = .00683$$

$$K' = K_{crit}\sqrt{\frac{Q_1 - Q_2}{Q_2}}$$

Reference Radiotronics 128

$$Q_2 = \frac{Q_1}{1+\beta} \text{ where } \beta = \left(\frac{K'}{K_{crit}}\right)^2$$

$$Q_2 = 117/1.6 = 74.$$

Optimum coupling of IF_1 was obtained by means of a Q meter, K being adjusted for a Q_2 value of 74. This procedure resulted in an inside spacing between windings of ¾". The physical position of the I.F. tuning capacitance (200 μμF) was found to have a pronounced effect on the Q of the windings, and care was taken to mount these capacitors as far as possible from the windings.

The loading effect on the second transformer I.F. of the diode and diode load effectively reduces both Q and R_D, thus increasing K_{crit}. As a result it was found necessary to increase the coupling in IF_2, a spacing of ⅜" corresponding to an unloaded K' of 97% K_{crit} being found satisfactory. Universal Selectivity curves were used for determining optimum coupling in the case of IF_2, since it was found difficult to reproduce accurately the loading effects on IF_2 when the transformer was adjusted externally to the receiver, for values of Q_2 corresponding to optimum coupling.

Broadcast Band:

Aerial and R.F. Coils: Aegis "Permaclad" Slug tuned.

Oscillator:

Former: 7/16".
Winding: Single pie honeycomb wound.
Shield Can: 1 7/16" dia. round. Slug ⅜" x ½".
Padder: 440 μμF.
Turns: 78½ turns tapped at 5½ turns from inside of winding. Winding width 1/16" to tap, then ⅛" overlapping tapping.

Tracking Points:

600 Kc/s; 1000 Kc/s; 1400 Kc/s.

Short Wave Band:

All formers ¾" diam. grooved 16 T.P.I. Coils unshielded. Tuned with slugs ⅜" in diam. ½" long.

Aerial Coil:

Primary—1.8 turns 34 A.W.G. (B&S) enam. interwound from bottom end of secondary.
Secondary—10 turns 24 S.W.G. enam. wound in groove 16 T.P.I.

R.F. Coil:

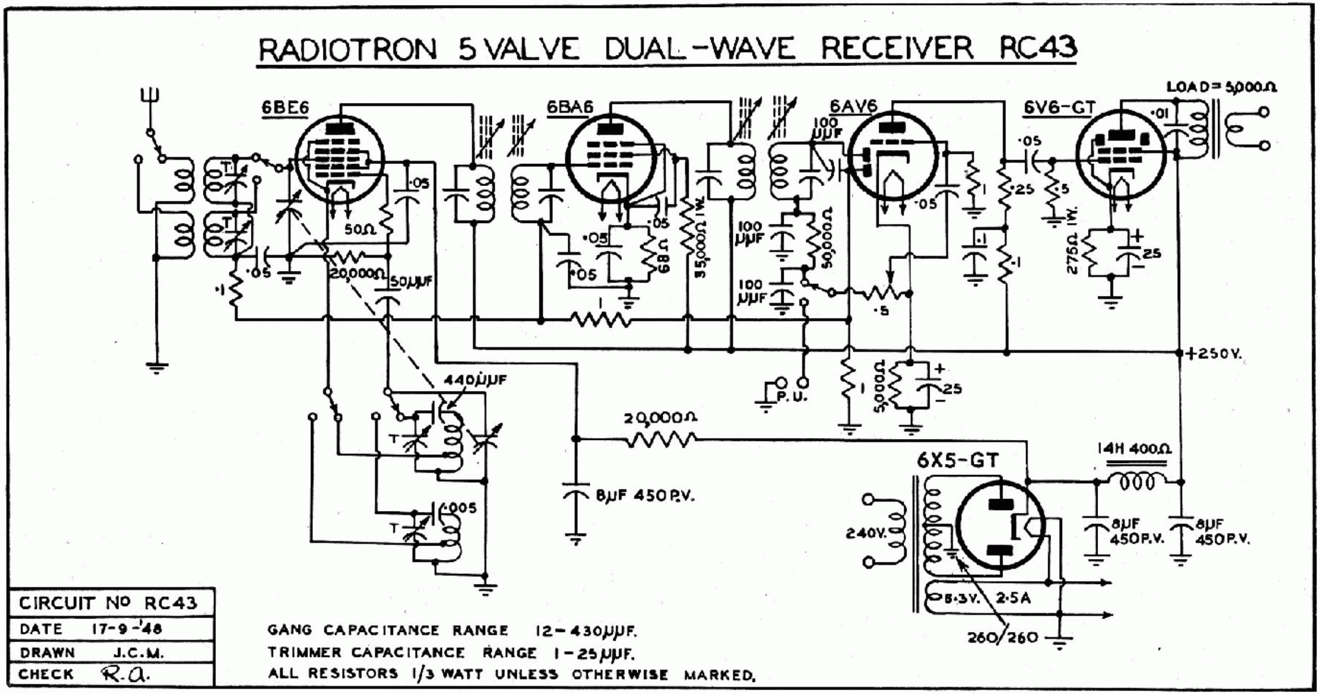
Primary—5.8 turns 34 A.W.G. (B&S) interwound from bottom end of secondary.
Secondary—Same as Aerial Coil.

Oscillator Coil:

Total Coil—8.4 turns 24 S.W.G. enam. tapped 1.2 turns from bottom.
Padder—0.005 μF.
Tracking Points—6.5 Mc/s. 11.0 Mc/s. 17.0 Mc/s.
Gang Condenser—A.W.A.

Frequency Coverage:

Broadcast—540 - 1600 Kc/s.
S/W Band—6 Mc/s — 18.2 Mc/s.


RADIOTRON 5 VALVE DUAL-WAVE RECEIVER RC43
6BE6
6BA6
6AV6
6V6-GT
6X5-GT
LOAD = 5,000Ω
+250V.
440μμF
·005
20,000Ω
8μF 450P.V.
14H 400Ω
8μF 450P.V.
8μF 450P.V.
240V.
6·3V. 2·5A
260/260
P.U.
50Ω
20,000Ω
50μμF
68Ω
35,000Ω 1W.
100 μμF
50,000Ω
5,000Ω
275Ω
·5 1W.
CIRCUIT No RC43
DATE 17-9-'48
DRAWN J.C.M.
CHECK R.a.
GANG CAPACITANCE RANGE 12-430μμF.
TRIMMER CAPACITANCE RANGE 1-25μμF.
ALL RESISTORS 1/3 WATT UNLESS OTHERWISE MARKED.

OSCILLATOR PERFORMANCE RC43 AND RC54

Frequency	E_K	I_{C1}
540 Kc/s	1.35 V R.M.S.	370 µA
1000 Kc/s	1.05 V R.M.S.	420 µA
1600 Kc/s	0.87 V R.M.S.	410 µA
6 Mc/s	0.85 V R.M.S.	220 µA
11 Mc/s	1.1 V R.M.S.	290 µA
18.2 Mc/s	0.95 V R.M.S.	200 µA

E_K measured with valve voltmeter connected between cathode and ground of 6BE6.

I_{C1} measured with milliameter connected between earthed end of grid resistor and ground.

OSCILLATOR SHIFT RC54 AT 11 MC/S

Input	Frequency Shift
1 µV	0
10 µV	0
100 µV	0
1 mV	0.65 Kc/s
10 mV	2.6 Kc/s
100 mV	3.9 Kc/s

OSCILLATOR SHIFT RC43 AT 11 MC/S

Input	Frequency Shift
1 µV	0
10 µV	0
100 µV	20 c/s
1 mV	0.85 Kc/s
10 mV	2.0 Kc/s
100 mV	3.2 Kc/s

A.V.C. CHARACTERISTIC — RC54

Input to Aerial at 1000 Kc/s

Input	Output (Odb = 0.6 W)	AVC Volts
3 µV	− 6.5 db	0.4 V
10 µV	+ 10.4 db	1.15 V
30 µV	+ 12.3 db	1.8 V
100 µV	+ 14.2 db	2.7 V
300 µV	+ 15.5 db	3.6 V
1 mV	+ 17.0 db	4.8 V
3 mV	+ 18.4 db	6.4 V
10 mV	+ 20.6 db	9.5 V
30 mV	+ 22.6 db	12.5 V
100 mV	+ 24.7 db	17.5 V
300 mV	+ 26.3 db	21.5 V
1 V	+ 28.5 db	27.0 V

A.V.C. CHARACTERISTIC — RC43

Input to Aerial at 1000 Kc/s

Input	Output (Odb = 0.6 W)	AVC Volts
3 µV	— 4 db	0
10 µV	+ 7.2 db	0.1 V
30 µV	+ 10 db	0.85 V
100 µV	+ 14.2 db	1.95 V
300 µV	+ 16.2 db	3.1 V
1 mV	+ 17.8 db	4.0 V
3 mV	+ 18.5 db	5.0 V
10 mV	+ 20.5 db	6.9 V
30 mV	+ 23.2 db	10.3 V
100 mV	+ 25.6 db	15.8 V
300 mV	+ 27.5 db	21.0 V
1 V	+ 29.2 db	27.0 V

RC54

No-signal Static Voltages

Voltages measured with 1000 ohms volt meter

Valve	E_b	I_b	E_{c2}	I_{c2}	E_K
6V6-GT	238V	43mA	250V	2.1mA	12.4V
6AV6	115V	.33mA			1.6V
6BA6	250V	5.1mA	85V	2.15mA	1.85V
6BE6	250V	2.6mA	100V	6.8mA	
6BA6	250V	4.5mA	85V	1.6mA	2.75V
6X5-GT	260V	R.M.S. per plate			

Total B+ Current 68 mA

RC43

No-signal Static Voltages

Voltages measured with 1000 ohms volt meter

Valve	E_b	I_b	E_{c2}	I_{c2}	E_K
6V6-GT	239V	43.0mA	250V	2.1mA	12.5V
6AV6	97V	0.3mA			1.5V
6BA6	250V	10.7mA	100V	4.3mA	1.1V
6BE6	250V	2.5mA	95V	6.7mA	
6X5-GT	260V	R.M.S. per plate			

Total B+ Current 69.6 mA

SELECTIVITY RC54

1000 Kc/s to Aerial

Input times	Bandwidth
3	6 Kc/s
10	10 Kc/s
30	14 Kc/s
100	17 Kc/s
300	21 Kc/s
1000	26 Kc/s
3000	33 Kc/s
10,000	40 Kc/s

SELECTIVITY RC43

1000 Kc/s to Aerial

Input times	Bandwidth
3	8 Kc/s
10	12 Kc/s
30	16 Kc/s
100	20 Kc/s
300	25 Kc/s
1000	33 Kc/s
3000	41 Kc/s
10,000	52 Kc/s

AUDIO FREQUENCY RESPONSE

Resistive Load

Frequency	Output RC43	Output RC54
50 c/s	−13 db	−5.5 db
100 c/s	−7 db	−1.5 db
300 c/s	−1 db	0 db
1000 c/s	0 db	0 db
3000 c/s	−2 db	−0.5 db
5000 c/s	−5.5 db	−1.5 db
10000 c/s	−10.5 db	−4.5 db

SENSITIVITY RC54

For an Absolute Output of 50 Milliwatts

Input to	Frequency	Input	Ratio	Im. Ratio	Ensi.
6AV6 Control Grid	400 c/s	0.024 V			
6AV6 Diode Plate	455 Kc/s	0.26 V			
6BA6 Control Grid	455 Kc/s	1500 μV			
6BE6 Control Grid	455 Kc/s	34 μV			
6BE6 Signal Grid	600 Kc/s	39 μV	38.5		2.8 μV
6BE6 Signal Grid	1000 Kc/s	39 μV	38.5		2.9 μV
6BE6 Signal Grid	1400 Kc/s	38 μV	39.5		3.6 μV
6BE6 Signal Grid	6.5 Mc/s	37 μV	40.5		3.2 μV
6BE6 Signal Grid	11.0 Mc/s	38 μV	39.5		3.2 μV
6BE6 Signal Grid	17.0 Mc/s	37 μV	40.5		3.2 μV
6BA6 Control Grid	600 Kc/s	0.93 μV	41.9		0.44 μV
6BA6 Control Grid	1000 Kc/s	0.95 μV	41.1		0.46 μV
6BA6 Control Grid	1400 Kc/s	1.0 μV	38.0		0.42 μV
6BA6 Control Grid	6.5 Mc/s	3.4 μV	10.9		0.42 μV
6BA6 Control Grid	11.0 Mc/s	2.6 μV	14.6		0.41 μV
6BA6 Control Grid	17.0 Mc/s	1.2 μV	30.8		0.47 μV
Aerial	600 Kc/s	0.2 μV	4.15		0.27 μV
Aerial	1000 Kc/s	0.2 μV	4.25		0.28 μV
Aerial	1400 Kc/s	0.25 μV	4.0		0.36 μV
Aerial	6.5 Mc/s	2.1 μV	1.64	2050	0.49 μV
Aerial	11.0 Mc/s	0.9 μV	2.9	444	0.34 μV
Aerial	17.0 Mc/s	0.7 μV	1.73	43	0.26 μV

SENSITIVITY RC43

For an Absolute Output of 50 Milliwatts

Input to	Frequency	Input	Ratio	Im. Ratio	Ensi.
6V6-GT Grid	400 c/s	0.8 V	19.75		
6AV6 Grid	400 c/s	0.014 V	57		
6AV6 Diode Plate	455 Kc/s	0.19 V			
6BA6 Grid	455 Kc/s	800 μV			
6BE6 Signal Grid	455 Kc/s	15 μV	53 3		
6BE6 Signal Grid	600 Kc/s	16 μV	50.0		2.3 μV
6BE6 Signal Grid	1000 Kc/s	16 μV	50.0		2.6 μV
6BE6 Signal Grid	1400 Kc/s	16.5 μV	48.5		2.8 μV
6BE6 Signal Grid	6.5 Mc/s	15.5 μV	51.5		2.7 μV
6BE6 Signal Grid	11.0 Mc/s	15.5 μV	51.5		3.0 μV
6BE6 Signal Grid	17.0 Mc/s	15.5 μV	51.5		2.6 μV
Aerial	600 Kc/s	2.1 μV	7.6		.36 μV
Aerial	1000 Kc/s	2.4 μV	6.7		.48 μV
Aerial	1400 Kc/s	2.7 μV	6.1		.48 μV
Aerial	6.5 Mc/s	9.4 μV	1.65	20.2	1.9 μV
Aerial	11.0 Mc/s	6.3 μV	2.46	8.9	1.3 μV
Aerial	17.0 Mc/s	5.8 μV	2.67	3.2	1.4 μV

Single-Section Filament Operation of Types 3S4 and 3V4

[R.C.A. Application Note AN-135 reprinted by courtesy of the Radio Corporation of America.]

When it is desirable to minimize power consumption in a receiver or other equipment at the expense of power output, operation of types 3S4 and 3V4 utilizing only one section of the two-section filament is permissible. These types, designed for dry-battery operation, are power output tubes with two filament sections arranged so that they may be heated either in series with 2.8 volts and 50 milliamperes, or in parallel with 1.4 volts and 100 milliamperes. One filament section is connected between pins 1 and 5, and the other is connected between pins 5 and 7.

Tube operation utilizing one section heated with 1.4 volts and 50 milliamperes is permissible subject to the following recommendations:—

1. Use only filament section between pins 5 and 7. Make no connection to pin 1.
2. Apply the filament voltage so that pin 7 is positive and pin 5 is negative.
3. Do not switch from single-filament operation to series or parellel filament operation, or from one filament section to the other.

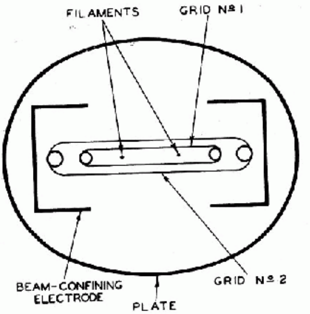


Fig. 1 — Cross-Sectional View of Tube Structure

Recommendations 1 and 2 are made primarily to insure consistency between testing results and tube operation. Recommendation 3 is made because prolonged operation of a tube with only one filament section utilized may result in deterioration of the other section. Subsequent use of the other section, therefore, would not give results predictable from initial ratings. Ratings, typical operating conditions, and characteristics for types 3V4 and 3S4 with single-section filament operation follow.

Filament Arrangement:

Pin 7 connected to filament (+); pin 5 connected to filament (—); pin 1, no external connection.

Maximum Ratings:

	Type 3S4	Type 3V.*	
Total Zero-Signal Cathode	90 max.	90 max.	volts
Plate Voltage	67.5 max.	90 max.	volts
Grid No. 2 (Screen) Voltage . Current	4.5 max.	6 max	ma
Total Maximum-Signal Cathode Current	5.5 max.	6 max.	ma

Typical Operation and Characteristics:

Filament Voltage	1.4	1.4	volts
Filament Current	0.050	0.050	amperes
Plate Voltage	90	90	volts
Grid No. 2 Voltage	67.5	90	volts
Grid No. 1 Voltage	−7.0	−4.5	volts
Peak AF Grid No. 1 Voltage	7.0	4.5	volts
Zero-Signal Plate Current	3.7	4.8	ma
Zero-Signal Grid No. 2 Current	0.7	1.1	ma
Plate Resistance (approx.)	0.2	0.2	megohm
Transconductance	800	1100	μmhos
Load Resistance	16000	20000	ohms
Total Harmonic Distortion	12	7	per cent
Maximum-Signal Power Output	135	135	mw

*Data for type 3V4 apply also to type 3Q4.

Comparison of characteristics given above with the published characteristics of type 3V4 and 3S4 for parallel-filament operation shows that (1) the plate and grid—No. 2 currents, the transconductance, and the power output have values approximately one-half of the values given for parallel-filament operation; and (2) the plate resistance and the recommended load resistance have values approximately twice those given for parallel-filament operation. These results indicate that the two filament sections function almost independently in their contributions to the performance of these tube types.

Geometrical considerations also support the theory that operation of the two filament sections of types 3S4 and 3V4 should be nearly independent. Fig. 1 shows a cross section, approximately to scale, of the structure of one of these tubes. Because the distance from either filament section to the closest point of grid No. 1 is considerably less than half the distance between the two filament strands, the effect of the electric field of the space charge about one of the filament sections on the electric field in the vicinity of the other section is very small.

Adjustment of Filament Voltage of RCA-1B3-GT by Observation of Filament Temperature

R.C.A. application note AN-134; reprinted by courtesy of the Radio Corporation of America.

When RCA-1B3-GT is used as the high-voltage rectifier with an rf power supply or a pulse-operated power supply for a television receiver, its filament is supplied from a high-frequency power source which is at a high dc potential with respect to ground. Consequently, adjustment of the filament operating conditions by direct measurement of the filament voltage or current is usually impractical. However, a simple method utilizing visual comparison of filament temperatures can be used for adjustment of filament power. Such a method is described in this Note.

The cutaway view of the 1B3-GT, as given in Fig. 1, reveals that the filament is mounted well inside the plate cylinder. This mounting is an important feature of the valve because, if the emitting surface of the filament extended below the edge of the plate, electrons drawn from the filament could miss the plate, strike the glass with high velocity, and lead to gas liberation and early valve failure. The most common mounting position for the 1B3-GT is vertical, base down, inside a shield enclosing the power supply. In such a position, it is generally not possible to observe the filament directly for a temperature determination. In a dark room, however, it is possible to see the light from the filament reflected from the shield collar (Fig. 1). A feasible method for determining the filament temperature, therefore, involves observing the reflected light when the filament is heated with a measured dc or low-frequency ac voltage, connecting the high-frequency supply, and then adjusting the high-frequency power until the same light is obtained.

Procedure.

When adjustments are made on high-voltage supply units designed for commercial production, it is desirable to use a measurement technique which does not depend on the memory of the operator from one measurement to another. The following method leads to accurate, reproducible results.

1. Procure two high-voltage power supply units of the type to be adjusted; or alternatively, mount a second 1B3-GT socket near the power supply unit in such a position that the valve is observable from the same angle as the valve in the power supply unit.
2. Disconnect the high-frequency circuits and connect dc (or low-frequency ac) supplies to both sockets.
3. Insert valves in both sockets. Adjust the voltage at one socket to the desired value (1.25 volts for normal line voltage); darken the test area and vary the filament voltage of the second valve until the light reflected from the shield of this valve appears to match that from the first valve. Then, read the voltage on the second valve.
4. Repeat step 3 several times to determine the accuracy with which readings can be duplicated. During the course of these tests, interchange the valves. It is also desirable to have more than one observer participate.
5. If there is a consistent difference in the voltage required to obtain the same appearance with the two valves used, try other valves until a pair is found which match closely in reflected-light-vs-voltage characteristics.
6. Connect high-frequency power to one of the supplies. With test area darkened and light from other valves in the unit under test blocked by shields, adjust the dc or low-frequency ac voltage on the second valve to obtain a visual match with the valve operated from the high-frequency supply. Measure the voltage on the second valve. Several repetitions with interchange of valves will show whether consistent results are being obtained.
7. Make appropriate adjustments on the unit under test until the correct rf filament voltage is obtained.
8. Step 6 may now be repeated with other high-voltage supply units to determine variations among them. The filament adjustment finally made should, in general, be that indicating a filament voltage of 1.25 volts with an average valve in an average unit operated at rated line voltage.

If records are kept of the observations made during such a sequence of measurements, the observers will have data indicating the probable accuracy of the results. Tests made in the laboratories of the Valve Department indicate a standard deviation of 0.024 volts for a series of comparison readings made with dc on the filaments of both valves of the pair under test. An accuracy of better than 5 per cent. in the adjustment of filament voltage at standard line voltage is desired in order to minimise excessive deviation in one direction or the other with line voltage variation. Because the purpose of control of filament voltage and current is to control filament temperature, matching of brightness between filaments is an effective procedure for establishing the desired operating conditions.

Methods Employing Direct Observation.

With many power supplies, it is possible to place a small mirror near the base of the 1B3-GT in such a position that the reflection of the filament can be observed directly. Because this method permits direct comparison of filament colours, more light can be tolerated in the room when comparisons are being made. A further improvement is to project the images of the two filaments, side by side, on a translucent screen; two mirrors, two simple lenses, and a piece of tracing paper, arranged as in Fig. 1, are required. A very high accuracy of matching can be achieved with such an arrangement. It would also be possible to use an optical pyrometer with the aid of a mirror, but comparisons should still be made between colour temperatures observed with dc and high-frequency power to avoid any error which might arise from discoloration of the mirror or the glass of the valve.

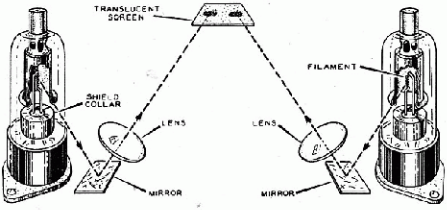


Fig. 1—Method Utilizing Direct Observation for Adjustment of Filament Voltage. Plate Cylinders Cut Away to Show Filaments.

TYPES DISCONTINUED BY R.C.A.

Type 1J5-G—2.0 volt power amplifier pentode now considered obsolete and discontinued.

Type 5HP1-A—Identical with the 5BP1-A except for micanol base. Now discontinued.

Type 6A4/LA—Discontinued. Directly interchangeable with the 6A4.

Type 15—Introduced in 1936 and now considered obsolete and hence discontinued.

Type 1840—6.3 volt orthicon now discontinued. Image orthicons, 2P23 or 5655, are recommended as replacements.

Type 1848—6.3 volt iconoscope limited to sales for renewal use only.

Type 8014A—Originally made for certain radar applications and now withdrawn from the R.C.A. line.

New R.C.A. Releases

Radiotron type 6W4-GT—is a half-wave vacuum rectifier of the 6.3 volt indirectly-heated cathode type intended primarily for use as a damper diode in magnetic deflection circuits for television receivers. It may also be used as a rectifier in conventional power supply applications.

Radiotron type 10KP7—is a 10 inch directly viewed cathode ray tube of the magnetic focus and magnetic deflection type having a long-persistence cascade (two-layer) screen. It is intended primarily for use in radar indicator service, but is also useful in general oscillographic applications where a temporary record of electrical phenomena is desired.

(Continued overleaf)

NEW R.C.A. RELEASES

(Continued from Page 11)

During excitation the screen of the 10KP7 exhibits bluish fluorescence of short persistence and greenish-yellow phosphorescence which persists for several minutes.

The type 10KP7 is intended to replace type 12DP7A.

Radiotron type 19J6—is a medium-mu twin triode of the 7-pin miniature type intended primarily for converter service in A.C./D.C. F.M. and A.M. receivers. In such service, one triode unit may be used as mixer, and the other as oscillator. The 19J6 may also be used for oscillator, amplifier, or mixer service in television receivers of the "transformerless" type.

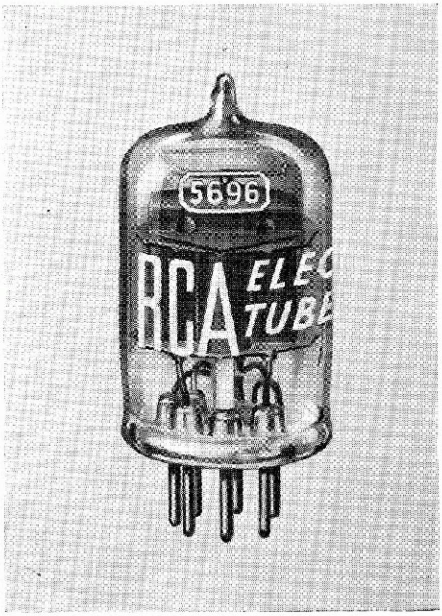
The type 19J6 is the equivalent of the 6J6 except for the 18.9 volt heater.

Radiotron type 672A—is an improved version of the 672 which it supersedes. It is interchangeable with the type 672.

Radiotron type 812A—is an improved version of the 812 which supersedes and replaces type 812.

Radiotron type 5696—is an inert gas thyratron of the miniature 7-pin type intended for use principally in electric blanket controls and in business machine calculators.

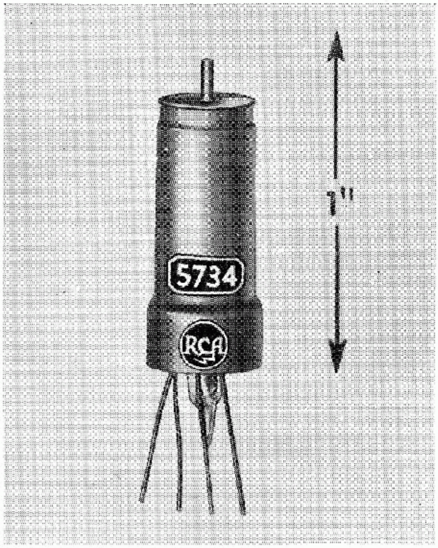
The type 5696 is similar to the 2D21 but draws lower heater current and has a lower cathode current rating.



Radiotron type 5713—is a compact power triode of the forced-air-cooled radiator type for use in V.H.F. unmodulated class C service. It has a maximum rated plate dissipation of 250 watts, and can be operated with full ratings at frequencies as high as 220 Mc/s. The 5713 is especially useful in grounded-grid circuits, particularly those of the transmission line type.

Radiotron type 5731—is an acorn triode of the 6.3 volt heater-cathode type intended primarily for radiosonde applications. It can be operated at frequencies up to 600 Mc/s.

Radiotron type 5734—is a triode transducer intended to provide a method of converting mechanical vibrations into electrical current variations which can be observed and measured. It has a deflection



sensitivity of 40 volts per degree deflection of the plate shaft. The part of the plate shaft within the valve has a minimum free cantilever resonance of 12,000 cycles per second permitting, with suitable mechanical coupling to the external end of the plate shaft, measurements of vibration up to 12,000 c/s. The moving element of the 5734 is designed to have low inertia.

ERRATUM: RADIOTRONICS 132

"Electronics Timers Employing Thyratrons 2D21 or 2050" Page 72, Col. 1, Line 4. Timing control potentiometers R_7 and R_{11} are incorrectly identified as R_1 and R_2. Please change R_1 to R_7 and R_2 to R_{11}.