

Instructions for RCA Victor 221

Six-Tube "Selective Short-Wave" Superheterodyne

INTRODUCTION

This console radio receiver may be operated in either of two tuning ranges, one covering the usual band of from 540 to 1500 kilocycles and the other covering a band of from 5400 to 15,350 kilocycles. Between the limits of the latter range are included four of the internationally-assigned short-wave broadcast bands, located at 49, 31, 25 and 19 meters, respectively. Thus, in addition to providing entertainment from the accustomed broadcasting stations, this instrument permits direct reception of programs from the principal short-wave broadcast transmitters located in all parts of the world.

Short-wave facilities in this instrument are built-in as integral parts of the radio chassis—not simply connected to an existing chassis as a short-wave adaptor—resulting in distinctly superior performance. Both tuning ranges are quickly interchangeable by means of a push-pull switch on the front of the cabinet. Other features contributing to tuning ease and accuracy are: (1) the "vernier" dual-ratio station selector drive, permitting either rapid or fine adjustments independently; and (2) the clock-type "full-vision" illuminated dial, calibrated directly in frequency for both ranges.

INSTALLATION

Location—The instrument should be placed convenient to the antenna and ground connections and near an electrical outlet.

Tubes—The instrument is equipped and tested at the factory with RCA Radiotrons and is shipped with these tubes installed. Before making the required external connections, however, it will be advisable to examine the tube installation, as one or more of the tubes, shields or dome terminal clips may have been jarred loose in shipment. Refer to the tube location diagram printed on the rating label inside the cabinet and *make certain*:

- (1) That all tubes are in the proper sockets and pressed down firmly.
- (2) That all shields are rigidly in place over the tubes represented by double circles on the diagram.
- (3) That the spring connectors of the short flexible (grid) leads shown on the diagram are securely attached to the dome terminals of the proper tubes.

NOTE—The grid lead for the RCA-2B7 must be enclosed by the cylindrical tube shield. A slot is provided at the bottom of this shield for entrance of the lead.

Antenna and Ground—The efficiency of any antenna varies greatly with the frequency of incoming radio waves, a given length being excellent at certain frequencies and comparatively poor at others. For uniform results throughout a wide tuning range such as found in this instrument, therefore, an antenna of adjustable length would be desirable theoretically. From a practical standpoint, however, very good results will be obtained using two

antennas of different length, one 24–29 feet for short-wave reception and the other 50–100 feet for reception in the standard broadcast band (540–1500 kc.), the lead-in considered as part of the total length in each case.

The shorter antenna may be used alone if preferred, but probably will not be satisfactory for receiving distant or low-power stations in the standard broadcast band. Further, no advantage will be gained by its use on the shorter wavelengths unless it can be installed so that the majority of its length is unshielded (not contained in a building of metallic construction) and sufficiently remote from sources of man-made interference (such as house-wiring, power lines, street-railways and passing automobiles) to prevent excessive noise. If these conditions cannot be fulfilled, it will be preferable to erect a single antenna of compromise length (100–105 feet overall), which, in addition to providing excellent results in the standard broadcast band, will also favor reception in the short-wave broadcast bands located at 49, 31, 25 and 19 meters.

Good reception in many installations will be obtained without connecting the instrument to an external ground, since the power line characteristics often render a separate radio ground unnecessary. In any case, however, best results will be insured by grounding the set in the conventional manner to a water-pipe or radiator, or to a metallic pipe or stake driven from five to eight feet into the soil. The ground lead when used should be short, preferably

not more than 15 feet in length, and connected to a clean portion of the pipe or stake surface by means of an approved ground clamp.

A terminal board is provided at the rear of the receiver chassis for connection to the antenna and ground. Attach the antenna wire or lead-in to the left-hand terminal (marked ANT.) and the ground wire to the right-hand terminal (marked GND.). Tighten both terminals with a screw-driver to insure permanent electrical connections.

Power Supply—Connect the power cord of the instrument to an electrical outlet supplying alter-

nating current at the voltage and frequency (cycles) specified on the rating label. While any voltage within the specified limits may be employed, a change in the internal connections will be required if the local voltage is less than 110 (for 100-125 volt models) or 220 (for 200-250 volt models). The alternative connections are shown in the Service Data section of this booklet and the changeover, when necessary, preferably should be made by the dealer. Consult your power company if you are in doubt as to the specific voltage or frequency of the supply.

OPERATION

Controls—The four control knobs on the front of the cabinet, in sequence from left to right, are:

- (1) **Power Switch and Tone Control**—The power switch operates at the counter-clockwise end of the control range. A slight clockwise rotation actuates the switch, causing illumination of the dial—indicative of normal operation. Continued clockwise rotation increases the treble response gradually.
- (2) **Volume Control**—Sound level (volume) increases upon rotation of this control in a clockwise direction.
- (3) **Station Selector (Dual Knob)**—The large knob (adjacent to panel) should be used for rapid approximate settings of the dial pointer and the small outer knob for accurate or "vernier" adjustments. The lower end of the pointer traverses a scale calibrated directly in kilocycles to facilitate the selection of stations transmitting in the standard broadcast band (540 to 1500 kc.). Stations in the short-wave range (5400 to 15,350 kc.), however, should be located with the upper end of the pointer which passes over a scale calibrated in "megacycles" (thousands of kilocycles). Bracketed segments adjacent to the upper scale indicate the positions and approximate spans of the short-wave broadcast bands, each being identified with respect to its nominal wavelength: 49 M, 31 M, 25 M and 19 M (meters).
- (4) **Range Switch**—This switch is of push-pull construction and adapts the receiver for operation within either tuning range as follows:
 - (a) **Inward Position**—For standard broadcast band (540 to 1500 kilocycles).
 - (b) **Outward Position**—For short-wave range (5400 to 15,350 kilocycles).

Procedure—The actual operation is simple and not unlike that of more conventional instruments designed for the reception of standard broadcast programs alone. However, the full possibilities of any short-wave receiver cannot be attained unless the user has a practical knowledge of short-wave transmission behavior and operating schedules. It is therefore recommended that the appended Notes

on Short-Wave Reception and the inserted Short-Wave Broadcasting Station List and Program Schedule be studied carefully.

A brief outline of the recommended operating procedure should suffice:

1. Set the Range Switch for the frequency range within which the desired station is included.
2. Turn the Power Switch "on" and adjust the Tone Control to its extreme clockwise position—*for full-range reproduction*. Wait a few seconds in order that the tubes may attain the proper temperature before attempting further operation.
3. Advance the Volume Control to a position near the middle of its range and rotate the Station Selector until the dial indicator assumes a position coincident with the listed frequency of the desired station. Then with the vernier control (small knob), turn the selector *very slowly* over a narrow range on each side of that setting, advancing the Volume Control further in a clockwise direction and repeating the tuning process, if necessary, until the signal is heard.

NOTE—This procedure is important—especially so for short-wave reception. Because of the wide band of frequencies covered by the short-wave range, tuning is critical (sharp). A signal of suitable strength often will be imperceptible if passed through rapidly or in a haphazard manner.

4. After receiving the signal, turn the Volume Control counter-clockwise until the volume is reduced to a low level. Then readjust the Station Selector accurately to the position mid-way between the points where the quality becomes poor or the signal disappears. *This setting minimizes the proportion of background noise and provides the fine quality of reproduction possible with this instrument.*

5. Adjust the Volume Control to the desired volume level.

NOTE—The automatic volume control built into this instrument maintains the volume level substantially constant irrespective of normal fluctuations of signal strength (fading). Also, other stations with good signal strength will be received at approximately the same volume without readjustment of the Volume Control.

6. Turn the Tone Control counter-clockwise if decreased treble response is preferred or to reduce noise interference if excessive.

7. When through operating, return the Tone Control to its counter-clockwise extremity, thus switching "off" the power.

NOTES ON SHORT-WAVE RECEPTION

While the design of this instrument is such that no previous experience or special skill is required for proper operation, its full possibilities can be realized only by those familiar with the general characteristics of transmission on the shorter wave-lengths. The following notes are a summary of extensive data compiled mainly by experimentation and should be found both interesting and helpful, especially to beginners in the field of short-wave reception.

Broadcast transmission at 49 meters is most reliable when received from a distance of 300 miles (500 kilometers) or more, although good reception at distances greater than 1500 miles (2400 kilometers) can be expected only when a large portion of the signal path lies in darkness.

Thirty-one (31) meter stations afford greatest reliability of service to receivers situated at a distance exceeding 800 miles (1300 kilometers). Good reception from distant stations in this band is possible both day and night.

Reception from stations operating in the 25 meter band is most common when a span of 1000 miles (1600 kilometers) or more separates the receiver and transmitter. Such transmission over distances of less than 2000 miles (3200 kilometers) will be received best during daylight hours. The more distant stations, however, can still be heard well after nightfall under favorable conditions.

In the 19 meter band, stations situated at a distance of 1500 miles (2400 kilometers) or greater will be found most satisfactory. Signals in this band will generally be heard during daylight hours—rarely after nightfall or when any appreciable portion of the transmission path is in darkness. Wave-lengths below 19 meters are useful only when transmitted entirely through daylight and over long distances (2000 miles or more); ordinarily they cannot be received after sunset.

Transmitted signals of any wave-length are known to divide into two components—the “ground” wave and the “sky” wave. The former remains close to the earth’s surface, providing reliable service only over short distances from the broadcasting station.

The sky wave, however, travels into the higher layers of the atmosphere and is reflected back to the earth’s surface at an appreciable distance from the station. With short-wave signals, the sky wave usually does not return within the radius covered by the ground wave, resulting in a so-called dead-spot region within which reception is impossible or extremely unsatisfactory. The length of the region wherein such conditions are effective is known as the skip distance, varying greatly from day to night and from summer to winter approximately as shown in Table I.

When attempting to receive distant or foreign stations, the time standards observed at various longitudes throughout the world must be considered. At 8:00 P. M. in New York or 7:00 P. M. in Chicago, it is of the next day—1:00 A. M. in London, 2:00 A. M. in most of Europe and 11:00 A. M. in Australia. On the American continents, therefore, regular evening broadcasts from Europe will be received in the late afternoon and from Australia in the early morning. Special programs, however, are frequently transmitted from European stations at times chosen for evening reception in America.

Although reception on the short wave-lengths is less affected by atmospheric or static and good results may be had in midsummer even during a thunder storm, the reverse is true of man-made interference. Electrical machinery such as trolleys, dial telephones, motors, electric fans, automobiles, airplanes, electrical appliances, flashing signs and oil burners create far more interference to the shorter waves than to frequencies in the standard broadcast band (200 to 555 meters).

While the foregoing statements are valid, many other factors may so influence the transmission of short waves that exceptions are probable in certain locations. Experience in the operation of short-wave receivers in a given location is the best guide as to what to expect in reception at various times.

Any person interested primarily in short-wave reception will find membership in the International Short-Wave Club of great value. The club is a non-commercial organization and issues a monthly magazine (International Short-Wave Radio) which contains up-to-date information pertaining to short-wave broadcasting, amateur activities and commercial, police and aircraft services. The annual membership fee, including the magazine subscription, is one dollar (\$1.00), U. S. Currency; single copies of the periodical may be procured by non-members for ten cents (\$0.10), U. S. Currency, each. Address International Short-Wave Club, P. O. Box 713, Klondyke, Ohio, U. S. A.

Table I—Effect of Time of Day and Season of Year on Short-Wave Transmission*

Wave-length (Meters)	Ground-Wave Range		Sky Wave (Mid-Summer) Approximate Range				Sky Wave (Mid-Winter) Approximate Range			
			Noon		Midnight		Noon		Midnight	
	Miles	Kilom.	Miles	Kilom.	Miles	Kilom.	Miles	Kilom.	Miles	Kilom.
100	90	145	—90	—145	90—600	145—960	90—100	145—160	90—2500	145—4000
49	75	120	100—200	160—320	250—5000	400—8000	200—600	320—960	400—∞	640—∞
31	60	97	200—700	320—1125	1000—∞	1600—∞	500—2000	800—3200	1500—∞	2400—∞
25	50	80	300—1000	480—1600	1500—∞	2400—∞	600—3000	960—4800	2000—∞	3200—∞
19	35	56	400—2000	640—3200	2500—∞	4000—∞	900—4000	1450—6400	X	X
15	15	24	700—4000	1125—6400	X	X	1500—∞	2400—∞	X	X

∞—Unlimited distance.

X—Ordinarily cannot be heard.

*Time and season apply to transmitting station. Distances specified are based on relatively high-power transmission and favorable conditions of reception.

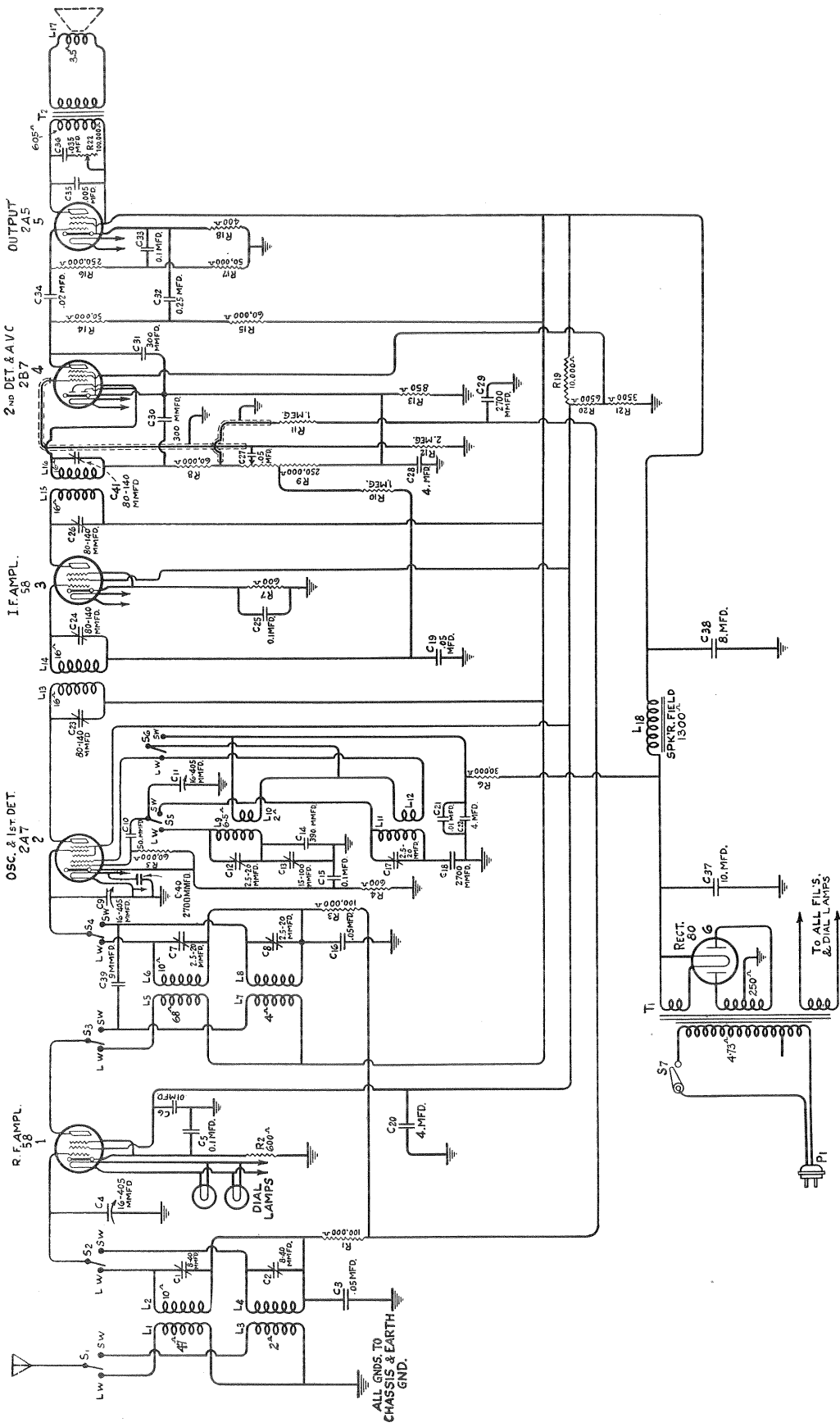


Figure A—Schematic Circuit Diagram

SERVICE DATA

Electrical Specifications

Voltage Rating.....	100-125 Volts
Frequency Rating.....	25-60 and 50-60 Cycle
Power Consumption.....	.60 Cycle, 75 Watts; 25 Cycle, 80 Watts
Number and Type of Tubes.....	2 RCA-58, 1 RCA-2A7, 1 RCA-2B7, 1 RCA-2A5, 1 RCA-80—Total 6
Tuning Ranges.....	540 K. C.—1500 K. C.—5400 K. C.—15.350 K. C.
Undistorted Output.....	1.75 Watts

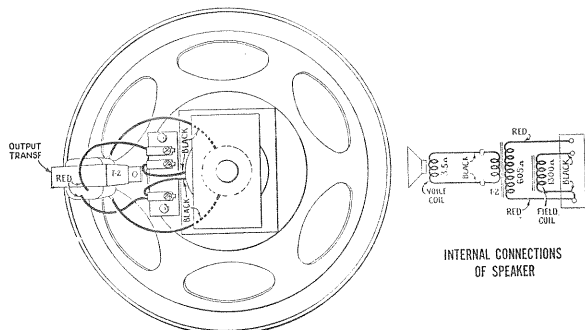


Figure C—Loudspeaker Wiring

This receiver is a six-tube two-band A. C. operated Superheterodyne Receiver combining the standard and short-wave broadcasting bands. The frequency ranges are selected by means of a two-position switch. Other features include a double reduction vernier drive using two concentric knobs giving a 10-1 and a 55-1 ratio of speed reduction, a continuously variable tone control, ten-inch electrodynamic loudspeaker, automatic volume control, single Pentode output tube and the inherent sensitivity, selectivity and tone quality of the Superheterodyne.

The chassis is of compact construction, affording unusual accessibility to all parts and adjustments. An "Airplane" type dial calibrated in frequency and showing the location of the short-wave bands is a special feature of this instrument. Figure A shows the schematic circuit, Figure B the wiring diagram and Figure C the loudspeaker wiring.

Line-Up Capacitor Adjustments

In order to properly align this receiver, it is essential that Stock No. 9050 Test Oscillator be used. This oscillator covers the frequencies of 150 K. C. to 20,000 K. C. continuously, has good stability and includes an attenuator. In addition to the oscillator, a non-metallic screwdriver such as Stock No. 7065 and an output meter are required. The output meter should be preferably a thermo-couple galvanometer connected across or in place of the cone coil of the loudspeaker.

I. F. Tuning Adjustments—Two transformers comprising four tuned circuits are used in the intermediate amplifier. These are tuned to 370 K. C. and the adjustment screws are accessible as shown in Figure D. Proceed as follows:

- Short-circuit the antenna and ground terminals and tune the receiver so that no signal is heard. Set the volume control at maximum and connect a ground to the chassis.
- Connect the test oscillator output between the first detector control grid and chassis ground. Connect the output meter across the voice coil of the loudspeaker and adjust the oscillator output so that, with the receiver volume control at maximum, a slight deflection is obtained in the output meter.
- Adjust the secondary and primary of the first and then the second I. F. transformers until a maximum deflection is obtained. Keep the oscillator output at a low value so that only a slight deflection is obtained on the output meter at all times. Go over these adjustments a second time, as there is a slight interlocking of adjustments. This completes the I. F. adjustments.

R. F. and Oscillator Adjustments—The R. F. line-up capacitors are located at the bottom of the coil assemblies instead of their usual

position on the gang capacitor. They are all accessible from the bottom of the chassis except the 600 K. C. series capacitor, which is accessible from the rear of the chassis. Proceed as follows:

- Connect the output of the oscillator to the antenna and ground terminals of the receiver. Check the position of the indicator pointer when the tuning capacitor plates are fully meshed. It should be coincident with the radial line adjacent to the dial reading of 540. Then set the Test Oscillator at 1400 K. C., the dial indicator at 1400 and the oscillator output so that a slight deflection will be obtained in the output meter when the volume control is at its maximum position.
- With the Range Switch at the "in" position, adjust the three trimmers under the three R. F. coils, designated as L. W. in Figure D, until a maximum deflection is obtained in the output meter. Then shift the Test Oscillator frequency to 600 K. C. The trimmer capacitor, accessible from the rear of the chassis, should now be adjusted for maximum output while rocking the main tuning capacitor back and forth through the signal. Then repeat the 1400 K. C. adjustment.
- Now place the Range Switch at the "out" position, shift the Test Oscillator to 15,000 K. C. and set the dial at 15 on the mega-cycle scale. Adjust the three trimmer capacitors designated as S. W. in Figure D for maximum output, beginning with the oscillator trimmer. It will be noted that the oscillator and first detector trimmers will have two positions at which the signal will give maximum output. The position which uses the lower trimmer capacitance, obtained by turning the screw counter-clockwise, is the proper adjustment for the oscillator, while the position that uses a higher capacitance is correct for the detector. Both of these adjustments must be made as indicated irrespective of output. The R. F. is merely peaked. In conjunction with the detector adjustment, it is necessary to rock the main tuning capacitor back and forth while making the adjustment. This completes the line-up adjustments.

The important points to remember are the need for using the minimum oscillator output to obtain a deflection in the output meter with the volume control at its maximum position and the manner of obtaining the proper high frequency oscillator and detector adjustments.

Power Transformer Connections

The power transformer used in this model has a tapped primary winding. The transformer is normally connected for lines ranging in voltage from 110 to 125 volts. If for any reason the line is normally below 110 volts,

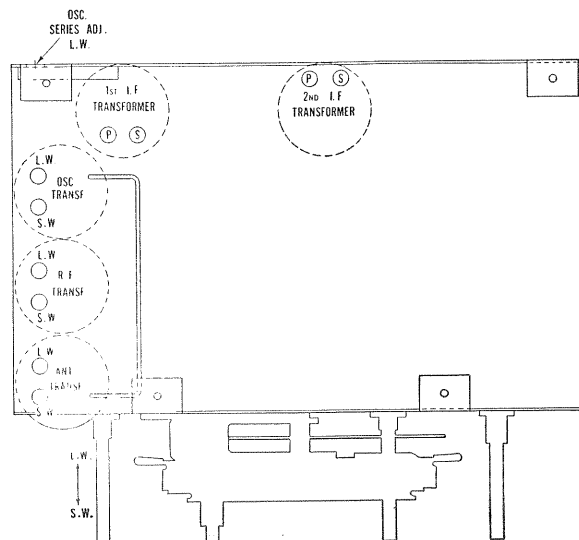


Figure D—Location of Line-Up Capacitors

the connections should be changed so the tap will be used. This is done by unsoldering the black with red tracer transformer lead connected to the power switch (on tone control) and substituting the red and black lead normally taped up. The black with red tracer lead should then be carefully taped to prevent short-circuit.

TUBE SOCKET VOLTAGES

115 Volts, A. C. Line—No Signal

Type No.	Cathode to Control Grid, Volts	Cathode to Screen Grid, Volts	Cathode to Plate, Volts	Plate Current M. A.	Heater Volts
1. RCA-58 R. F.	3.0	100	265	6.0	2.42
2. RCA-2A7 1st Det. Osc.	3.0	100*	265*	2.0*	2.42
3. RCA-58 I. F.	3.0	100	265	6.0	2.42
4. RCA-2B7 2nd Det. A. V. C.	1.5	35	100	1.5	2.42
5. RCA-2A5 Power	16.0	255	240	35.0	2.42
6. RCA-80 Rectifier					4.80
725 Volts R. M. S.—75 M. A. Total Current					
* The voltages and current refer to the detector part of the tube.					

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	DESCRIPTION	List Price	Stock No.	DESCRIPTION	List Price
RECEIVER ASSEMBLIES					
2240	Resistor—30,000 ohms—Carbon type—1 watt (R6).....	\$0.22	4032	Capacitor—390 mmfd. (C14).....	\$0.34
2747	Cap—Contact cap—Package of 5.....	.50	4075	Knob—Range switch or tone control knob—Package of 5.....	1.00
3056	Shield—2nd detector Radiotron shield—Package of 2.....	.40	4119	Screw—No. 8-32-1/4" headless cup point set screw for station selector knob—Package of 20.....	.38
3076	Resistor—1 megohm—Carbon type—1/2 watt (R10, R11)—Package of 5.....	1.00	4120	Knob—Volume control knob—Package of 5.....	1.18
3252	Resistor—100,000 ohms—Carbon type—1/2 watt (R1, R3)—Package of 5.....	1.00	4121	Knob—Station selector knob—Package of 5.....	1.18
3470	Resistor—6,500 ohms—Carbon type—1 watt (R20)—Package of 5.....	1.10	6188	Resistor—2 megohm—Carbon type—1/2 watt (R12)—Package of 5.....	1.00
3514	Resistor—250,000 ohms—Carbon type—1/2 watt (R16)—Package of 5.....	1.00	6282	Resistor—60,000 ohms—Carbon type—1/2 watt (R5, R8, R15)—Package of 5.....	1.00
3529	Socket—Dial lamp socket.....	.32	6571	Capacitor—10 mfd. (C37).....	1.20
3572	Socket—7-contact Radiotron socket.....	.38	6614	Glass—Station selector dial glass.....	
3594	Resistor—50,000 ohms—Carbon type—1/2 watt (R14, R17)—Package of 5.....	1.00	6615	Ring—Retaining ring for dial glass—Package of 5.....	.34
3631	Resistor—850 ohms—Carbon type—1/2 watt (R13)—Package of 5.....	1.00	6620	Capacitor—Comprising one .005 mfd. and one .035 mfd. (C35, C36).....	.50
3639	Capacitor—.02 mfd. (C34).....	.25	6676	Socket—6-contact Radiotron socket—Output.....	.40
3683	Shield—Radiotron shield top.....	.20	6694	Condenser—3-gang variable tuning condenser (C4, C9, C11).....	3.75
3701	Capacitor—.01 mfd. (C6, C21).....	.30	6695	Volume control (R9).....	1.20
3702	Capacitor—.25 mfd. (C32).....	.42	6696	Switch—Range switch (S1, S2, S3, S4).....	2.24
3768	Screw—Square head No. 6-32-1/4" set screw for condenser drive—Package of 10.....	.35	6697	Transformer—First intermediate frequency transformer (L13, L14, C23, C24).....	1.80
3796	Capacitor—4. mfd. (C28).....	.60	6698	Transformer—Second intermediate frequency transformer (L15, L16, C26, C41).....	1.78
3849	Capacitor—50 mmfd. (C10).....	.30	6699	Coil—R. F. coil (L5, L6, L7, L8, C7, C8)....	2.44
3859	Socket—4-contact Radiotron socket.....	.30	6700	Coil—Oscillator coil (L9, L10, L11, L12, C12, C17).....	2.30
3861	Capacitor—Adjustable capacitor (C13).....	.78	6701	Coil—Antenna coil (L1, L2, L3, L4, C1, C2).....	2.64
3877	Capacitor—.1 mfd. (C5, C15, C25, C33).....	.32	6702	Drive—Variable tuning condenser drive assembly complete.....	1.86
3878	Screw—No. 4-40-3/16" screw for fastening station selector pointer—Package of 20.....	.25	6703	Capacitor pack—Comprising one 8. mfd. and two 4. mfd. capacitors (C20, C22, C38)....	2.46
3888	Capacitor—.05 mfd. (C19, C27).....	.25	6704	Shaft—Tuning condenser drive assembly shaft.....	.64
3892	Resistor—600 ohms—Carbon type—1/2 watt (R2, R4, R7)—Package of 5.....	1.00	6705	Tone control complete (R22).....	1.20
3897	Resistor—400 ohms—Carbon type—1 watt (R18)—Package of 5.....	1.10	6841	Dial—Station selector dial—Package of 5....	2.74
3901	Capacitor—.05 mfd. (C3, C16).....	.36	6840	Bezel—Metal bezel for station selector dial..	.56
3905	Screw—Chassis mounting screw assembly comprising 4 screws, 4 washers, and 4 cushions.....	.46	6842	Pointer—Station selector pointer—Package of 5.....	.46
3906	Mounting assembly—Variable condenser mounting assembly comprising 3 bushings, 3 lockwashers, 3 nuts, and 3 washers.....	.28	7485	Socket—6-contact Radiotron socket.....	.40
3937	Capacitor—300 mmfd. (C30, C31).....	.34	7487	Shield—I. F. and R. F. amplifier Radiotron shield.....	.25
3938	Capacitor—9 mmfd. (C39).....	.25	9446	Transformer—Power transformer—105-125 volts 50-60 cycles (T1).....	5.40
3939	Resistor—3,500 ohms—Carbon type—1/2 watt (R21)—Package of 5.....	1.00	9451	Transformer—Power transformer—105-125 volts 25-40 cycles.....	5.40
3942	Shield—1st detector Radiotron shield.....	.18	10194	Ball—Steel ball for condenser drive assembly—Package of 20.....	.25
3943	Screen—Translucent screen for dial light—Package of 2.....	.18	REPRODUCER ASSEMBLIES		
3944	Shield—Antenna, R. F. or oscillator coil shield.....	.28	6770	Transformer—Output transformer (T2).....	2.00
3991	Resistor—10,000 ohms—Porcelain type (R19).....	.60	6843	Cable—3-conductor reproducer cable.....	.38
4031	Capacitor—2,700 mmfd. (C18, C29, C40)....	.50	8935	Cone—Reproducer cone (L17)—Package of 5.....	5.25
			9460	Coil—Field coil, Magnet and cone support (L18).....	6.00
			9461	Reproducer complete.....	8.50