GENERAL PURPOSE COMMUNICATION RECEIVERS

MODELS AR-77 and AR-77E

MI-8302 D, E, F and G

Manufactured by

RCA Manufacturing Company, Inc.

Camden, N. J., U. S. A.

IB-31005

"A SERVICE OF THE RADIO CORPORATION OF AMERICA"

GENERAL PURPOSE COMMUNICATION RECEIVERS

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(MI-8302 D, E, F and G)

INSTRUCTIONS

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RCA Manufacturing Company, Inc.

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"AN RCA SERVICE"

Printed in U. S. A.

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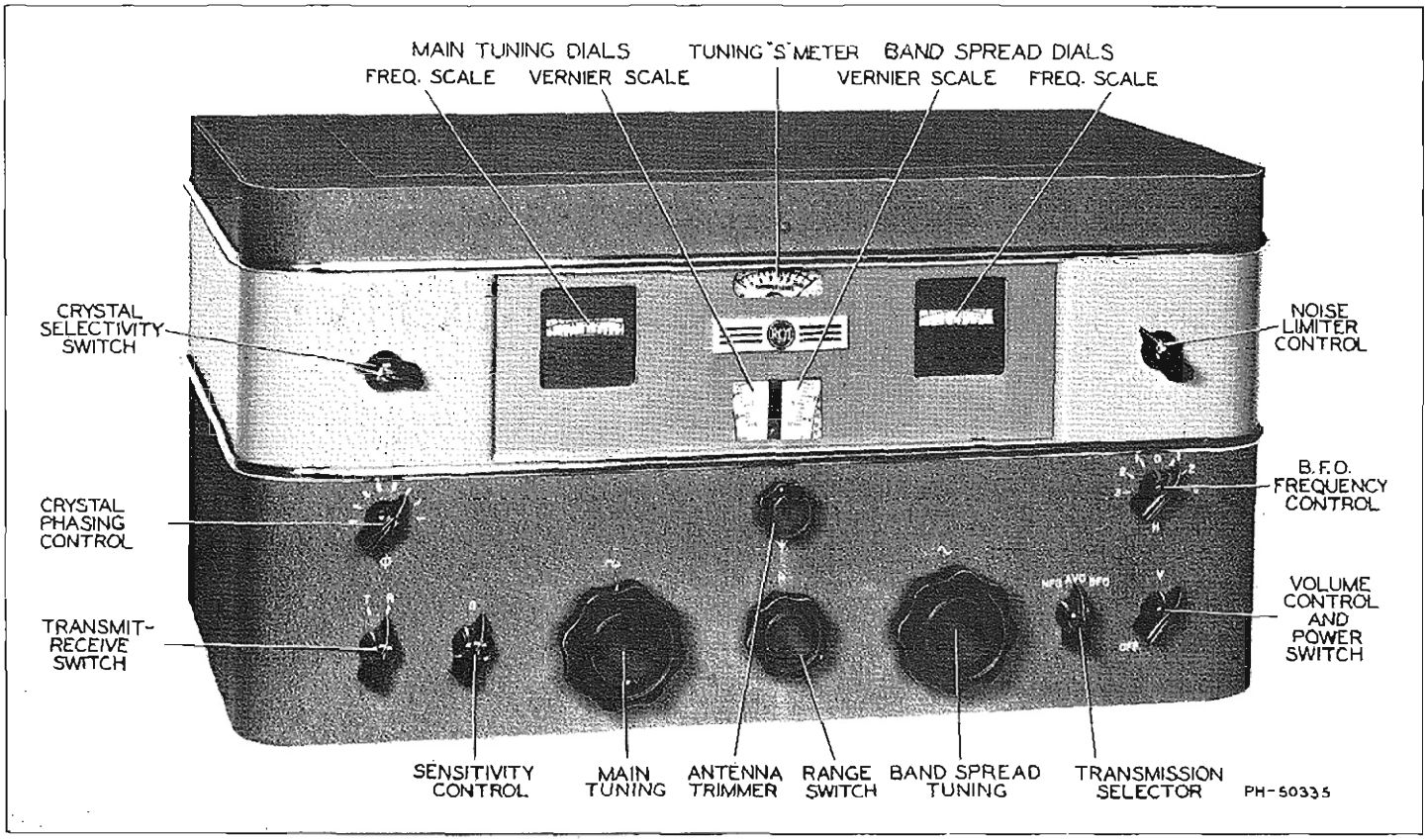

Figure 1—General Purpose Communication Receiver (Table Mounting Type)

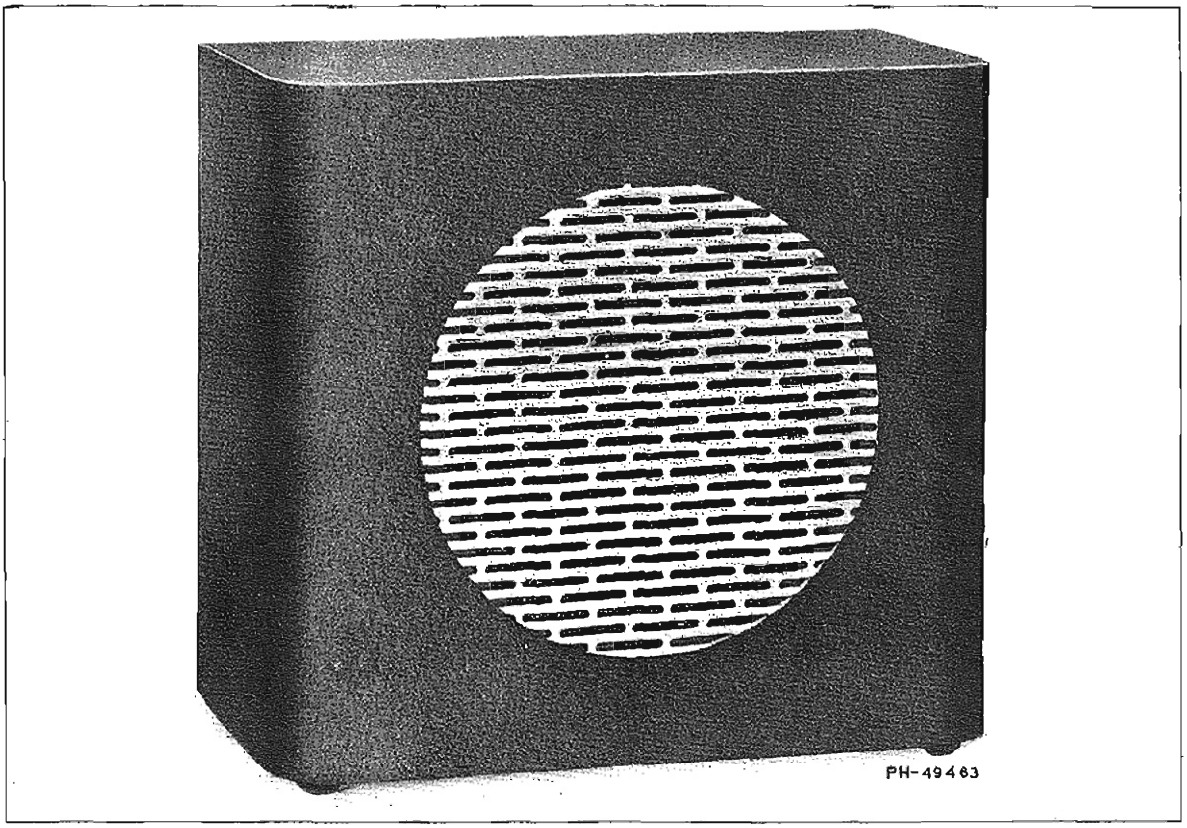

Figure 2—Loudspeaker

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GENERAL PURPOSE COMMUNICATION RECEIVERS MODELS AR-77 and AR-77E

TECHNICAL SUMMARY

All performance data were obtained on an average receiver. Slight variations above or below these values may be encountered due to practical manufacturing tolerances. A 300-ohm dummy antenna was used in series with the receiver input in making all measurements.

ELECTRICAL CHARACTERISTICS—

Frequency Range (total, 6 bands) ..... 540 to 31,000 kc

- Band 1 ..... 540 to 1,340 kc
- Band 2 ..... 1,340 to 3,300 kc
- Band 3 ..... 3,300 to 5,800 kc
- Band 4 ..... 5,800 to 10,200 kc
- Band 5 ..... 10,200 to 18,000 kc
- Band 6 ..... 18,000 to 31,000 kc

Frequency Stability:

Warm-up Shift, 1 minute to 1 hour, 68° F. Ambient (Average Humidity Conditions) ..... Less than 3.5 kc at 30 mc

Shift with Line Voltage Variation, 105 to 125 volts..... Less than 1,300 cycles at 29 mc
Shift is proportionally less at lower frequencies

Sensitivity: Input (30% mod.) required for 0.05 watt output ..... Less than 2 microvolts

Signal-to-Noise and Image Ratios:

Band	Frequency KC	Microvolts Input for 2:1 Signal-to-Noise Ratio	Image Ratio
1	540	0.9	50,000
	1,340	1.7	3,900
2	1,340	1.7	5,000
	3,300	1.9	910
3	3,300	1.4	1,000
	5,800	1.2	320
4	5,800	1.4	550
	10,200	1.2	100
5	10,200	1.8	380
	18,000	1.6	88
6	18,000	1.7	60
	31,000	1.0	25

Selectivity ..... See Figure 6

Overall Fidelity (measured across speaker voice coil) ..... See Figure 7

Maximum Undistorted Output (approximate) ..... 3 watts

Power Supply Requirements:

Line Rating—

Model AR-77 ..... 105-125 volts, 50/60 cycles

Model AR-77E* ..... 105-130/140-160/195-250 volts, 50/60 cycles

* See "EQUIPMENT" list below for special rack models and optional power packs available.

Power Consumption ..... 70 watts

TUBE COMPLEMENT—

R-F and I-F Amplifiers 3 RCA-6SK7

1st Detector and R-F Oscillator 1 RCA-6K8

2nd Detector and Noise Limiter 1 RCA-6H6

A.V.C. and A-F Amplifier 1 RCA-6SQ7

Power Amplifier 1 RCA-6F6G

Beat-Frequency Oscillator 1 RCA-6SJ7

Rectifier 1 RCA-5Y3G

Voltage Regulator 1 RCA-VR150

MECHANICAL SPECIFICATIONS—

Dimensions ..... $20\frac{1}{8}$ inches (width) x $10\frac{1}{2}$ inches (height) x $11\frac{5}{8}$ inches (depth)

Weight (net) ..... $48\frac{1}{2}$ pounds

EQUIPMENT

Model AR-77: Domestic Model in Cabinet (see "Line Rating") MI-8302D

Model AR-77E: Export Model in Cabinet (see "Line Rating") MI-8302E

Model AR-77: Domestic Model in Cabinet (105-125 v., 25 cycles) MI-8302F

Model AR-77: Domestic Model on Standard 10-15/32-inch Panel (see "Line Rating") MI-8302G

Model AR-77E: Export Model on Standard 10-15/32-inch Panel (see "Line Rating") MI-8302H

Optional Equipment:

Loudspeaker in Styled Cabinet to match Receiver MI-8303

Loudspeaker on Standard 10-15/32-inch Panel MI-8303A

Extended Range Loudspeaker in Console Cabinet MI-8314

Extended Range Loudspeaker in Wall Type Cabinet MI-8314A

Panel Kit for Rack Mounting of Model AR-77 (12-7/32-inch Panel) MI-8304

Panel Kit for Rack Mounting of Loudspeaker (10-15/32-inch Panel) MI-8305

Power Pack for Model AR-77 or AR-77E (105-125 volts d-c) MI-8307-2

Power Pack for Model AR-77 or AR-77E (210-250 volts d-c) MI-8307-3

Power Pack for Model AR-77 or AR-77E (6-volt battery) MI-8308

Phone Plug MI-6216

Headphones MI-5803

A-F Coupling Transformer for 500-ohm line MI-4904

DESCRIPTION

The Model AR-77 Receiver is intended especially for short-wave communications service. both amateur and commercial. Every effort has been directed toward obtaining the best possible performance, the stability necessary to withstand severe climatic and line voltage variations, and the utmost ease of operation. Withal, a very pleasing appearance has been achieved by modern functional design.

Among the many features of this receiver, the most important are: (1) Electrical band spread calibrated directly in frequency; (2) crystal filter for ultra-sharp selectivity where required; (3) noise limiter and automatic volume control circuits insuring excellent weak-signal reception; and (4) "S" meter for indicating relative strengths of incoming signals. An additional feature worthy of mention is that the standard broadcast band is included in the overall tuning range—540 to 31,000 kc.

Excellent fidelity is obtained through the use of compensated negative feedback in the audio amplifier. A comparatively low value of maximum undistorted power output—approximately 3 watts—is employed to minimize chassis heating and thereby improve the stability. All insulating materials are of the highest quality and treated to withstand tropical service.

INSTALLATION

POWER SUPPLY—The power supply circuit is integral with the receiver in both the Model AR-77 and the Model AR-77E. At installation, the line voltage and frequency should be determined and checked for conformance to the nominal rating of the receiver. Reference should be made from the MI number on the instrument label on the top of the chassis to the corresponding rating shown in the "Equipment" list. Three power packs are available as accessory items to permit operation on special power supplies.

For connection of an external power pack, there are two terminals on the rear of the chassis connected by a link as shown in Figure 3A. This link should not be disturbed, except for the purpose intended. It is connected in the tube heater supply circuit.

In the Model AR-77E, MI-8302E and -8302H, the power transformer primary may be connected in any of three arrangements to accommodate a wide range of line voltages. Remove the small metal cap from the top of the power transformer and place the "U" shaped connector between the center terminal and that outside terminal marked with a value nearest to the actual line voltage. Thus, if the line voltage were 130 volts, the connector should be placed in the "125 V." position.

If the receiver is to be used for continuous service, especially when unattended, a 3-ampere fuse should be installed in series with the power source.

TUBES—Inspect the chassis before applying power to make certain that all tubes are firmly seated in their sockets and that the grid lead to the RCA-6K8 tube is in place.

ANTENNA—For general use it is recommended that an antenna of the doublet type, either single or double, be used. Connections to either type are shown in the accompanying diagram. Both types will give very good performance in any two amateur bands.

Any of the directive type antennas used for transmission may be satisfactorily employed for reception with this receiver. It will be found that very good results also may be obtained with a single wire antenna from 25 to 75 feet long.

In locations where the antenna transmission line is near power wiring or other sources of noise interference, it is recommended that a coupling transformer such as RCA Stock No. 9813 be connected between the receiver and the antenna transmission line. This transformer, however, is satisfactory only for the 160-, 40- and 20-meter bands. Transmission line such as RCA Stock No. 12430 or Stock No. 9882 is recommended for use with the doublet antennas, the latter being recommended for lengths in excess of 100 feet. The characteristics of these lines are:

Stock No. 12430 (90-foot length) or Stock No. 12429 (45-foot length)

Impedance 100 ohms

DB loss per 100 feet at 10 mc ..... 2 db dry
DB loss per 100 feet at 30 mc ..... 5 db dry
DB loss per 100 feet at 10 mc . 4 db 90% humidity
DB loss per 100 feet at 30 mc . 8 db 90% humidity

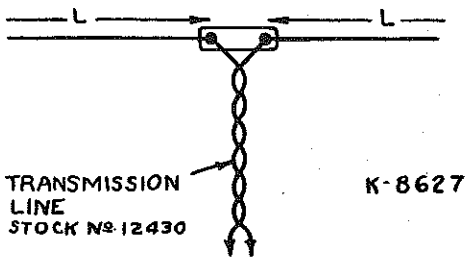
Stock No. 9882

Impedance 100 ohms

DB loss per 100 feet at 10 mc ..... 1 db dry
DB loss per 100 feet at 30 mc ..... 2.5 db dry
DB loss per 100 feet at 10 mc. 1.5 db 90% humidity
DB loss per 100 feet at 30 mc. 3.5 db 90% humidity

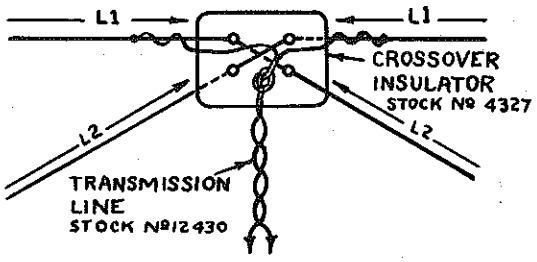
This transmission line, as well as other RCA antenna materials, may be purchased through RCA Parts Distributors.

The terminal board at the back of the chassis, near the center, contains the connecting terminals for the transmission line (or for the antenna lead-in) and ground. If an ordinary antenna is used, the adjacent transmission-line terminal should be connected to the ground terminal, and the antenna to the other transmission-line terminal.



SINGLE-DOUBLET ANTENNA

L =	130	feet	for	160-Meter	(1,900 kc)	Band
L =	65	"	"	80- "	(3,800 kc)	"
L =	33	"	"	40- "	(7,150 kc)	"
L =	16	"	"	20- "	(14,200 kc)	"
L =	8	"	"	10- "	(28,000 kc)	"



DOUBLE-DOUBLET ANTENNA

L_1 =	130	feet	for	160-Meter		Band
L_1 =	65	"	"	80- "		"
L_1 =	33	"	"	40- "		"
L_1 =	16	"	"	20- "		"
L_2 =	65	"	"	80- "		"
L_2 =	33	"	"	40- "		"
L_2 =	16	"	"	20- "		"
L_2 =	8	"	"	10- "		"

Doublet Antenna Connections

SPEAKER OR PHONES—This receiver is designed for use with a permanent-magnet dynamic type speaker, having a voice-coil impedance of from 2 to 3 ohms. The RCA Stock No. MI-8303 speaker (see Figure 2) is designed and recommended for the purpose. The terminals for connection to the speaker are shown in Figure 3A.

The RCA Manufacturing Company also produces two deluxe extended range speakers. One, MI-8314, is housed in a walnut cabinet; the other, MI-8314A, is contained in a walnut cabinet for wall mounting.

A jack is provided on the right-hand side of the cabinet, near the front, for plugging in a pair of 600-ohm headphones. The speaker is automatically disconnected when the phones are plugged in.

RACK PANEL MOUNTING OF RECEIVER—If it is desired to mount the receiver on a rack panel, the necessary panel and supports (MI-8304) are available for this type of mounting. This set of parts includes everything necessary to mount the standard receiver chassis to the rack panel.

The receiver chassis is first removed from the cabinet. For this purpose first remove all knobs from the control shafts. Next remove the perforated metal screen on the back of the cabinet by taking out the five self-tapping screws. Remove the five 1/4-inch machine screws underneath the cabinet. Next disconnect the tuning meter on the front panel. The chassis is now ready to be removed from the cabinet. The chassis should be tipped up at the rear just before entirely removing to prevent hitting the two front brackets against the upper angle at the rear of the cabinet.

With the chassis removed, the dial window mask and window should then be assembled to the rack panel. The panel is fastened to the chassis by means of six machine screws. Spacers are placed between the panel and the chassis. The side brackets should then be attached.

One of the headphone jacks should be wired directly to the receiver output terminals. This jack will then allow the receiver output to be monitored in installations where the output of the receiver is connected to a line.

The other headphone jack should be connected exactly like the one on the side of the receiver chassis. This may be simplified in the following manner: It will be observed that the ground and output terminal connections are already connected to the first jack. Jumpers may then be placed between the two jacks for these connections. The remaining connection is to the output transformer primary. This lead should be removed from the jack on the side of the receiver and connected to the jack on the panel. The purpose of this second jack is to connect a pair of headphones and at the same time remove the receiver output from the line. Thus, in a diversity system, one receiver may be easily removed from the combined output and tuned or adjusted without disturbing the others.

A receiver, mounted on a 10-15/32 inch x 19 inch panel, ready to be installed on a rack, is also available. The Model AR-77, MI-8302G, is for use with a power supply of 105-125 volts, 50/60 cycles; and the Model AR-77E, MI-8302H, is for use with 105-130; 140-160; 195-250 volts, 50/60 cycles.

RACK PANEL MOUNTING OF LOUDSPEAKER—The loudspeaker, Stock No. MI-8303, may be converted for rack mounting by purchasing the panel kit, MI-8305, available for this purpose.

OPERATION

Before attempting to operate the receiver, this entire section should be carefully studied so that the operator may obtain a general understanding of the various controls and their functions and adjustment. The symbols on the panel used to designate the various controls should be learned with respect to function as shown on Figure 1.

TUNING—In tuning this receiver, the various controls should be approximately set for the class of signal it is desired to receive. Select the frequency band desired by rotating control knob "R" until the proper scale appears in the slot at the upper left of the panel. Before proceeding, adjust the antenna trimmer to maximum for this band (see next paragraph—"Antenna Trimmer"). The frequency calibrations on the main dial scales are correct for tuning, when the bandspread dial is turned to its maximum frequency position only.

The bandspread dial is calibrated for the amateur bands of 10, 20, 40 and 80 meters only. To use the bandspread on these bands, set the main tuning dial at the highest frequency on that band, then tune with the bandspread dial. On the 160-meter band, the calibrations on the main dial are spread sufficiently so that it is not necessary to use the bandspread tuning. For an extremely accurate calibration, set the bandspread dial for a signal of known frequency, and then adjust the main dial until the station is tuned in. When this position has been obtained, note the setting of the arbitrary scale with its vernier index, on the main dial.

For commercial operation, or bands other than Amateur, the arbitrary scales should be used on the main tuning and bandspread dial. If the bandspread is not used, it should be left at the high frequency end of its range and then the main dial calibration is correct.

Curves may be plotted, giving arbitrary scale readings versus frequencies, on any band, by observing the readings on the arbitrary scales for a number of stations of known frequency on the same band, and working them on a suitable graph or chart.

ANTENNA TRIMMER—Before tuning on any frequency range, the antenna trimmer should be adjusted for maximum performance on that band. This control may be adjusted by tuning for maximum background noise. Occasionally it is desired to test a signal that seems out of place, to see whether or not it is a fundamental signal or an "image."

When adjusting the antenna trimmer, if the maximum signal point coincides with the point of maximum background noise, the signal is a fundamental. If the control does not affect the signal strength, or if it is maximum at some other point, the signal heard is an "image."

CRYSTAL SELECTIVITY SWITCH—For general operation while tuning, it is recommended that the crystal switch be in the "OFF" position. After the main tuning dial has been set at the desired point, the crystal may be placed in the circuit while tuning over the bandspread range. Crystal selectivity positions 1 and 2 should be used for phone or modulated signal reception and 3, 4 and 5 for CW telegraph reception.

It will be noticed that when tuning in a modulated signal with the crystal in, the speaker volume is greater on either side of the point which gives the maximum tuning meter indication. The reason for this is that the carrier voltage controls the gain of the receiver by means of the A.V.C. circuit, and if the carrier frequency is detuned slightly from resonance, the gain of the receiver increases so that part of the side band frequencies are amplified very much more than they are when the carrier is tuned to exact resonance. This is characteristic and normal for receivers with this degree of selectivity and provided with A.V.C. Care should be taken to tune the receiver for a maximum meter indication. Very much better results will be obtained. The background noise and adjacent channel interference will be materially reduced.

This receiver has been designed to have a selectivity characteristic which is slightly flat at resonance when the crystal is out, so that better fidelity of reception may be enjoyed when interference conditions permit. It is therefore likely that when the crystal is placed in the circuit, slight retuning may be necessary. This is due to the fact that exact tuning is much more necessary when using a sharp I-F circuit than when using a broad circuit.

CRYSTAL PHASING CONTROL—There is a normal or "neutral" position for this control, in which position it should be set for all normal reception. To locate this position, set the Crystal Selectivity Switch on position 3 or 4, and, using high gain with no incoming signal, adjust the phasing control for minimum noise. This control should be changed from this position only when a strong signal is producing a heterodyne action with the desired signal. In this case, the control should be adjusted for a minimum heterodyne effect.

VOLUME AND SENSITIVITY CONTROLS—For phone reception the sensitivity control should be set at maximum and the audio volume control used to obtain the desired volume. For CW telegraph reception the audio volume control should be set at three-fourths to maximum position and the desired volume obtained by adjustment of the sensitivity control.

NFB-AVC-BFO SWITCH—These letters stand for "NEGATIVE FEED-BACK," "AUTOMATIC VOLUME CONTROL," "BEAT FREQUENCY OSCILLATOR." The "NFB" position places the compensated negative feedback in the audio circuits, resulting in an increase in fidelity. This is useful for tests in voice transmissions and for entertainment use such as on broadcast reception. When using this position the volume control must be advanced slightly. This position is not recommended for other forms of reception.

The A.V.C. is in operation on both the "NFB" and "AVC" positions of this switch.

The A.V.C. is "OFF" when the switch is in the "BFO" position. This position connects the beat-frequency oscillator.

BFO FREQUENCY CONTROL—This control is provided to secure any desired audio beat frequency, for the reception of CW code signals. It should be set slightly off the central position, in normal use. The exact position may be found by experiment. With the crystal switch "OFF," the desired beat note may be obtained by tuning the receiver. However, in conditions of interference, when the crystal filter is used, the receiver must first be tuned to the desired signal, regardless of the beat frequency produced. If the beat note is not satisfactory, it may be changed with the BFO control. In other words, first tune for maximum signal strength, then adjust for the desired audio pitch.

When tuning in the same direction (that is, going from the high frequency to the low frequency end of the band, or vice versa), ALL signals will be changing in pitch in the same direction when resonance is reached. That is, the pitch will either be increasing or decreasing, depending on whether the BFO control is on one side or the other side of I-F resonance. It does not matter on which side the BFO control is placed, the CHANGE OF PITCH should be noted when tuning. If the change of pitch is opposite to that known to exist when passing through resonance, the signal is an audio image. Never try to receive an audio image. The signal can be made much stronger by tuning to the other side of zero beat.

NOISE LIMITER LEVEL CONTROL—When starting to tune the receiver, this control should be set in the "OUT" position, or advanced about one-quarter to three-quarters of the way in the counter-clockwise direction. Should external noise conditions interfere with reception, this control may be advanced as necessary, avoiding distortion of the signal. This control may be found especially helpful for reducing certain types of interference encountered on the 10-meter band. For CW reception with the noise-limiter, the sensitivity control should be advanced, and the volume control reduced until limiting action occurs.

TRANSMIT-RECEIVE SWITCH—This switch opens the plate circuits of the receiver on the transmit position and shorts the two terminals on the antenna terminal strip (shown in photograph Figure 3A), which may be connected to a relay for operation of the transmitter.

In addition, terminals J2 and J3 are provided so that, if desired, the plate circuit of the receiver may be opened by a transmitter switch. Note that these terminals are at plate potential.

TUNING OR "S" METER ADJUSTMENT—The "S" meter should normally give a low scale reading when no signal is being received. To adjust this meter, tune the receiver to a point free of signals, turn the sensitivity control to maximum, switch in A.V.C. switch crystal "OUT," have antenna trimmer turned off resonance, and then adjust the potentiometer at the back of the receiver as shown in Figure 4 until the meter pointer just coincides with the mark at the low end of the scale. The meter will usually rise slightly when the antenna trimmer is tuned to resonance.

The calibration of this meter is arbitrary, since no standard has been set for conversion of the "S" units to microvolts. However, in this receiver, "S1" is equivalent to approximately 0.5 microvolt input to the receiver. Each unit above this is 6 db up to "S9". Thus, "S2" is equivalent to 1 microvolt, "S3" to 2 microvolts. Above "S9" the meter is calibrated to 40 db, which would be equivalent to 12,800 microvolts.

For CW telegraph reception, the "S" meter provides a visual indication of the position of the sensitivity control.

BREAK-IN OPERATION—Break-in operation may be obtained on CW telegraph operation by connecting a separate antenna to the receiver. A single wire antenna or a doublet tuned to a different band than that on which the transmitter is working is recommended. If a doublet antenna tuned to the transmitter frequency is used, sufficient voltage may be induced in the receiving antenna to damage the receiver.

DIVERSITY RECEPTION—Two or three of these receivers may be connected together for diversity reception of modulated signals, with no additional equipment necessary. Each receiver must be provided with a separate antenna in the usual manner. The unconnected terminal on the back of the receiver, shown in Figure 3, is connected inside the receiver to the A.V.C. circuits. This terminal must be connected to the corresponding terminals of the No. 2 and No. 3 receivers. The receiver outputs should all be connected in parallel. Note that one of the output terminals of this receiver is at ground potential.

FOR CONNECTION TO A TELEPHONE LINE—It is recommended that a transformer such as RCA type MI-4904 be used. The connections to the type MI-4904 transformer should be made as follows:

1. Connect the output terminals of one or more Model AR-77 receivers in parallel to terminals No. 4 and No. 41 of the transformer.
2. Connect the 500-ohm line to transformer terminals 1A and 3B.
3. Connect a jumper between transformer terminals 1B and 3A.
4. Connect a 500 to 600 ohm, ½ to 1-watt resistor across the 500-ohm line, or across terminals 1A and 3B.

Connecting a pair of headphones in the jack on each receiver will disconnect it from the combined output so that the tuning or other adjustments may be checked. Obviously, the audio volume control on each receiver should be set to approximately the same level. For CW telegraph diversity reception, it is recommended that a combining and tone-keyer unit be used.

MAINTENANCE

CIRCUIT DETAILS AND FEATURES—In reading the following discussion of the electrical circuit, reference should be made to the schematic diagram, Figure 5.

INPUT COUPLING—The antenna coupling system is designed to provide optimum coupling from transmission lines of 50 to 500 ohms, or from conventional antenna and ground systems. The coupling coils are balanced to ground and may be connected directly to a balanced transmission line. An antenna trimmer capacitor adjustment is provided on the front panel to insure first circuit resonance with any antenna system.

RADIO-FREQUENCY AMPLIFIER—The r-f amplifier is designed to provide as much selectivity as possible ahead of the first detector. The amplification is adjusted to provide optimum signal to noise ratio by making noise contributions of circuits following the first tube negligible in comparison with the noise contributed by the first r-f grid circuit. A uniform amplification is obtained over all frequency ranges. On the two highest frequency ranges the oscillator frequency is placed below the signal frequency. This gives better freedom from image signals in the higher frequency amateur bands.

BAND SPREAD—Band spreading is accomplished by means of a capacitor gang having sections of capacity suitable for each amateur band. The sections of this capacitor are connected by the band switch so that on each amateur band, proper size of capacitor is used to spread the band over the entire tuning dial. The dials are directly calibrated in frequency.

R-F HETERODYNE OSCILLATOR—The r-f oscillator circuit is of the tuned-grid type with plate circuit feedback. A voltage regulator is used to stabilize the plate voltage. Temperature changes are compensated for by a special capacitor. This capacitor is composed of a small bi-metal plate, which is adjusted to have a temperature coefficient which will compensate for all other circuit changes. This type of temperature compensation was found to be quite satisfactory since the circuit minimum and maximum capacities are the same on the higher frequency ranges. That is, the temperature coefficient of this compensating capacitor is adjusted at the factory for best results on the high frequency end of the highest frequency range. The compensation is then near optimum on the high frequency end of each band. As the receiver is tuned from the high frequency end to the low frequency end of each band more tuning capacity is added and less compensation is needed. Since the capacity of the compensating capacitor is small compared to the tuning capacitor, less compensation results. Thus, a fairly uniform temperature characteristic is obtained over a very wide frequency range.

INTERMEDIATE-FREQUENCY AMPLIFIER—As may be seen from the schematic diagram, two stages of i-f amplification are used. A crystal filter is placed between the first detector and the first intermediate amplifier. This filter is adjustable by means of a control on the front panel and provides five positions of selectivity. A crystal phasing control of the usual type is also provided on the front panel. The intermediate frequency is 455 kc.

BEAT-FREQUENCY OSCILLATOR—The BFO second heterodyne oscillator used for CW reception is a separate pentode. The coupling to the second detector is just sufficient to provide suitable heterodyne action. A panel control is provided for changing the frequency a small amount so that any desired audio beat-frequency may be obtained.

AUTOMATIC VOLUME CONTROL AND "S" METER—The A.V.C. circuit is a simple diode rectifier. Referring to the schematic diagram, Figure 5, the received signal carrier produces a voltage across R-38 which is filtered by R-36 and C-72 and applied to the control grids of the r-f and i-f amplifiers. The "S" meter is connected in the cathode circuit of the first i-f tube and thus records changes in plate current caused by changes of A.V.C. voltage applied to the grid. This type of "S" meter circuit provides the desired wide range and the greater portion of the scale is approximately linear with respect to db input.

NOISE LIMITER—A noise limiter is provided in the second detector circuit. The limiter is manually adjusted. This provides best limiter action since noise voltages cannot increase the limiter bias.

It has been found that noise such as that produced by the ignition systems of automobiles may have an effective value in excess of that of a weak signal. This is particularly true on the 10-meter band. In order to be effective, the limiter must have a bias or "gate opening" of not more than twice the signal carrier amplitude. If this "gate opening" is provided by the signal such as is done in present automatic noise circuits, the noise voltage, if it has a higher effective value than the signal, will open the "gate" to such a high value that the limiter circuit is ineffective. The action of the noise circuit in this receiver is such as to make signals readable which are below the effective noise voltage.

Referring to the schematic diagram, Figure 5, the signal and noise voltages appear across R-32 and the noise peaks alone appear across R-33, since the bias applied to R-31 by the potentiometer R-34 prevents this diode from operating with the signal voltage. The sum of these voltages (across R-32 and R-33) are applied to the audio amplifier. It is apparent that the noise peak voltage across R-32 is out of phase or opposed to that across R-33. The "balance" of this circuit is adjusted by potentiometer R-33. The potentiometer R-34 is the front panel bias control.

SERVICE—This receiver has been carefully adjusted and aligned by the manufacturer before shipment, and should maintain its adjustments over a considerable period of time. It is recommended that any major adjustments or repairs be made by a competent service man.

TUBES—In a receiver which is used quite consistently, the first trouble which is likely to occur is that of deficient vacuum tubes. Usually the symptom of deficient tubes is a noticeable decrease in the sensitivity of the receiver. If the receiver will operate on all bands, but with low sensitivity, the tubes should be removed and checked. The tube locations are shown on the label on the large metal shield on top of the chassis.

BAND CHANGE SWITCH—After a long period without being operated, the band change switch may become noisy or inoperative because of dust or oxide film on contacting surfaces. In some cases, normal operation may be restored by rotating the switch a number of times. If it is found impossible to clean the switch sufficiently by rotation, the defective switch section must be located and replaced. The receiver should be removed from the cabinet and operated in a position such that the switch sections are accessible.

With the switch in the defective position, a slight movement of each section with an insulated screwdriver will usually determine the defective section.

To remove a switch section it will first be necessary to remove the switch shaft. The antenna trimmer control shaft must also be removed in order to unsolder the leads on the tuning capacitor. After all leads are disconnected the entire coil and switch assembly may be removed by taking out the three screws holding the assembly to the chassis.

TEST OF CIRCUIT ALIGNMENT—Under normal operating conditions the r-f amplifier and oscillator circuits should remain in line. If, however, it is found desirable to check the alignment of these circuits, the following test should first be made. Disconnect the antenna or transmission line and connect a 50- to 300-ohm carbon resistor across the two antenna terminal posts. Connect an output voltmeter to the output of the receiver and connect a 20-ohm resistor across the meter. Turn the sensitivity and volume controls to maximum. The A.V.C. switch should be on the A.V.C. position. The output noise voltage should be at least 0.1 volt, with the antenna trimmer tuned to resonance. The maximum noise voltage is a direct measurement of the sensitivity of the receiver. If the test shows that this voltage is less than 0.1 volt, the circuits should be realigned. First be sure that the decreased sensitivity is not caused by poor tubes. It probably will not be necessary to align all bands; however, the correct procedure for all bands is given below.

ALIGNMENT OF I-F CIRCUITS—Remove the bottom cover plate of the receiver cabinet, tune in a steady outside signal on one of the lower frequency bands with the A.V.C. switch on the BFO position and the crystal filter switch in position 2 or 3. The signal should be tuned for a peak response at the crystal frequency. Do not use too strong a signal. The sensitivity control should be adjusted for approximately 1 volt output. Referring to Figure 5 adjust T-1, L-19, T-2, T-3 and T-4 for a maximum output voltage. The signal should now be detuned approximately 1,000 cycles and adjustments T-1, L-19 and T-2 retuned for a maximum output.

The T-2 adjustment on top of the chassis is sealed with polystyrene cement. Applying a soldering iron to the adjusting screw for a few seconds will soften the cement. The intermediate frequency is 455 kc.

ALIGNMENT OF R-F AND OSCILLATOR CIRCUITS—Under usual conditions, the oscillator frequency will not shift far enough to throw the frequency calibration off, therefore, unless it is found that the frequency calibration is incorrect, the oscillator adjustments should not be changed. In any case, the oscillator circuit should not be changed unless a frequency calibrated test oscillator is available. The following procedure is for the r-f alignment of band No. 1 (540 to 1,300 kc). Tune in a signal near the high-frequency end of the band. (Do not use too strong a signal.) Reduce the sensitivity control until the output is approximately 1 volt. Referring to Figure 6, adjust C-18 and the antenna trimmer control on the front panel for maximum output. Next, tune in a signal near the low frequency end of the band. Adjust L-1 and L-7 for a maximum signal output. The same procedure may be followed for all bands. Make sure that the bandspread tuning is at the high-frequency end of the scale. The bottom cover should be held over the oscillator trimmer capacitors while adjusting the high frequency end of each band, so that when the cover is replaced, the frequency will not shift. The adjustments for each particular band are shown in the table herewith.

Band	R-F Ind.	Det. Ind.	Det. Cap.	Osc. Ind.	Osc. Cap.
540- 1,340 ..	L-1	L-7	C-18	L-13	C-24
1,340- 3,300 ..	L-2	L-8	C-17	L-14	C-23
3,300- 5,800 ..	L-3	L-9	C-22	L-15	C-28
5,800-10,200 ..	L-4	L-10	C-21	L-16	C-27
10,200-18,000 ..	L-5	L-11	C-20	L-17	C-26
18,000-31,000 ..	L-6	L-12	C-19	L-18	C-25

DIAL SHUTTER ADJUSTMENT—If the dial shutters do not line up with the dial calibration, they may be adjusted by means of an idler pulley bracket which adjusts the tension of the cord. By loosening the two screws which clamp the idler pulley bracket to the chassis the bracket may be shifted until the shutter opening lines up with the dial scale.

Another adjustment may be made by loosening the two nuts on adjusting screw fastened to back of shutter. To raise or lower the shutter, adjust the nuts accordingly.

NOISE BALANCE ADJUSTMENT—This adjustment is the potentiometer mounted on the right flange of the chassis (R-33). The correct adjustment has been carefully made at the factory and should ordinarily require no further attention. However, in servicing the receiver, in the event that the adjustment is accidentally moved, it may be reset as follows: First tune in a strong modulated signal such as a broadcast station. Next turn the noise control on the front panel all the way clockwise. Now adjust the potentiometer for a minimum signal output. This point will be found to be very sharp. When properly

adjusted, the signal output will be quite low until the noise control on the front panel is turned back counterclockwise.

TUBE SOCKET VOLTAGES—If the receiver is found to be completely inoperative, it is likely that a resistor is open-circuited or a capacitor is short-circuited. The bottom cover plate of the receiver cabinet should be removed. The tube socket terminal voltages should be measured and should be approximately the values given in the table below. The tubes should remain in the sockets for this test. A voltmeter having a resistance of at least 50,000 ohms should be used. Place switch on BFO and turn Sensitivity Control to maximum.

TUBE SOCKET VOLTAGES

Tube	Symbol	Cathode to Ground	Screen Grid to Ground	Plate to Ground	Suppressor Grid to Ground	Oscillator Plate to Ground	Heater (A-C) Pin No. 2 to Pin No. 7
RCA-6SK7 (R-F Amplifier)	V8	3.0 (Pin No. 5)	90 (Pin No. 6)	180 (Pin No. 8)	3.0 (Pin No. 3)	—	6.1
RCA-6K8 (Det. Osc.)	V6	2.6 (Pin No. 8)	75 (Pin No. 4)	240 (Pin No. 3)	—	60 (Pin No. 6)	6.1
RCA-6K7 6SK7 (1st I-F Amp.)	V5	3.0 (Pin No. 5)	82 (Pin No. 6)	200 (Pin No. 8)	0 (Pin No. 3)	—	6.1
RCA-6SJ7 (Beat Freq. Osc.)	V2	0 (Pin No. 5)	50 (Pin No. 6)	15 (Pin No. 8)	—	—	6.1
RCA-6SK7 (2nd I-F Amp.)	V7	4.5 (Pin No. 5)	115 (Pin No. 6)	220 (Pin No. 8)	4.5 (Pin No. 3)	—	6.1
RCA-6H6 (2nd Det.)	V1	—	—	—	—	—	6.1
RCA-6SQ7 (A-F Amp.-A.V.C.)	V3	0.7 (Pin No. 3)	—	85 (Pin No. 6)	—	—	6.1 (Pin No. 7 to Pin No. 8)
RCA-6F6G (Output)	V4	16 (Pin No. 8)	260 (Pin No. 4)	250 (Pin No. 3)	—	—	6.1
RCA-5Y3Z (Rectifier)	V10	300.0 (Pin No. 8)	—	375 a.c. (Pins Nos. 4 & 6)	—	—	5.1 (Pin No. 2 to Pin No. 8) (Caution—300 v. d.c., voltage to ground)
RCA-VR-150 (Voltage Regulator)	V9	—	—	150 (Pin No. 5)	—	—	—

PARTS LIST

RECEIVER PARTS

Item	DESCRIPTION	Stock No.	Item	DESCRIPTION	Stock No.
C-1, C-2, C-3, C-4, C-5, C-6	Condenser — 3-gang, 6-section main tuning—less split gear, brass pinion, gear, and bearing assembly	34879	C-29	Condenser—3 to 25 mmfd., 7-plate beat-frequency oscillator control	34893
C-7, C-8, C-9, C-10, C-11, C-12, C-13, C-14, C-15	Capacitor — 3-gang, 9-section band-spread—less split gear, brass pinion gear, and bearing assembly	34880	C-30	Condenser—2.5 to 17.9 mmfd., 5-plate crystal phase adjusting condenser	37238
C-16	Condenser—3.6 to 35 mmfd., 10-plate antenna adjuster	34892	C-31	Capacitor—180 mmfd., 400 volts	13003
C-17, C-18	Condenser—Air trimmer	12714	C-32, C-33, C-34	Capacitor—0.01 mfd., 1000 volts	43764
C-19, C-20, C21, C-22	Condenser—Air trimmer	12807	C-35	Capacitor—68 mmfd., 400 volts	13057
C-23, C-24, C-25, C-26	Condenser—Same as C-17		C-36, C-37	Capacitor—Same as C-32	
C-27, C-28	Condenser—Same as C-21		C-38	Capacitor—10 mmfd., 400 volts	13200
			C-39	Capacitor—0.1 mfd., 400 volts	37327
			C-40	Capacitor — 1000 mmfd., 400 volts	12635
			C-41	Capacitor—5.6 mmfd., 400 volts	12814

PARTS LIST (Continued)

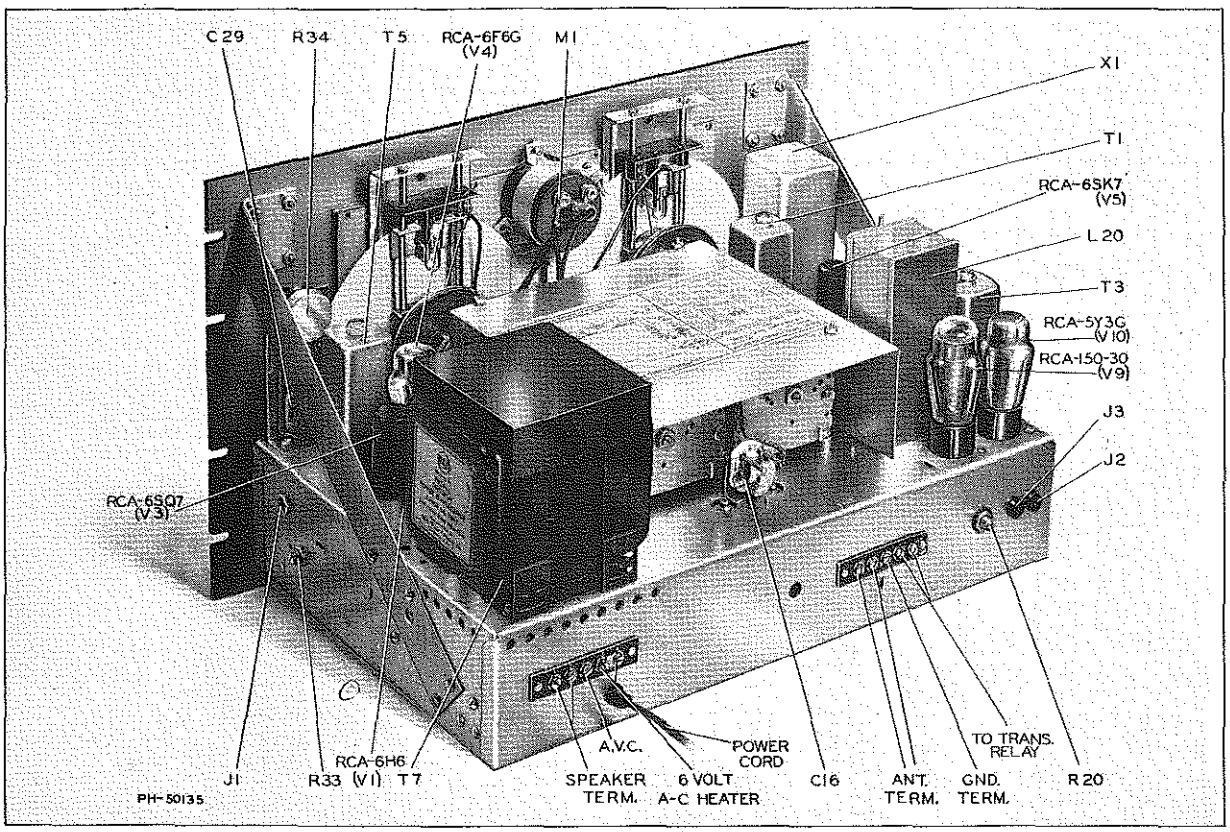
Item	DESCRIPTION	Stock No.
C-42	Capacitor—330 mmfd., 400 volts	12952
C-43	Capacitor—2700 mmfd., 400 volts	30057
C-44	Capacitor—Same as C-40	
C-45	Capacitor—0.05 mfd., 400 volts	37328
C-46	Condenser — Stabilizing condenser	34895
C-47	Capacitor — 120 mmfd., 400 volts	12724
C-48	Capacitor—Same as C-45	
C-49, C-50, C-51	Capacitor — 100 mmfd., 400 volts	12720
C-52	Capacitor—Same as C-32	
C-53, C-54, C-55	Capacitor—Same as C-45	
C-56, C-57	Capacitor — 220 mmfd., 400 volts	12694
C-58, C-59, C-60	Capacitor—Same as C-45	
C-61	Capacitor—Same as C-49	
C-62	Capacitor—56 mmfd., 400 volts	12723
C-63	Capacitor—12 mmfd., 400 volts	13002
C-64	Capacitor—47 mmfd., 400 volts	13141
C-65, C-66	Capacitor—Same as C-56	
C-67		
C-68	Capacitor — 1200 mmfd. 400 volts	13054
C-69	Capacitor—Same as C-45	
C-70	Capacitor—Same as C-49	
C-71	Capacitor—Same as C-64	
C-72, C-73	Capacitor—Same as C-45	
C-74	Capacitor—Same as C-63	
C-75	Capacitor—6.8 mmfd.	14079
C-76	Capacitor—Same as C-45	
C-77, C-78	Capacitor—5-5-5 mfd., 350 volts	34890
C-79	Capacitor—Same as C-39	
C-80	Capacitor—Same as C-49 (contained in T-5)	
C-81	Capacitor—Same as C-64 (contained in T-5)	
C-82, C-83	Capacitor—Same as C-45	
C-84, C-85	Capacitor — 20-20 mfd., 450 volts	34889
C-88	Capacitor—Same as C-32	
C-89, C-90	Capacitor—Same as C-45	
C-91	Capacitor—4 to 100 mmfd., mica trimmer	37219
C-92	Capacitor—0.25 mfd.	4839
J-1	Jack—Headphone jack	7903
J-2, J-3	Jack—Phone tip jack for transmitter relay connections	33891
L-1	Coil—Antenna 540-1340 kc	37232
L-2	Coil—Antenna 1340-3300 kc	37233
L-3	Coil—Antenna 3.3-5.8 mc	37234
L-4	Coil—Antenna 5.8-10.2 mc	37235
L-5	Coil—Antenna 10.2-18.0 mc	37236
L-6	Coil—Antenna 18.0-31.0 mc	37237
L-7	Coil—Detector 540-1340 kc	37226
L-8	Coil—Detector 1340-3300 kc	37227
L-9	Coil—Detector 3.3-5.8 mc	37228
L-10	Coil—Detector 5.8-10.2 mc	37229
L-11	Coil—Detector 10.2-18.0 mc	37230
L-12	Coil—Detector 18.0-31.0 mc	37231
L-13	Coil—Oscillator 540-1340 kc	37220
L-14	Coil—Oscillator 1340-3300 kc	37221
L-15	Coil—Oscillator 3.3-5.8 mc	37222
L-16	Coil—Oscillator 5.8-10.2 mc	37223
L-17	Coil—Oscillator 10.2-18.0 mc	37224
L-18	Coil—Oscillator 18.0-31.0 mc	37225
L-19	Crystal Filter Assembly—Coil core, capacitor and form—less shield can—includes C-51	34891
L-20	Reactor—Filter reactor	35327
M-1	Meter—Carrier level meter complete	34946
R-1	Resistor—470,000 ohms, ½ watt	35524
R-2	Resistor—10,000 ohms, ½ watt	37137
R-3	Resistor—330 ohms, ½ watt	18039
R-4	Resistor—22,000 ohms, ½ watt	37136
R-5	Resistor—150,000 ohms, ½ watt	37271
R-6	Resistor—Same as R-4	
R-7	Resistor—Same as R-3	
R-8	Resistor—Same as R-5	
R-9	Resistor—Same as R-2	
R-10	Resistor—Same as R-4	
R-11	Resistor—10 ohms, ½ watt	18471
R-12	Resistor—Same as R-2	
R-13	Resistor—6800 ohms, ½ watt	37273
R-14	Resistor—15,000 ohms, ½ watt	12759
R-15	Resistor—Same as R-4	
R-16	Resistor—68,000 ohms, ½ watt	37274
R-17	Resistor—Same as R-1	
R-18	Resistor—68 ohms, ½ watt	37275
R-19	Resistor—220 ohms, ½ watt	37276
R-20	Control—80-ohm tuning meter zero adjustment	34910
R-21	Control—30,000-ohm sensitivity control	34940
R-22	Resistor—Same as R-1	
R-23	Resistor—Same as R-4	
R-24	Resistor—Same as R-16	
R-25	Resistor—Same as R-2	
R-26	Resistor—Same as R-3	
R-27	Resistor—47,000 ohms, ½ watt	37139
R-28	Resistor—4700 ohms, ½ watt	30494
R-29	Resistor—100,000 ohms, ½ watt	19736
R-30, R-31	Resistor—Same as R-5	
R-32	Resistor—Same as R-27	
R-33	Control—100,000-ohm noise balance adjustment	34941
R-34	Control — 30,000-ohm limiter control	34938
R-35	Control—500,000-ohm volume control and power switch (S-1)	34939
R-36	Resistor—220.000 ohms, ½ watt	35510
R-37	Resistor—5600 ohms, ½ watt	37277
R-38	Resistor—1 megohm, ½ watt	35521
R-39	Resistor—1000 ohms, ½ watt	19739
R-40	Resistor—Same as R-29	
R-41	Resistor—Same as R-29	
R-42	Resistor—Same as R-1	
R-43	Resistor—820 ohms, ½ watt	35513
R-44, R-45, R-46	Resistor—Same as R-29	
R-47	Resistor—Same as R-1	
R-48	Resistor—470 ohms, 1 watt	37278
R-49	Resistor—Same as R-29	
R-51	Resistor—3000 ohms, 10 watts	34943
R-52, R-54	Resistor—Same as R-29	
S-1	Power Switch—Combined with R-35	
S-2	Switch—Range switch wafer	34915
S-3	Switch—Range switch wafer	34916
S-4	Switch—Range switch wafer—Same as S-2	
S-5	Switch—Range switch wafer	34914
S-6	Switch—Range switch wafer—Same as S-2	
S-7	Switch—Range switch wafer—Same as S-5	
S-8	Switch — Crystal selectivity switch	34912
S-9	Switch—A.V.C. switch	34911
S-10	Switch — Transmit-receive switch	34913

PARTS LIST (Continued)

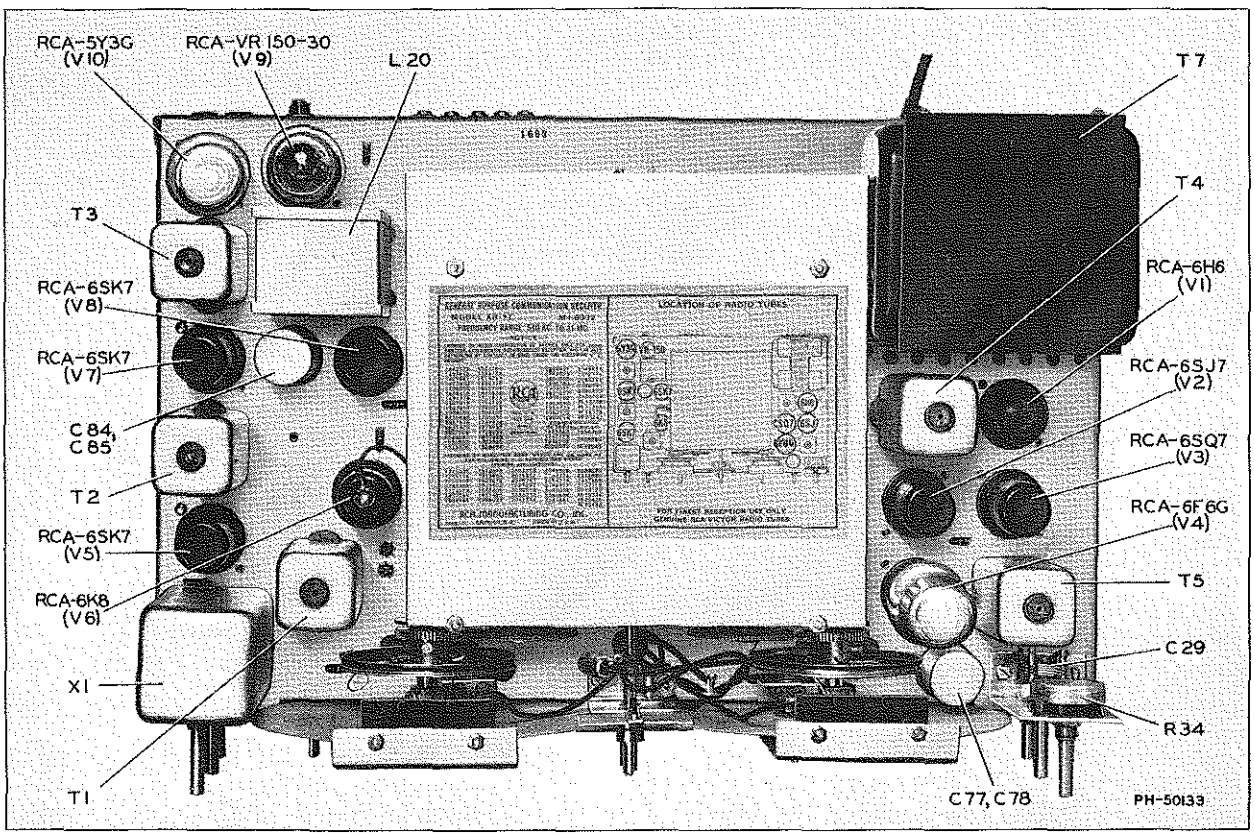
Item	DESCRIPTION	Stock No.
T-1	Transformer — First detector plate I-F transformer complete—includes C-47, R-12	34885
T-2	Transformer—I-F transformer complete — includes C-56, C-57, R-25	34887
T-3	Transformer—I-F link transformer complete — includes C-61, C-63, R-28	34884
T-4	Transformer—Diode I-F transformer complete — includes C-62, C-64	34888
T-5	Transformer — CW oscillator transformer complete — includes C-80, C-81, R-42	34886
T-6	Transformer — Output transformer	14355
T-7	Transformer—105-115 volts, 25-cycle power transformer (Used in MI-8302F only)	34693
T-7	Transformer — 110 - 125 - 150 - 210-240 volts, 50/60 cycle power transformer (Used in MI-8302E only)	37243
T-7	Transformer—105-125 volts, 50/60 cycle power transformer (Used in MI-8302D and MI-8302G only)	9551
X-1	Crystal—455 kc crystal filter and case	MI-7593
	MISCELLANEOUS	
	Bracket — Flywheel mounting bracket	34903
	Board—3-contact terminal board	12716
	Board—5-contact terminal board	34896
	Cord—Dial drive or range shutter control cord	32634
	Coupling—Range switch coupling with set screws	34937
	Detent—Range switch detent plate assembly	34936
	Dial—Transluscent band spread dial complete with hub and set screws	34900
	Dial—Transluscent main tuning dial complete with hub and set screws	34901
	Drum—Large dial drive drum complete	34908
	Flywheel — Tuning flywheel with set screws	34902
	Gear—Brass pinion gear and bearing assembly	34882
	Gear — Split main or band spread condenser drive gear	34881
	Guide, Band indicator shutter guide rods and strap assembly	34899
	Lamp — 6.3 volt dial lamp, Mazda No. 44	11891
	Pulley—Left-hand band indicator idler pulley and bracket	37241
	Pulley—Right-hand band indicator idler pulley and bracket	37242
	Pulley—Small dial drive pulley and hub with set screws	31271
	Scale — Calibrated stationary vernier scale—less support	34905
	Screw—No. 8-32 set screw for dial drive drum	14350
	Shaft—Dial drive flywheel shaft	34904
	Shaft—Range switch shaft—10¼ inches long	34935
	Shutter—Left-hand band indicating shutter and pilot lamp bracket assembly	37239
	Shutter—Right-hand band indicating shutter and pilot lamp bracket assembly	37240
	Socket—8-contact phenolic socket	18007
	Socket—8-contact wafer socket	33084
	Spring—Band indicator shutter lift spring	34898
	Spring—Dial drive cord tension spring	32481
	Spring—Triple loop spring used on rear end of band switch shaft	34944
	Support—Vernier scale support and hub assembly	34906
	Knob—Antenna adjuster control knob	34949
	Knob—Bar type control knob (8 used)	34950
	Knob—Main tuning or band spread control knob	34947
	Knob—Range switch control knob	34948
	Mask—Metal window mask plate	34953
	Nut—Clamping nut for air trimmers	14028
	Socket—Pilot lamp socket	34951
	Socket—Pilot lamp socket and clip	34909
	Window—Clear dial window sheet	34952

SPEAKER PARTS

Item	DESCRIPTION	Stock No.
	Cone—Speaker cone and voice coil	31310
	Escutcheon—"RCA" escutcheon	13059
	Plug—3-contact male plug for speaker	5118
	Socket—3-contact female socket for speaker cable	5119
	Speaker—Speaker unit only less panel	9712



A. Rack-Type Chassis



B. Cabinet-Type Chassis

Figure 3—General Purpose Communication Receiver (Chassis Top Views)

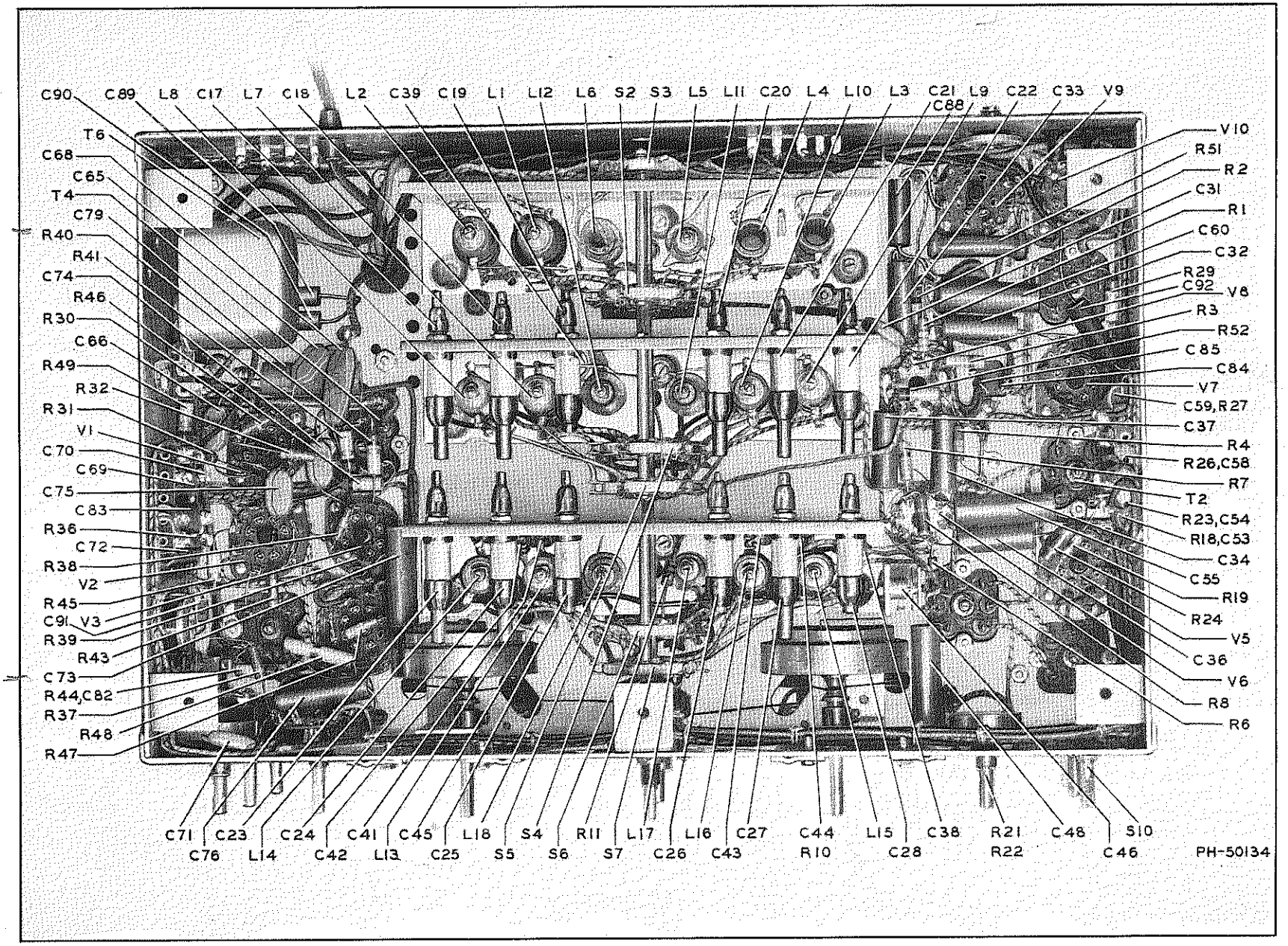


Figure 4—General Purpose Communication Receiver (Chassis Bottom View)

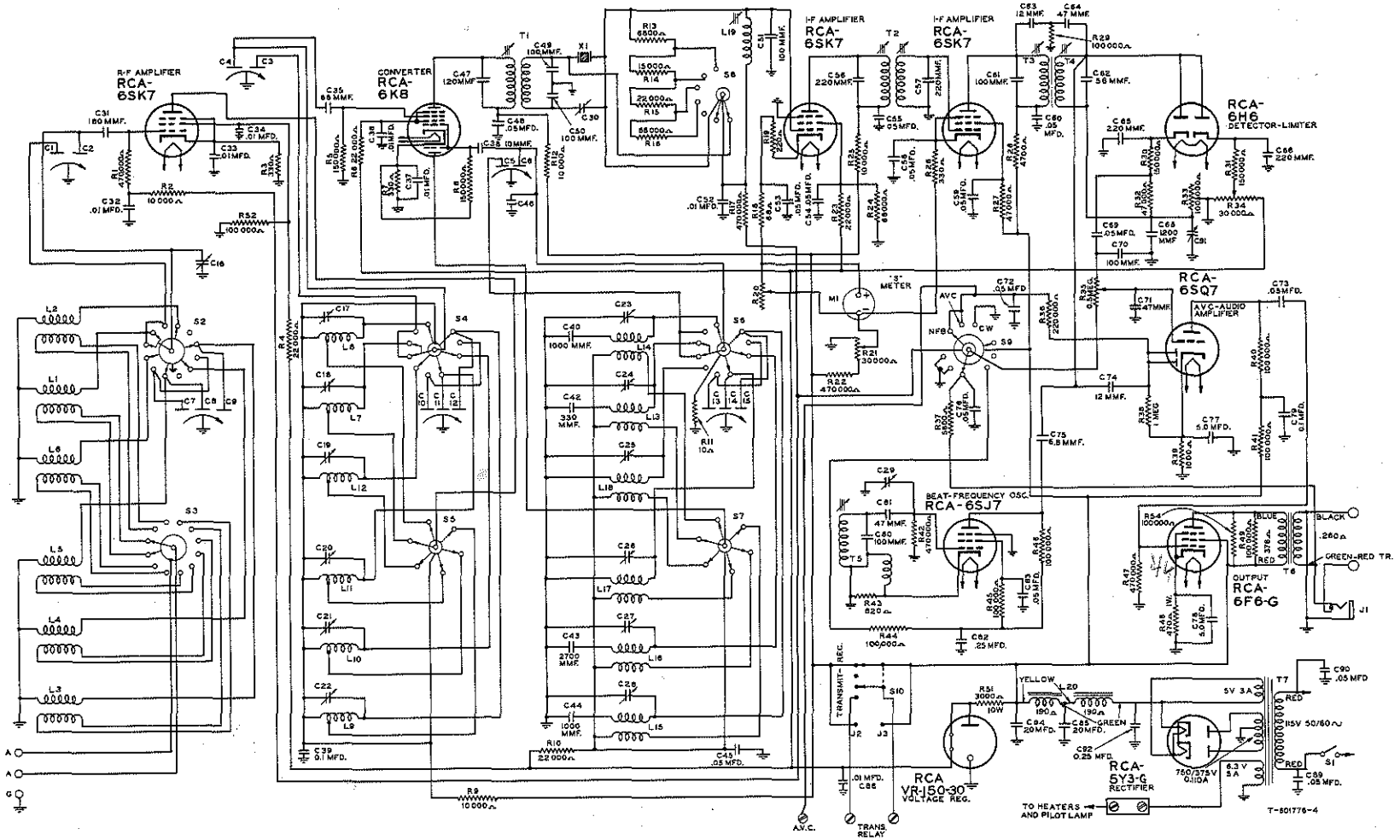


Figure 5—General Purpose Communication Receiver (Schematic T-601776)

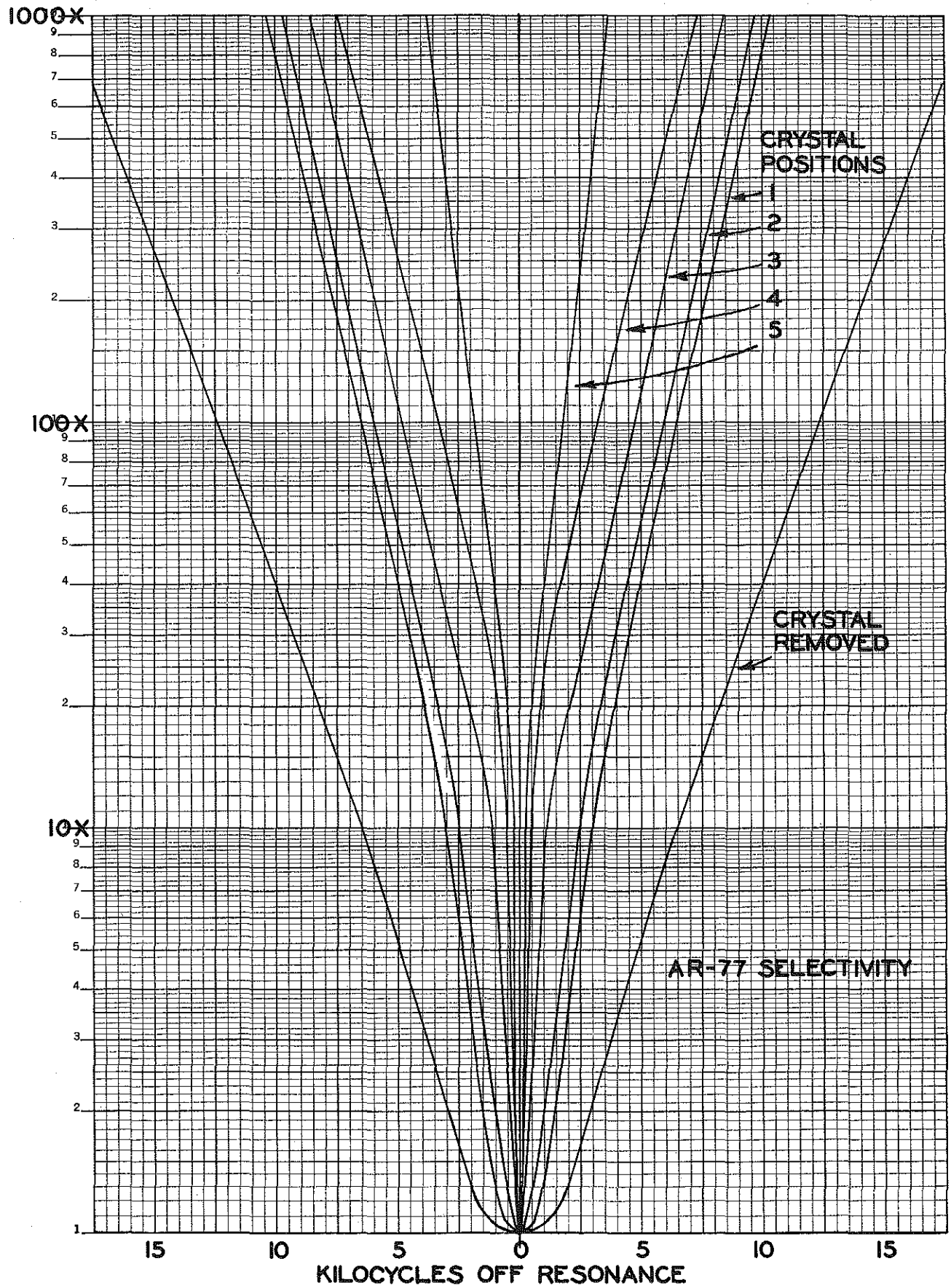


Figure 6—Selectivity Curves (S-851297)

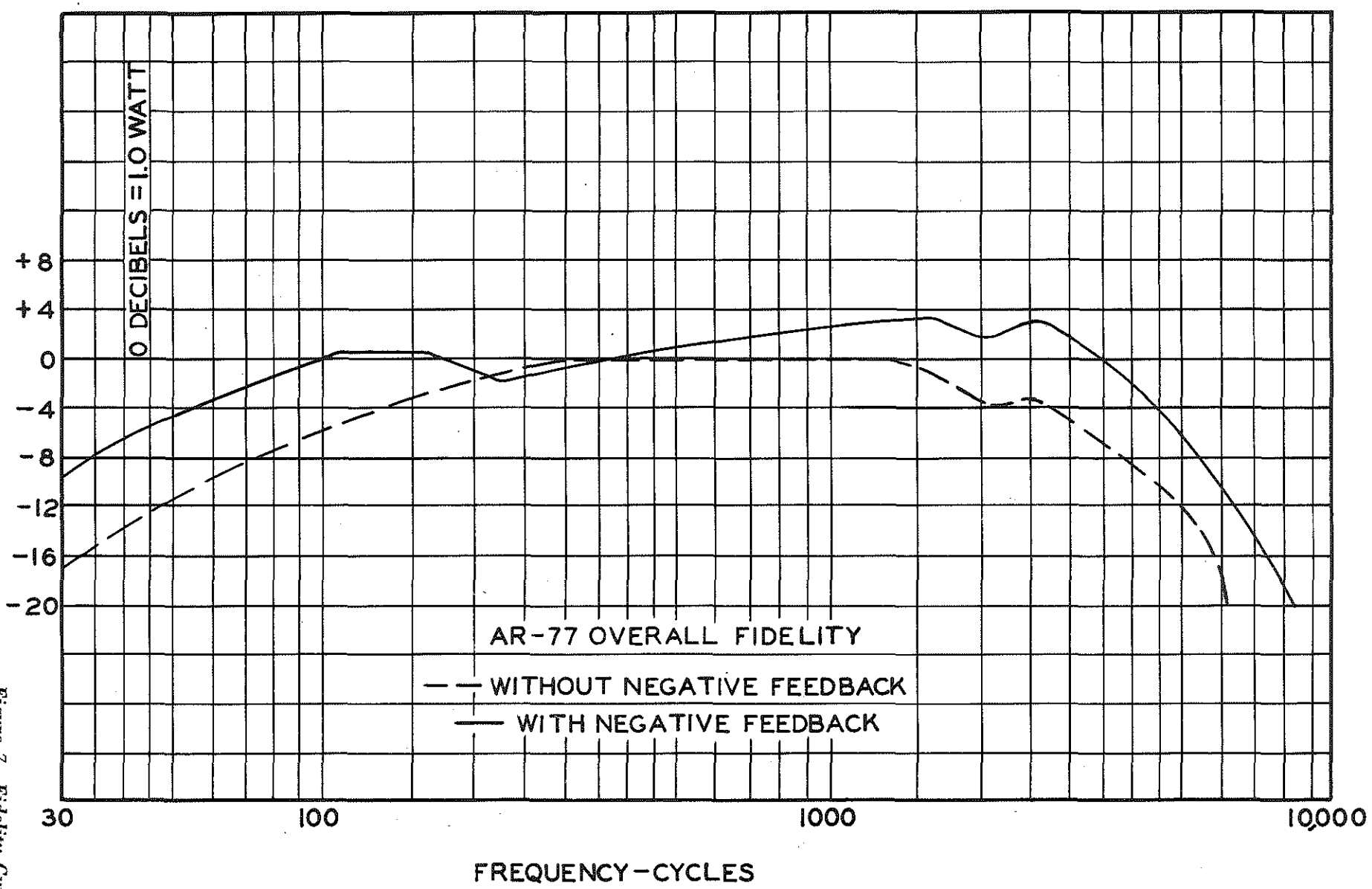


Figure 7—Fidelity Curves (S-851298)