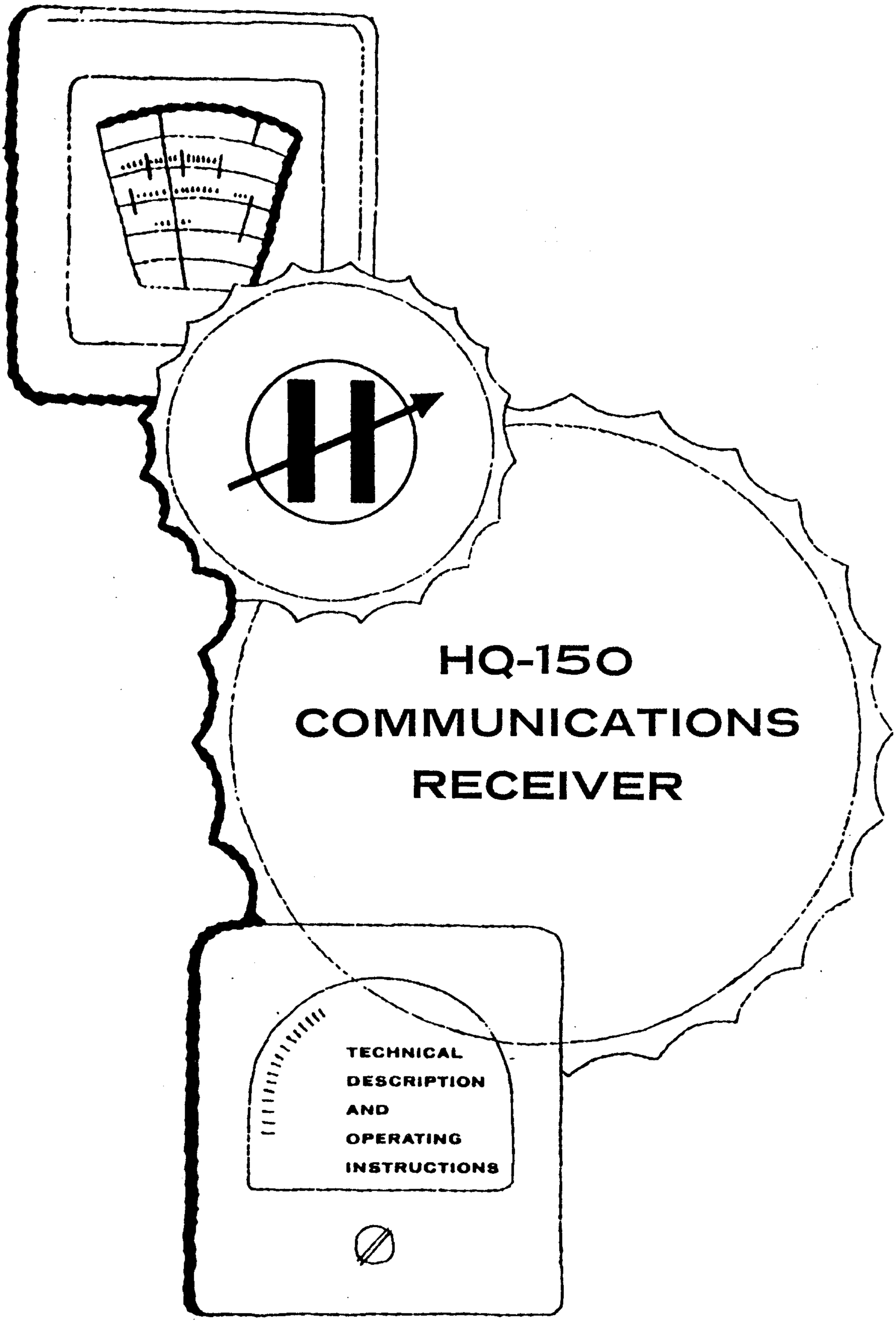
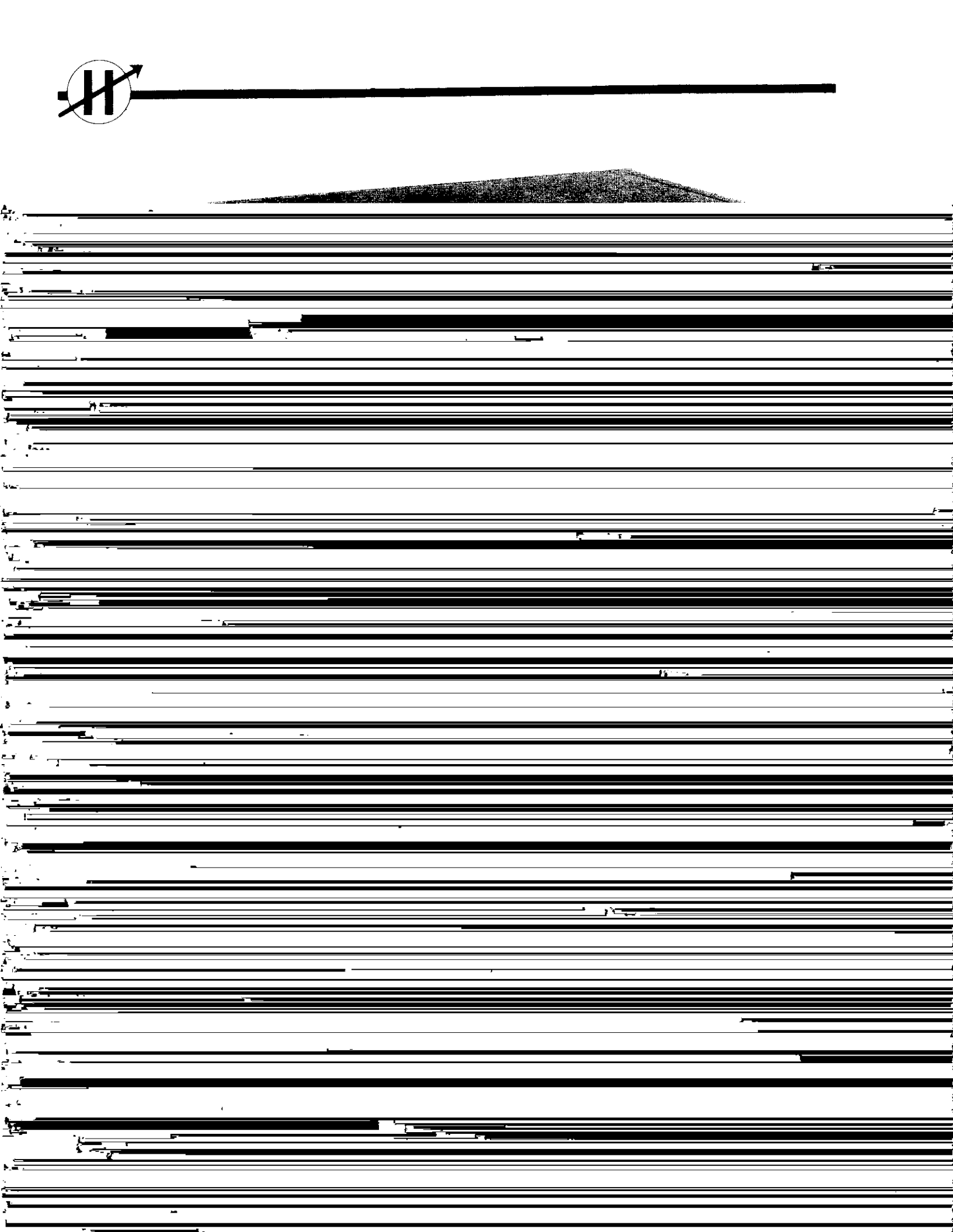


HAMMARLUND

Hammarlund Manufacturing Company
A Giannini Scientific Co.
53 West 23rd Street, New York 10, N. Y.
Export Department: 13 East 40th Street, New York 16, N. Y.



INTRODUCTION

The Hammarlund HQ-150 is an advanced design, general purpose, superheterodyne communications receiver designed to maintain high performance characteristics for many years without adjustment. The receiver has a self-contained stabilized power supply operating from a 50-60 cps, 105-125 volt AC source.

Frequency coverage is continuously tunable from 540 KCS to 31 KCS (555 to 9.7 meters) with extremely fine control of selectivity to separate crowded signals. Full use of the receiver's high sensitivity is available for reception of even the weakest stations because of inherently high signal-to-noise ratio and the superior Hammarlund noise

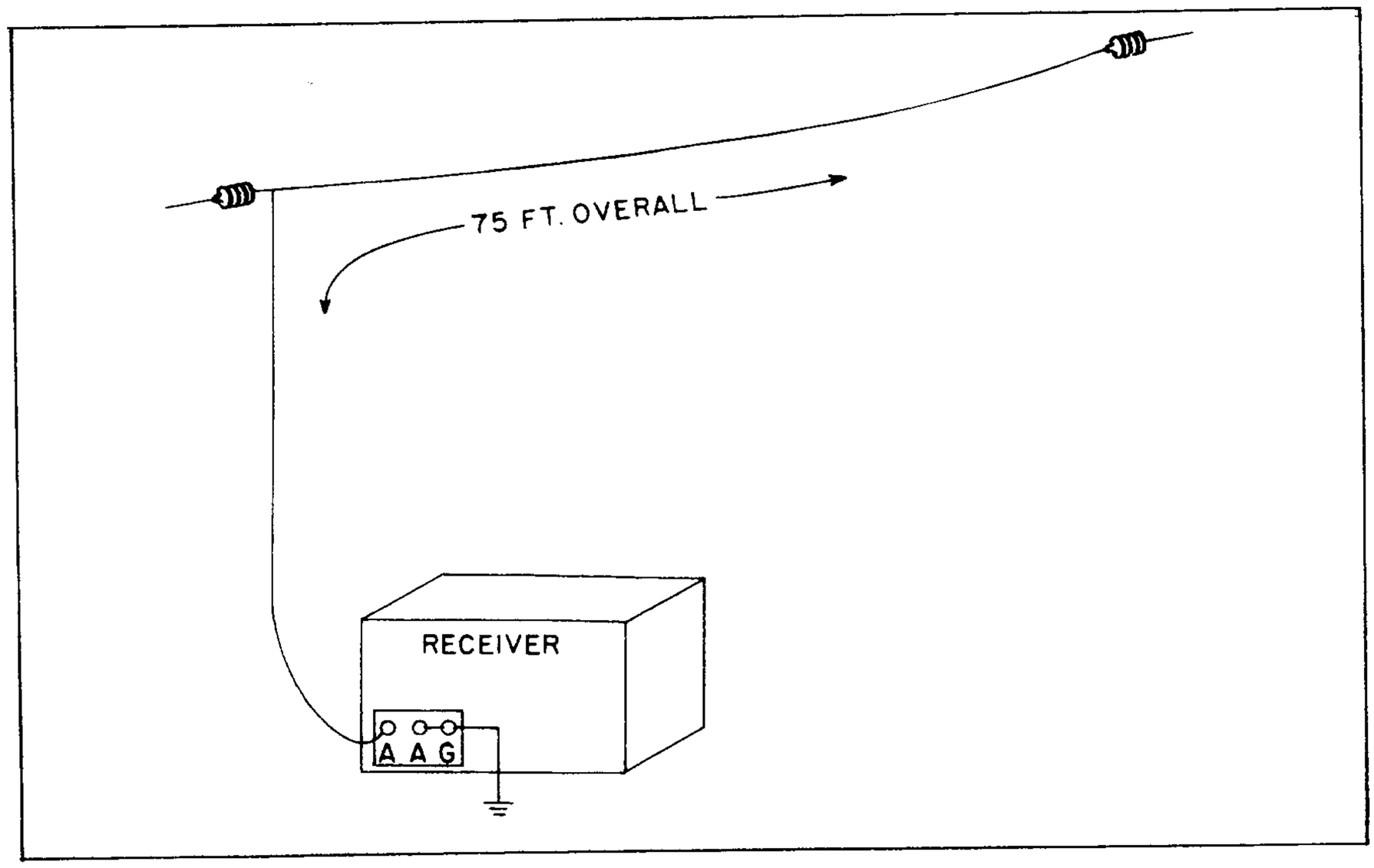


Figure 2. Installation of Single-wire Antenna

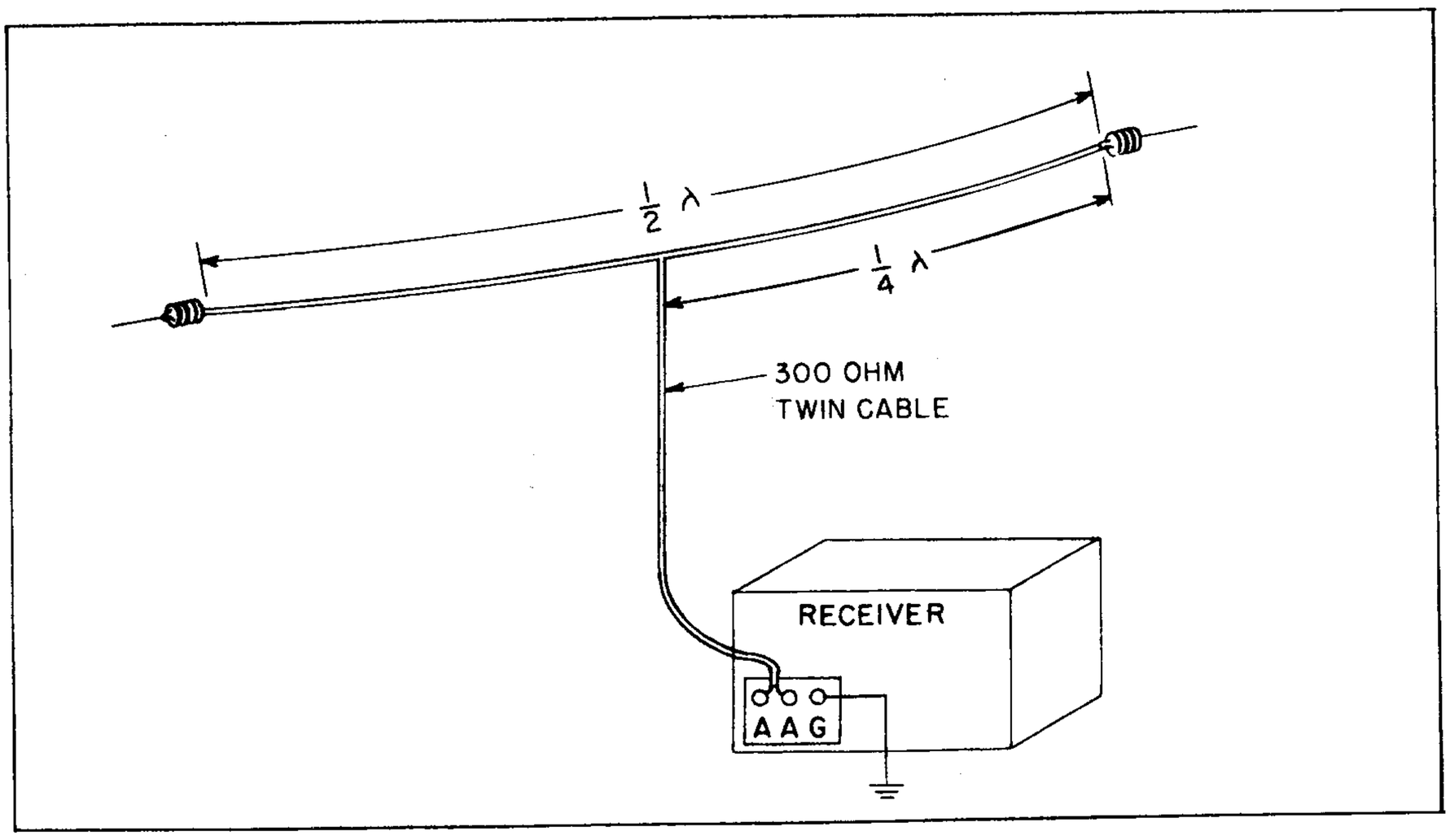


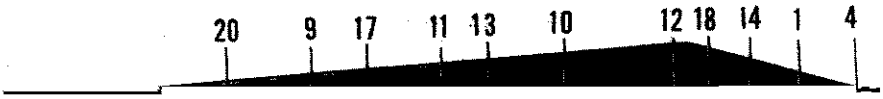
Figure 3. Installation of Folded Dipole Antenna

INSTALLATION

UNPACKING

Unpack the receiver carefully. Make sure that the

For general coverage an indoor antenna of 20 to 50 feet will give surprisingly good reception. A long single wire outdoor antenna such as shown in Figure 2 will generally give entirely satisfactory performance


20
9
17
11
13
10
12
18
14
1
4

OPERATION

Basically, all that is necessary to operate a radio receiver are the tuning and volume controls. The additional knobs and switches found on a professional-type receiver such as the HQ-150 control functions which greatly improve operating performance.

NORMAL CONTROL SETTINGS

For initial operation, set the controls as indicated on Figure 5.

The receiver ON-OFF switch is on the AUDIO GAIN control. If you are unfamiliar with the type of power available, check with the local power company before

To tune in a standard broadcast station, it is merely necessary to tune the MAIN TUNING dial to the desired frequency. The BAND SPREAD dial is inoperative on the first two ranges.

For reception of short-wave stations with the MAIN TUNING dial only, it is necessary to set the BAND SPREAD dial to 100 in order to attain correct calibration of the MAIN TUNING dial scale.

The BAND SPREAD dial is calibrated directly for the 80, 40, 20, 15, and 10 meter amateur bands.

Band	Low End	Middle	High End
3.2 - 5.7 MCS	0.4 MC	0.7 MC	1.25 MCS
5.7 - 10 MCS	0.2 MC	0.5 MC	0.9 MC
10 - 18 MCS	0.2 MC	0.5 MC	0.9 MC
18 - 31 MCS	0.6 MC	1.2 MCS	2.2 MCS

The following is an example of the use of the above table.

Main Tuning Dial Setting	Band Spread Dial Rotated 100 to 0 Will Cover	Band Switch Range
Low end of range	400 KCS or .4 MC	3.2 - 5.7 MCS
Middle of range	700 KCS or .7 MC	3.2 - 5.7 MCS
High end of range	1,250 KCS or 1.25 MCS	3.2 - 5.7 MCS

volume. When headphones are plugged into the jack in the lower right-hand corner of the panel, the speaker is disconnected. On the rear of the chassis are two pin-jacks marked RELAY which can be connected to the send-receive relay of the transmitter for break-in operation. With the STANDBY-RECEIVE switch in STANDBY, the receiver is silent but ready for instant use.

The PHASING control normally is set at the arrow in the center of its scale, but may be adjusted to cut out interference from stations on either side of the signal. With the CRYSTAL SELECTIVITY switch the operator can choose the degree of selectivity that provides the greatest fidelity with minimum interference. The first three positions are for phone reception and the fifth and sixth for single signal code reception in extremely crowded bands.

SINGLE SIDE-BAND (SSB) OPERATION

The BFO (Beat Frequency Oscillator) provides a wide choice of tones for CW code operation and carrier reinsertion for single side-band reception (SSB). Turning the MAN-AVC-BFO switch to BFO disconnects the automatic volume control, and the SENSITIVITY control must then be employed. When using the receiver for single side-band reception the following procedure should be observed:

1. Set the CW TONE control to 2 on either side of zero.

2. Using the BAND SPREAD control, first zero beat the desired SSB (single side-band) signal, then tune for maximum intelligibility.

3. Should the signal still not be intelligible, rotate the CW TONE control to 2 on the other side of zero.

4. Carefully adjust the BAND SPREAD control for greatest clarity.

It is often a great help to use the LIMITER in short-wave reception.

TUNING RANGES

Band	Frequency	Meters Wave Length

CIRCUITRY

PRESELECTION

The antenna input coupling and RF amplifier stage provide the necessary preselection and gain for high performance and rejection of undesired signals. The high signal level at the mixer grid, V3, contributes to

use of a separate mixer (6BE6), V3, and an independent oscillator (6C4), V1.

The output signal from RF amplifier, V2, is heterodyned with the output of the local high frequency oscillator, V1, and electronically combined within the mixer tube, V3. On the four lower frequency ranges

CRYSTAL FILTER AND PHASING NETWORK

tuated by the advancement of the PEAK control ap-

ditions where the use of the crystal filter and/or the Q Multiplier (as the result of the increased selectivity they achieve) may make it possible to eliminate adjacent channel interference.

For example, if two short-wave broadcasting stations are operating on almost the same frequency, the additional selectivity provided by either the crystal filter or the Q Multiplier may make it possible to minimize, if not eliminate entirely, the undesired signal. It is wise to remember however that as a result of increasing the selectivity by narrowing the band width.

settings. By limiting the control of these functions to the PEAK/NULL switch and the FREQUENCY CONTROL, the operation of the Q Multiplier is greatly simplified. Usually the proper position of the NULL control will be found more critical for maximum rejection than adjustment of the PEAK control. Once the best possible adjustment is obtained in the NULL position, the crystal filter may be brought into play, and additional rejection of the undesired signal obtained by the use of the crystal phasing control.

It must be realized in view of the many variables in-

in order to maintain stability. Iron core permeability-tuned transformers improve performance and add to the ease of adjustment. The intermediate frequency is 455 KC, the RTMA standard.

AVC SYSTEM

Automatic Volume Control minimizes fading and signal strength variations by controlling the gain of the RF stage V2 and the IF stages V4 and V5. As a result, a comfortable and constant level of audio is maintained.

The Automatic Volume Control is operative only when the MAN-AVC-BFO switch is in the AVC position. With AVC, greatest signal-to-noise ratio will result with the SENSITIVITY control set at maximum. It may be necessary to reduce sensitivity slightly for unusually strong signals.

"S" METER (CARRIER LEVEL)

The "S" or Tuning Meter is provided to assist in tuning and to give an indication of relative signal strength. Because the meter readings are proportional to AVC voltage, it is operative only when the MAN-AVC-BFO switch is in the AVC position.

The meter, which is calibrated to 20 db over S-9, is factory adjusted so that a signal input of approximately 50 microvolts gives a reading of S-9. Each "S" unit indicates a 6 db increase, equivalent to doubling signal strength. Should meter readjustment be necessary:

1. Set front panel SENSITIVITY control to "10" and CRYSTAL SELECTIVITY to "OFF".
2. With receiver off, mechanically zero pointer with a fine screwdriver.
3. With AVC on and the 1st IF tube V4 removed, zero pointer with ZERO ADJ potentiometer R-19.
4. With AVC on and V4 replaced adjust meter sensitivity with SENS potentiometer R-23

only operates efficiently in AVC ON position or MANUAL position but not in BFO position.

BEAT FREQUENCY OSCILLATOR (BFO)

The Beat Frequency Oscillator, which employs one section of the 12AX7 (V8), is designed to provide reception of CW or unmodulated code signals also for reinserted carrier SSB. The CW TONE control permits selection of the desired audio tone. Each calibration division represents approximately 1000 cycles.

The BFO is only operative when the MAN-AVC-BFO switch is in the BFO position.

CRYSTAL CALIBRATOR

The Crystal Calibrator is a highly stable 100 KC crystal oscillator. It is provided with an adjustable trimmer capacitor for accurately adjusting the oscillator frequency against a standard frequency, such as WWV. It provides signal markers at 100 KC intervals throughout the tuning range of the receiver.

AUDIO AMPLIFIER

The first audio stage is a resistance coupled voltage amplifier using the other section of the 12AX7 (V8). The audio output stage, a 6V6GT/G beam power amplifier (V9) provides an undistorted output of at least 2 watts.

The output transformer impedance is 6 ohms to match the voice coil of the Hammarlund or other suitable permanent magnet speaker. The phone jack is

REALIGNMENT PROCEDURE

IF AMPLIFIER ALIGNMENT

The intermediate-frequency transformers are iron-core permeability-tuned and resonated with fixed silvered-mica capacitors. A high degree of stability results

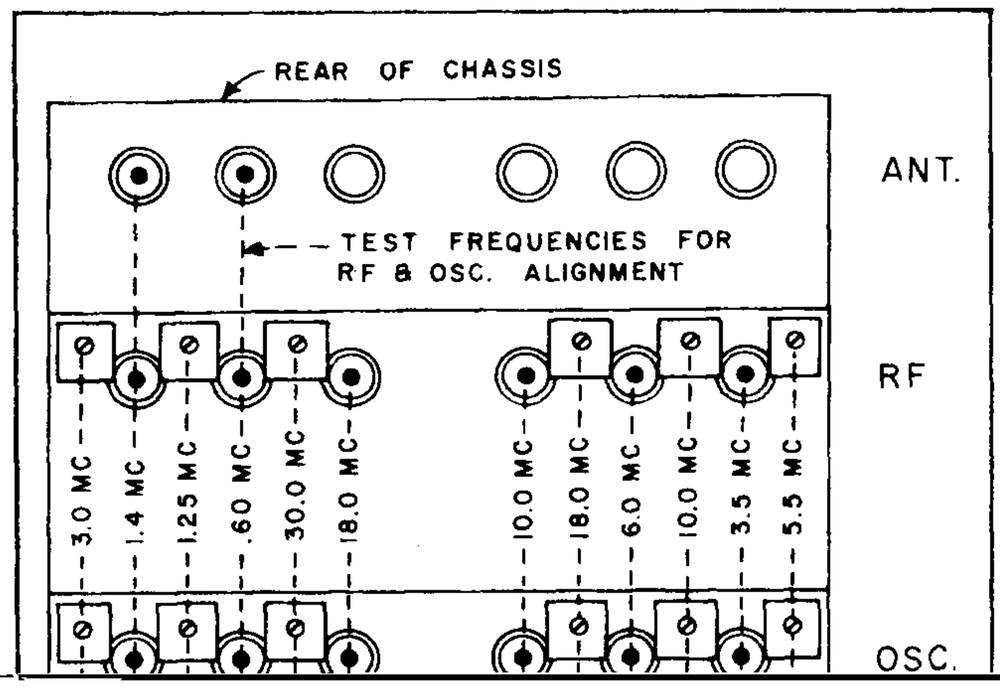
a stage-by-stage alignment, starting with the last IF transformer (Z4) and continuing back through the first IF transformer (Z1).

EQUIPMENT REQUIRED

CONTROL SETTINGS

Set receiver controls as follows:

MAIN TUNING DIAL	.54 MC
Bandswitch (TUNING RANGE) . . .	.54 - 1.32 MCS
STANDBY-RECEIVE	RECEIVE
LIMITER	OFF
MAN-AVC-BFO	MAN
CRYSTAL SELECTIVITY	OFF



PROCEDURE

Observe the following steps when realigning the IF amplifier stages:

a. With generator set at 455 KC apply signal to the grid (pin No. 1) of the 3rd IF tube (V6). Adjust

The middle row of adjustments control RF alignment and the rear adjustments are for antenna alignment.

CONTROL SETTINGS

PROCEDURE

NOTE

Each band is adjusted for maximum response

a. With signal generator connected to the receiver ANTENNA terminals through a series resistor equal to 100 ohms minus the signal generator output impedance, and output meter connected to the SPEAKER terminals, adjust L17 until maximum deflection is obtained on the meter.

d. Change signal generator to 3 MCS, and set MAIN TUNING dial to 3 MCS to correspond. Adjust C64 to tune in signal and C58 for maximum response.

NOTE

This procedure is followed for each band and should be repeated until calibration and tracking are as desired.

MAINTENANCE

The HQ-150 is designed to give years of trouble-free service without need for repairs. Tube failure is the most common source of trouble. The second most common cause of difficulty is component failure among small resistors and fixed capacitors.

The following charts give voltages and resistances between tube socket terminals and chassis. Voltages indicated are those measured with a vacuum tube voltmeter; resistances with a vacuum tube ohmmeter. Slight variations from voltages indicated may be disregarded.

With the aid of the chart and the schematic diagram, defective components can usually be located. The parts list in the back of this manual gives values and Hammarlund part numbers.

Standard items may be purchased locally. Non-standard components are available on order from the factory.

A sensitive communications receiver should be entrusted only to a qualified technician. Should difficulty be experienced, please write the company for advice or to arrange for factory service.

TUBE SOCKET VOLTAGES TABLE HQ-150

LINE VOLTAGE 117 Vac SENSITIVITY AND AUDIO GAIN CONTROLS MAX. NO SIGNAL, LIMITER OFF, SEND RECEIVE SWITCH ON RECEIVE

DIAL AT 4.9 mc	MAN-AVC-BFO SWITCH ON MAN. VOLTAGES MEASURED WITH TUBE VOLTMETER									MAN-AVC-BFO SWITCH ON MAN	BFO
Pin No. to Gnd.	RF 6BA6	Mixer 6BE6	Osc 6C4	1st IF 6BA6	2nd IF 6BA6	3rd IF 6BA6	Det Avc 6AL5	Output 6V6/GT	Rect. 5U4GB	Volt. Reg. 0C3/VR105	Calibrator 1/2 6BZ6	Q Multiplier 12AX7 on Min Null	1st Audio 1/2 12AX7	BFO 1/2 12AX7
Pin 1			97				-.38			Tiepoint 215	-30	100	70	
Pin 2		1.35		1.0	1.35	2.45	-.76		310		9.7			
Pin 3	6.2 ac	6.2 ac	6.2 ac	6.2 ac	6.2 ac	6.2 ac	6.2 ac	265		109		.75	.6	
Pin 4								280	280 ac				6.2 ac	
Pin 5	205	212	97	195	210	205				109	90		6.2 ac	
Pin 6	105	96		100	105	125		Tiepoint 215	280 ac		80	220		170
Pin 7	1.25			1.0	3.1	2.45	-.38	6.2 ac			9.7			-15
Pin 8								14.5	310			2.3		
Pin 9											6.2 ac	6.2 ac		

TUBE SOCKET RESISTANCE TABLE HQ-150

POWER PLUG OUT, SENSITIVITY AND AUDIO GAIN CONTROLS MAX. SEND RECEIVE SWITCH ON RECEIVE													MAN-AVC-BFO SWITCH ON-	
	MAN-AVC-BFO SWITCH ON MAN			RESISTANCE MEASURED WITH V.T. OHMMETER									MAN	BFO
Pin No. to Gnd.	RF 6BA6	Mixer 6BE6	Osc 6C4	1st IF 6BA6	2nd IF 6BA6	3rd IF 6BA6	Det Avc 6AL5	Output 6V6/GT	Rect. 5U4GB	Volt. Reg. 0C3/VR105	Calibrator 1/2 6BZ6	Q Multiplier 12AX7 on Min Null	1st Audio 1/2 12AX7	BFO 1/2 12AX7
Pin 1	470K	22K	78K	10K	480K	1.4	242K			Tiepoint 74K	470K	294K	570K	
Pin 2	0	150		130	270	240	550K	0	73K	0	4700	2.2 MEG.	250K	
Pin 3								73K	73K	76K		1500	2200	
Pin 4	0	0	0	0	0	0	0	73K		90	0	0		
Pin 5	74K	74K	78K	74K	74K	74K	0	500K		76K	540K	0		
Pin 6	78K	78K	47K	78K	78K	105K	0	Tiepoint 75K	85		170K	131K		86K
Pin 7	52	47K	0	30	570	240	242K			76K	4700	2.2 MEG.		33K
Pin 8								360	73K	74K		6800		0
Pin 9														

Schematic Designation	Description	Hammarlund Part No.
	CAPACITORS	
C1, A-F	Main Tuning, variable. . . . . (Part of 20840-G1)	
C2, A-I	Band Spread, variable. . . . . (Part of 20840-G1)	
C3, 4, 5	Ceramic disc, .02 mf W. V. D. C.	23034-9
C6	Silver mica, 51 mmf 500 W. V. D. C.	23003-87C
C7, 8, 9	Ceramic disc, .02 mf W. V. D. C.	23034-9
C10	Silver mica, 240 mmf 500 W. V. D. C. (Part of Z1, I. F. Transformer Assembly #26121)	23071-56
C11	Silver mica, 260 mmf 500 W. V. D. C. (Part of Z1, I. F. Transformer Assembly #26121)	23003-112
C12, 13, 14, 15	Ceramic disc, .022 mf W. V. D. C.	23034-24
C16	Silver mica, 220 mmf 500 W. V. D. C. (Part of Z2, Crystal Filter Assembly #26125)	23071-55
C17, 18	Silver mica, 100 mmf 500 W. V. D. C. (Part of Z2, Crystal Filter Assembly #26125)	23003-94
C19	Crystal phasing variable, (Part of Z2, Crystal Filter Assembly #26125)	11776-G1
C20	Silver mica 75 mmf 500 W. V. D. C. (Part of Z2, Crystal Filter Assembly #26125)	DM15C750J
C21	Silver mica 3900B mmf 500 W. V. D. C. (Part of Z2, Crystal Filter Assembly #26125)	23015-51
C22, 23, 24	Ceramic disc, .022 mf W. V. D. C.	23034-24
C25	Ceramic, NPO 1.5 mmf 500 W. V. D. C.	23022-2
C26	Silver mica, 240 mmf 500 W. V. D. C. (Part of Z3, I. F. Transformer Assembly #26123)	23071-56
C27	Silver mica, 260 mmf 500 W. V. D. C. (Part of Z3, I. F. Transformer Assembly #26123)	23003-112
C28, 30, 31, 32	Ceramic disc, .02 M. F. D. 600 W. V. D. C.	23034-9
C29	Silver mica 51 mmf 500 V. D. C. W.	23003-87C
C33, 34	Silver mica, 95 mmf 500 W. V. D. C. (Part of Z4, Final I. F. Transformer Assembly #26112). . .	23071-62
C35, 36	Mica, 100 mmf 500 W. V. D. C.	DM15-C101K
C37	Ceramic disc, .001 mf 600 V. D. C. W.	23034-4
C38	Paper tubular, .02 mf 600 W. V. D. C.	23034-9
C39	Discap .01 mf 1000 W. V. D. C.	23034-8
C40	Ceramic disc, .02 mf W. V. D. C.	23034-9
C41	Silver mica, 10 mmf 500 W. V. D. C.	23006-8
C42	Silver mica, 240 mmf 500 W. V. D. C. (Part of Z5, B. F. O. Assembly #26105).	23071-56
C43	B. F. O. variable, (Part of Z5, B. F. O. Assembly #26105).	11735-G42
C44	Silver mica, 220 mmf 500 W. V. D. C. (Part of Z5, B. F. O. Assembly #26105).	23071-55
C45	Ceramic disc, .01 1000 W. V. D. C.	23034-8

PARTS LIST HQ-150 (cont)

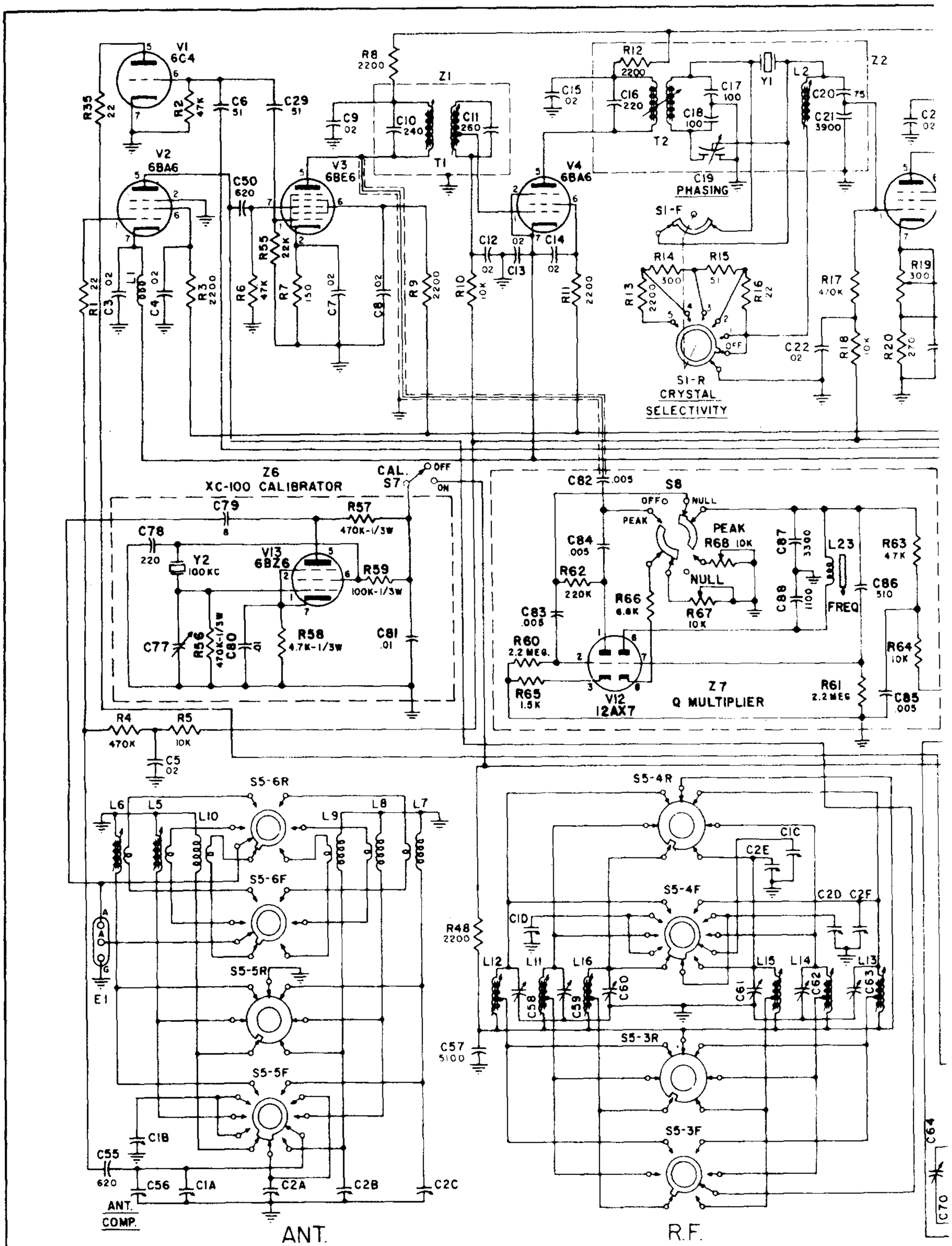
Schematic Designation	Description	Hammarlund Part No.
	CAPACITORS (Continued)	
C68	Trimmer, ceramic NPO 3-12 mmf	23059-2
C69	Trimmer, mica 1.5-9 mmf	16089-1
C70	Silver mica, 673 mmf 500 W.V.D.C.	23004-2
C71	Silver mica, 300 mmf 500 W.V.D.C.	23003-105
C72	Ceramic disc, .02 W.V.D.C.	23034-9
C73	Mica, 1500 mmf 500 W.V.D.C.	23015-20
C74	Mica, 1000 mmf 500 W.V.D.C.	23015-40
C75, 76	Ceramic disc, .02 mfd 500 V.D.C.W.	23034-9
C77	Trimmer, 8-50 mmf	23038-5
C78	Silver mica, 220 mmf.	DM15C221J
C79	Silver mica, 8 mmf	23034-11
C80, 81	Ceramic disc, .01 mfd	23034-5
C82, 83, 84, 85	Ceramic disc, .005 mfd.	23034-1
C86	Silver mica, 510 mmf	23003-74
C87	Silver mica, 3300 mmf ±5%	23011-43

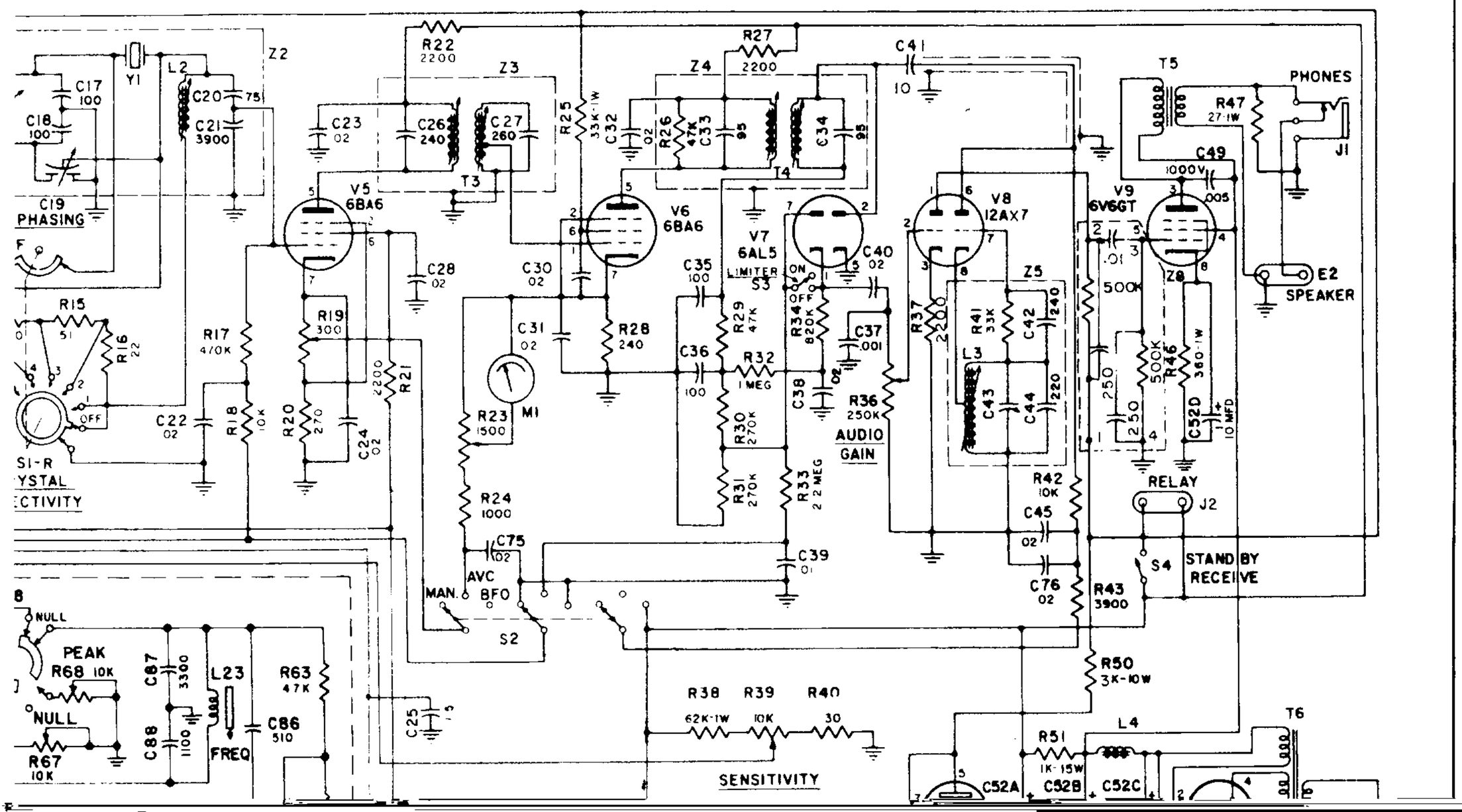
Schematic Designation	Description	Hammarlund Part No.
	RESISTORS (Continued)	
R11	2,200 Ohms, 1/2 W	19309-57
R12	2,200 Ohms, 1/2 W (Part of Z2, Crystal Filter Assembly #26125)	19309-57
R13	2,200 Ohms, 1/2 W	19309-57
R14	300 Ohms, 1/2 W	19309-202
R15	51 Ohms, 1/2 W	19309-193
R16	22 Ohms, 1/2 W	19309-9
R17	470,000 Ohms, 1/2 W	19309-113
R18	10,000 Ohms, 1/2 W	19309-73
R19	Potentiometer, 300 Ohms	15368-1
R20	270 Ohms, 1/2 W	19309-262
R21, 22	2,200 Ohms, 1/2 W	19309-57
R23*	Potentiometer, 1,500 Ohms	15368-2
R24*	1,000 Ohms, 1/2 W	19309-49
R25	33,000 Ohms, 1 W	19310-293
R26	47,000 Ohms, 1/2 W (Part of Z4, I. F. Transformer Assembly #26113)	19309-89
R27	2,200 Ohms, 1/2 W	19309-57
R28	240 Ohms, 1/2 W	19309-201
R29	47,000 Ohms, 1/2 W	19309-89
R30, 31	270,000 Ohms, 1/2 W	19309-107
R32	1 Meg Ohms, 1/2 W	19309-121
R33	2.2 Meg Ohms, 1/2 W.	19309-129
R34	820,000 Ohms, 1/2 W	19309-119
R35	Resistor 22 Ohms, 1/2 W	19309-9

PARTS LIST HQ-150 (cont)

Schematic Designation	Description	Hammarlund Part No.
	SWITCHES	
S1, F, R,	Crystal Selectivity	
S2	MAN-AVC-BFO	26161-1
S3	Limiter	15864-2
S4	Standby-Receive	15864-2
S5-1F, R	H. F. Osc. plate	6331
S5-2F, R	H. F. Osc. grid	6332
S5-3F, R	Detector grid tap	6064
S5-4F, R	R. F. plate	6063
S5-5F, R	R. F. grid	6063
S5-6F, R	Antenna	6062
S6	Power (Part of R36, Potentiometer #6095)	
S7	Calibrator	6098
S8	Q Multiplier	26217-1
	TRANSFORMERS AND IMPEDANCE ASSEMBLIES	
T5	Audio Output Transformer	6086-3
T6	Power Transformer	26109-1
Y1	Crystal, 455 kc	6338-1
Y2	Crystal, 100 kc	38661-1
Z1	1st I. F. Assembly, includes C10, C11, and T1	26121-G1
Z2	Crystal Filter Assembly (2nd I. F.), includes C16, C17, C18, C19, C20, C21, L2, R12, T2, and Y1	26125-G1
Z3	3rd I. F. Assembly, includes C26, C27, and T3	26123-G1
Z4	Final I. F. Assembly, includes C33, C34, R26, and T4	26112-G1
Z5	B. F. O. Assembly, includes C42, C43, C44, L3, and R41.	26105-G1
Z6	Crystal Calibrator Assembly, includes C77, C78, C79, C80, C81, R56, R57, R58, R59 and Y2	38653-G4
Z7	Q Multiplier Assembly, includes C82, C83, C84, C85, C86, C87, C88, L23, R60, R61, R62, R63, R64, R65, R66, R67, R68 and S8	26219-G1
Z8	Audio RC Printed Network	38846-1

*Resistor R24, in some models of the HQ-150, will be a 2.5K Variable Resistor, in substitution for


V1 6C4
V2 6BA6
V3 6BE6
V4 6BA6
R35 22
R2 47K
C6 51
C29 51
R8 2200
Z1
C9 02
C10 240
C11 260
T1
C50 620
R55 22K
R1 22
C3 02
L1
C4 02
R3 2200
R6 47K
R7 150
C7 02
C8 02
R9 2200
R10 10K
C12 02
C13 02
C14 02
R11 2200
R12 2200
C15 02
C16 220
C17 100
C18 100
T2
Y1
L2
C20 75
C21 3900
Z2
C19 PHASING
S1-F
R14 300
R15 51
R16 22
R13 2200
S1-R CRYSTAL SELECTIVITY
C22 02
R17 470K
R18 10K
R19 300
R20 270
Z6 XC-100 CALIBRATOR
CAL. S7 OFF ON
C79
R57 470K-1/3W
C78 220
Y2 100KC
V13 6BZ6
R59 100K-1/3W
C77
R56 470K-1/3W
C80
R58 4.7K-1/3W
C81 .01
C82 .005
S8
OFF NULL PEAK
PEAK R68 10K
NULL
R67 10K
C84 .005
R62 220K
C83 .005
R66 6.8K
C87 3300
C88 1100
L23
FREQ
R63 4.7K
C86 510
R64 10K
C85 .005
R60 2.2 MEG.
R65 1.5K
V12 12AX7
Z7 Q MULTIPLIER
R61 2.2 MEG
R4 470K
R5 10K
C5 02
S5-6R
S5-6F
S5-5R
S5-5F
L6 L5 L10 L9 L8 L7
A O O G
E1
C1B
C55 620
C56
C1A
C2A
C2B
C2C
ANT. COMP.
ANT.
S5-4R
S5-4F
S5-3R
S5-3F
C1C
C2E
C2D C2F
C1D
R48 2200
L12 L11 L16 L15 L14 L13
C58 C59 C60 C61 C62 C63
C57 5100
C64
C70
R.F.


Z2
Y1
L2
C17 100
C18 100
C20 75
C21 3900
C19 PHASING
R15 51
R16 22
OFF
SI-R
YSTAL
CTIVITY
C22 02
R17 470K
R18 10K
R19 300
R20 270
C24 02
2200
R21
C28 02
Z3
R22 2200
C23 02
C26 240
C27 260
T3
V5 6BA6
R25 33K-1W
C30 02
C31 02
M1
R23 1500
R24 1000
C75 02
AVC
MAN.
BFO
S2
V6 6BA6
C32 02
R26 47K
C33 95
T4
R27 2200
Z4
C34 95
V7 6AL5
LIMITER
S3
ON
OFF
C40 02
C41 10
R28 240
C35 100
C36 100
R29 47K
R32 1 MEG
R30 270K
R31 270K
R33 2.2 MEG
C38 02
C39 01
R34 820K
C37 .001
R36 250K
AUDIO GAIN
V8 12AX7
Z5
R37 2200
R41 33K
C42 240
C43
C44 220
T5
PHONES
R47 27-1W
J1
C49 1000V .005
V9 6V6GT
.01
500K
250
250
500K
R46 380-1W
C52D 10 MFD
Z8
E2
SPEAKER
RELAY
J2
R42 10K
C45 02
C76 02
R43 3900
S4
STAND BY
RECEIVE
R50 3K-10W
NULL
PEAK
R68 10K
NULL
R67 10K
C87 3300
C88 1100
L23
FREQ
R63 47K
C86 510
C25
R38 62K-1W
R39 10K
R40 30
SENSITIVITY
C52A
R51 1K-15W
C52B
C52C
L4
T6