

THE HQ-110 COMMUNICATIONS RECEIVER

INSTRUCTION AND SERVICE INFORMATION



ESTABLISHED 1910

In order to receive the full unconditional 90-day warranty against defective material and workmanship in this receiver, the warranty card must be filled out and mailed within two weeks of purchase. Please refer to serial number of warranty in correspondence.

THE HAMMARLUND MANUFACTURING CO., INC.
460 West 34th Street : : : : New York 1, N.Y.



Figure 1. The HQ-110 Communications Receiver

TUBE COMPLEMENT

Symbol	Type	Tube	Function
V1	6BZ6	Pentode	RF Amplifier
V2	6BE6	Pentagrid Converter	Mixer
V3	6BE6	Pentagrid Converter	Converter
V4	12AX7	Twin Triode	Q-Multiplier, First AF Amplifier
V5	6BA6	Pentode	First IF Amplifier
V6	6AZ8	Triode-Pentode	Linear Detector - Second IF Amplifier, BFO
V7	6BJ7	Triple Diode	Detector, Noise Limiter, AVC
V8	6AQ5	Pentode	AF Output
V9	6BZ6	Pentode	Crystal Calibrator Oscillator
V10	6C4	Triode	HF Oscillator
V11	OB2	Gas Filled Diode	Voltage Regulator
V12	5U4-GB	Twin Diode	Rectifier



INTRODUCTION

The Hammarlund HQ-110 is an all-new amateur communications receiver representing entirely new concepts in electrical and mechanical design. It will provide years of top performance with minimum maintenance. The HQ-110 has a self-contained power supply operating from a 60 cps, 105-125 volt AC source. Power consumption is 80 watts. The Hammarlund HQ-110-C incorporates a telechron automatic electric clock-timer in its design. The export model, HQ-110-E, will operate from a 50-60 cps, 115-230 volt AC source. Because of possible variations in power supply operating frequency, the automatic timer and clock are not incorporated in the export model.

The HQ-110 is a superheterodyne receiver with a frequency coverage of the amateur bands as follows:

- 160 meter band, 1.8 to 2.0 mc, calibrated in 5 KC divisions.
- 80 meter band, 3.5 to 4.0 mc, calibrated in 5 KC divisions.
- 40 meter band, 7.0 to 7.3 mc, calibrated in 5 KC divisions.
- 20 meter band, 14.0 to 14.4 mc, calibrated in 5 KC divisions.
- 15 meter band, 21.0 to 21.6 mc, calibrated in 10 KC divisions.
- 10 meter band, 28.0 to 30.0 mc, calibrated in 20 KC divisions.
- 6 meter band, 50.0 to 54.0 mc, calibrated in 50 KC divisions.

A 100-division, 0 to 100 arbitrary scale is provided. Double conversion is employed for the 40, 20, 15, 10 and 6 meter bands.

A single control provides extremely fine tuning for the separation of crowded signals. A very high signal-to-noise ratio, plus the famous Hammarlund noise limiter circuit, permits full use of the receiver's ex-

cellent sensitivity on the weakest signal. A Q-Multiplier is provided for varying the selectivity of the receiver.

A new audio output circuit feature is the Auto-Response, which automatically narrows and widens the frequency range of the audio output, according to the gain required. This feature permits higher fidelity reception on stronger signals, while providing the sharp cutoff required in receiving communications under adverse conditions. A second advantage of the Hammarlund Auto-Response is the rapid damping of the audio power in the speaker voice coil which greatly minimizes undesirable speaker "hangover." The receiver may be used with either speaker or headphones. Fast acting AVC maintains a constant audio level. Adequate filtering practically eliminates AC power ripple.

The HQ-110 is equipped with a stable beat frequency oscillator which provides the operator with a continuous range of audio tones when receiving telegraph code signals. When used in conjunction with the Q-Multiplier, single signal reception is assured.

A 100 KC crystal-controlled oscillator is incorporated to provide 100 KC check points for precise calibration on all seven bands.

A linear detector is provided for the optimum reception of SSB and CW signals.

An "S" meter is provided to obtain accurate readings on received phone signals and to assure "on-the-nose" tuning. A send-receive switch is provided to silence the receiver while transmitting.

Large, comfortable controls in logical groupings are provided for greatest operating ease. The new futuristic front panel is clearly marked to permit full attention to the operation at hand.

The HQ-110 was designed with you in mind. You'll have many hours of pleasure and use in operating this truly fine communications instrument.

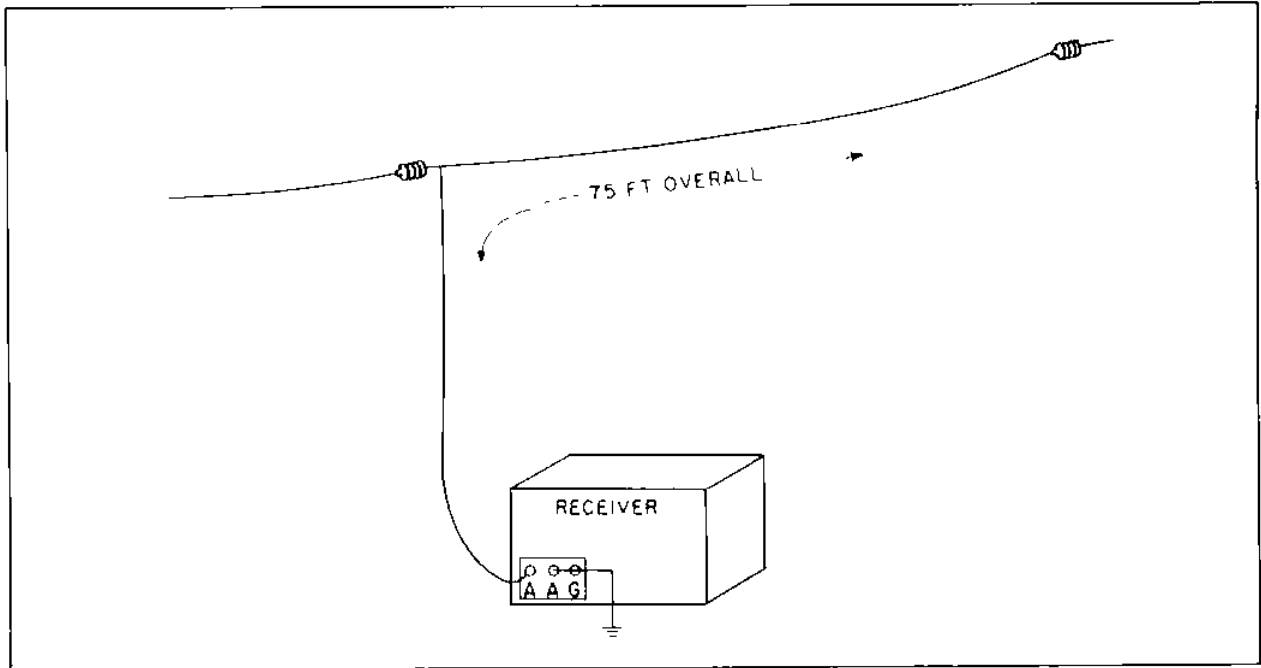


Figure 2. Installation of Single-wire Antenna

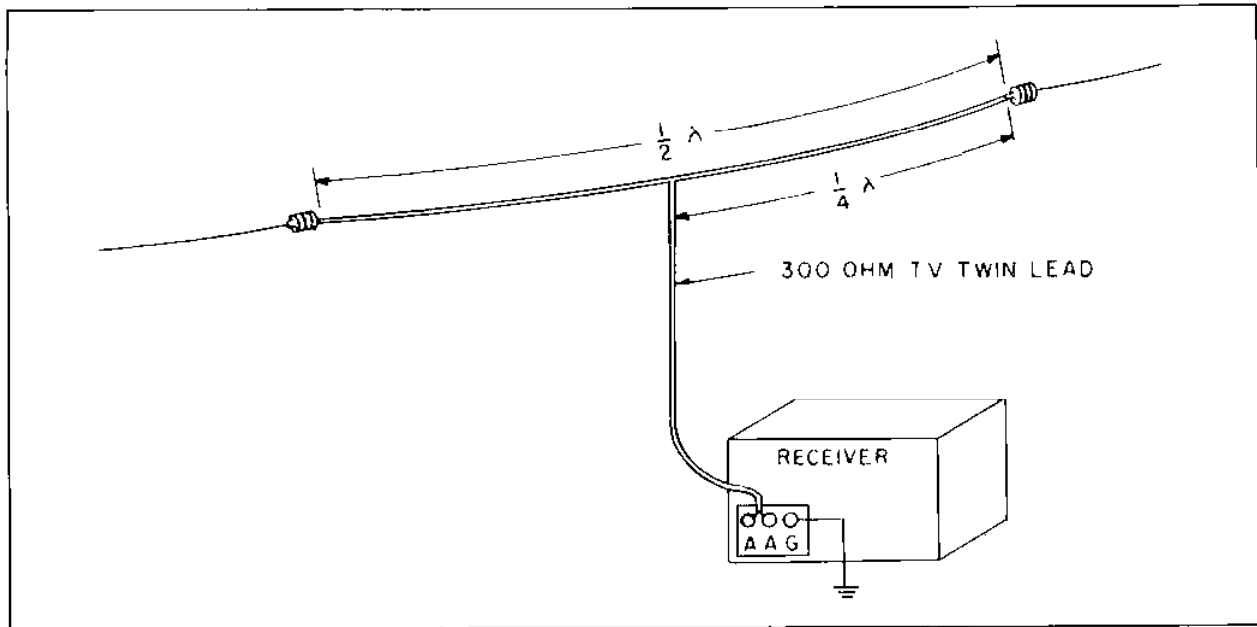


Figure 3. Installation of Folded Dipole Antenna



INSTALLATION

UNPACKING

Unpack the receiver carefully. Make sure the tubes, associated tube shields and pilot lamps are in place.

SPEAKER CONNECTION

Connect a 3.2 ohm permanent magnet dynamic speaker (Hammarlund S-100 Speaker) to the two terminals marked SPKR. on the rear of the chassis. (Note Figure 4.) For best performance do not place speaker on top of receiver cabinet.

POWER CONNECTIONS

Before inserting attachment plug into power outlet, make certain power source is of proper voltage and frequency. (Refer to paragraph one of INTRODUCTION.)

INSTALLING ANTENNA

The HQ-110 is designed to operate with a single wire or a balanced type antenna. The front panel antenna trimmer control (Figure 5) permits a good match to most antennae systems of 50 to 600 ohms.

For general coverage, single wire antennae of 20 to 50 feet length will provide surprisingly good recep-

tion. A long single wire outdoor antenna, such as the one shown in figure 2, will generally provide entirely satisfactory performance. This wire may be 50 to 150 feet long.

For best reception, the antenna should be isolated as much as possible from neighboring objects and at right angles to power lines or busy highways so as to minimize possible interference pickup.

Optimum performance on a particular amateur band or other narrow tuning range will be obtained by using a tuned half-wave dipole or folded dipole fed with 300 ohm transmission line or other suitable lead-in, as shown in figure 3.

To tune the one-half wave length dipole, the following formula for the length of the antenna may be used.

$$\text{Length (feet)} = \frac{468}{\text{Freq. (MCS)}}$$

Each half (1/4 wave length) is half the length found from the above formula.

A good ground, although not always necessary, will generally aid in reception and reduce stray line hum. Reversal of polarity of power cord plug may possibly further reduce line hum in some locations.

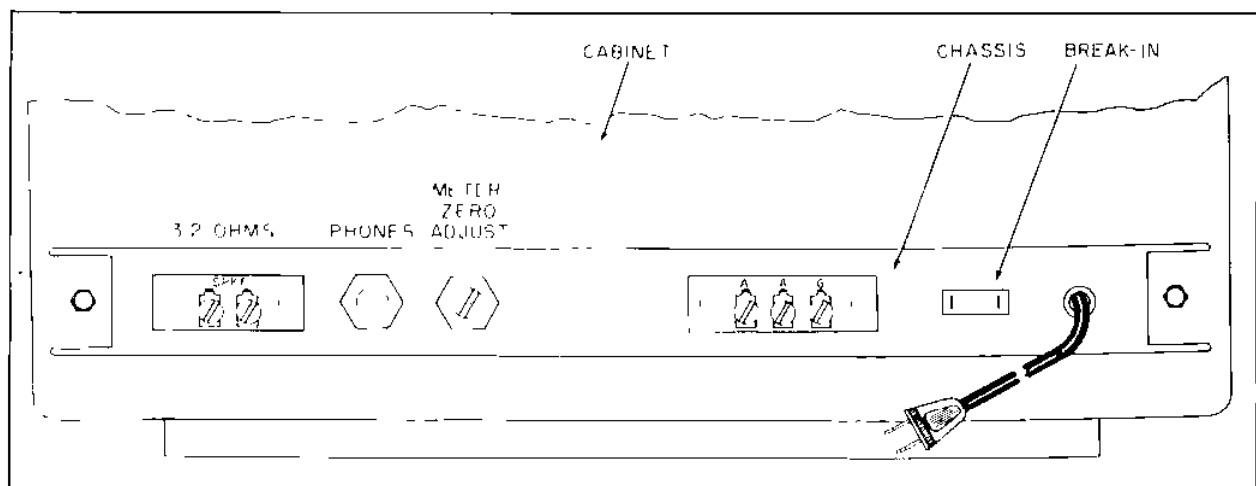
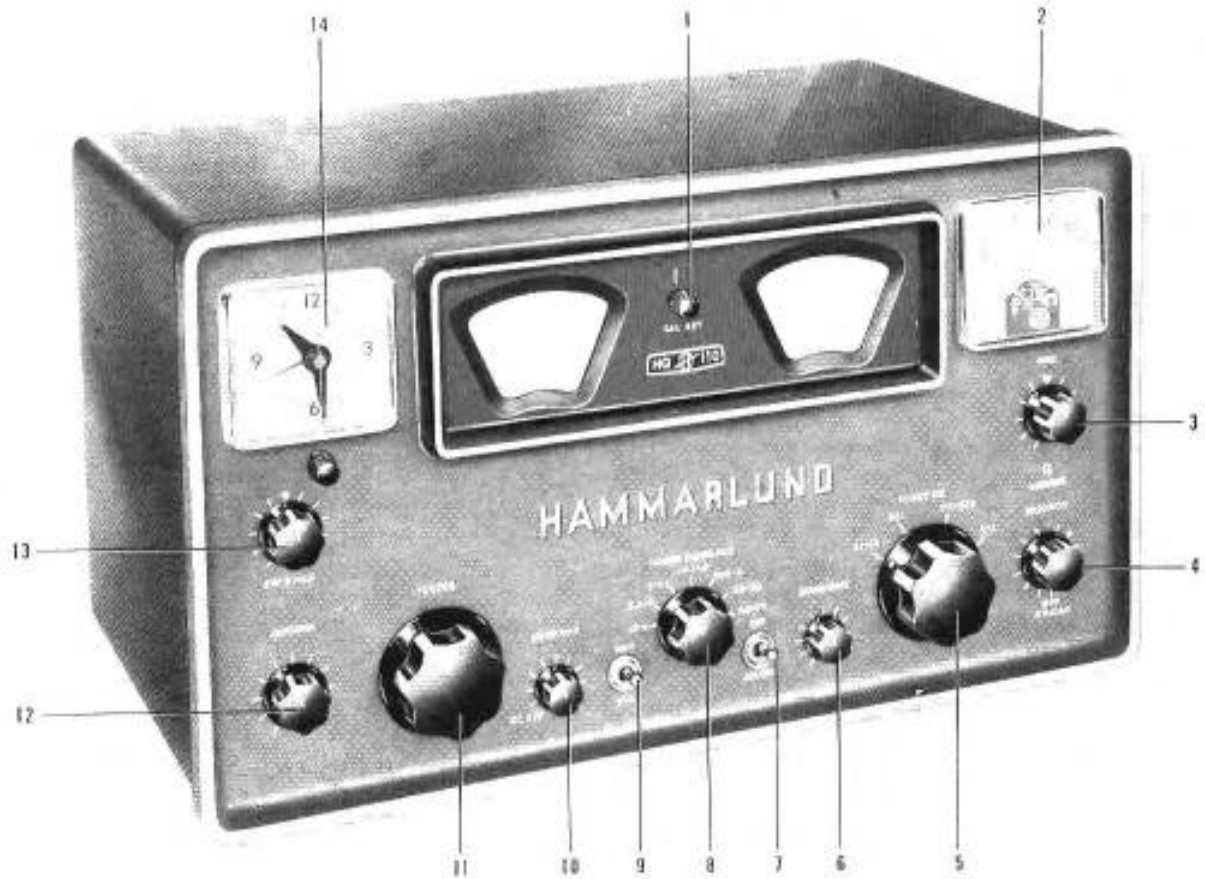


Figure 4. Connection Points at Rear of Chassis



INDEX NO.	CONTROL	INDEX NO.	CONTROL
1	CAL SET Control	8	TUNING RANGE Switch (Band Selector)
2	"S" Meter (Carrier Level)	9	MAN-AVC Switch
3	FREQ. Control (Q-Multiplier)	10	SENSITIVITY Control
4	SELECTIVITY Control (Q-Multiplier)	11	TUNING Control
5	FUNCTION Switch	12	ANTENNA Trimmer
6	AUDIO GAIN Control	13	CW PITCH Control (Beat Frequency Oscillator)
7	LIM Switch (Noise Limiter)	14	Telechron Automatic Clock (Timer)

Figure 5. Location of Controls



OPERATION

AM RECEPTION

For AM reception the position of the controls should be as follows:

- FUNCTION Switch Receive (REC)
- TUNING RANGE Switch Set to desired frequency range
- MAN - AVC Switch AVC
- FREQ. Control Set pointer to triangular marker
- CAL SET Control Set to vertical marker
- LIM Switch As required
- TUNING Control Tune for highest "S" meter reading on signal
- ANTENNA Trimmer Tune for highest "S" meter reading on signal
- SELECTIVITY Control Fully counter-clockwise*
- SENSITIVITY Control Fully clockwise**
- AUDIO GAIN Control Adjust for required level***

*Normally for AM reception, the Q-Multiplier is switched OFF (fully counterclockwise) for maximum bandwidth. However, the Q-Multiplier may be useful in eliminating interference from closely adjacent signals at some sacrifice in the fidelity. The bandwidth is narrowed by clockwise rotation of the SELECTIVITY control

**For normal AM reception, the SENSITIVITY control is fully clockwise. The "S" meter calibration holds only in this position on AVC operation. In the presence of extremely strong signals, the SENSITIVITY control may be reduced to prevent overloading.

***A feature of the audio system is the variable negative feedback employed. Maximum feedback is provided at low settings of the AUDIO GAIN control for the best quality reception of strong signals. As the AUDIO GAIN control is increased, the feedback decreases so that on reception of weak signals additional selectivity is provided by the audio system. This results in an increased signal-to-noise ratio. A further advantage is the critical damping of the speaker for elimination of speaker "hangover." This upgrades the reception of speech and decreases the noise output of the receiver. A further advantage is the reduction of distortion at low settings of the AUDIO GAIN control.

CODE SIGNAL RECEPTION

For CW code reception the position of the controls should be as follows:

- FUNCTION Switch CW-SSB
- TUNING RANGE Switch Set to desired frequency range
- MAN - AVC Switch MAN
- FREQ. Control Set pointer to triangular marker*
- CAL SET Control Set to vertical marker
- CW PITCH Control Pointer on triangular marker for zero beat tuning and then offset either left or right for desired pitch
- TUNING Control Tune for zero beat
- ANTENNA Trimmer Tune for maximum response
- SELECTIVITY Control "ON" and advanced as required**
- SENSITIVITY Control Adjust for desired output level
- AUDIO GAIN Control Clockwise to 12 or 2 o'clock position

*The FREQ. control will peak the selectivity curve to the left or right over the pass band of the IF amplifier permitting a high degree of the control of selectivity for closely adjacent interfering signals.

**The broadest position of the SELECTIVITY control (corresponding to a 6 db bandpass of 3 KCS) is with the control turned clockwise just sufficiently to operate its switch. This puts the Q-Multiplier in operation. Further clockwise rotation of the control narrows the bandwidth until a position is reached, just short of oscillation, where the bandwidth is of the order of 100 cycles. The control should be adjusted below the point of oscillation and to the desired bandwidth as required by interference.

SSB RECEPTION

For SSB reception the position of the controls should be as follows:

- FUNCTION Switch CW-SSB
- TUNING RANGE Switch Set to desired frequency range



MAN - AVC Switch	MAN
FREQ. Control	Set pointer to triangular marker
CAL SET Control	Set to vertical marker
TUNING Control	Tune for maximum clarity
ANTENNA Trimmer	Tune for maximum response
SELECTIVITY Control	"ON" but not advanced beyond switch*
SENSITIVITY Control	As required**
AUDIO GAIN Control	Clockwise to 12 or 2 o'clock position***
CW PITCH Control	Approximately 1 division left or right****

*The SELECTIVITY control should only be advanced beyond the switch "ON" position if required to increase the selectivity due to interference.

**The SENSITIVITY control should be advanced only sufficiently to provide the required output. The use of a minimum SENSITIVITY control setting insures that no overload distortion occurs in the receiver.

***Operating with the AUDIO GAIN control advanced 1/2 to 2/3 rotation insures sufficient power output while permitting the reduced SENSITIVITY operation described above.

****The CW PITCH control is set approximately 1 division to the right or left of the triangular marker, depending on whether the upper or the lower side band, respectively, is transmitted. The CW PITCH control is adjusted for maximum clarity, once the signal has been tuned in. There will be a correct setting of this control for each sideband and once these two settings are determined, they should be noted for future use in SSB reception.

CALIBRATE

For dial calibration checking, the FUNCTION switch is set at the CAL position and the other controls should be set as listed under CODE SIGNAL RECEPTION. The receiver is aligned with the CAL SET control set at the vertical marker and should be closely correct. The CAL SET control is used to accurately reset the

dial indicator lines if they are found to be slightly off calibration at any point on the dials where correct calibration is desired. The receiver is tuned to produce a zero beat response with the PITCH control set at the triangular marker, on any 100 KCS multiple in the desired band. The CAL SET control is then used to reset the dial indicator to the correct marker. If the dial calibration should be found to be beyond the range of the CAL SET control, the HF Oscillator will require readjustment (see under SERVICE AND REALIGNMENT).

On switching from the CW-SSB position to the CAL position, an increase in level will be noticed. This is done deliberately to provide additional gain for the higher-order harmonics of the 100 KCS crystal calibrator, regardless of whether the receiver is in MAN or AVC position.

Note

No provisions have been provided in this receiver to zero beat the 100 KCS crystal calibrator against a frequency standard signal, such as WWV. The 100 KCS crystal-controlled oscillator has been accurately set at the factory. Thus, plus the fact that a very low drift .005% crystal is employed, will insure sufficient accuracy for all practical purposes. For those who desire frequency accuracy of the crystal calibrator in the order of cycles, the procedure outlined on Page 13 should be employed.

BREAK-IN RELAY

The receiver is equipped with a female chassis connector at the rear of the chassis, alongside the power cord entry bushing for the purpose of providing connection for remote control of the receiver by a suitable relay. As shipped from the factory, the two terminals of the connector are jumpered together on the underside of the chassis. In order to utilize the remote control break-in feature, it is necessary to clip the jumper lead from between the two terminals. Remove the receiver from the cabinet as described on page 10 under Service and Alignment Procedure. Clip out the jumper wire carefully with a diagonal cutting plier and reassemble receiver into cabinet.



CIRCUIT THEORY

The HQ-110 is a superheterodyne receiver covering the 6, 10, 15, 20, 40, 80 and 160 meter amateur frequency bands. Double conversion is employed in the 6 through 40 meter bands. Twelve tubes are used, including the Rectifier and Voltage Regulator of the self-contained power supply. The circuitry of the receiver includes a 100 KCS crystal calibrator, a Q-Multiplier for full control of selectivity, an effective noise limiter and a separate highly stable Beat Frequency Oscillator.

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, V2, contributes to a favorable signal-to-noise ratio.

Both grid and plate circuits of the RF stage are tuned; individual tuning coils are selected for each band.

The antenna compensating capacitor, adjustable from the front panel, permits the receiver to be resonated for optimum performance with the particular antenna in use.

CONVERTER STAGE

A high degree of oscillator stability is attained by the use of a separate mixer (6BE6), V2, and an independent oscillator (6C4), V10.

The output signal from RF amplifier, V1, is heterodyned with the output of the local high frequency oscillator, V10, and electronically combined within the mixer tube, V2. On the 80 and 160 meter bands, the local oscillator is 455 KCS above the signal frequency. On the 10 to 40 meter bands, the local HF Oscillator is 3035 KCS above the signal frequency. On the 6 meter band, the local HF Oscillator is 3035 KCS below the signal frequency.

When operating in the 6 to 40 meter bands, the difference frequency of 3035 KCS is heterodyned with the output of the 3490 KCS crystal controlled oscillator and electronically combined within the converter tube, V3, to produce the 455 KCS final intermediate frequency.

Low-loss tube sockets, low-loss phenolic, temperature compensating capacitors, and stable, coaxial glass trimmers all contribute to oscillator stability. Additional frequency stability is attained by applying regulated voltage to the oscillator circuit and by the

rugged construction of the entire HF oscillator section assembly.

Q-MULTIPLIER

The Q-Multiplier circuit employed in this receiver provides a means of peaking any signal within the pass band of the IF amplifier. The degree of peaking is controlled by the SELECTIVITY control. The bandwidth varies from 3 KCS with the SELECTIVITY control switch just "ON" to approximately 100 cps with the control just below the oscillation point. If interference is experienced caused by two stations operating very close to one another, the Q-Multiplier may be employed under these circumstances to minimize, if not eliminate, the interference by the improved selectivity or the decreased bandwidth proper adjustment will provide. The proper use of the Q-Multiplier can actually enhance many times the results obtained with the receiver. In view of this, it is suggested that a little time be spent in learning just how to properly adjust the Q-Multiplier frequency and selectivity controls under different receiving conditions. The Q-Multiplier is a very handy tool in the hands of an experienced operator and, unfortunately, it is beyond the scope of this instruction manual to attempt to be more definite than we have.

When the SELECTIVITY control is operated, putting the Q-Multiplier into the circuit, some loss of gain, or "S" meter reading, will be observed. This is caused by the additional loading of the Q-Multiplier.

IF AMPLIFIER

Nine stable tuned circuits, in three stages of IF amplification, V3, V5, and V6A, contribute to sensitivity and selectivity. On the 80 and 160 meter bands, the Intermediate frequency is 455 KCS. On the 6 to 40 meter bands, the first conversion is to an intermediate frequency of 3035 KCS, employing two tuned circuits and the second conversion is to the 455 KCS Intermediate frequency employing seven tuned circuits. Iron core permeability-tuned transformers improve performance and add to the ease of adjustment.

AVC SYSTEM

Automatic Volume Control minimizes fading and signal strength variations by controlling the gain of the RF stage, V1, and the IF stage, V5. As a result, a comfortable and constant level of audio is maintained. The AVC voltage for the RF Amplifier tube, V1, is provided with a delay voltage which prevents the AVC from operating on the RF Amplifier tube on extremely



weak signals, thus maintaining the maximum sensitivity and signal-to-noise ratio.

"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 in the AVC position and on AM reception. In the MAN position of the MAN-AVC switch, the meter pointer will not indicate signal strength. However, the meter pointer will assume various positions, including slightly off scale, depending on the setting of the SENSITIVITY control and the FUNCTION switch. In any operating position of the FUNCTION switch, receiver overload is indicated by a reverse reading of the meter.

The meter, which is calibrated to 40 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 FUNCTION switch to REC.
2. Set front panel SENSITIVITY control to "10."
3. With receiver off, mechanically zero pointer with a fine screwdriver
4. With AVC on and the ANT. terminals shorted, adjust the pointer to zero with ZERO ADJ potentiometer R19.

DETECTOR AND NOISE LIMITER

One section of the 6BJ7 tube, V7, is used for the second detector and AVC system for the IF amplifier. This system produces a minimum of distortion.

One section of the V7 operates as a series, self-adjusting noise limiter. It will reduce automobile ignition and other types of impulse noise to a minimum.

Intelligibility is not affected by the noise limiter, although it may be switched off if desired. The third

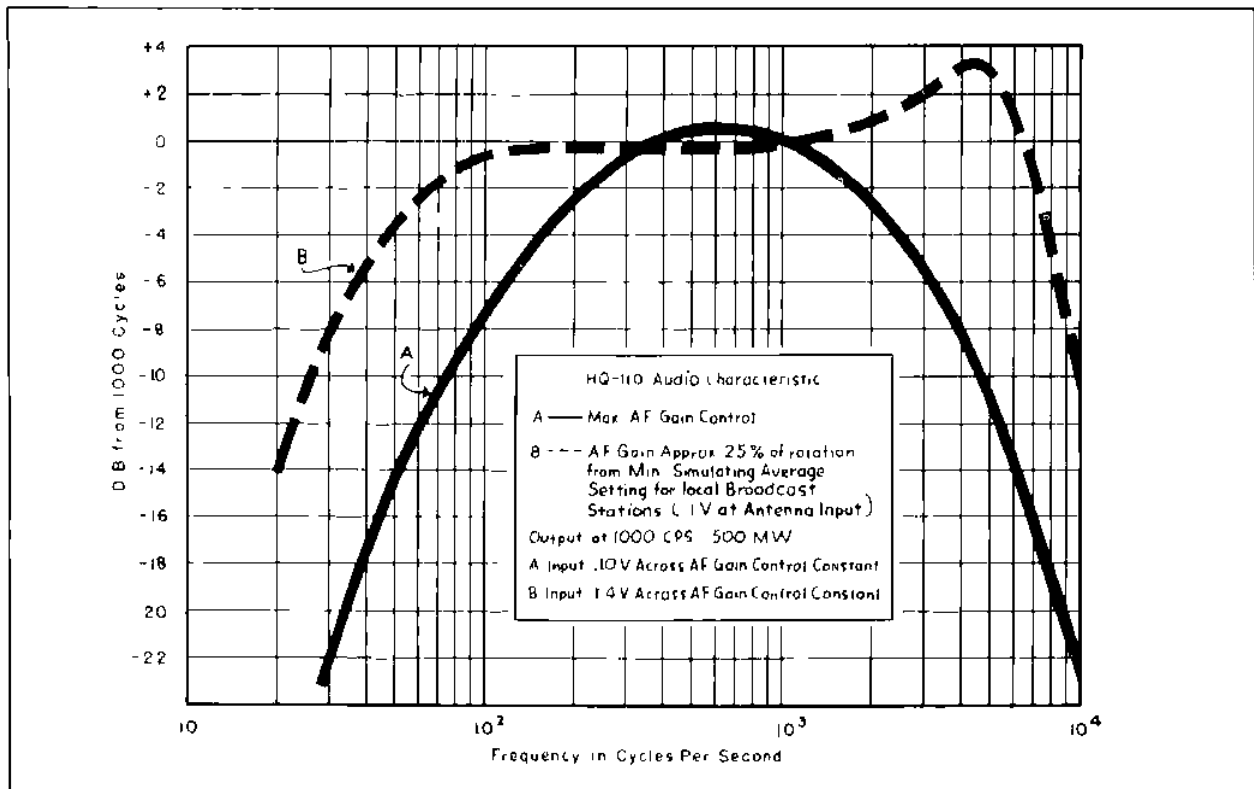


Figure 6. Auto-Response Curve



section of the V7 provides delayed AVC for the RF amplifier tube.

BEAT FREQUENCY OSCILLATOR (BFO)

The triode section of the (6AZ8) V6B is used for the beat frequency oscillator. The CW PITCH control is used to vary the beat tone. Each calibration division of this control represents approximately 1000 cycles. When receiving single side band transmission, the generally accepted procedure of setting the beat frequency oscillator approximately 2000 cycles above or below zero beat should be employed. In other words, if the beat frequency oscillator CW PITCH control is set two degrees clockwise or counterclockwise from the center position, optimum single side band reception will usually be obtained. Whether the beat frequency oscillator control will be set clockwise from zero beat will depend on whether upper or lower side band is being transmitted. If the beat frequency oscillator is on the wrong side of zero beat, it will be impossible to obtain intelligibility of the single side band signal when the dial is tuned very slowly through the single side band signal. Should such a condition arise, merely rotate the CW PITCH control from the two degrees counterclockwise to the two degrees clockwise position and then very carefully adjust the tuning for intelligible speech. Here again experience is the best teacher. The stability of both the high frequency oscillator and the beat frequency oscillator employed in this receiver plus the excellent mechanical rigidity

will provide excellent single side band reception. Refer to the above paragraph on the Q-Multiplier for improved single side band reception.

CRYSTAL CALIBRATOR

A (6BZ6) tube, V9, a hermetically sealed quartz crystal unit and associated components, provide a highly stable 100 KC crystal-controlled oscillator. An adjustable ceramic trimmer capacitor is provided for accurately adjusting the oscillator frequency against an external standard frequency such as WWV. It provides signal markers at 100 KC intervals throughout the tuning range of the receiver.

LINEAR DETECTOR

The pentode section of the (6AZ8) V6A functions as a linear detector for CW and SSB reception, resulting in a clear undistorted beat note on CW and greater ease of tuning and freedom from interference on SSB reception.

AUDIO AMPLIFIER

The first audio stage is a resistance coupled voltage amplifier employing the other section of the (12AX7) V4H. The audio output stage is a (6AQ5) beam power amplifier, V8, providing an undistorted output level of at least one watt.



SERVICE AND ALIGNMENT PROCEDURE

NOTE

Before servicing this receiver, disconnect from power source and remove all leadwires attached to terminal connections at rear of chassis apron. Carefully turn the receiver up onto the front panel face on a smooth clean surface. Remove the two No. 10 hex machine screws at the extreme ends of the chassis apron at the rear of the cabinet, and the knob from the clock adjustment shaft if receiver is so equipped. Lift cabinet straight up and off of chassis. To reassemble, use reverse procedure.

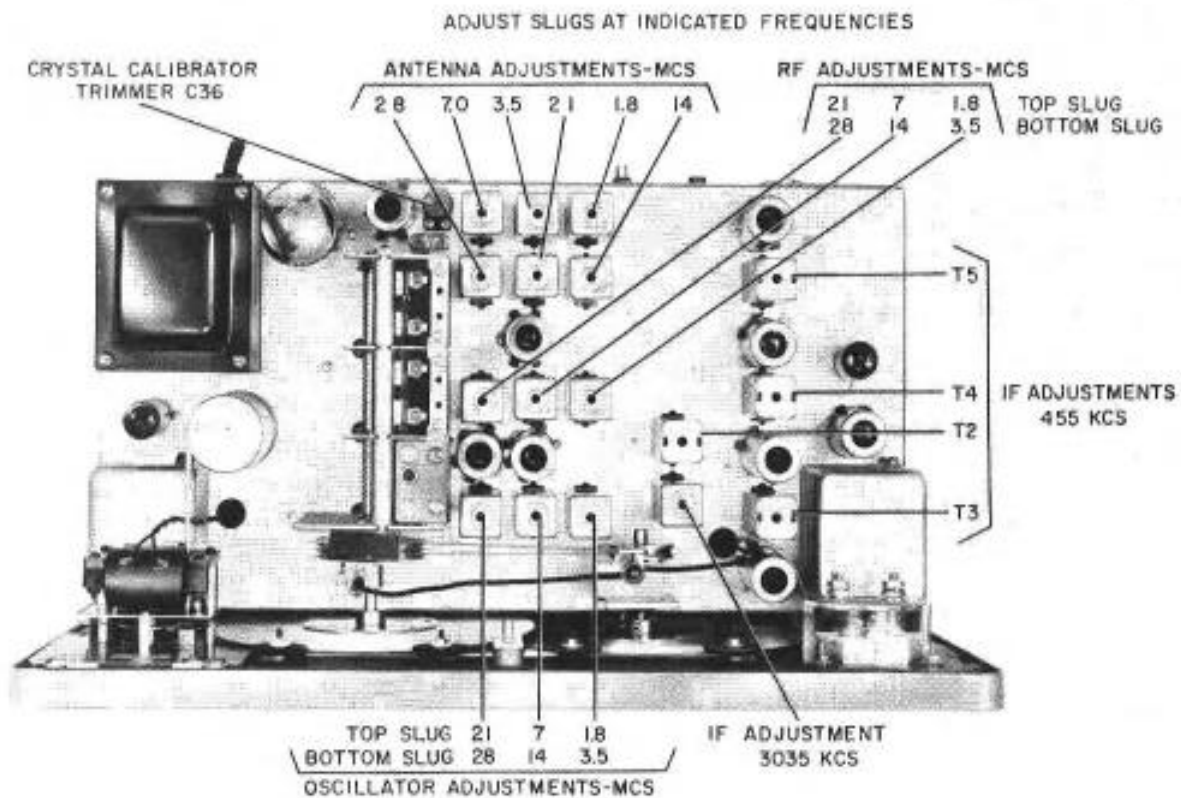


Figure 7. Top View of Chassis



IF ALIGNMENT

Note

Use a non-metallic alignment tool such as General Cement Co. No. 5097, or equal.

- a. Connect the output cable of a 455 KCS unmodulated, signal generator to the bus lead of the (6BE6) V2 mixer grid. The frequency accuracy of the generator may be checked with sufficient precision by picking up its second harmonic (910 KCS) in any receiver whose calibration at 910 KCS has been checked as correct and then adjusting the generator frequency.
- b. Connect a DC vacuum tube voltmeter, set for negative voltage reading to terminal 2 of the T5 IF transformer and chassis ground.
- c. Set the receiver controls as follows:
 - CAL SET control on marker
 - FUNCTION switch on REC.
 - Tuning dial on 1.8 mc
 - Noise limiter (LM) switch on OFF
 - AUDIO GAIN control at minimum
 - SELECTIVITY control OFF
 - TUNING RANGE switch on 1.8-2.0 mc
 - MAN - AVC switch on MAN.
 - SENSITIVITY control on 3 from maximum
- d. During alignment, adjust the generator output and the SENSITIVITY control to prevent overloading. Final adjustment should be made with the SENSITIVITY control at approximately the third indice from its maximum (clockwise) position. Adjust each of the four IF transformers, T2, T3, T4 and T5, for maximum meter reading. Topside adjust-

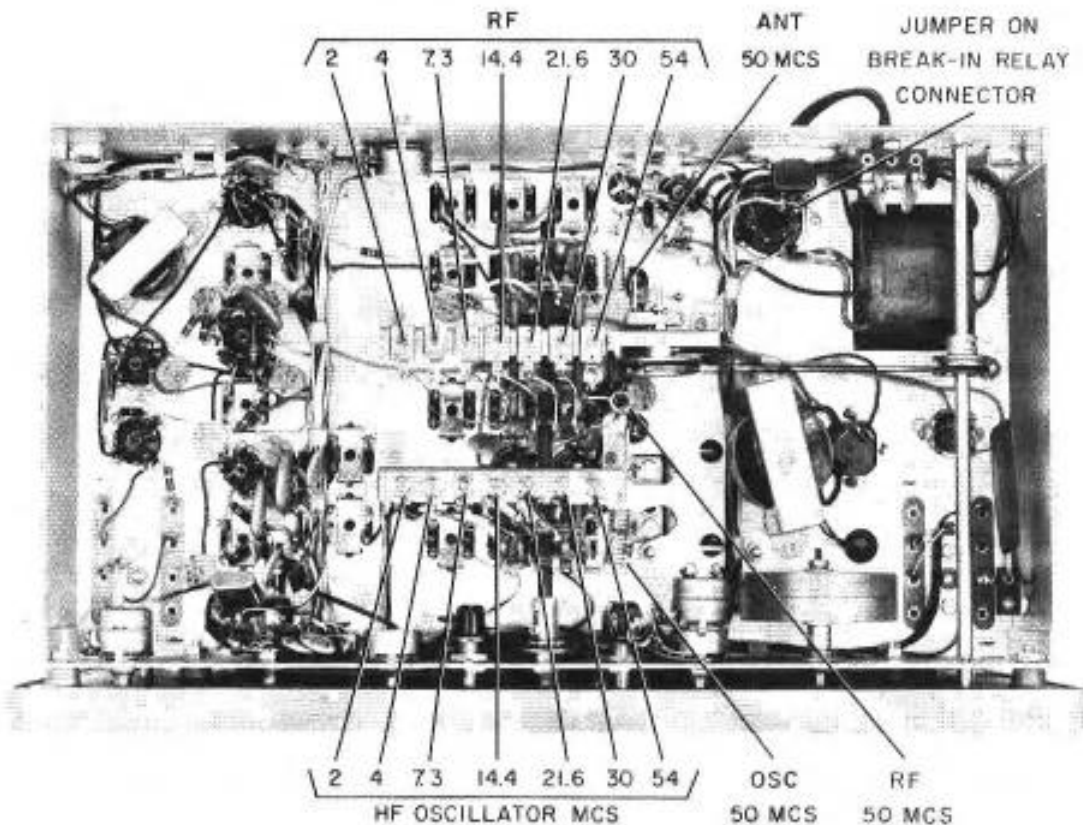


Figure 8. Bottom View of Chassis



ments are secondaries or grid circuits, bottom of chassis adjustments are primaries or plate circuits.

- c. Turn the **SELECTIVITY** control clockwise to a position below the oscillating point. With its collar set-screw loosened to permit the frequency shaft to turn without hindrance by the stop, adjust the **FREQ.** control to obtain a maximum meter indication. The input signal must be adjusted to a value just sufficient to obtain a good meter swing. This adjustment is the center frequency of the pass band. While the meter is at maximum, turn the collar so that the long set screw is in a position 180 degrees directly opposite the stop lug. Holding it in this position, tighten the set screw, making sure that the shaft has not turned by checking the zero setting.
- f. Turn the **FUNCTION** switch to **CW-SSB** and with the **CW PITCH** control stop collar loosened, adjust the **CW PITCH** control for zero beat. Turn the collar so that the long set screw is in a position 180 degrees from the stop lug. Holding it in this position, tighten the set screws, making sure that the shaft has not turned from the zero beat position.
- g. Turn the **FUNCTION** switch to **REC** and the other controls as shown under "c." Set the **TUNING RANGE** switch to **7.0 - 7.3 MCS**. Set the unmodulated signal generator frequency to **3035 KCS**. Using a non-metallic alignment tool, such as General Cement Co. No. 8282, or equal, adjust the top and bottom cores of the transformer **T1** for maximum meter reading. During this alignment, adjust the generator output and the **SENSITIVITY** control to prevent overloading.
- h. With the **MAN - AVC** switch on **AVC**, the **SENSITIVITY** control at maximum, with grid, pin 1, of the **V1** amplifier tube grounded, and with no signal input, adjust the **METER ZERO ADJUST.** potentiometer at the rear of the chassis for a reading of zero on the "S" meter.

RF ALIGNMENT

Note

Use a non-metallic alignment tool such as General Cement Co. No. 8282, or equal.

- a. The slugs and trimmers, having been factory adjusted, should require a minimum amount of adjustment for any realignment.
- b. All RF and oscillator slug adjustments are made from the top of the shield cans. 50-54 mcs. coils

do not have slugs. The RF and OSC coils of this band are "knifed" for adjustment of inductance. A slight spreading of the turns decreases the inductance. Pushing the turns slightly closer together increases the inductance.

- c. Connect the unmodulated, signal generator output cable to the antenna and ground terminals of the receiver, with the **A** terminal adjacent to the **G** terminal jumped together. Leave the vacuum-tube voltmeter connected as for IF alignment.
- d. Set the controls the same as for IF alignment, "c," above. Adjust the **SENSITIVITY** control as required to obtain a sufficient voltmeter reading and to prevent overloading. Set the **CAL SET** control to the vertical marker.
- e. The oscillator adjustment is made first. The **RI** is adjusted next to obtain maximum amplitude. The antenna slugs are adjusted last. A certain amount of interaction will occur between the oscillator and **RI** adjustments, particularly on the higher frequency bands. Final adjustment should be accomplished by combined or alternate adjustment of the oscillator and **RF** for maximum amplitude.

Note

The trimmer adjustments, if required, should be the final adjustments for each band.

- f. Note that the oscillator frequency in the **HQ-110** is on the high side of the signal frequency, except on the 6 meter band, 50-54 mcs, where it is on the low side of the signal. Therefore, it is necessary to make sure that the oscillator frequency is not adjusted below the signal frequency which would be an image response of the signal on all bands except 50-54 mcs where the reverse is true.
- g. It will be necessary to repeat low and high end alignment adjustments of each band since the adjustments are interdependent. The process should be repeated until maximum amplitude is obtained at both alignment frequencies of each band.
- h. On the 6-meter band, a shift in oscillator frequency occurs upon replacing the receiver in the cabinet, with the result that the dial reads approximately 50 KCS, or one division low. This condition may be corrected as follows:
 - (1) After alignment in the normal manner with the receiver out of the cabinet, squeeze together the turns of **T23**, the 6-meter oscillator



coil, until a 50.00 KCS signal is received at approximately 50.05 on the dial.

- (2) Place the chassis in the cabinet, or place a metal plate (such as a cookie sheet) over the bottom of the chassis. The dial reading should be approximately correct. If it is not, compress or expand the turns of T23 as required.

Note

The receiver should be warmed up at least one-half hour before final oscillator frequency adjustments are made for the dial calibration check.

CALIBRATOR ALIGNMENT

The crystal calibrator is factory adjusted to zero-beat with the Bureau of Standards Radio Signal WWV. If minor adjustments are determined necessary, to re-zero the calibrator, an external receiver capable of receiving station WWV on any one of its operating frequencies is necessary since the tuning bands of HQ-110 do not include any one of these frequencies.

To re-zero the calibrator, loop one or two turns of insulated wire around the envelope of V9 (6BZ6) and connect the wire to the antenna terminal of the receiver used for heterodyning. Tune in a strong signal on any one of the WWV frequencies and zero-beat the calibrating oscillator with WWV by slowly rotating ceramic trimmer C-36 at the top rear of the chassis.

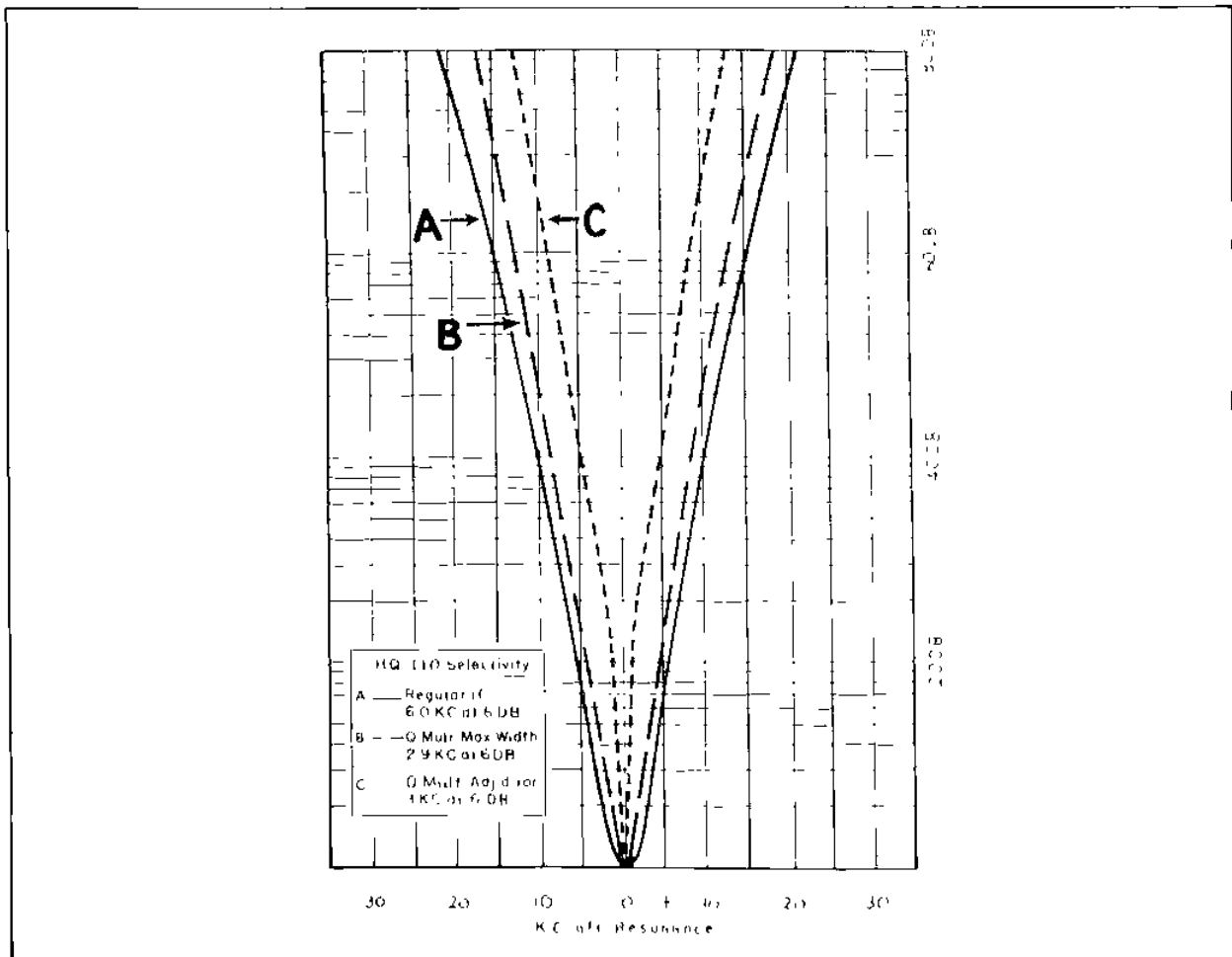


Figure 9. Selectivity Curves

TABLE 1. TUBE SOCKET VOLTAGES

Measured from tube socket pins to chassis with vacuum tube voltmeter. AUDIO GAIN minimum. BAND SELECTOR on 7.0 - 7.3 MCS. Noise Limiter OFF. MAN-AVC on MAN. SENSITIVITY Control maximum except where noted. Function switch on CW-SSB, except where noted. SELECTIVITY control ON but counterclockwise. Line voltage 117. No signal input.

TUBE	SOCKET PIN NUMBERS								
	1	2	3	4	5	6	7	8	9
V1 RF 6BZ6	-	1.4 4.2 Sens Min	-	6.3 ac	235	105	-	-	-
V2 MIXER 6BE6	Approx. -8.5	1.9	-	6.3 ac	235	105	-	-	-
V3 CONVERTER 6BE6	-3.5	-	-	6.3 ac	233	64	-	-	-
V4 Q-MULT-1st AF 12AX7	233	-	2.6	6.3 ac	6.3 ac	88	-	.8	-
V5 1st IF 6BA6	-	-	6.3 ac	-	230	105	2.3 68 (SENS MIN)	-	-
V6 LIN DET-2nd IF BFO 6AZ8	200	145	2.75 68 (SENS MIN)	6.3 ac	-	-	2.6	103	Approx. -3.6
V7 DET-LIM-AVC 6BJ7	-	-.6 on REC	-	6.3 ac	-	-	2.2 on REC	-.34 on REC	-.34 on REC
V8 AF OUTPUT 6AQ5	-	13.2	6.3 ac	-	260	240	-	-	-
V9 CALIBRATOR 6BZ6	-12 to -58 on CAL	9.2 on CAL	-	6.3 ac	105 to 84 on CAL	91 to 82 on CAL	9.2 on CAL	-	-
V10 HF OSC 6C4	100	-	-	6.3 ac	-	Approx. -6	-	-	-
V11 VOLTAGE REG OB2	105	-	-	-	105	-	-	-	-
V12 RECTIFIER 5U4-GB	-	270	-	235 ac	-	235 ac	-	270	-

TABLE 2. TUBE SOCKET RESISTANCES

Measured from tube socket pins to chassis with vacuum tube ohmmeter with pin 1 of V6, 6AZ8, temporarily grounded except as noted. AUDIO GAIN ON but counterclockwise; Noise Limiter switch ON; SENSITIVITY control maximum except where noted; MAN - AVC on MAN; FUNCTION switch on CW - SSB except where noted; TUNING RANGE on 7.0 - 7.3 MCS.

TUBE	SOCKET PIN NUMBERS											
	1	2	3	4	5	6	7	8	9	10	11	12
V1 RF 6BZ6	470K	180 1.7K Sens Min	0	-	4.7K	8.7K	0	-	-	-	-	-
V2 MIXER 6BE6	22K	160	0	-	4.7K	8.7K	0	-	-	-	-	-
V3 CONVERTER 6BE6	22K	0	0	-	5.7K	19.7K	0	-	-	-	-	-
V4 Q MULT -1st AF 12AX7	5.7K	2.2 Meg	17K 6.8K Sel max	-	-	505K	1 Meg	2.2K	0	-	-	-
V5 1st IF 6BA6	100K	0	-	0	5.7K	8.7K	150 10K Sens Min	-	-	-	-	-
V6 LIN, DET-2nd IF BFO 6AZ8	4.7K*	38K	200 10K Sens mir	-	0	100K 110K Sens min	1K	52K	2.2 Meg	-	-	-
V7 DET-LIM-AVC 6BJ7	0	195K	0	-	0	470K ON AVC	4.7K	2.2 Meg	2.2 Meg	-	-	-
V8 AF OUTPUT 6AQ5	500K	430	-	0	5.3K	4.7K	300K	-	-	-	-	-
V9 CALIBRATOR 6BZ6	470K	4.7K	0	-	Inf 475K on Cal	Inf 105K on Cal	4.7K	-	-	-	-	-
V10 HF OSC 6C4	9.7K	-	0	-	-	47K	0	-	-	-	-	-
V11 VOLTAGE REG. OB2	8.7K	-	-	-	8.7K	-	0	-	-	-	-	-
V12 RECTIFIER 504-GB	-	5.1K	-	60	-	83	0	5.1K	-	-	-	-

Note* With pin 1 of V6 ungrounded and with pin 6 of V8, 6AQ5 grounded.



PARTS LIST

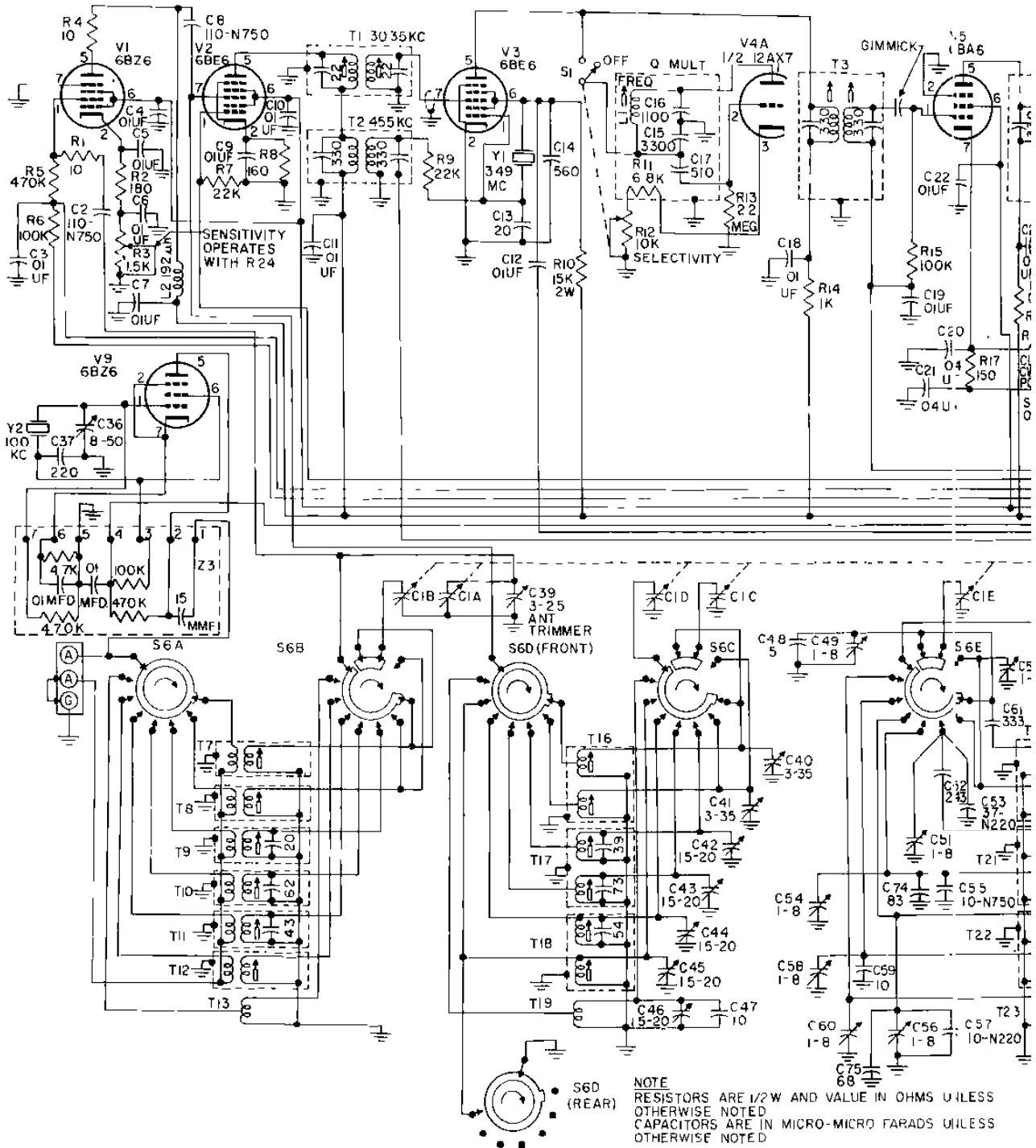
SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
CAPACITORS		
C1, A-F	Variable Tuning	P38901-1
C2	Fixed, ceramic disc, 110 mmf 1000 W V.D.C.	K23010-5
C3, 4, 5, 6, 7	Fixed, ceramic disc, .01 mf 600 W.V.D.C.	M23034-19
C8	Fixed, ceramic disc, 110 mmf 1000 W V D C	K23010-5
C9, 10, 11, 12	Fixed, ceramic disc, .01 mf 600 W V D.C	M23034-19
C13	Fixed, silver mica, 20 mmf 500 W V.D.C	K23006-17
C14	Fixed, silver mica, 560 mmf 500 W V.D.C	K23027-6
C15	Fixed, silver mica, 3300 mmf 500 W V.D.C	K23041-2
C16	Fixed, silver mica, 1100 mmf 500 W V.D.C	K23027-2
C17	Fixed, silver mica, 510 mmf 500 W V D C	K23027-3
C18, 19	Fixed, ceramic disc, .01 mf 600 W.V.D.C	M23034-19
C20, 21	Fixed, ceramic disc, .04 mf 600 W.V.D.C.	M23034-12
C22, 23, 24	Fixed, ceramic disc, .01 mf 600 W V D C.	M23034-19
C25	Fixed, ceramic disc, .04 mf 600 W.V.D.C.	M23034-12
C26, 27	Fixed, ceramic disc, .01 mf 600 W.V.D.C	M23034-19
C28	Fixed, ceramic disc, .001 mf 1000 W V D.C	M23034-20
C29, 30, 31, 32	Fixed, ceramic disc, .01 mf 600 W.V.D.C	M23034-19
C33	Fixed, ceramic disc, .005 mf 1000 W V D C	M23034-10
C36	Variable, ceramic trimmer, 8 - 50 mmf	K23038-5
C37	Fixed, ceramic disc, 220 mmf 500 W.V.D.C.	K23006-10
C39	Variable, antenna tuning, 3 - 25 mmf	K34454-G14
C40, 41	Variable, mica trimmer, 3 - 35 mmf	K23043-5
C42, 43, 44, 45, 46	Variable, mica trimmer, 1.5 - 20 mmf	K23043-6
C47	Fixed, silver mica, 10 mmf 500 W.V.D.C	K23006-8
C48	Fixed, silver mica, 5 mmf 500 W V D.C.	K23006-5
C49, 50, 51	Variable, glass trimmer, 1 - 8 mmf	K42093-G2
C52	Fixed, silver mica, 243 mmf 300 W V D C.	K23006-27
C53	Fixed, ceramic, temp. comp. 37 mmf N220	K23062-23E
C54	Variable, glass trimmer, 1 - 8 mmf	K42093-G2
C55	Fixed, ceramic, temp. comp. 10 mmf N750	K23061-13J
C56	Variable, glass trimmer, 1 - 8 mmf	K42093-G2
C57	Fixed, ceramic, temp. comp. 10 mmf N220	K23061-90J
C58	Variable, glass trimmer, 1 - 8 mmf	K42093-G2
C59	Fixed, silver mica, 8 mmf 300 W.V.D.C.	K23006-31
C60	Variable, glass trimmer, 1 - 8 mmf	K42093-G2
C61	Fixed, silver mica, 333 mmf 300 W V.D.C.	K23006-28
C62	Fixed, ceramic, temp. comp. 47 mmf N750	K23061-26F
C63	Fixed, ceramic, temp. comp. 1.5 mmf N4700	K23061-300
C64	Fixed, ceramic, temp. comp. 47 mmf N750	K23061-26F
C65	Fixed, ceramic disc, .01 mf 600 W V.D.C	M23034-19
C66	Fixed, silver mica, 1100 mmf 500 W V.D.C	K23027-2
C67	Fixed, silver mica, 3300 mmf 500 W.V.D.C.	K23041-2
C68	Fixed, silver mica, 510 mmf 500 W.V.D.C.	K23027-3
C69	Fixed, silver mica, 3 mmf 500 W.V.D.C.	K23006-18
C70	Fixed, ceramic disc, .01 mf 600 W.V.D.C	M23034-19
C71, 72	Fixed, ceramic disc, .01 mf 1000 W V.D.C.	M23034-8
C73, A, B, C	Fixed, electrolytic, 20, 20 mf 450V, 25 ml 50V	K15504-62
C74	Fixed, silver mica, 78 mmf 300 W.V.D.C	K23006-33
C75	Fixed, silver mica, 68 mmf 300 W V D C.	K23006-30
CMC	Clock, Telechron, Auto-timer	K38874-1
	Crystal, panel clock window	M38877-1
I1, 2	Lamp, pilot, No. 47, 6.3V, .15A	K16004-1



SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
J1	Phone jack	K35608-1
J2	External relay receptacle	K35013-1
COILS		
L1	Coil & ferrule assembly	K26215-G2
L2	RF Choke, 192 microhenrys	K38971-1
L3	Coil & ferrule assembly	K26215-G2
L4	Filter reactor, 8 Hy-100 ma, 375 ohms dc	K38939-1
M1	Meter, "S" (Carrier level)	K26119-4
RESISTORS		
R1	10 ohms, 1/2 W	K19309-1
R2	180 ohms, 1/2 W	K19309-260
R3	Variable, 1500 ohms, dual with R24 and S5	K38940-1
R4	10 ohms, 1/2 W	K19309-1
R5	470,000 ohms, 1/2 W	K19309-113
R6	100,000 ohms, 1/2 W	K19309-97
R7	22,000 ohms, 1/2 W	K19309-81
R8	180 ohms, 1/2 W	K19309-199
R9	22,000 ohms, 1/2 W	K19309-81
R10	15,000 ohms, 2 W	K19304-46
R11	6,800 ohms, 1/2 W	K19309-69
R12	Variable, 10,000 ohms, with tandem switch S1	K15378-4
R13	2.2 megohms, 1/2 W	K19309-129
R14	1,000 ohms, 1/2 W	K19309-49
R15	100,000 ohms, 1/2 W	K19309-97
R16	1,000 ohms, 1/2 W	K19309-49
R17	150 ohms, 1/2 W	K19309-259
R18	1,200 ohms, 1/2 W	K19309-268
R19	Variable, 200 ohms	K15368-6
R20, 21	100,000 ohms, 1/2 W	K19309-97
R22	33,000 ohms, 1/2 W	K19309-85
R23	4,700 ohms, 1/2 W	K19309-65
R24	Variable, 10,000 ohms, see R3.	
R25	1 megohm, 1/2 W	K19309-121
R26	2.2 megohms, 1/2 W	K19309-129
R27	470,000 ohms, 1/2 W	K19309-113
R28	220,000 ohms, 1/2 W	K19309-105
R29	4,700 ohms, 1/2 W	K19309-65
R30	1 Megohm, variable	K26218-3
R31	47 ohms, 1/2 W	K19309-17
R32	100 ohms, 1/2 W	K19309-25
R33	2,200 ohms, 1/2 W	K19309-57
R34	430 ohms, 1 W	K19310-212
R39	47,000 ohms, 1/2 W	K19309-89
R40	10 ohms, 1/2 W	K19309-1
R41	1,000 ohms, 1/2 W	K19309-49
R42	47,000 ohms, 1/2 W	K19309-89
R43	2.2 megohms, 1/2 W	K19309-129
R44	1,000 ohms, 1/2 W	K19309-49
R45	4,000 ohms, 10 W	K19330-2
R46	22,000 ohms, 1/2 W	K19309-81



SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO
SWITCHES		
S1	Q Multiplier switch, (Part of R12)	
S2	Limiting switch, SPST toggle	K38857-1
S3	MAN - AVC switch, DPST toggle	K38949-1
S4	Function switch, SEND-REC-CW SSB-CAL	K38948-1
S5	AC ON-OFF switch, (Part of R3)	
S6A	Switch wafer, ANT primary	K38952-1
S6B, C	Switch wafer, ANT sec and RF sec	K38952-2
S6D	Switch wafer, RF tap	K38952-3
S6E	Switch wafer, HF OSC tank	K38952-2
S6F	Switch wafer, HF OSC tap	K38952-4
TRANSFORMERS AND IMPEDANCE ASSEMBLIES		
T1	IF Transformer, 3,045 KC	K38947-1
T2	IF Transformer, 455 KC	K38946-1
T3 1	IF Transformer, 455 KC	K38829-2
T5	IF Transformer, 455 KC	K38829-1
T6	Output Transformer, Max power 5W, Impedance match; 10,000 ohms pri to 4 ohms voice coil	K38828-1
T7	ANT Trans. 1.8 to 2.0 MC	K38926-1
T8	ANT Trans. 3.5 to 4.0 MC	K38927-1
T9	ANT Trans. 7.0 to 7.3 MC	K38928-1
T10	ANT Trans. 14.0 to 14.4 MC	K38929-1
T11	ANT Trans. 21.0 to 21.6 MC	K38930-1
T12	ANT Trans. 28.0 to 30.0 MC	K38931-1
T13	ANT Trans. 50.0 to 54.0 MC	K38943-1
T14	Power Trans. Pri, 115V-60 cycle, Sec, 230-0-230V - 110 ma	M38938-1
T14a	Power Trans. Pri, 115-230V 60 cycle, Sec; 230-0-230V - 110 ma	M38938-2
T16	RF Coil assembly, 1.8-2.0 and 3.5-4.0 mc	K38932-1
T17	RF Coil assembly, 7.0-7.3 and 14.0-14.4 mc	K38933-1
T18	RF Coil assembly, 21.0-21.6 and 28.0-30.0 mc	K38934-1
T19	RF Trans. coil, 50.0-54.0 mc	K38944-1
T20	HF Osc coil assembly, 1.8-2.0 and 3.5-4.0 mc	K38935-1
T21	HF Osc coil assembly, 7.0-7.3 and 14.0-14.4 mc	K38936-1
T22	HF Osc coil assembly, 21.0-21.6 and 28.0-30.0 mc	K38937-1
T23	HF Osc coil, 50.0-54.0 mc	K38945-1
Y1	Quartz Crystal, 3,490 KC	K38972-1
Y2	Quartz Crystal, 100 KC	K38661-1
Z1	RC Printed Network	K38846-1
Z2	RC Printed Network	K38885-1
Z3	RC Printed Network	K38981-1



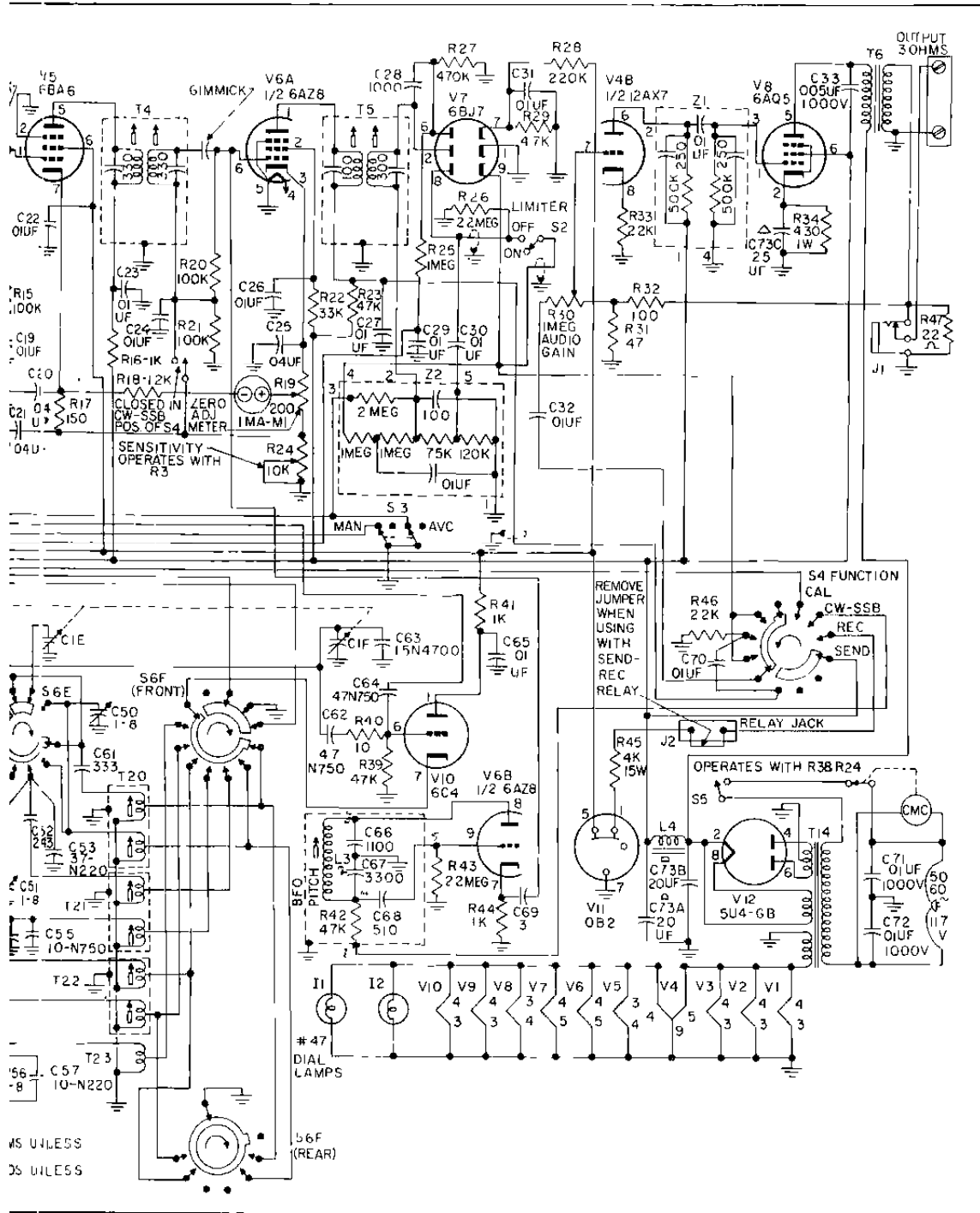


Figure 10. Hammarlund HQ-110 Communications Receiver. Schematic Diagram