

**PRO-310
COMMUNICATIONS
RECEIVER**

**TECHNICAL
DESCRIPTION
AND
OPERATING
INSTRUCTIONS**

HAMMARLUND

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PRO-310

COMMUNICATIONS RECEIVER

INSTRUCTION AND SERVICE INFORMATION

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FIGURE 1
FRONT VIEW OF HAMMARLUND
PRO-310 RECEIVER
WITH MATCHING SPEAKER

GENERAL DESCRIPTION

The Hammarlund PRO-310 is a modern general-purpose dual-conversion super-heterodyne communications receiver which provides for signal reception at any frequency within the range from 550 kilocycles to 35.52 megacycles (545 to 8.45 meters). It is designed to maintain its precise alignment for years, so that it is the ideal receiver for the radio amateur and others interested in continuous operating performance.

Among the outstanding features of the PRO-310 are: the dual-control differential drive tuning mechanism; the printed-circuit RF section; effective single side band reception; and, a choice of an extremely sharp, skirt selective IF channel for each contemplated mode of operation.

On all bands, the signal frequency is the sum of two readings in megacycles. On the Broadcast Band, however, accuracy of setting can be achieved by use of the Main Tuning dial alone.

The receiver provides the signal (or phono-attachment input) for either headset or loud-speaker use; and, also, as a 52 KCS I-F output for oscilloscope or diversity use. The receiver can be switched (send-receive) for (press-to-talk) transmitter working and instant return to reception. Incorporated in the PRO-310 are: a noise limiter of the preferred series type, an automatic gain control (AGC) for MCW reception, and an extremely stable Beat Frequency Oscillator (BFO), with buffer-amplifier stage, for CW reception. Power hum is negligible. The receiver front-panel tuning meter can be read directly in "S" units to establish received Signal-strength levels up to a 50 microvolt (S9) level, and also, directly in db, above this level. The receiver self-contained power supply requires a primary AC power source of 115 volts, 50 to 60 cycles.

The PRO-310 table model measures 8 15/16 inches in height, 17 7/8 inches in width, and 15 1/2 inches in depth; with a net weight of 65 pounds.

At customer's option, the PRO-310 may be ordered as a rack mounting receiver suitable for use in a standard 19 inch rack. The receiver for rack mounting is of the same dimensions as the table model and of approximately the same weight.

The table model is readily convertible to rack mounting through the use of a simple conversion kit furnished on separate order. The rack-mounted PRO-310 occupies only 8 3/4 inches of panel height in a standard 19" rack.

A built-in, Crystal Calibrator provides accurate calibration markers every 100 Kcs over the entire tuning range of the PRO-310. A trimmer capacitor provides adjustment for zero beat against a primary frequency standard such as WWV.

SPECIFICATIONS

Frequency Range (overall) .55 to 35.52 MCS

| | | | |
|--------|------------------|--------|--------------------|
| Band 1 | .55 to 1.11 MCS | Band 4 | 4.40 to 8.88 MCS |
| Band 2 | 1.10 to 2.22 MCS | Band 5 | 8.80 to 17.76 MCS |
| Band 3 | 2.20 to 4.44 MCS | Band 6 | 17.60 to 35.52 MCS |

Bandsread Range

| | | | |
|--------|---------|--------|----------|
| Band 1 | --- | Band 4 | .44 MCS |
| Band 2 | .11 MCS | Band 5 | .88 MCS |
| Band 3 | .22 MCS | Band 6 | 1.76 MCS |

Antenna Input: Impedance 75-300 ohms. Provides for the use of co-axial transmission line.

Power Supply : Standard model is for 115 v. 60 cps
(Primary)

Power Consumption: 110 watts

Audio Output: Maximum: two watts undistorted; 6 ohms output impedance

Output Impedance: Audio 6 ohms
IF 70 ohms

Variable Selectivity: Three positions: .5 KCS, 2.0 KCS, and 4.0 KCS

Sensitivity: 1 microvolt CW signal produces a 10 to 1 Signal-to-Noise Ratio.

IF Stages: Double conversion. IF frequencies at 1802 and 52 KCS.

Image Rejection: For the range 2.2 -17.6 MCS, better than 70 db below signal.
For broadcast and above 17.6 MCS better than 50 db below signal.

Spurious Response: Equal to or better than Image Rejection

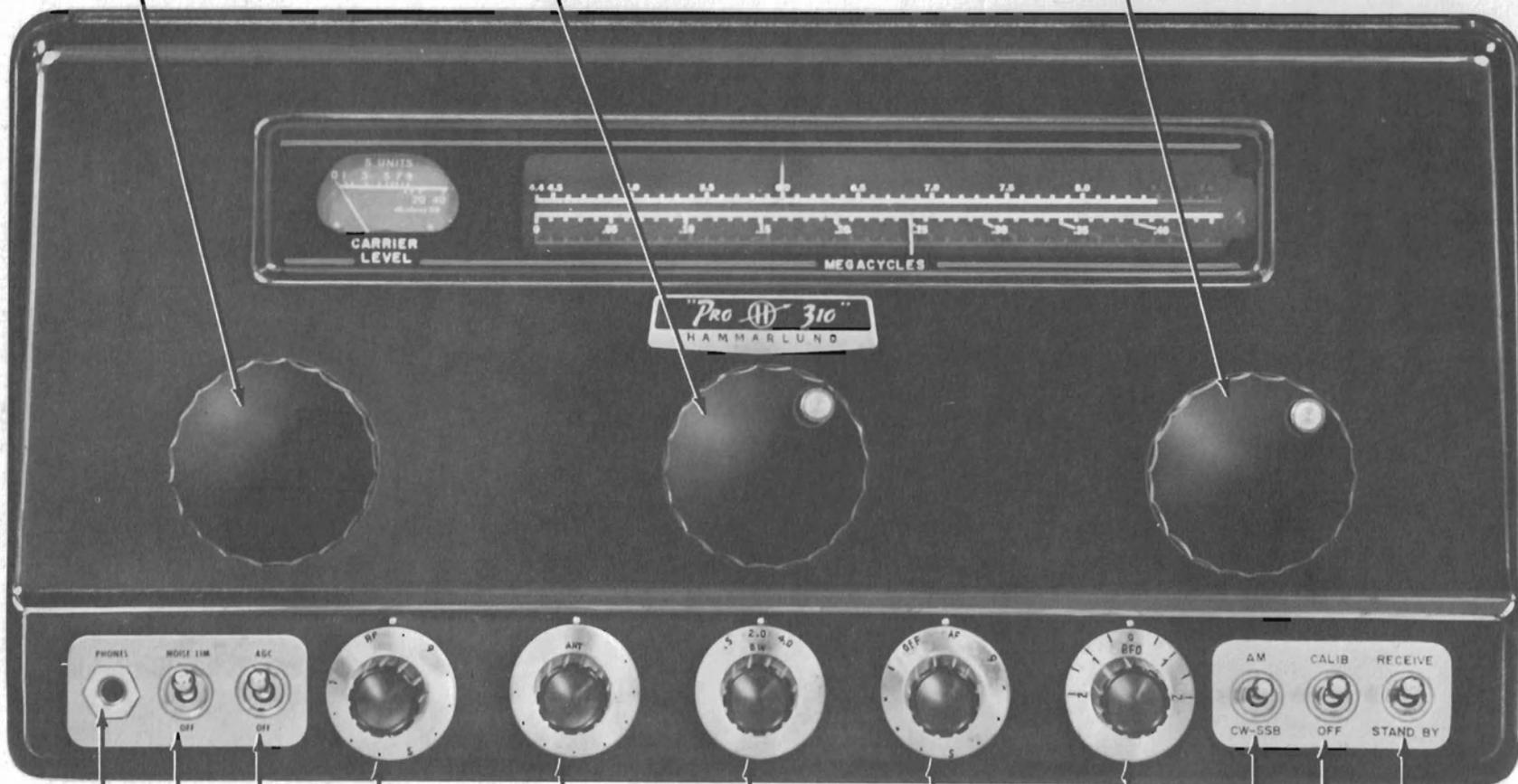
Tube Complement

| <u>Symbol</u> | <u>Tube</u> | <u>Type</u> | <u>Function</u> |
|---------------|-------------|-----------------------------|-----------------------|
| V1 | 6BA6 | Remote Cut-off Pentode | RF Ampl. |
| V2 | 6BE6 | Pentagrid Converter | 1st Mixer |
| V3 | 6C4 | Triode | High Freq. Osc. |
| V101 | 6C4 | Triode | 1.75 MCS Crystal Osc. |
| V102 | 6BE6 | Pentagrid Converter | 2nd Mixer |
| V103 | 6BZ6 | Semi-Remote Cut-off Pentode | 1st IF Ampl. |
| V104 | 6BZ6 | Semi-Remote Cut-off Pentode | 2nd IF Ampl. |
| V105 | 6AL5 | Twin Diode | Detector and Limiter |
| V150 | 12AX7 | Twin Triode | 1st Audio and AGC |
| V151 | 6V6GT | Beam Power Pentode | Power Ampl. |
| V152 | 6AN8 | Triode-Pentode | BFO and Buffer Ampl. |
| V-153 | 5U4G | Full Wave Rectifier | B+ Rectifier |
| V-155 | 6AL5 | Twin Diode | C-Bias Rectifier |
| V-154 | OB2 | Voltage Regulator | Volt. Regulator |
| V-301 | 6BZ6 | Semi-Remote Cut-off Pentode | Crystal Calibrator |

BAND CHANGE

MAIN TUNING

BANDSPREAD



PHONES JACK

AGC

RF GAIN CONTROL

ANTENNA TRIMMER CONTROL

BW CONTROL

ON-OFF SWITCH & AUDIO GAIN CONTROL

BFO

CW AM SSB

XTAL CALIB

RECEIVE-STANDBY SWITCH

FIGURE 2
FRONT VIEW OF
PRO-310 RECEIVER

CONTROL FUNCTION

The operator of the PRO-310 should be thoroughly familiar with the identification and function of the various controls before attempting to operate the receiver. It is suggested that reference be made to Figure 2, while reading this section.

Selectivity Control - The BW (Band Width) Selectivity control is a three-position switch which provides three degrees of selectivity, ranging from extremely sharp for CW reception, to broad for good fidelity MCW operation.

RF Gain Control - The RF Gain control varies the overall gain of the receiver. This control is operative in either position of the AGC-OFF switch.

Audio Gain Control - The AF (Audio Gain) control varies the input voltage to the audio amplifier, controlling sensitivity when the AGC-MANUAL switch is in the MANUAL position. This control is also operative in either position of the AGC switch.

Power Switch - The power, "on" or "off" switch is combined with the AF Gain control. A clockwise movement of this control and attending "click" indicates power "on" condition. Full counter-clockwise rotation of the AF Gain control throws the power switch to the "off" position, as indicated on the AF Gain control dial.

Antenna Compensator - Permits compensation for loading effects of various types of antennae and improves image ratio. This control is to be used as required.

PHONES Jack - The PHONES Jack is a single circuit jack operating with the sleeve grounded and designed to receive any standard single circuit phone plug. It is in the circuit at all times and is connected to the audio output transformer, which provides an attenuated signal for headphones, See INSTALLATION.

Audio Output - The Audio Output is available at the two screw terminal board marked SPEAKER at the rear of the chassis, for connection to a 6-ohm load. See INSTALLATION.

Noise Limiter - The NOISE LIM control switches the noise peak limiter in or out of the circuit. This control is operative independently of any position of any other control. See CIRCUIT DESCRIPTION.

BFO - The Beat Frequency Oscillator control varies the tuning of the 52 kcs beat frequency oscillator over a range from zero beat to plus or minus 2 kilocycles.

Automatic Gain Control - In the AGC position, the AGC-OFF switch applies automatic bias potentials to the controlled RF and IF amplifier tubes, thereby holding the audio output relatively constant over a wide variation in the strength of received signals. The RF Gain control is operative on AGC operation, when necessary to control exceptionally strong signals or to reduce noise. AGC is operative in all modes of operation. However, "S" Meter reading is not available in CW or SSB operation. In the OFF position the AGC potential is removed from the controlled tubes and the Gain of the receiver is manually controlled by the RF Gain control.

Tuning Meter - The Tuning or "S" Meter provides indication of relative signal strength and, facilitates tuning. Since the meter readings are proportional to AGC voltage, the meter is operative only when the AGC-OFF switch is in the AGC position.

Should readjustment of the meter be necessary, see ALIGNMENT Section.

CW-SSB-AM Switch - The CW-SSB-AM control in the CW-SSB position, energizes the Beat Frequency Oscillator and provides the BFO output for the reception of single side-band signals. In the AM position, the Beat Frequency Oscillator is inoperative and the conditions are established for either voice modulated or tone modulated signal reception.

RECEIVE-STANDBY - The RECEIVE-STANDBY control is a single pole, single throw toggle switch. In the STANDBY position, during transmission periods, it desensitizes the RF and IF amplifiers.

TUNING - The tuning mechanism and the circuitry of the PRO-310 are designed to permit the greatest possible accuracy and stability of calibration. Careful attention to the tuning techniques described below will insure the maximum satisfaction in the operation of this receiver.

There are two independently geared dial controls, one for MAIN TUNING and one for BANDSPREAD TUNING. Both the MAIN TUNING and BANDSPREAD controls rotate the tuning capacitor, with the BANDSPREAD CONTROL effecting rotation at one-tenth the rate of the MAIN TUNING CONTROL. Movement of the MAIN TUNING CONTROL directs the pointer of the MAIN TUNING scale, while movement of the BANDSPREAD TUNING CONTROL directs the pointer of the BANDSPREAD scale.

DIAL - The Tuning dial has six distinct frequency bands or ranges (See SPECIFICATIONS). Each band, except the Broadcast Band-Band #1 (where Bandspread control is not needed), contains one MAIN TUNING scale and two BANDSPREAD scales. The calibration of the Bandspread scales are in a direct ten-to-one ratio to the calibration of the Main Tuning scale. That is, each identifiable MAIN TUNING section of bands 2 through 6, may be expanded to ten times its "tuneable spread" for more precise tuning.

Note: When the MAIN TUNING scale dial pointer is indicating a setting in the white portion of the dial, the white BANDSPREAD scale is used to ascertain frequency. When the pointer is in the red portion of the MAIN TUNING scale, the red BANDSPREAD scale is used.

The precision geared differential construction of both tuning controls employs the principal of a dual mechanical input, which provides accurate frequency readings regardless of the position of the dial pointers. At any time, on any band except Band #1, the calibrated frequency will be the sum of the settings of the MAIN TUNING and the BANDSPREAD scales. For example: to tune in a frequency of 8.23 MCS, carefully set the MAIN TUNING pointer to 8.2 MCS and advance the BANDSPREAD pointer to .03 MCS. An alternative to this method would be the setting of the MAIN TUNING pointer to 8.0 mcs and the advancement of the BANDSPREAD pointer to .23 MCS. It is recommended that the MAIN TUNING pointer be at the closest possible frequency setting to the desired frequency.

On BAND #1 the frequency is read directly from the pointer indication on the MAIN TUNING dial. (The use of a crystal calibrator for tuning is described further in this section.

BAND SELECTOR - Each revolution of the BAND SELECTOR control turns the turret which contains the RF and HF oscillator coil and trimmer and switch contact assemblies, from one frequency band to the next. The turret may be turned either clockwise or counter-clockwise. A positive detent mechanism assures correct location of the various bands.

THE CRYSTAL CALIBRATOR

The Crystal Calibrator may be used on every band to provide extremely accurate dial setting calibration. "Marker tones" emitted from the Calibrator appear at every multiple of 100 kcs throughout the tuning range.

For normal use of the Crystal Calibrator, proceed as outlined below:

(Figures in parentheses are given as specific examples for calibrated setting of 7.250 mcs)

1. Turn CAL-OFF switch to CAL.
2. Set CW-SSB-AM switch at CW-SSB.
3. Place BANDSPREAD dial pointer at "0".
4. Set BFO at "0".
5. Advance MAIN TUNING dial pointer until 100 kcs "marker tone" nearest below the desired frequency is heard, and using the MAIN TUNING control only, tune to zero beat (The 7.2 marking).
6. Leaving MAIN TUNING dial set at this position (7.2 mcs), advance BANDSPREAD dial pointer until its setting (.05) plus the setting on the MAIN TUNING scale (7.2) equals the desired frequency (7.250 mcs).
7. Turn CAL-OFF switch to OFF.

CALIBRATION OF AMATEUR BANDS

For greatest accuracy of Bandsread Tuning, it is advisable to set the selected range with the Bandsread Dial Pointer near the center of its scale as in the following example for the 10 Meter Band:

Set the Main Tuning pointer at the 28.0 mcs. mark, set the Bandsread Dial pointer at the 1.00 mark. The result is a setting of 29.0 mcs. Turn on the Crystal Calibrator. "rock" the Bandsread Control to locate the 100 kcs beat. If the marker tone is slightly high or low of the setting, reset to the 1.00 mark and zero beat marker tone using the Main Tuning Dial pointer. The Main Tuning Dial pointer should then be, at maximum, one-half the width of the dial pointer from the 28.0 mcs. mark, if it varies at all. The Bandsread dial may now be used to tune the entire 10 meter band from 28.0 mcs. to 29.7 mcs. with excellent accuracy.

The suggested calibration set-points for the remaining amateur Bands

| Band | Main Tuning (Set-point) | Bandsread (set-point) |
|------------------------|----------------------------|--------------------------|
| 160 Meter (upper half) | 1.9 | .06 |
| (lower half) | 1.8 | .06 |
| 80 Meter (upper half) | 3.8 | .12 |
| (lower half) | 3.5 | .12 |
| 40 Meter | 7.0 | .20 |
| 20 Meter | 14.0 | .40 |
| 15 Meter | 21.0 | 1.00 |
| 11 Meter | 26.9 | 1.00 |

OPERATING PROCEDURE

Turn Receiver "on", using AF Gain Control switch.

After allowing a 15 minute warm-up period, controls should be set at the following initial positions:

| <u>CONTROL</u> | <u>M O D E S O F O P E R A T I O N</u> | | |
|-----------------|--|-------------|----------------|
| | AM or MCW | CW | SSB |
| AF Gain | as required | as required | Full Clockwise |
| NOISE LIM | as required | as required | as required |
| RECEIVE-STANDBY | RECEIVE | RECEIVE | RECEIVE |
| AGC | AGC | as required | as required |
| CW-SSB-AM | AM | CW-SSB | AM |
| RF Gain | Full clockwise | as required | as required |
| BW | 2.0 KCS or 4 KCS | .5 KCS | 2.0 KCS |
| BFO | OFF | as required | as required |

TUNING

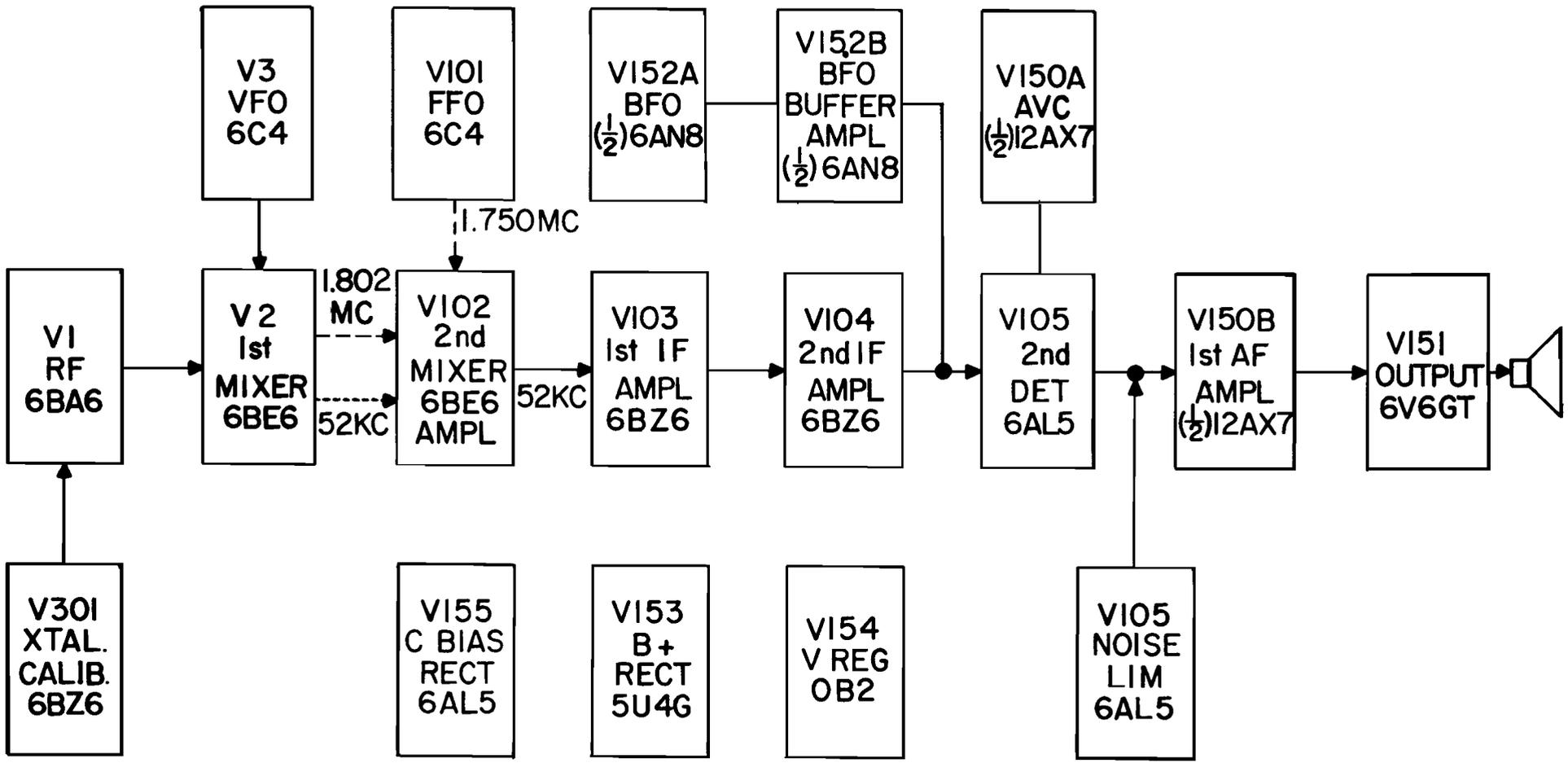
AM or MCW: For tuning in a standard broadcast station, it is necessary to use only the MAIN TUNING dial. The "S" Meter will prove helpful in indicating resonance. If the noise level is high, the NOISE LIM switch should be thrown "on". The RF Gain may be turned down to reduce noise encountered in traversing the tuning range. In searching for very weak AM signals, the CW-SSB position of the CW-SSB-AM switch will facilitate pinpointing of carrier; after zero beat is reached, switch back to AM position.

CW: Proceed as outlined above in initial operation instructions for CW Reception. The BFO control may be adjusted in either direction from "0" to provide satisfactory audio tone. Comfortable signal level may be attained by synchronized adjustment of the AF and RF Gain controls.

SINGLE SIDEBAND RECEPTION

For Single Sideband (SSB) Reception, proceed as outlined above for initial positioning of controls. With AF Gain in full "on" position, and CW-SSB-AM switch in the AM position, tune in the signal for the greatest audio response. The SSB signal will sound like a garbled or distorted signal. When maximum audio input is attained, throw the CW-SSB-AM switch to the CW-SSB position. Use either the BAND-SPREAD control or the BFO to attain maximum signal clarity and adjust the RF control to provide a comfortable level of reception. The NOISE LIM control may be used when man-made interference is present.

NOTE: For ALL operations, if the Receiver is to be used sporadically, with short time intervals of non-use, leave power "on" and throw RECEIVE-STANDBY switch to STANDBY. This condition will keep Receiver ready for instant use between periods of reception. When operation of the Receiver is completed, turn power "off" by turning AF Gain Control to OFF position.



BLOCK DIAGRAM
FIGURE 3

- SIGNAL PATH TO ALL FREQUENCIES
- SIGNAL PATH FOR FREQUENCIES ABOVE 2.2 MC
- - - - - SIGNAL PATH FOR FREQUENCIES BELOW 2.2 MC

CIRCUIT DESCRIPTIONGENERAL

The circuit is shown schematically in Figure 8. A block diagram Figure 3, is provided to show more clearly the arrangement and functions of the various circuit sections. The location of the various tubes is shown in Figure 4.

The circuit for single conversion, used for signal frequencies up to 2.2 mc (Bands 1 and 2), consists of: a one-stage RF Amplifier V1; First Mixer V2; First Heterodyne Oscillator V3; three stages of IF Amplification, V102, V103, and V104; Second Detector and AGC V150A; Noise Limiter V105; Beat Frequency Oscillator V152A; AF Amplifier V150B; and, Output stage V151.

In the circuit for double conversion, used for signal frequencies above 2.2 mc (Bands 3 through 6), the Second Heterodyne Oscillator is added to the circuit, operating simultaneously with First Heterodyne Oscillator V3.

The Power Supply System includes B Power Rectifier V153, C Bias Rectifier V155, and Voltage Regulator V154.

Input Coupling - The antenna coupling is designed to provide optimum coupling from a 75-ohm transmission line. Either a balanced doublet or straight wire antenna may be used.

RF Amplifier - A rotary turret is employed to change bands and to place the coil assemblies of the antenna, RF Amplifier V1, Mixer V2, and First Heterodyne Oscillator V3 stages directly adjacent to their respective tubes. This assures maximum sensitivity at high signal-to-noise ratio.

Intermediate Frequency Amplifier - Single conversion to 52 kcs is employed for signal frequencies below 2.2 mcs. Double conversion is employed for signal frequencies above 2.2. mcs. The signal is heterodyned to 1.802 mcs. by the First Mixer V2 and Heterodyne Oscillator V3. The 1.802 mcs. signal is then heterodyned to 52 kcs by the Second Mixer V102 and the 1.750 mcs. Fixed Crystal controlled Oscillator V101 for selectivity.

Detector and Limiter - The V105 tube is used as a high level Detector and Series-type noise limiter.

Beat Frequency Oscillator - The Beat Frequency Oscillator employs a high capacity Clapp type circuit which gives a high order of frequency stability and minimizes oscillator harmonics. The coupling of the Beat Frequency Oscillator V152 into the detector circuit through the Buffer Amplifier V152B, eliminates oscillator lock-in. The BFO control on the front panel varies the audio beat frequency, from zero beat to plus or minus 2 kcs. For single sideband operation, the BFO is exalted to operate as the local carrier.

Audio Frequency Amplifier - A resistance-coupled amplifier triode V150B amplifies the audio frequency signal from the detector.

Audio Output - The audio output tube V151 is transformer-coupled to deliver 2.0 watts undistorted output to a 6-ohm line load.

IF Output - The 52 kcs IF Output is available through an output jack located at the rear of the receiver.

First Heterodyne Oscillator V3 - Single conversion is employed on all signal frequencies below 2.2 MCS. For these frequencies, the First Heterodyne Oscillator V3 operates at a frequency 52 KCS above the received signal frequency. For Double Conversion, employed on all signal frequencies above 2.2 MCS, V3 operates at a frequency 1.802 MCS above the signal frequency.

Second Heterodyne Oscillator V101 - The Second Heterodyne Oscillator V101, operating at 1.750 MCS, is switched into the circuit when the receiver is tuned to signals above 2.2 MCS. The 1.802 MCS signal delivered by the First Mixer V2, is passed into the Second Mixer V102, simultaneously with the 1.750 MCS signal, to produce the 52 KCS which is fed to the IF Amplifier.

IF Amplifier - The IF Amplifier is comprised of two sections, the Low frequency section (52 KCS) and the High frequency section (1.802 MCS), plus two stages of amplification.

The Low frequency section includes an input filter (52 KCS) plus 3 double-tuned variable-coupled transformers.

The High frequency section includes an input filter (1.802 MCS) followed by a second converter which accepts the signal and converts it to 52 KCS. This is then fed through the three double-tuned transformers of the low frequency section. Three positions of selectivity are provided (front panel control) .5 KCS, 2.0 KCS, and 4 KCS.

Noise Limiter - The Noise Limiter V105 limits the noise interferences from ignition systems or other sources of pulse type noise. A Noise Limiter control switch (front panel) permits optional use of the Limiter.

Power Supply - The Power Supply, an integral part of the receiver, includes the B/rectifier V153 and the C(Bias) Rectifier V155, together with their respective low pass filters and the Voltage Regulator V154. The power transformer covers a power line source range of 105 to 125 volts, 50 to 60 cycles. The power transformer and filter components are protected by fuses in the primary and plate supply circuits. The Power Supply is adequately filtered to provide hum-free reception.

Radiation - The design and shielding of the high frequency second conversion crystal and beat frequency oscillators has reduced radiation to a minimum.

INSTALLATION

NOTE - After unpacking the receiver see that all tubes are firmly in their sockets and that all packing material is removed from the receiver. Also note that tubes V6 through V10 and tubes V13 and V14 are not shielded, but that tube V12 is housed within a heat shield.

The Hammarlund PRO-310 receiver is intended for enclosed station use. The shielding of the unit is such that it may be located (with due consideration for proper ventilation) in the closest proximity to other station equipment.

LOUDSPEAKER

Connect a permanent-magnetic type loudspeaker to the SPEAKER terminals on the rear of the receiver. The loudspeaker should have a voice coil impedance of approximately 6 ohms and the capability of handling 4 watts. A loudspeaker specifically designed for use with the PRO-310 is available as optional equipment.

HEADPHONES

The PHONES jack is located on the front of the receiver. Since the output impedance load is not critical, any commercial type headphones may be used. The phone jack is connected across the SPEAKER terminals and silences the speaker when the phone plug is inserted.

ANTENNAS

The PRO-310 may be used with either a single wire, half-wave doublet, or other tuned antenna with impedance of 75 to 300 ohms.

Solder-connect the lead-in end(s) of the antenna wire(s) into either terminal of the antenna input connector plug at the rear of the receiver. When a single wire antenna is used, be sure to connect the remaining terminal of the antenna input connector to a suitable ground - such as the shell of the antenna connector.

GROUND

Connect suitable ground wire to GND terminal at rear of receiver.

POWER SUPPLY

Connect receiver power cord to 115 volt, 50 to 60 cycle AC source.

Note: If in doubt as to rating of available source, check with local power company before connecting receiver.

TRANSMITTER OPERATION

The relay sockets on the rear of the receiver connect to the send-receive relay of the transmitter for break-in operation. Tip jacks with insulator tubing are provided to facilitate this connection. With the RECEIVE-STANDBY switch in STANDBY, the receiver is silent during transmission but ready for instant use.

RECORD PLAYER

A PHONO jack is provided on the rear of the receiver for use in conjunction with a record player. When desired, simply plug in phono attachment jack. NOTE: PHONO jack must be removed for normal use of receiver.

INSTALLATION CHECK LIST

Prior to use, but subsequent to the proper installation of the receiver, make the following preliminary checks in the sequence given.

1. Check all installation connections made, for positive electrical contacts.
2. With receiver power switch in its "off" position, check the fuses to see that the primary fuse is rated at 2 amperes and B- fuse is rated at 3/8 amperes. Note that power switch is located at the extreme counter-clockwise position of the Audio Gain Control.
3. With receiver power "on", check to see that all electron tubes and pilot lamps light and that voltage regulator VL4 is fired (glowing a pale blue).
4. To avoid microphonics it is best if loudspeaker is not located on top of receiver.

MAINTENANCE

GENERAL

The PRO-310 receiver is designed for continuous duty and should normally require little attention beyond the replacement of tubes.

Operation and maintenance of this receiver will be greatly facilitated if the contents of this instruction book are thoroughly read and understood.

The mechanical elements of the tuning drive should require no attention since the metallic parts have been chosen for the qualities of low friction and extremely long life. Brushing dust from the gear or lead-screw parts is not recommended since a particle of dust may accidentally become lodged between critical parts. Lubrication should not be added since the drive belts and all metal parts coming in contact with them must be free of any substance which would decrease the friction necessary for driving the tuning mechanism. The bearings of the tuning knob shafts have "Teflon"* inserts and do not require lubrication.

LOCATING FAULTS

If the dial lamps do not light when the power switch is turned on, check for a blown line fuse F201 and, if blown, replace it.

To replace a faulty dial lamp pry up the appropriate dial lamp bracket with the blade of a screw driver. The four lamp brackets are located along the top of the front frame and immediately visible when the receiver cover is lifted. If the dial lamps light but there is no sound at all in the headphones or speaker, check for a blown B minus fuse, F202, and if blown, replace it. In replacing fuses, make sure that only a 2 amp fuse is inserted in the line fuse holder and that only a 3/8 amp fuse is inserted in the B minus fuse holder. Caution: Do not use Slo-Blo type fuses. Should neither fuse be blown, nor replacement of the fuses restore operation, the receiver should be internally inspected for visual signs of trouble. The receiver is provided with a bottom cover plate which should be removed for purposes of inspection and repair.

Vacuum Tubes

Weak or defective vacuum tubes are the most common cause of decrease in sensitivity, faulty performance, or failure of operation in a receiver. In case of such faults, first remove the tubes and check them in a tube tester of reliable design. If a tube tester is not available, substitution of a new tube for each tube type and position should be tried. Such substitution is best made, one tube at a time in order that the faulty tube may be detected by the improvement or restoration of performance by the new tube.

Some sectionalizing of faults is possible, when the fault is not existent on all of the frequency bands. Non-operation of the four higher frequency bands, with normal operation on the two lower frequency bands, indicates that the fault may be associated with the circuits of tube V101 or Transformer T1 or T101. If only the two lower frequency bands are affected, the fault may be associated with the circuits of T2 and L101. If only one single band is affected, refer to HF Oscillator and RF Coil Assemblies in this section.

* "Teflon" - Du Pont trade mark for Tetrafluoroethylene.

Visual evidence of trouble is usually a burned or darkened resistor, which is probably caused by excessive current due to a short-circuited capacitor or tube element at the load side of the resistor. In such a case, both the capacitor or tube and the resistor should be replaced as indicated. Refer to Figure 7 and Parts List for location and values of components. If visual inspection and the checks on tubes and fuses fail to disclose the fault, the tube socket voltages and resistances should be measured and checked against the values given in Tables 1 and 2. Any appreciable departure beyond a normal variation of approximately 15 percent from the values in these tables will generally indicate the component or circuit at fault. If the foregoing procedure does not reveal the fault, then a stage-by-stage check of amplification should be made as shown in Table 4. Any great difference from the values of input shown in the table will indicate the stage at fault. If a tuned circuit component, such as an IF transformer, RF or HF oscillator coil assembly, is found defective and replaced, only the replaced unit need be aligned. Follow the alignment procedure in Alignment Section for the unit involved.

The IF Transformers, Dual Conversion Filter, Beat Frequency Oscillator and the 1.75 mcs Crystal Controlled Oscillator assemblies are each mounted on the chassis independently of their respective shields. The shield can assemblies are easily removed for inspection of these units, without disturbing the soldered connections.

IF Transformers

If a fault is traced to one of the variable coupled IF Transformers, T1, T2, L101, T101, T102, T103, or T104, check whether the fault exists on all positions or only on one position of the selectivity switch S101. If the faulty operation occurs on only one switch position, check for continuity of the coupling coil associated with that position, check for imperfect soldered connections at the coil and switch terminals, and check the switch contact involved. If faulty operation is localized at one transformer and exists on all positions of the selectivity switch, make the continuity check on the plate coils, on the main grid coil, and on the wiring associated with these coils.

Beat Frequency Oscillator

If the operation of the Beat Frequency Oscillator is faulty, remove the two nuts and lock washers on the top of the audio-BFO- power supply chassis that hold the BFO shield to the underside of the chassis. If the fault is associated only with the CW-SSB position of the CW-SSB-AM switch, check for continuity at that switch. If the fault persists when switched to the CW-SSB position, check for continuity of the oscillator coil and continuity of the interlocking circuit of the buffer stage through the Switch S204.

Adjustment of BFO

With the SELECTIVITY control on the 0.5 KCS position, tune in an unmodulated signal for maximum tuning meter reading. Set the CW-SSB-AM switch to CW-SSB and with the BFO dial at 0, adjust the BFO screw on the top side of the chassis for zero beat. Turn the BFO dial to each KC position and check the output beat frequency against a known audio frequency source (such as a good audio oscillator). If the beat frequencies obtained at each 2 KCS position is not within the 2 to 2.5 KCS range, loosen the set screws of the BFO shaft coupling and turn the shaft of the BFO with respect to the drive shaft and repeat the above, resetting the 0 adjustment by the top screw of the BFO unit each time until the above is realized. One set screw should be tightened just enough to allow the drive shaft to operate the BFO shaft until the range is correct; then tighten both screws.

HF Oscillator And RF Coil Assemblies

If faulty operation occurs in only one frequency band of the receiver, the trouble may be found in one of the four coil assemblies for that band in the tuning unit turret. For example: assemblies of coil L51, L52 and L53 should be examined if Band 1 (.55 to 1.11 MCS) only, does not perform normally. To remove these coil assemblies turn the receiver upside down and remove the bottom cover plate. Turn the band change control to place the band in question in its normal operating position and then turn the band change control three revolutions counter-clockwise. This will place the band coil assemblies parallel and at the bottom of the tuning unit. Now remove the two springs holding one coil assembly in the turret and carefully remove the coil assembly by sliding it radially out from the center of the turret. It is best to remove only one coil assembly at a time and inspect it for defects or substitute a replacement assembly if available. Caution: Make sure that the coil and capacitor adjustments face in the proper direction and that the coil base is firmly seated and secured by its retaining springs before going to the next assembly or turning the band change control. Failure to do this may damage the switch spring contacts beyond repair. Repeat this procedure until the faulty assembly is found. In checking these assemblies, first check for continuity of the coils, particularly the small toroidal coils found in the antenna input assemblies. These latter coils are liable to damage if the receiver is operated in the presence of very strong transmitter signals. In replacing these toroidal coils be careful to note which leads are color coded before removing the defective coil.

RF Printed Circuit Board

If the receiver fails to perform normally on any of the six frequency bands and the previous tests indicate that performance of the IF and audio frequency amplifiers is normal, including the gain check in accordance with Table 4 for the input to pin 7 of V2, the fault is indicated to be on the RF Printed Circuit Board or in the main tuning capacitor. It is advisable to remove the top shield cover and inspect the main tuning capacitor connections first. Observe that the tuning capacitor is operating properly when the tuning control is rotated. Using a miniature tube adapter, (see Alignment Section) apply a modulated rf test signal to pin 1 of V1 and V2. For each of these positions of the adapter and signal, tune through the proper dial setting for the signal frequency used. The absence of signal output, when the input signal is applied to pin 7 of V2 will indicate trouble in the HF Oscillator section or Mixer section of the unit; loss of signal through pin 1 of V1 indicates trouble in the RF section; and loss of signal through the input to the Antenna terminal indicates trouble in the Antenna section.

Any replacement of components on the RF Printed Circuit Board should be made with caution. The components have been "dip-soldered" in place on an etched foil circuit pattern. The leads pass through terminal holes with metal-plated walls and are sometimes bent over slightly on the other side to secure them during soldering. With a low wattage iron, remove the defective component and clear the terminal hole for insertion of the new component. Excessive heat applied to any one part for too long a time will cause damage to the etched foil pattern. Watch carefully for accumulations of solder that may short across adjacent parts of the circuit pattern. In some cases it may be simpler to cut the defective part out by snipping the leads as close to the body of the part as possible. The leads of the new components are then twisted around the old leads and soldered. Make sure that all new components occupy the same position as the original components so that the shield will fit properly.

TUBE SOCKET VOLTAGES - TABLE 1

Voltage to chassis. Measurements made with an RCA - 11 Megohm input. Line voltage 117, no signal input. Maximum RF sensitivity. CW-SSB-AM switch on CW, RECEIVE-STANDBY switch on RECEIVE, AGC-OFF switch on OFF, NOISE LIM-OFF switch on OFF, BW switch on 2.0 KCS position.

| S O C K E T P I N N U M B E R S | | | | | | | | | | | |
|---------------------------------|----------|-------|--------|--------|--------|--------|--------|-------|-------|----|--------------------|
| TUBE | ITEM NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | OPERATION |
| 6BA6 | 1 | -1.3 | 0 | 6.3 AC | 0 | +178 | +93 | 0 | -- | -- | R.F. Amp. |
| 6BE6 | 2 | -9.2 | 0 | 6.3 AC | 0 | +223 | +99 | -1.4 | -- | -- | 1st Mixer |
| 6C4 | 3 | +97 | 0 | 6.3 AC | 0 | +97 | -10.5 | 0 | -- | -- | V.F.O. |
| 6C4 | 101 | -.5 | -.1 | 0 | 6.3 AC | -.5 | -.4 | 0 | -- | -- | 1.75 MC Xtal Osc. |
| 6BE6 | 102 | -.4 | .96 | 0 | 6.3 AC | +165 | +83 | -1.65 | -- | -- | 2nd Mixer |
| 6BZ6 | 103 | 0 | .68 | 0 | 6.3 AC | +186 | +102 | .68 | -- | -- | 1st I.F. Amp. |
| 6BZ6 | 104 | 0 | +1.8 | 0 | 6.3 AC | +220 | +143 | +1.8 | -- | -- | 2nd I.F. Amp. |
| 6AL5 | 105 | +1.25 | -10 | 0 | 6.3 AC | -10 | 0 | -19 | -- | -- | 2nd Det.& Limiter |
| $\frac{1}{2}$ 12AX7 | 150A | -1.2 | +3.8 | +3.8 | 6.3 AC | 6.3 AC | -- | -- | -- | -- | AGC |
| $\frac{1}{2}$ 12AX7 | 150B | -- | -- | -- | -- | -- | +141V | -1.4 | 0 | -- | 1st A.F. Amp. |
| 6V6GT | 151 | 0 | 6.3 AC | +270 | +290 | 0 | 0 | 0 | +15.5 | -- | A.F. Power Amp. |
| Triode 6AN8 | 152A | +55 | +21 | +24 | 6.3 AC | 0 | -- | -- | -- | -- | B.F.O. |
| Pent 6AN8 | 152B | -- | -- | -- | -- | -- | +205 | +40 | -4.0 | 0 | B.F.O. Buffer Amp. |
| 5U4GB | 153 | 0 | +320 | +320 | 310 AC | 6.3 AC | 310 AC | 0 | +320 | -- | B+ Rectifier |
| OB2 | 154 | +104 | 0 | 0 | 0 | +104 | 0 | 0 | -- | -- | Volt. Regulator |
| 6AL5 | 155 | 72 AC | -100 | 0 | 6.3 AC | 72 AC | 0 | -100 | -- | -- | Bias Rectifier |

NOTE: Tolerances on Voltage measurements, referring to above chart is $\pm 20\%$.

TUBE SOCKET TERMINAL RESISTANCE - TABLE 2

Resistance to chassis. Measurements made with an RCA VTVM - 11 Megohm input. Tube removed from socket under measurement. Maximum RF sensitivity, CW-SSB-AM switch on CW, RECEIVE-STANDBY on RECEIVE, AGC-OFF switch on OFF, NOISE LIM-OFF switch on OFF, AF Gain Control switch on OFF, BW switch on 2.0 kcs position

| SOCKET PIN NUMBERS | | | | | | | | | | |
|---------------------|----------|--------|----------|-------|-------|-------|----------|----------|-------|----|
| TUBE | ITEM NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 6BA6 | 1 | 900 K | 0 | .05 | 0 | >50 K | >50 K | 0 | -- | -- |
| 6BE6 | 2 | 100 K | 0 | .05 | 0 | >50 K | >50 K | 220 K | -- | -- |
| 6C4 | 3 | >50 K | 0 | .05 | 0 | >50 K | 47 K | 0 | -- | -- |
| 6C4 | 101 | 220 K | ∞ | 0 | .25 | 220K | 47 K | 0 | -- | -- |
| 6BE6 | 102 | 47 K | 150 | 0 | .25 | >50 K | >50 K | 850 K | --- | -- |
| 6BZ6 | 103 | 600 K | 50 | 0 | .05 | >50 K | >50 K | 50 | -- | -- |
| 6BZ6 | 104 | 180 | 160 | 0 | .05 | >50 K | >50 K | 160 | -- | -- |
| 6AL5 | 105 | 12 K | 100 K | 0 | .05 | 100K | 0 | | -- | -- |
| $\frac{1}{2}$ 12AX7 | 150 A | 1.5M | 6.8 K | 6.8 K | .05 | .05 | -- | -- | -- | -- |
| $\frac{1}{2}$ 12AX7 | 150 B | -- | -- | -- | .05 | .05 | >270K | 1 K | 0 | 0 |
| 6V6GT | 151 | 0 | .05 K | >50 K | >50 K | 1.0 M | ∞ | 0 | 360 | -- |
| Triode 6AN8 | 152 A | >100 K | 65 K | 15 K | .05 | 0 | -- | -- | -- | -- |
| Pent 6AN8 | 152 B | -- | -- | -- | .05 | 0 | 50 K | 30 K | 100 K | 0 |
| 5U4G B | 153 | | 50 K | >50 K | 47 | .05 | 47 | ∞ | >50 K | -- |
| OB2 | 154 | >50 K | 0 | | 0 | 200K | ∞ | 0 | -- | -- |
| 6AL5 | 155 | 12 | 50 K | 0 | .05 | 12 | ∞ | 50 K | -- | -- |

NOTE. Tolerance on resistance as measured, referring to above chart is +10%

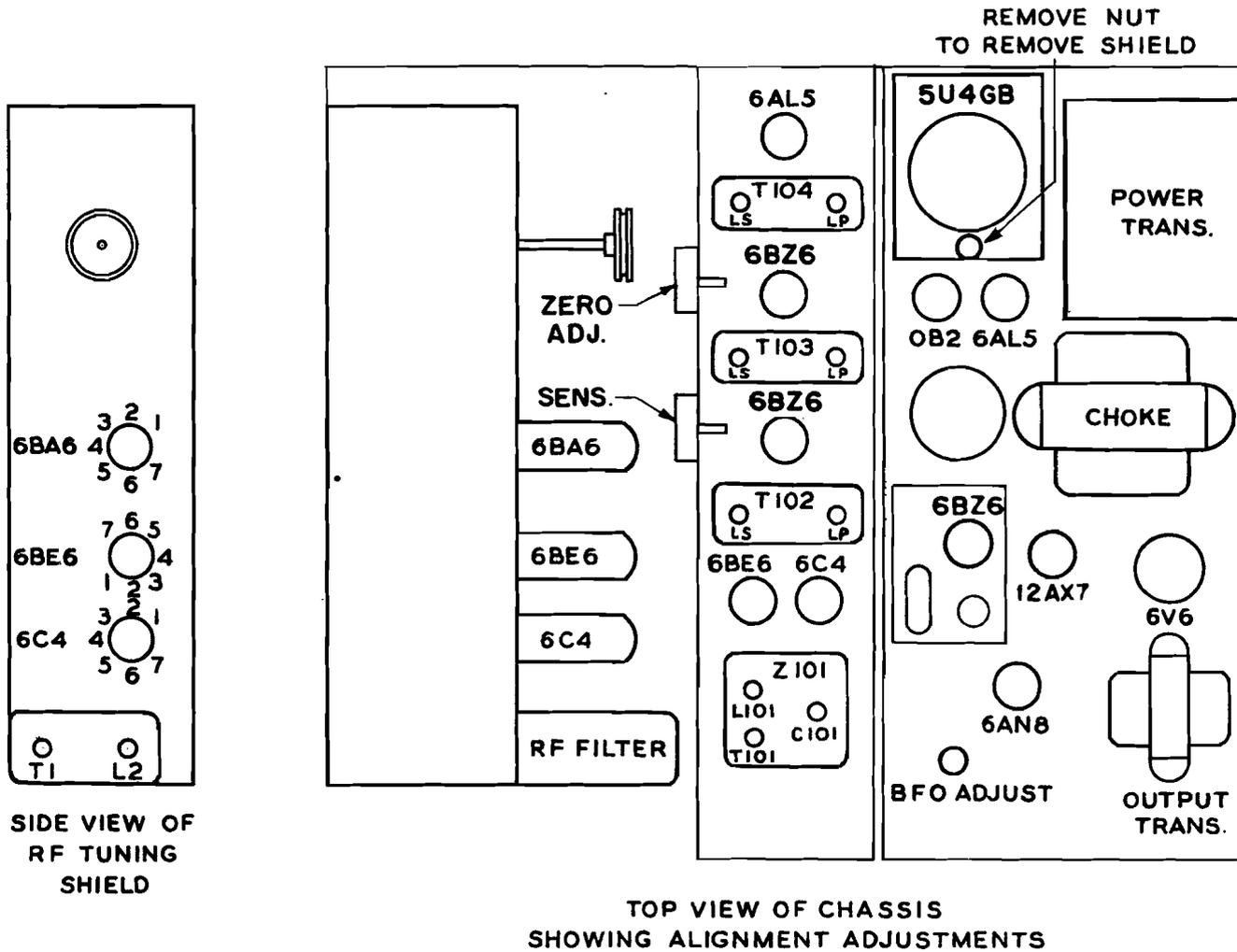


FIGURE 4

IF SELECTIVITY CURVES

- 1. NARROW BAND WIDTH
- 2. MEDIUM BAND WIDTH
- 3. BROAD BAND WIDTH

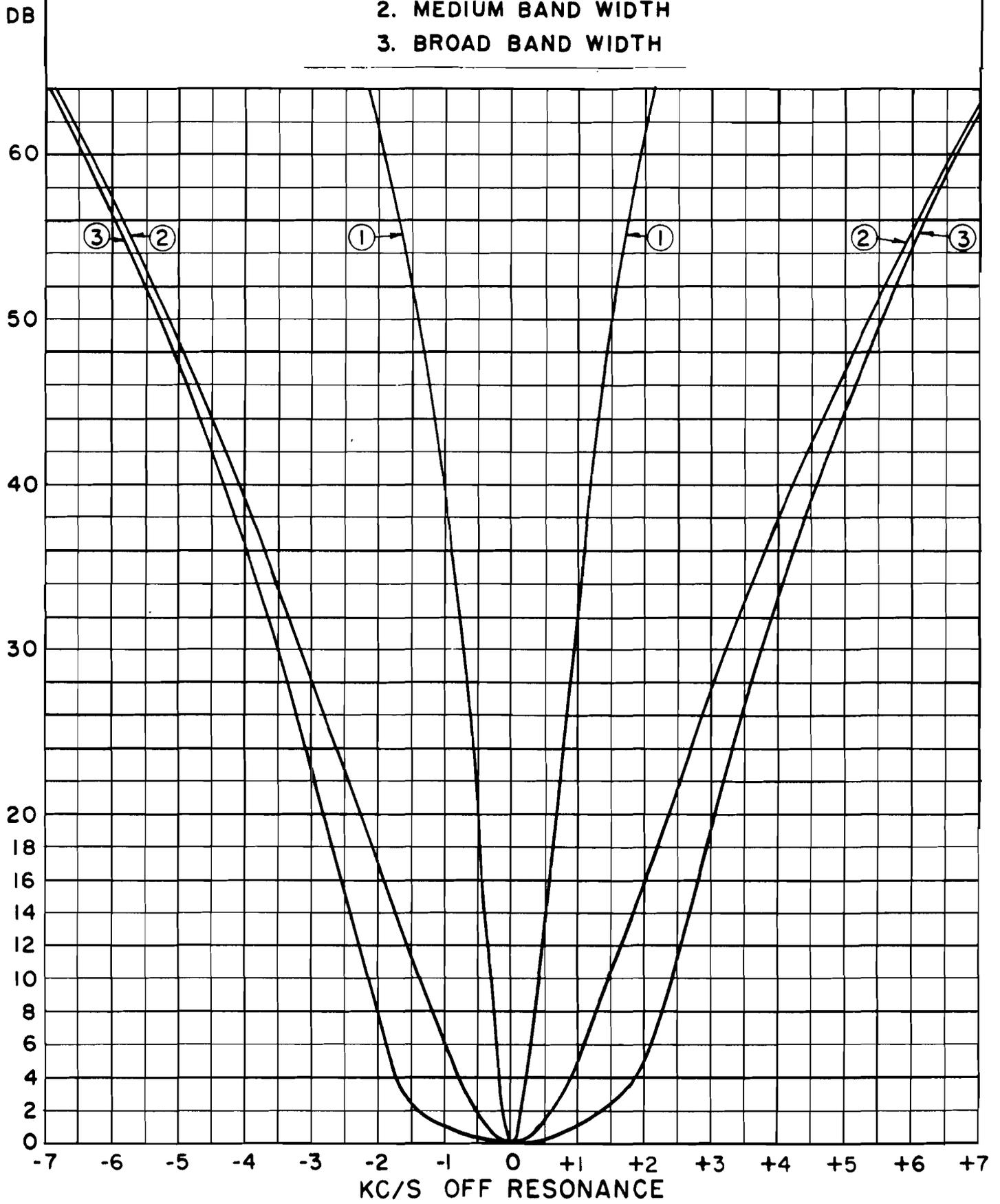


FIGURE 5

ALIGNMENT

Under normal service the receiver will stay in alignment for extremely long periods of time, consequently realignment should not be attempted unless all other possible causes of a particular trouble have been eliminated. When it has been determined that any realignment is needed, a great deal of caution should be exercised in making the adjustments, since any required adjustment should not entail more than a slight angular motion of the adjusting screw.

ALIGNMENT OF THE IF STAGES

The low frequency IF should be aligned first. The recommended method for aligning the low frequency IF involves the use of a sweep frequency signal generator and an oscilloscope. Since these instruments are not always available, an alternate method, using a signal generator and an output meter, will be described first.

Procedure:

The signal generator should be coupled to the grid of the mixer tube V2 through a capacitance of approximately .01 mfd. An output meter should be connected across the output terminals of the receiver or the speaker voice coil. The receiver controls should now be set as follows:

| Control | Position |
|-------------------|--------------------------|
| Bandwidth | 0.3 KCS |
| Receive - Standby | Receive |
| CW-SSB-AM | AM |
| AGC - OFF | OFF |
| Audio Gain | Set for approx. 20 volts |
| RF Gain | Max. |
| Band Switch | 1.7 MCS |

Turn the selectivity switch to the .5 KCS position and advance the RF Gain control to maximum. Set the signal generator frequency to 52 KCS and adjust its output until some deflection is noted on the output meter. Refer to Figure 4 for the location of the various alignment adjustments. Adjust Lp and Ls of T104, Lp and Ls of T103 and Lp and Ls of T102 for maximum output, reducing the signal generator output and the RF Gain control as required to prevent overload or excessive output. Before changing this set-up, the BFO should be turned on by throwing the CW-SSB-AM switch to CW-SSB and checked for zero beat with the BFO knob dial at its zero reading. If necessary L151* should be adjusted for zero output. This check and adjustment of the BFO should be done with the signal generator carrier unmodulated.

The input filter Z101 should be aligned next. Z101 contains two transformers (T1 and T101) and two high frequency filters (L2 and L101).

With the generator still set on 52 KCS open coaxial cable connection to pin 7 on Z101. Place the probe of an AC VTVM on the printed circuit board marked test point and tune L2 for maximum output. Re-connect coaxial cable to pin 7 and place a jumper across pins 8 and 10. Tune L101 for a null. Remove jumper and place VTVM on the grid of pin 7 of V102 and repeak L2. The low frequency filter should then be aligned.

* BFO Adjust

The high frequency filter should be aligned next. Set the Band Switch to the 2.2-4.44 MC band. All other receiver settings are unchanged. Adjust the signal generator frequency to 1.802 MCS. Place the probe of the VTVM on the test point located on the printed circuit board. Open coaxial cable at pin 9 of Z101 and tune T1 to maximum output. NOTE: A large signal input may be required. Re-connect cable to pin 9 and place a jumper from pin 3 to grid. Tune C101 for a null. Remove jumper from pin 3 and grid and tune T101 for maximum output. Remove VTVM from printed circuit board to pin 3 of V102 and repeak T1. The high frequency filter should then be aligned.

The procedure for the visual method of aligning the low frequency IF is the same as the procedure outlined above except that the adjustments are made for both maximum amplitude and coincidence of the oscilloscope images. The oscilloscope vertical input should be connected across the diode detector load resistance, from the junction of R124 and R133 to chassis.

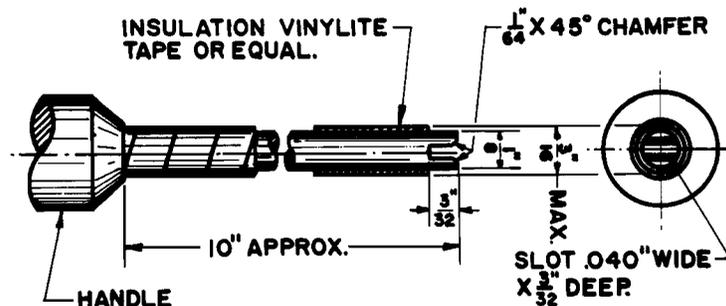
Adjustment of Tuning Meter

In the event that meter re-adjustment is necessary, the following procedure should be followed, using Figure 4, page 21 as reference:

1. Set front panel Sensitivity (RF) control to "10", and Selectivity (BW) control in the 2.0 KC position.
2. Remove tube V102, and with AGC on, zero meter needle using the ZERO ADJ (ust) potentiometer R130.
3. With AGC on, and V102 replaced, adjust meter sensitivity using SENS(itivity) potentiometer R132.

ALIGNMENT OF THE RF AMPLIFIER AND HF OSCILLATOR

To adequately align the RF Amplifier and HF Oscillator, an accurately calibrated signal generator, an output meter, and an appropriate alignment tool (such as is shown in inset) are required. The frequencies for alignment are shown in Table 3. RF adjustments are located at the rear of the chassis, accessible through an aperture in the rear panel. Oscillator and Mixer adjustments are located on the front of the turret assembly. The Oscillator adjustments are accessible with the removal of the Band Change knob on the front panel (upper-L; lower-C) Access to the Mixer adjustment is gained by removing the knobs and escutcheon plates, removing the two screws on the underside of the front panel, then lifting the front panel free of the chassis. The adjustments will be found to the right of the BAND CHANGE shaft. Use of Table 3 should be made in following this part of the alignment, described below for one frequency band. The same procedure should then be followed for the other frequency bands.



To align the 5.5 - 1.11 MC band, the signal generator is coupled to the antenna input terminal through a 75-ohm carbon resistor. The generator should be modulated 30 percent at 400 cycles and the output meter connected across the receiver output terminals. The receiver controls should be set as follows:

| <u>Control</u> | | <u>Position</u> |
|-------------------|----|-------------------------------|
| Selectivity (BW) | -- | 1.5KCS |
| RECEIVE-STANDBY | -- | RECEIVE |
| CW-SSB-AM | -- | AM |
| AGC-OFF | -- | See Text |
| Audio Gain (AF) | -- | Set for approx. 20 milliwatts |
| RF Gain | -- | See Text |
| Band Switch | -- | Set for band to be aligned |
| Limiter (LIM-OFF) | -- | OFF |

Set the receiver and signal generator dials to .55 MCS. The RF Gain control should be set at maximum and the AGC-OFF switch set on AGC. The HF Osc. L adjustment should now be set for maximum output. Then the 1st RF and 1st Mixer L adjustments should be set for maximum output. The receiver and signal generator dials are now set to 1.1 MCS and the C adjustments should be adjusted for maximum output in the same order, beginning with the Osc C adjustment and then making the C adjustments for the 1st RF and 1st Mixer. This procedure should be carefully repeated until no increase in output can be realized. The AGC-OFF switch should then be set to OFF and the signal generator should be set for approximately 3 microvolts. The L and C adjustments should now be checked for maximum output, adjusting the RF Gain control as found necessary to maintain the output at approximately 20 milliwatts.

Following the frequencies shown in Table 3, align the remaining bands using the same procedure as above.

TABLE NO. 3

RF AND HF OSCILLATOR ALIGNMENT FREQUENCIES AND ADJUSTMENT DESIGNATIONS

| FREQ. BAND IN MCS | .55- 1.11 | 1.1-2.22 | 2.2-4.44 | 4.4- 8.88 | 8.8-17.76 | 17.6-35.52 |
|-----------------------------|-----------|----------|----------|-----------|-----------|------------|
| RF & HF OSC ADJUST L AT. | .55 | 1.1 | 2.2 | 4.4 | 8.8 | 17.6 |
| RF & HF OSC ADJUST C AT. | 1.1 | 2.2 | 4.4 | 8.8 | 17.6 | 35.52 |

APPROXIMATE SIGNAL INPUT AT IF & AF STAGES FOR 20 MILLIWATTS OUTPUT

Output measured across a 6-ohm resistive load at output terminals of receiver. RF signals modulated 30 percent at 400 cycles. Signals applied to tube grids through a .01 mfd capacitor. Selectivity switch at 2.0 KCS. AGC-OFF switch on OFF. CW-SSB-AM switch on AM. RF Gain and Audio Gain at maximum.

TABLE NO. 4

| BAND SWITCH | FREQUENCY | INPUT TO | APPROX. INPUT |
|----------------|------------------|--------------|------------------|
| Any | Audio 400 cycles | Pin 5, V151 | 1.0 volts |
| Any | Audio 400 cycles | Pin 7, V150B | 15K microvolts |
| .55 - 1.11 MCS | Mod RF 52 KCS | Pin 1, V104 | 6,000 microvolts |
| .55 - 1.11 MCS | Mod RF 52 KCS | Pin 1, V103 | 86 microvolts |
| .55 - 1.11 MCS | Mod RF 52 KCS | Pin 1, V102 | 95 microvolts |
| .55 - 1.11 MCS | Mod RF 52 KCS | Pin 7, V2 | 6.1 microvolts |
| 2.2 - 4.44 MCS | Mod RF 1.802 KCS | Pin 7 V2 | 7.8 microvolts |
| 2.2 - 4.44 MCS | Mod RF 1.802 KES | Pin 7, V102 | 18 microvolts |

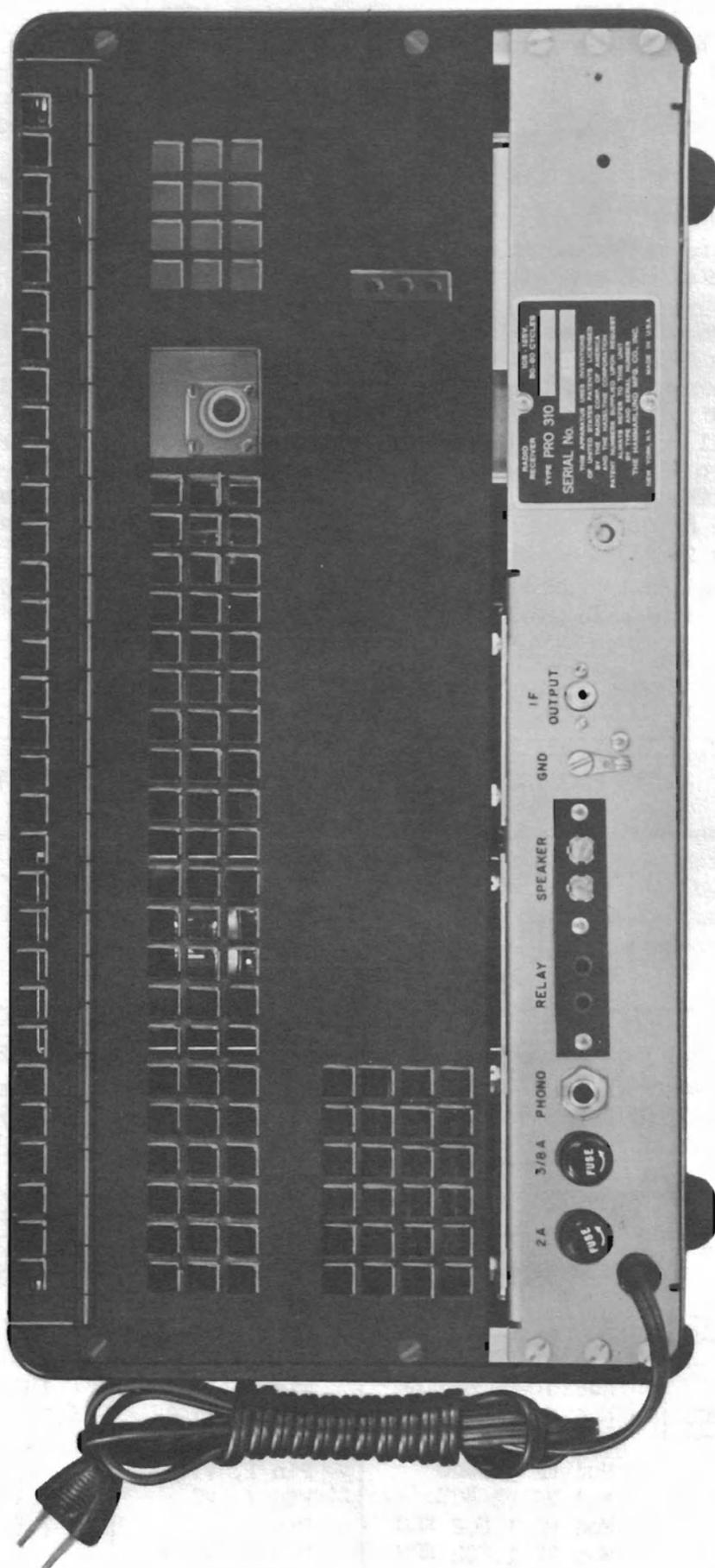


FIGURE 6
REAR VIEW OF
PRO-310 RECEIVER

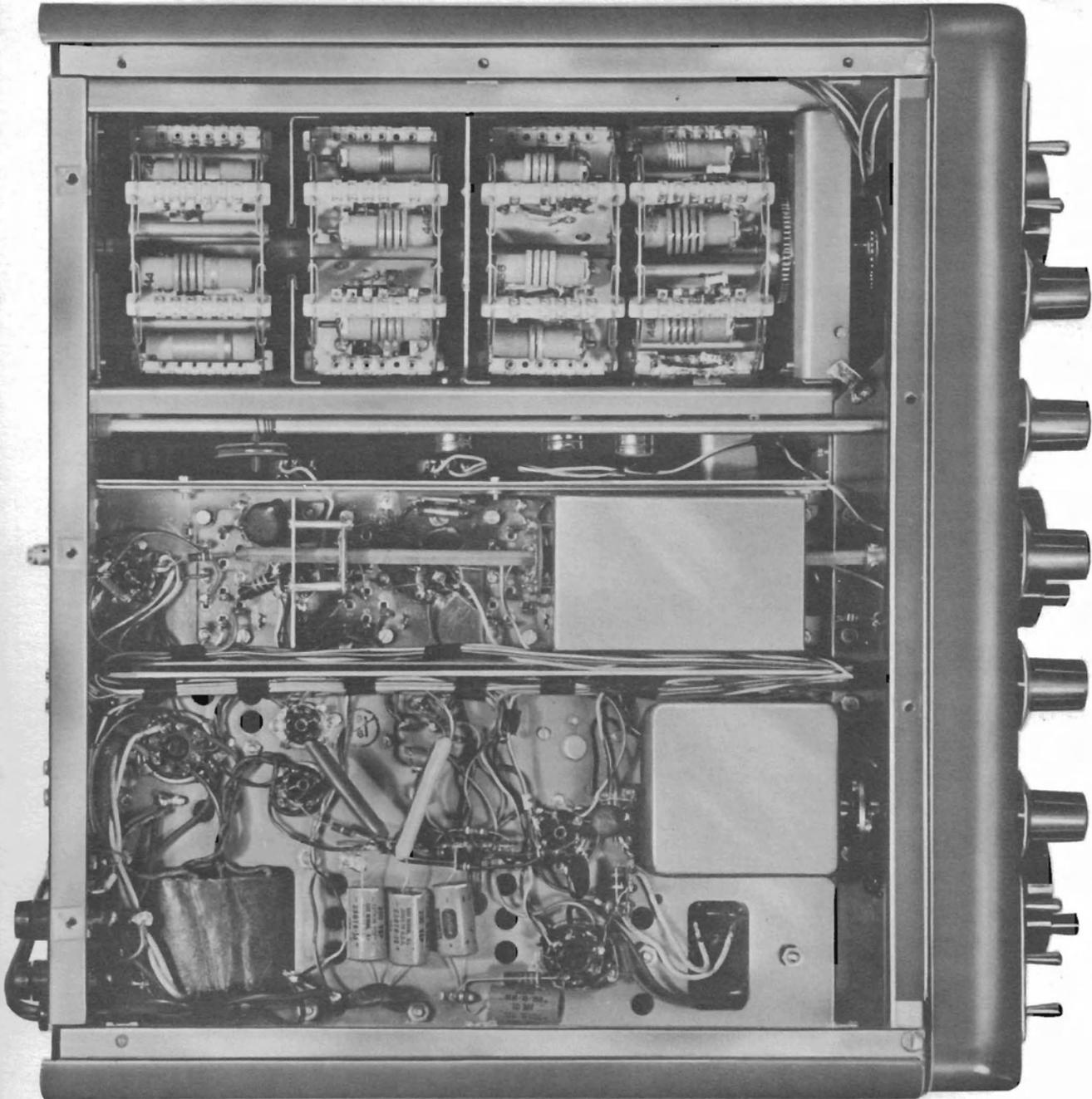


FIGURE 7
BOTTOM VIEW OF
PRO-310 RECEIVER

REPLACEABLE PARTS LIST

| <u>ITEM NO.</u> | <u>DESCRIPTION</u> | <u>PART NO.</u> |
|--|--------------------------------|-----------------|
| C3 | Capacitor, Fixed 1000 MMF | K 23072-3 |
| C4 | Capacitor, Fixed .01 MFD | M 23034-23 |
| C5 | Capacitor, Fixed .022 MFD | M 23034-24 |
| C6 | Capacitor, Fixed .01 MFD | M 23034-23 |
| C7 | Capacitor, Fixed .1 MFD | M 23032-47 |
| C8 | Capacitor, Fixed 1000 MMF | K 23072-3 |
| C9 | Capacitor, Fixed .01 MFD | M 23034-23 |
| C10 | Capacitor, Fixed 24 MMF | K 23071-95 |
| C11, C12 | Capacitor, Fixed .022 MFD | M 23034-24 |
| C13 | Capacitor, Fixed 43 MMF | K 23071-96 |
| C16 | Capacitor, Fixed .01 MFD | M 23034-23 |
| C17 | Capacitor, Fixed .022 MFD | M 23034-24 |
| C18 | Capacitor, Fixed .01 MFD | M 23034-23 |
| C109, C110 | Capacitor, Fixed 33 MMF | K 23071-84 |
| C111, C112, C113, C114, C119, C124, C131 | Capacitor, Fixed .02 MFD | M 23034-9 |
| C133 | Capacitor, Fixed 100 MMF | K 23071-8 |
| C134 | Capacitor, Fixed .02 MFD | M 23034-9 |
| C151 | Capacitor, Fixed .005 MFD | M 23034-9 |
| C152 | Capacitor, Fixed 300 MMF | K 23071-12 |
| C153 | Capacitor, Fixed .005 MFD | M 23034-10 |
| C154 | Capacitor, Electrolytic 10 MFD | K 23078-13 |
| C155 | Capacitor, Variable | K 34454-G4 |
| C156 | Capacitor, Fixed 250 MMF | K 23071-11 |
| C157, C158 | Capacitor, Fixed .005 MFD | M 23034-1 |
| C159 | Capacitor, Fixed 470 MMF | K 23003-39 |

REPLACEABLE PARTS LIST

| <u>ITEM NO.</u> | <u>DESCRIPTION</u> | <u>PART NO.</u> |
|--------------------------|---|--------------------|
| C160 | Capacitor, Fixed 100 MMF | K 23071-8 |
| C161 | Capacitor, Fixed .02 MFD | M 23034-9 |
| C162 | Capacitor, Fixed .01 MFD | M 23034-23 |
| C163, C164 | Capacitor, Fixed .02 | M 23034-9 |
| C165, A,B,C | Capacitor, Electrolytic | K 15504-61 |
| C166, C167, C168 | Capacitor, Electrolytic 10 MFD | K 23078-13 |
| C169 | Capacitor, Fixed .001 MFD | M 23034-4 |
| C170 | Capacitor, Fixed .01 MFD | M 23034-23 |
| C173, C174 | Capacitor, Fixed .01 MFD | M 23034-5 |
| C175 | Capacitor, Fixed .02 MFD | M 23034-9 |
| C201 | Capacitor, Fixed .01 MFD | M 23034-23 |
| C203 | Capacitor, Fixed .02 MFD | M 23034-9 |
| C204 | Capacitor, Fixed .005 MFD | M 23034-10 |
| C205 | Capacitor, Fixed .001 MFD | M 23034-2 |
| F201 | Fuse Cartridge 2 Amp. | K 15928-7 |
| F202 | Fuse Cartridge 3/8 Amp. | K 15928-13 |
| I201, I202, I203 I204 | Lamp, Incandescent #47 | K 16004-1 |
| J201 | Jack, Phono | K 35608-1 |
| J202 | Jack, Phones | K 35608-1 |
| J203 | Jack, I. F. Output | K 35609-1 |
| L1 | Inductor | K 15627-1 |
| L3 | Inductor | K 15627-1 |
| L101 | Filament Choke | K 35433-G1 |
| L150 | Reactor | K 35202-1 |
| L151 | BFO Coil Assembly | K 35393-G1 |
| M201 | Meter, Carrier Level | K 35615-1 |
| P201 | Antenna Input Plug Male Tip-jacks for relay terminal | K 16016-1 35051 |

REPLACEABLE PARTS LIST

| <u>ITEM NO.</u> | <u>DESCRIPTION</u> | |
|-----------------|---------------------------------|-------------|
| P 202 | Plug, I. F. | M 35610-1 |
| R1 | Resistor, Fixed 470 K | K 19309-113 |
| R2 | Resistor, Fixed 100 K | K 19309-97 |
| R3 | Resistor, Fixed 33 K | K 19309-85 |
| R4 | Resistor, Fixed 2.2 K | K 19309-57 |
| R5 | Resistor, Fixed 100 K | K 19309-97 |
| R8 | Resistor, Fixed 1000 Ω | K 19309-49 |
| R9 | Resistor, Fixed 2.2 K 1W | K 19310-57 |
| R10 | Resistor, Fixed 47 K | K 19309-89 |
| R11 | Resistor, Fixed 1 K | K 19309-49 |
| R12 | Resistor, Fixed 47 K | K 19309-89 |
| R107 | Resistor, Fixed 120K | K 19309-99 |
| R108 | Resistor, Fixed 150 Ω | K 19309-259 |
| R109 | Resistor, Fixed 47K | K 19309-89 |
| R110 | Resistor, Fixed 22K | K 19309-81 |
| R111 | Resistor, Fixed 100 Ω | K 19309-25 |
| R114 | Resistor, Fixed 82 Ω | K 19309-257 |
| R115 | Resistor, Fixed 120 Ω | K 19309-258 |
| R118 | Resistor, Fixed 82 Ω | K 19309-257 |
| R119 | Resistor, Fixed 120 Ω | K 19309-258 |
| R120 | Resistor, Fixed 75 Ω | K 19309-195 |
| R122 | Resistor, Fixed 33K 1W | K 19319-352 |
| R123 | Resistor, Fixed 200 Ω | K 19309-200 |
| R127 | Resistor, Fixed 8.2 K | K 19309-277 |
| R129 | Resistor, Fixed 12K | K 19309-75 |
| R130 | Resistor, Variable 200 Ω | K 15368-6 |
| R131 | Resistor, Fixed 56 Ω | K 19309-19 |
| R132 | Resistor, Variable 2.5 K | K 15368-3 |

REPLACEABLE PARTS LIST

| <u>ITEM NO.</u> | <u>DESCRIPTION</u> | <u>PART NO.</u> |
|-----------------|---------------------------------|-----------------|
| R151 | Resistor, Fixed 470K | K 19309-113 |
| R154 | Resistor, Fixed 6.8K | K 19309-93 |
| R156 | Resistor, Fixed 270K | K 19309-107 |
| R157 | Resistor, Fixed 1 Meg. | K 19309-121 |
| R158 | Resistor, Fixed 360 Ω 1W | K 19310-211 |
| R159 | Resistor, Fixed 27 Ω 1W | K 19310-11 |
| R160 | Resistor, Fixed 47K | K 19309-89 |
| R161 | Resistor, Fixed 15K | K 19309-77 |
| R162 | Resistor, Fixed 100K | K 19309-97 |
| R163 | Resistor, Fixed 1K 10W | K 19330-3 |
| R164 | Resistor, Fixed 1K 10W | K 19330-2 |
| R165 | Resistor, Fixed 1K | K 19309-49 |
| R166, R167 | Resistor, Fixed 10K | K 19309-73 |
| R168 | Resistor, Fixed 100K | K 19309-97 |
| R169 | Resistor, Fixed 4.7K | K 19309-65 |
| R170 | Resistor, Fixed 100K | K 19309-97 |
| R171 | Resistor, Fixed 12K-1W | K 19310-75 |
| R172 | Resistor, Fixed 1K | K 19309-49 |
| R173 | Resistor, Fixed 510K | K 19309-159 |
| R174 | Resistor, Fixed 100K | K 19309-97 |
| R201 | Resistor, Fixed 240K | K 19309-177 |
| R202 | Resistor, Fixed 1 MEG | K 19309-121 |
| R203 | Resistor, Fixed 2.7K | K 19309-59 |
| R204 | Resistor, Variable 250K | K 35590-1 |
| R205 | Resistor, Variable 50K | K 35595-1 |
| R206 | Resistor, Fixed 1K | K 19309-49 |
| R207 | Resistor, Fixed 47K | K 19309-89 |

REPLACEABLE PARTS LIST

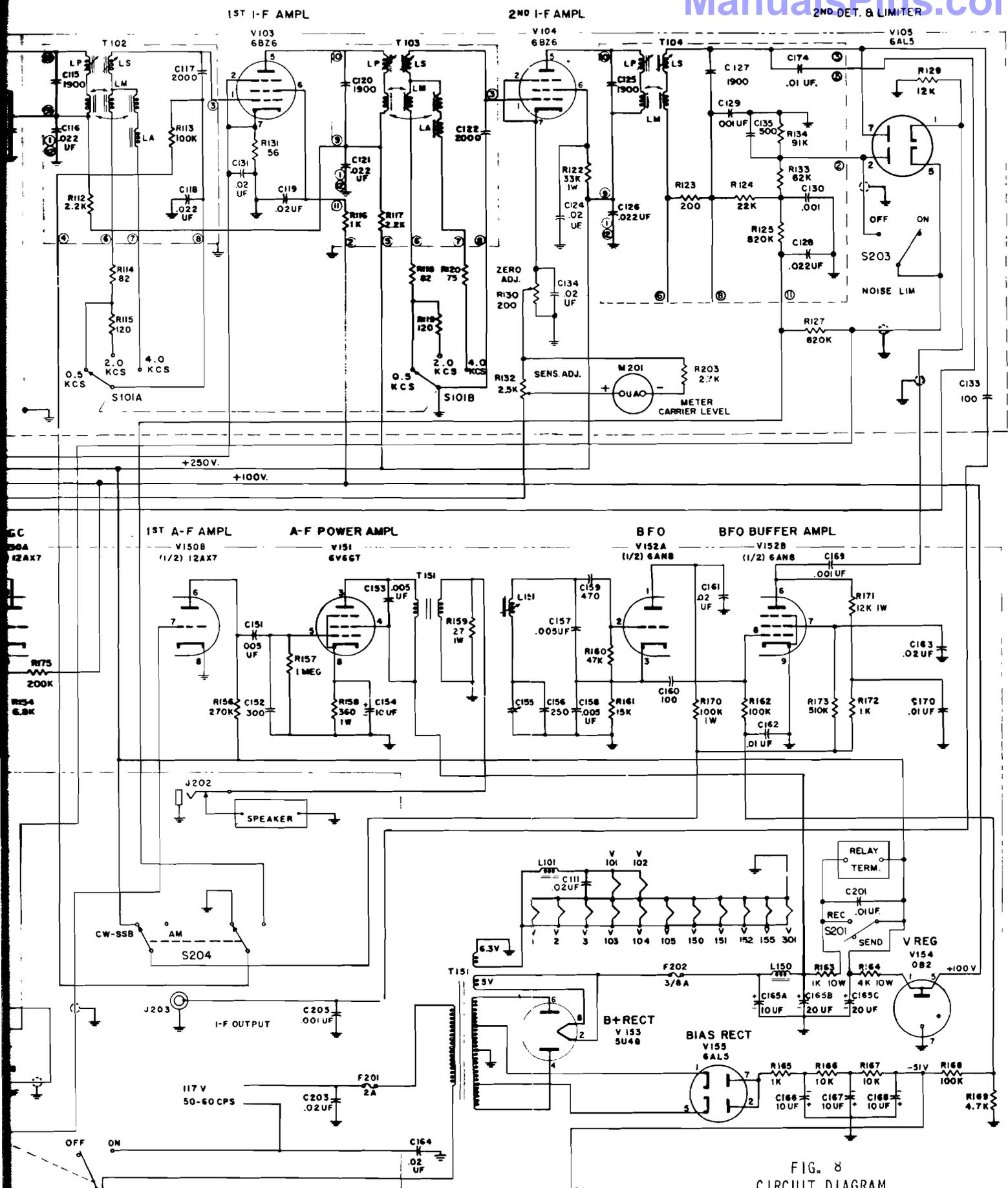
| <u>ITEM NO.</u> | <u>DESCRIPTION</u> | <u>PART NO.</u> |
|-----------------|---------------------------|---------------------|
| S201 | Switch SPST (Send-Rec.) | K 35094-1 |
| S202 | Switch DPDT (Man.-AGC) | K 35098-1 |
| S203 | Switch SPST (Limiter) | K 35094-1 |
| S204 | Switch DPDT (CW-SSB-AM) | K 35098-1 |
| S205 | Switch SPST (On-Off) | Included in R204 |
| S206 | Switch DPDT (Calib.) | K 35094-1 |
| T2 | Coil, Mutual | K 35525-G1 |
| T101 | I.F. Filter Coil Assembly | K 35304-G1 |
| T102 | 1st I.F. Transformer | M 35301-G1 |
| T103 | 2nd I.F. Transformer | M 35302-G1 |
| T104 | 3rd I.F. Transformer | M 35303-G1 |
| T150 | Transformer, Audio | K 6086-3 |
| T151 | Transformer, Power | P 35201-1 |
| V1 | Tube, Electron 6BA6 | K 16283-1 |
| V2 | Tube, Electron 6BE6 | K 16284-1 |
| V3 | Tube, Electron 6C4 | K 16288-1 |
| V101 | Tube, Electron 6C4 | K 16288-1 |
| V102 | Tube, Electron 6BE6 | K 16284-1 |
| V103, V104 | Tube, Electron 6BZ6 | K 16388-1 |
| V105 | Tube, Electron 6AL5 | K 16294-1 |
| V150 | Tube, Electron 12AX7 | K 16300-1 |
| V151 | Tube, Electron 6V6 | K 16231-4 |
| V152 | Tube, Electron 6AN8 | K 16385-1 |
| V153 | Tube, Electron 5U4GB | K 16215-1 |
| V154 | Tube, Electron 0B2 | K 16375-1 |
| V155 | Tube, Electron 6AL5 | K 16294-1 |
| X1 | Socket | K 35382-1 |
| X2 | Socket | K 35382-1 |

REPLACEABLE PARTS LIST

| <u>ITEM NO.</u> | <u>DESCRIPTION</u> | <u>PART NO.</u> |
|-----------------|--|-----------------|
| X3 | Socket | K 35382-1 |
| XF201, X202 | Fuse Holder | K 15923-1 |
| X1201, - 204 | Shell and Clip Assembly | M 35285-G1 |
| Y101 | Crystal | K 35436-1 |
| Z101 | Filter Assembly | M 35434-G1 |
| | Knob, Gold or Silver; Main Tuning Bandspread, and Band Change Control Gold or Silver | M 35509-G1 |
| | Knob, Gold; Band width Control | M 35413-G2 |
| | Knob, Gold; AF Gain Control, ON-OFF Control | M 35413-G2 |
| | Knob, Gold; Antenna Trimmer Control | M 35413-G3 |
| | Knob, Gold; RF Gain Control | M 35413-G4 |
| | Knob, Gold; BFO Control | M 35413-G5 |
| | Knob, Silver; Band Width Control | M 35412-G1 |
| | Knob, Silver; AF Gain Control and ON-OFF Control | M 35412-G2 |
| | Knob, Silver; Antenna Trimmer Control | M 35412-G3 |
| | Knob, Silver; RF Gain Control | M 35412-G4 |
| | Knob, Silver; BFO Control | M 35412-G5 |
| | R.F. Tuner Sub-Assembly Ant. .55 - 1.11 | K 35252-G1 |
| | R.F. Tuner Sub-Assembly Ant. 1.10 - 2.22 | K 35253-G1 |
| | R.F. Tuner Sub-Assembly Ant. 2.2 - 4.44 | K 35254-G1 |
| | R.F. Tuner Assembly Ant. 4.4 - 8.88 | K 35255-G1 |
| | R.F. Tuner Assembly Ant. 8.8 - 17.76 | K 35256-G1 |
| | R.F. Tuner Sub-Assembly Ant. 17.6 - 35.52 | K 35257-G1 |

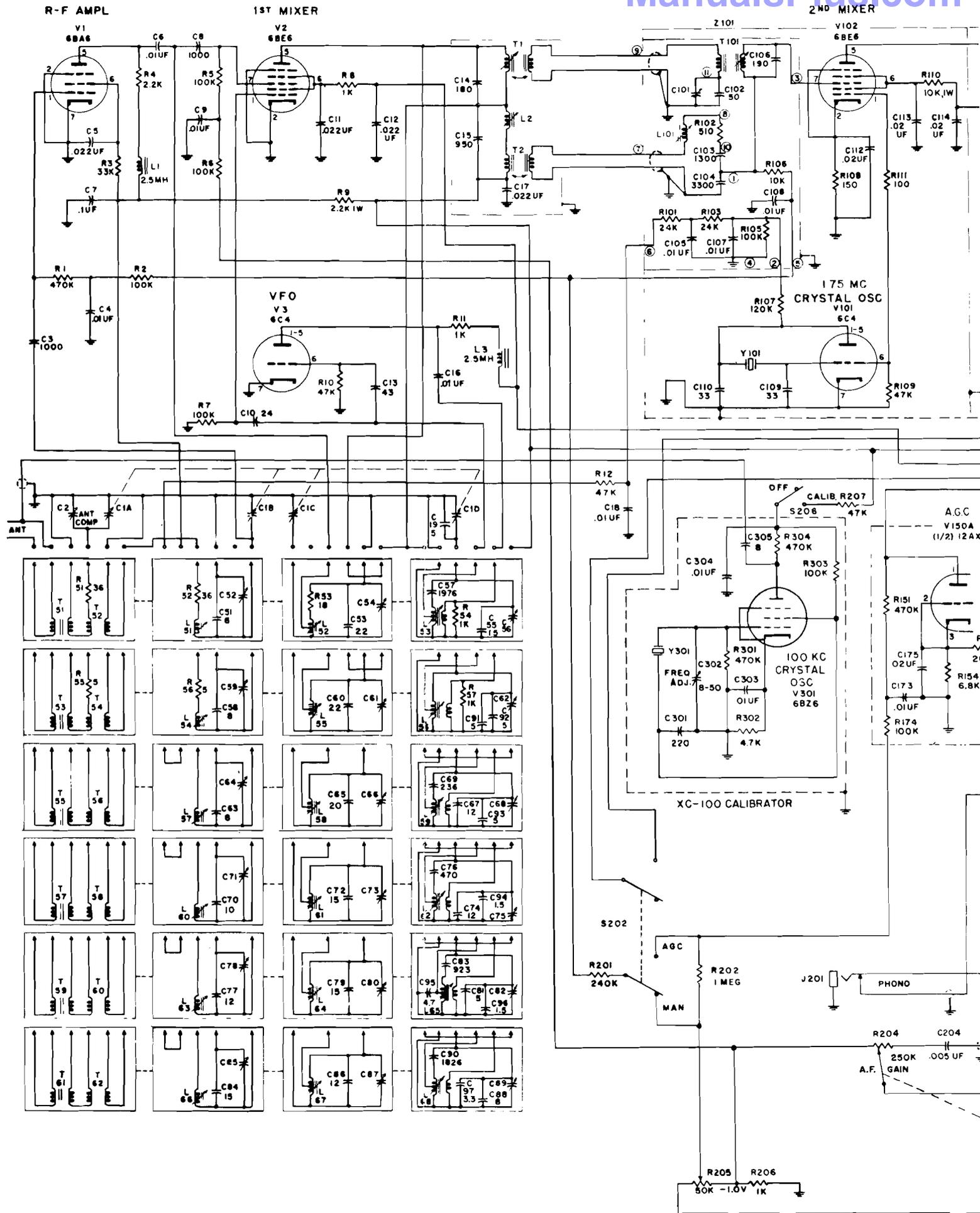
REPLACEABLE PARTS LIST

| <u>DESCRIPTION</u> | <u>PART NO.</u> |
|--|-----------------|
| R.F. Tuner Sub-Assembly R.F. Amplifier .55 - 1.11 | K 35258-G1 |
| R.F. Tuner Sub-Assembly R.F. Amplifier 1.11 - 2.22 | K 35259-G1 |
| R.F. Tuner Sub-Assembly R.F. Amplifier 2.2 - 4.44 | K 35260-G1 |
| R.F. Tuner Sub-Assembly R.F. Amplifier 4.4 - 8.88 | K 35261-G1 |
| R.F. Tuner Sub-Assembly R.F. Amplifier 8.8 - 17.76 | K 35262-G1 |
| R.F. Tuner Sub-Assembly R.F. Amplifier 17.6 - 35.52 | K 35263-G1 |
| R.F. Tuner Sub-Assembly Mixer .55 - 1.11 | K 35264-G1 |
| R.F. Tuner Sub-Assembly Mixer 1.10 - 2.22 | K 35265-G1 |
| R.F. Tuner Sub-Assembly Mixer 2.2 - 4.44 | K 35266-G1 |
| R.F. Tuner-Sub-Assembly Mixer 4.4 - 8.88 | K 35267-G1 |
| R.F. Tuner Sub-Assembly Mixer 8.8 - 17.76 | K 35268-G1 |
| R.F. Tuner Sub-Assembly Mixer 17.6 - 35.52 | K 35269-G1 |
| R.F. Tuner Sub-Assembly Oscillator .55 - 1.11 | K 35270-G1 |
| R.F. Tuner Sub-Assembly Oscillator 1.1 - 2.22 | K 35271-G1 |
| R.F. Tuner Sub-Assembly Oscillator 2.2 - 4.44 | K 35272-G1 |
| R.F. Tuner Sub-Assembly Oscillator 4.4 - 8.88 | K 35273-G1 |
| R.F. Tuner Sub-Assembly Oscillator 8.8 - 17.76 | K 35274-G1 |
| R.F. Tuner Sub-Assembly Oscillator 17.6 - 35.52 | K 35275-G1 |



NOTE
UNLESS OTHERWISE SHOWN CAPACITORS ARE IN MMF;
RESISTORS ARE IN OHMS, AND ARE 1/2 WATT.

FIG. 8
CIRCUIT DIAGRAM
PRO-310



THE HAMMARLUND MANUFACTURING COMPANY, INC.

Standard Warranty

The Hammarlund Manufacturing Company, Inc., warrants this equipment to be free from defects in workmanship and materials under normal and proper use and service for the uses and purposes for which it is designed, and agrees to repair or replace, without charge, all parts thereof showing such defects which are returned for inspection to the Company's factory, transportation prepaid, within a period of 90 days from date of delivery, provided such inspection discloses to the satisfaction of the Company that the defects are as claimed, and provided also, that the equipment has not been altered, repaired, subjected to misuse, negligence or accident, or damaged by lightning, excessive current or otherwise, or had its serial number or any part thereof altered, defaced, or removed. Tubes shall be deemed to be covered by the manufacturer's standard warranty applicable thereto, and such items shall be and are hereby excluded from the provisions of this warranty. Pilot lamps and fuses are not guaranteed for length of service.

Except as herein specifically provided, no warranty, express or implied, other than that of title, shall apply to any equipment sold hereunder. In no event shall the Company be liable for damages by reason of the failure of the equipment to function properly or for any consequential damages.

This Warranty is valid for the original owner of the equipment, and is contingent upon receipt of the Warranty Registration Card by the Company. No equipment shall be returned to the factory for repairs under warranty unless written authorization is obtained by the Company, and the equipment is shipped prepaid by the owner. The Company maintains Authorized Service Stations, names and locations of which will be sent upon request of the owner.

The Hammarlund Manufacturing Company, Inc.
460 West 34th Street
New York 1, N.Y.

