1. INTRODUCTION

This section provides maintenance, calibration, and troubleshooting instructions.

2. RECOMMENDED TEST EQUIPMENT

Item	Model
Spectrum Analyzer	HP 8568B
Signal Generator	HP 8657A
Frequency Counter	HP 5327C
Multimeter	FLUKE 8000A
Audio Generator	HP 204C
Oscilloscope	TEKTRONIX 465
Audio Analyzer	HP 8903B
Power Meter	HP 438A
30 dB/150 W Coaxial Attenuator*	Bird 8322
10 dB/1 W Attenuator	Bird 8302–100

* may be used as Dummy Load

NOTES

1. It is possible to perform the adjustments with the Motorola R2200 or R2600HS communications system analyzer. For accurate frequency calibration, a reference source of at least ±0.05 PPM is recommended.

2. Equivalent test equipment may be used.

3. When servicing a MICOM•XL radio, you must be equipped with the programming module FLN6304 (option S86), so as to be able to program the radio to all frequencies used in the tests.

3. PREVENTIVE MAINTENANCE

3.1 VISUAL INSPECTION

Check that all external surfaces of the equipment are free of dirt. Inspect all connecting cables for damage or loose connections.

If the equipment is dirty, wash the external surfaces with mild soap and water using a clean cloth. Be careful! Never allow electronic components or connectors to get wet.

3.2 PERFORMANCE TESTS

At initial installation and yearly thereafter, perform the power output, half-power output, 'tune' power output transmitter tests and the 10 dB SINAD and half-power sensitivity receiver tests. The tests should be performed on several channels covering the 1.6-30 MHz frequency range unless otherwise specified. It is recommended to check at 1.6 MHz and at the end of each range of the harmonic filter (refer to paragraph 3.5 in the Theory of Operation section of this manual). The readings of each test should be recorded and compared with previous readings to detect any possible deterioration.

The radio's frequency should be checked and calibrated after the first, third, sixth, and twelfth months, and yearly, thereafter. If the crystal is replaced, the above schedule should be repeated for the first year.

The frequency accuracy of the radio depends only on the frequency accuracy of the 9.105 MHz reference oscillator, located on the A board (see Figure 2 in the Description section of this manual). The oscillator has a normal aging of maximum 1 PPM/year. It is therefore

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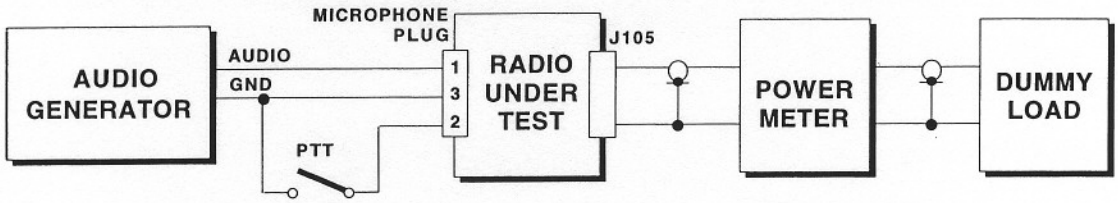
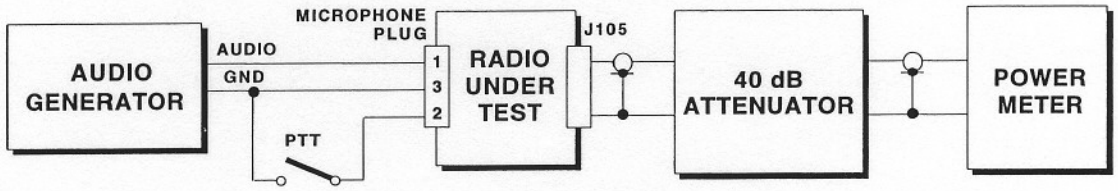
68P02940C99-O
April, 1994



a. Transmitter Test Setup with Serial Power Meter



b. Transmitter Test Setup with Terminating Power Meter

Figure 1. Transmitter Test Setup

necessary to periodically check the frequency accuracy (once every three months is recommended) and to correct it if needed.

Frequency measurement and calibration should be performed according to the instructions given in paragraph 4.

3.2.1 Transmitter Test
(See Figure 1)

For all transmitter tests perform the following steps, unless otherwise specified:

Step 1. Connect a power meter to the antenna connector (J-105) as shown in Figure 1.

Step 2. Connect an audio generator between pin 1 (Mic high) and pin 3 (Mic low) on the microphone connector. Adjust the oscillator to 1000 Hz and set its output level to minimum.

Step 3. Set the radio frequency to 29.900 MHz; select SSB. If applicable, select USB.

Step 4. The transmitter will be keyed by shorting either pin 2 (PTT) to pin 3 on the microphone connector or pin 1 (PTT) to pin 4 (Ground) on the accessory connector on the rear panel.

3.2.1.1 Half-Power Sensitivity

This test should be performed at initial installation and yearly thereafter.

Step 1. Key the transmitter.

Step 2. Gradually increase the audio oscillator output level until the wattmeter indicates 62.5 W (half of the rated power output). The audio oscillator output level should be between 20 mV and 70 mV; this level is the half-power sensitivity of the transmitter.

Step 3. De-key the transmitter.

3.2.1.2 Power Output

This test should be performed at initial installation and yearly thereafter.

Step 1. Key the transmitter.

Step 2. Increase the audio oscillator output level to 150 mV RMS. The wattmeter should indicate 125 ± 15 W.

Step 3. De-key the transmitter.

3.2.1.3 Power Output Data Operation

This test should be performed at initial installation and yearly thereafter.

Step 1. Connect the audio oscillator between pin 9 (TX Audio) and pin 12 (GND) on the auxiliary connector located on the underside of the radio housing.

Step 2. Key the transmitter by shorting pin 4 (Data PTT) and pin 7 (GND) on the auxiliary connector.

Step 3. Increase the audio oscillator output level to 150 mV RMS. The wattmeter should indicate 125 ± 10 W.

3.2.1.4 Power Output CW Operation

This test should be performed at initial installation and yearly thereafter.

Step 1. Disconnect the audio oscillator.

Step 2. Connect the telegraph key to the CW jack, and key the transmitter by closing the key. The wattmeter should indicate 125 ± 10 W.

3.2.1.5 Tune Power Output

Step 1. Disconnect the audio oscillator from the microphone connector.

Step 2. Key the transmitter by inserting the Tune plug (part of FLN 6335) into the 6-pin accessory connector J10 on the radio rear panel (the Tune plug grounds pin 3 of J10, the ANTENNA-TUNE line). The wattmeter should indicate 3.5 ± 1 W.

Step 3. Remove the tune plug to de-key the transmitter.

3.2.1.6 Power Amplifier Disable

Step 1. Set the audio oscillator output level to 150 mV, and key the transmitter.

Step 2. Connect to ground either pin 14 of antenna tuner connector J11, or pin 2 of accessory connector J10. The RF power output must drop to less than 1 W and remain at that level until the ground connection is removed.

Step 3. De-key the transmitter.

3.2.1.7 VSWR Protection

The VSWR protection test can be performed only with a serial power meter.

Step 1. Disconnect the 50 Ω load from the wattmeter, and set the audio oscillator output level to 150 mV.

Step 2. Key the transmitter. The wattmeter should indicate less than 25 W.

Step 3. De-key the transmitter, reconnect the 50 Ω load, and key the transmitter again. The wattmeter should indicate 125 ± 15 W.

Step 4. De-key the transmitter.

3.2.1.8 Frequency Test

The following steps should be performed if your RF counter is more accurate than your RF signal generator. Otherwise refer to paragraph 3.2.2.2. Make sure that the radio has been operated for at least 30 minutes before performing this test.

Step 1. Connect a frequency counter via an appropriate attenuator (at least 30 dB) to the antenna connector J105. The total accuracy of the counter should be ± 1 Hz. Disconnect the audio oscillator.

Step 2. Key the transmitter by inserting the tune plug into the 6-pin accessory connector J10 on the radio rear panel.

Step 3. Read the frequency on the frequency counter. If it differs by more than ± 5 Hz from the radio frequency (29.900 MHz), refer to paragraph 4.13 and adjust the 9.105 MHz reference oscillator.

Step 4. Remove the tune plug to de-key the transmitter.

3.2.2 Receiver Test
(See Figure 2)

The receiver tests should be performed on any of the customer channels.

3.2.2.1 Receiver Test Setup

Step 1. Ground the PA disable switch (either pin 14 of the antenna tuner connector J11, or pin 2 of the accessory connector J10) to prevent accidental transmission into the RF signal generator. Make sure that the PA is always disabled during all receiver tests.

Step 2. Connect a RF signal generator to antenna connector J105.

Step 3. Connect a 2 Ω/5-to-10 W load to the external speaker jack and connect an audio analyzer (HP 8903B or equivalent) across it.

Step 4. Turn on the ON-Volume-Control. Turn off the clarifier (CCW), the squelch (SQ Indicator OFF), the Noise Blanker (NB Indicator OFF), and the Dimmer (CCW).

Step 5. Allow five minutes for the radio to stabilize.

3.2.2.2 Frequency Test

The following steps should be performed if your RF generator is more accurate than your RF signal counter. Otherwise refer to paragraph 3.2.1.8.

Step 1. Set the RF signal generator output level to -47 dBm (1 mV) at the highest possible frequency plus 1 kHz (USB) or minus 1 kHz (LSB).

Step 2. Make sure that the clarifier control is OFF.

Step 3. Verify that the indication on the frequency counter is 1000 ±ΔF, where ΔF is the radio frequency divided by 5,000,000. If the measured audio frequency is out of the desired range, refer to paragraph 4.13 and adjust the 9.105 MHz reference frequency.

3.2.2.3 10 dB SINAD Sensitivity

Step 1. Set the RF signal generator output level to –107 dBm (1 μV). Set its frequency to the received frequency of the selected channel plus 1 kHz (USB) or minus 1 kHz (LSB).

Step 2. Reduce the RF signal generator output level until a 10 dB SINAD is obtained.

Step 3. The RF signal generator output level must be ≤–113 dBm (0.5 μV).

3.2.2.4 Half-Power Sensitivity

Step 1. Set the RF signal generator frequency to the received frequency of the selected channel plus 1 kHz (USB) or minus 1 kHz (LSB). Adjust its output level until the AC voltmeter shows 2.24 VAC (half output power = 2.5 W = 2.24 V RMS across 2 Ω).

Step 2. The RF signal generator output level must be ≤ –107 dBm (1 μV).

3.2.2.5 Clarifier Range

Step 1. The clarifier should be tested at the highest possible receive frequency.

Step 2. Set the RF signal generator output level to -47 dBm (1 mV) at the frequency that the radio is tuned to plus 1 kHz for USB reception or minus 1 kHz for LSB reception.

Step 3. Close the clarifier knob (maximum CCW).

Step 4. Read the audio frequency at the audio output.

Step 5. Vary the clarifier control over its entire range and verify that the change in frequency of the recovered audio is ± 200 Hz ±10%.

3.2.2.6 Audio Output Power Distortion & Current Drain During Reception

Step 1. Set the RF signal generator output level to –47 dBm (1 mV). Set its frequency to the received frequency of the selected channel plus 1 kHz (USB) or minus 1 kHz (LSB).

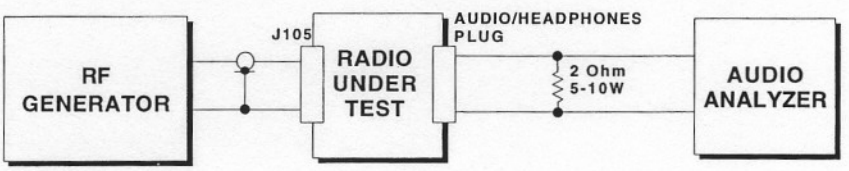


Figure 2. Receiver Test Setup

Step 2. Adjust the volume control until the AC voltmeter reads 3.16 VAC (rated power output = 5.0 W; 3.16 V RMS across 2 Ω).

Step 3. Maximum distortion (@ 1 kHz) is 5%. Maximum current drain is 2 A.

3.2.2.7 Audio Frequency Response

Step 1. Set the RF signal generator output level to –100 dBm.

Step 2. Set the RF signal generator output to the receive frequency of the selected channel, plus 1.5 kHz (USB), at a level of –100 dBm.

Step 3. Adjust the RF signal generator output frequency so that the frequency of the recovered audio is 1.5 kHz ± 10%.

Step 4. Adjust the volume control until the AC voltmeter reads 1 V RMS.

Step 5. Vary the RF signal generator output frequency so that the frequency of the recovered audio is between 350 Hz ± 10 Hz and 2700 Hz ± 10 Hz.

Step 6. The AC voltmeter must read at least 0.5 V RMS (no more than 6 dB attenuation) at these frequencies.

3.2.2.8 Squelch Response

Step 1. Set the RF signal generator output level to –107 dBm (1 μV). Set its frequency to the received frequency of the selected channel plus 1 kHz (USB) or minus 1 kHz (LSB).

Step 2. Reduce the RF signal generator output level until a 10 dB SINAD radio is obtained.

Step 3. Press the squelch key to turn on the squelch. Observe the delay in squelch activation. This delay should be a maximum of 2 seconds.

Step 4. Set the RF signal generator output to the receive frequency of the tested channel, plus 1.5 kHz (USB) at a level of –67 dBm (100 μV).

Step 5. Frequency modulate the RF signal generator with a 2 Hz ±10% sinusoidal signal so that the peak deviation of the RF signal is 500 Hz. The squelch must open and remain open while the 2 Hz modulation is applied.

Step 6. Remove the frequency modulated signal.

Step 7. Turn off the SQ switch. The SQ indicator will turn off.

3.2.2.9 RGC Dynamic Range

Step 1. Set the RF signal generator output level to +13 dBm (1 V).

Step 2. Adjust the volume control on the radio under test until the AC voltmeter reads 1 V RMS.

Step 3. Reset the RF signal generator output level to –87 dBm (10 μV).

Step 4. The audio output signal must decrease no more than 2 dB from the 1 V RMS reference level.

Step 5. Reset the RF signal generator output level to –83.5 dBm (15 μV).

Step 6. Adjust the volume control of the radio under test until the AC voltmeter reads 1 V RMS.

Step 7. Reduce the RF signal generator output level until the audio output signal drops 2 dB below the 1 V RMS reference level. This RF level is the RGC threshold and must be less than 10 μV.

4. ADJUSTMENT AND CALIBRATION
(See Figure 3)

4.1 INITIAL INTERNAL CONTROL SETTINGS

a. TGC – R38 (A board) Fully CCW.

b. AME – R16 (A board) Fully CCW.

c. Carrier – Balance R87 (A board) Centered.

d. IF Coil – L21 (A board) Flush with top.

e. Drivers – bias: R58 (PA board) Fully CW.

f. Final – bias: R57 (PA board) Fully CW.

g. ALC – R55 (PA board) Fully CW.

4.2 REFERENCE OSCILLATOR – 9.105 MHz INITIAL ADJUSTMENT

NOTE
This adjustment should be performed after at least 15 minutes of continuous operation of the radio.

4.2.1 Using RF Counter

Perform the following steps if your RF counter is more accurate than your RF generator. Otherwise refer to paragraph 4.2.2.

Step 1. Disconnect the coaxial cable from J10 on the S board (9.105 MHz reference signal) and connect it to a high input impedance frequency counter.

Step 2. Remove the plastic cap covering the tuning hole in the oven insulating cover and adjust the piston trimmer capacitor C115 (see Figure 3) to obtain a reading of 9.105 MHz ± 2 Hz on the frequency counter.

Step 3. Disconnect the frequency counter and replace the plastic cover on the oven insulating cover. Connect the coaxial cable again to J10 on the S board.

4.2.2 Using RF Generator

Perform the following steps if your RF generator is more accurate than your RF counter. Otherwise refer to paragraph 4.2.1.

Step 1. Disconnect the coaxial cable from J-7 on the S board and connect it to the RF signal generator. Adjust the signal generator frequency to 11.401 MHz (USB operation) and its output level to –50 dBm.

Step 2. Connect a 2 Ω/5-to-10 W load to the external speaker jack and connect an audio frequency counter (HP 8903B or equivalent) across it.

Step 3. Remove the plastic cap covering the tuning hole in the oven insulating cover and adjust the piston trimmer capacitor C115 (see Figure 3) to obtain a reading of 1000Hz ± 1 Hz on the frequency counter.

Step 4. Disconnect the frequency counter and the RF signal generator. Replace the plastic cover on the oven insulating cover. Reconnect the coaxial cable to J-7 on the S board.

4.3 SECOND INJECTION PLL ADJUSTMENT

Step 1. Program the radio to the 2.505 MHz frequency. Connect a high impedance frequency counter via a probe to pin 9 of U22 on the S board. The measured frequency should be 3.375 MHz. If this frequency is not obtained, press the [ENTER] button (IF shift) until the required frequency is obtained. Then, verify that the voltage at TP2 is in the range of 3.5 to 4.75 V.

Step 2. Without any change in the radio's mode of operation, adjust coil S34 (see Figure 3) to obtain 4 ± 0.1 V on the positive pole of C255.

4.4 IF – TRANSMIT

Step 1. Set the RF signal generator to 11.4 MHz and –10 dBm level and connect it to J7 phono connector on the S board.

Step 2. Connect a spectrum analyzer to J8 phono connector on the S board. Program the radio to 2.505 MHz USB and set it to transmit mode. The frequency measured on pin 9 of U22 should be 3.375 MHz. If not, press the [ENTER] button (IF shift) until this frequency is obtained.

Step 3. Tune coils S16-S17 (see Figure 3) to maximum output at J8. Then, vary the RF signal generator ± 10 kHz around the center frequency and return slightly S16-S17 to obtain maximum ripple of 1.5 dB within the ± 10 kHz range. The output level in the center should be –18 to +3 dBm.

Step 4. Program the radio to 28.125 MHz. The ripple and the output level should be as in the previous step, without any further tuning.

4.5 PA BIAS ADJUSTMENT

Step 1. Ensure that the PA heatsink temperature is 25°C ± 5°C and that no audio input is present. Key the transmitter on any channel.

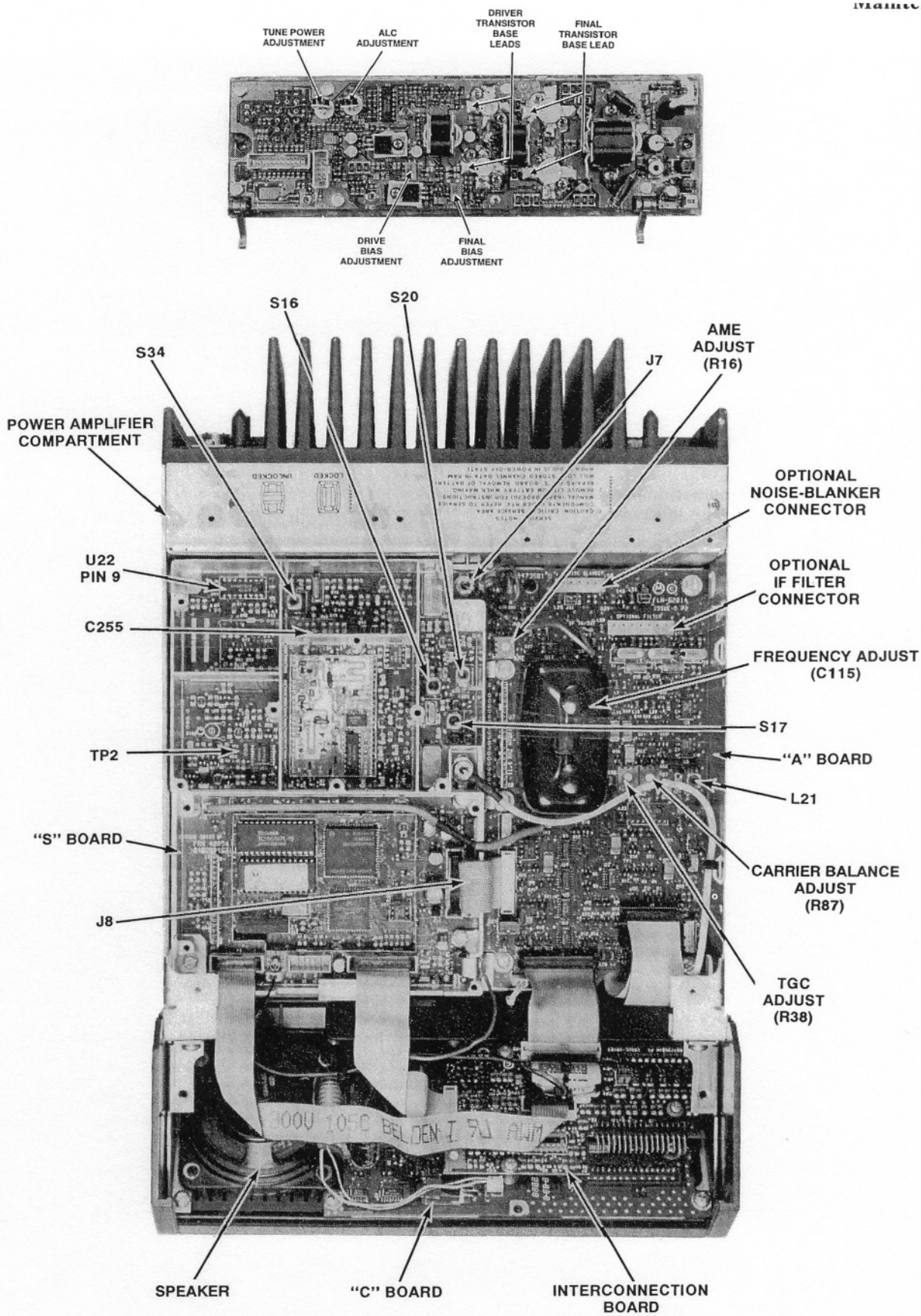


Figure 3. Location of Measurement and Adjustment Points

Step 2. Measure the base voltage of either of the final amplifier transistors Q18 or Q19. Adjust OUTPUT BIAS control R57 to obtain a base voltage of 0.63 ± 0.01 V.

Step 3. Note the current consumption of the radio. Adjust DRIVER BIAS control R58 so as to add 1 A to this reading.

4.6 TGC ADJUSTMENT

Step 1. Program the radio operating frequency to 1.6 MHz in SSB mode.

Step 2. Inject a 1 kHz, 300 mV RMS signal at the MIC input.

Step 3. Set the radio to transmit mode.

Step 4. Adjust the TGC potentiometer, R38 on the A board (see Figure 3) for output power of 145 W.

4.7 ALC ADJUSTMENT

Step 1. Program the radio operating frequency to 10 MHz in SSB mode.

Step 2. Inject a 1 kHz, 300 mV RMS signal at the MIC input.

Step 3. Set the radio to transmit mode.

Step 4. Adjust the ALC potentiometer (R55 on the PA board) for an output power of 125 W. The output power must be 125 ± 10 W on any frequency.

4.8 AME ADJUSTMENT

Step 1. Program the radio operating frequency to 1.6 MHz in AME mode.

Step 2. Inject a 1 kHz, 300 mV RMS signal at the MIC input.

Step 3. Adjust the AME potentiometer, R16 on the A board, for zero crossover distortion of the RF envelope as observed on an oscilloscope (see Figure 4).

Step 4. With no audio input, the output power in the AME mode should be minimum 32.5 W on all channels.

4.9 TUNE POWER ADJUSTMENT

Step 1. Program the radio operating frequency to 1.6 MHz in SSB mode.

Step 2. Set the radio to TUNE mode by shorting to ground pin 3 of J10 on the rear panel of the radio (this can be accomplished by inserting the tune plug, provided in FLN 6335).

Step 3. With no audio input, adjust the tune power to 3.5 W.

Step 4. The tune power should be 3.5 ± 1 W on all channels.

4.10 CARRIER BALANCE ADJUSTMENT

Step 1. Program the radio operating frequency to 1.6 MHz in SSB mode.

Step 2. Inject a 2 kHz, 300 mV RMS signal at the MIC input.

Step 3. Connect the antenna plug of the radio via a 36 dB attenuator (minimum) to the spectrum analyzer. Set the radio to transmit mode.

Step 4. Adjust the carrier balance potentiometer, R87 on the A board, for minimum carrier level as observed on the spectrum analyzer. Carrier suppression must be at least 46 dB below the desired sideband signal in USB and LSB operation.

4.11 IF ADJUSTMENT

Step 1. Program the radio operating frequency to 1.6 MHz in SSB mode.

Step 2. Disconnect the A board-to-S board coaxial cable (from J-7 on the S board).

Step 3. Inject a –100 dBm, 11.399 MHz (LSB) signal from the RF signal generator into the A board-to-S board coaxial cable.

Step 4. Adjust the 11.4 MHz IF amplifier coil L21 on the A board, and the 75 MHz receive path coil S20 on the S board for maximum recovered audio at the speaker (see Figure 3).

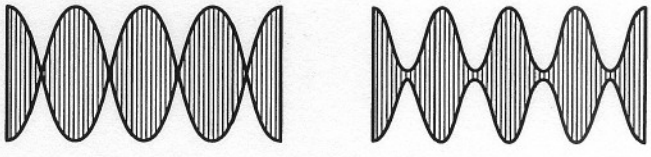


Figure 4. AME Waveforms

4.12 REFERENCE OSCILLATOR 9.105 MHz FINAL ADJUSTMENT

NOTE
This adjustment should be performed after at least 90 minutes of continuous operation of the radio.

4.12.1 Using RF Counter

Perform the following steps if your RF counter is more accurate than your RF generator. Otherwise refer to paragraph 4.12.2.

Step 1. Connect a frequency counter via an appropriate attenuator (36 dB at least) to the antenna connector J105.

Step 2. Program the radio to 29.900 MHz transmission and disconnect the microphone to ensure that no audio is present at the input.

Step 3. Switch the radio to TUNE mode by shorting pin 3 of J10 on the rear panel of the radio to ground (this can be accomplished by inserting the tune plug, provided in the FLN 6335).

Step 4. Remove the plastic access plug from the PVC oven cover located on the A board.

Step 5. Adjust the piston trimmer capacitor C115 using an insulated tuning tool (Motorola part no. 66B84903K01), so that the radio RF output (carrier) frequency deviates from 29.9 MHz by no more than ± 1 Hz.

Step 6. Replace the plastic access plug.

4.12.2 Using RF Generator

Perform the following steps if your RF generator is more accurate than your RF counter. Otherwise refer to paragraph 4.12.1.

Step 1. Connect a signal generator to the antenna connector J105. Adjust the signal generator to frequency of 29.901 MHz (USB operation) and to output level of -47 dBm (1 mV).

Step 2. Connect a 2 Ω/5-to-10 W load to the external speaker jack and connect an audio analyzer (HP8903B or equivalent) across it.

Step 3. Adjust the radio to frequency of 29.900 MHz and SSB (USB) operation.

Step 4. Remove the plastic access plug from the PVC oven cover located directly over the reference oscillator section of the A board.

Step 5. Adjust the piston trimmer capacitor C115 so that the audio frequency deviates from 1000 Hz by no more than ± 1 Hz.

Step 6. Replace the plastic access plug.

5. REMOVAL AND REPLACEMENT PROCEDURES

5.1 GENERAL

The radio includes four circuitry locations, shown in Figures 1 and 2 in the Description chapter of this manual. The locations of the radio's boards are listed below:

Board Name & Number	Location
A board	Lower side of main chassis
B board	Upper side of main chassis
C board	Control panel
S board	Lower side of main chassis
Power Amplifier	Power amplifier compartment
Interconnect board	Control panel
Harmonic Filter board	Upper side of main chassis

5.2 RADIO REMOVAL FROM THE MOUNTING TRAY AND HOUSING

Step 1. Loosen the two captive screws which hold the radio to the tray.

Step 2. Grasp the sides of the radio facing its front panel and pull it forward to release it from the mounting tray.

Step 3. Remove the six screws on the bottom of the housing; four are located along the back of the housing and two are located along the front of the housing. Normally, it is not necessary to remove the mounting tray bracket from the housing.

Step 4. Slide the housing away from the radio toward the rear.

5.3 FRONT PANEL REMOVAL

Step 1. Remove the radio from the housing.

Step 2. Remove the three screws securing the lower cover of the front panel to the upper cover and carefully pull it away while disconnecting the flex cable from the Interconnection board.

Step 3. Disconnect all cables connecting the front panel to the S and A boards. Do not disconnect the battery plug from the S board.

Step 4. Remove the five screws securing the front panel upper cover to the radio chassis. Three screws are accessible from the top side of the main chassis, and two screws are accessible from inside the front panel. Carefully separate the front panel from the radio.

5.4 A BOARD REMOVAL

Step 1. Remove the NB (Noise Blanker board) and the optional Filter board (if installed).

Step 2. Disconnect all plugs and cables connected to the A board. Open the top cover of the control section of the S board and disconnect the flat cable which is connected between the A board and the S board (p-5).

Step 3. Remove the five screws securing the A board and lift it away.

5.5 OVEN COVER REMOVAL

To remove the oven cover, release the cover lock fastener by turning the rotating portion ¼ turn in either direction. The oven cover is locked when the fixed and rotating portions of the cover lock fastener are parallel to each other, and is released when the fixed and rotating portions are perpendicular to each other – refer to Figure 5.

5.6 OPTIONAL FILTERS BOARD REMOVAL

To remove the optional filters board, grasp it by its edges and carefully pull it away from the A board.

5.7 OPTIONAL NOISE BLANKER BOARD REMOVAL

To remove the optional noise blanker board, remove the two screws that secure it to the chassis. Then grasp the noise blanker board by its edges and carefully pull it away from the A board.

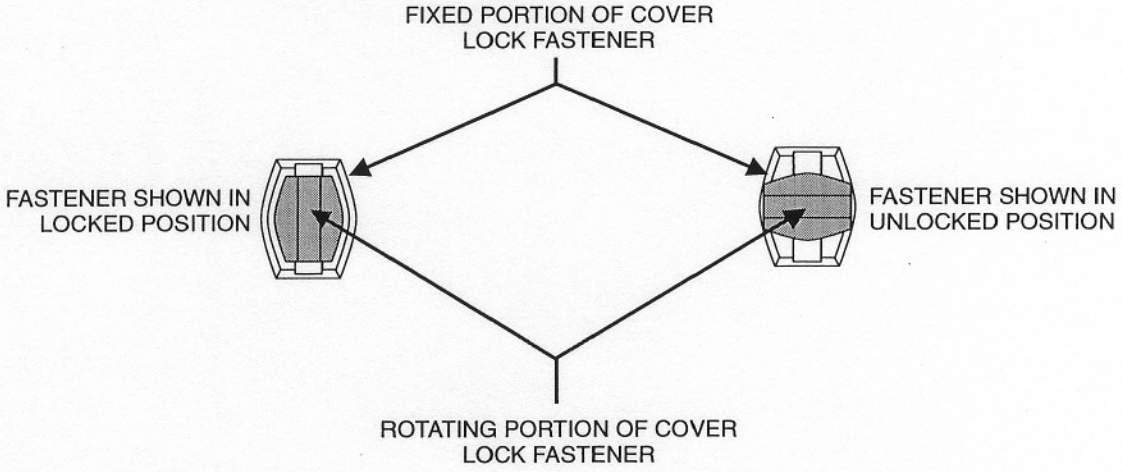


Figure 5. Oven Cover Lock Fastener

5.8 S BOARD REMOVAL

Step 1. Disconnect the coaxial cables connected to J7 and J8.

Step 2. Remove the A board as described in paragraph 3.4.

Step 3. Remove the top covers of the S board.

Step 4. Disconnect all connectors connected to the S board. Do not disconnect the battery connector unless it is absolutely necessary. Disconnection of the battery plug while no alternative power is supplied to the RAM will result in loss of the programmed data.

5.9 INTERCONNECTION BOARD REMOVAL

Step 1. Open the front panel as detailed in paragraph 3.3.

Step 2. Disconnect all flat cables connected to the Interconnection board. Do not disconnect the battery from the S board. Disconnection of the battery while no alternative power is supplied to the RAM will result in loss of the programmed data.

Step 3. Remove the three screws securing the Interconnection board to the C board and lift it away.

5.10 C BOARD REMOVAL

Step 1. Open the front panel as detailed in paragraph 5.3.

Step 2. Remove the Interconnection board as indicated in paragraph 5.9.

Step 3. Disconnect all connectors connected to the C board.

Step 4. Remove the six screws fastening the C board to the upper panel and carefully pull it out.

5.11 HARMONIC FILTER REMOVAL

To remove the harmonic filter (with its frame) perform the following steps:

Step 1. Loosen the two captive screws securing the power amplifier, and pivot the amplifier away from the radio.

Step 2. From the inside of the power amplifier compartment, disconnect the four phono plugs connected to the harmonic filter phono jacks J101-J104.

Step 3. Disconnect the harmonic filter flat cable from the B board. Disconnect the coaxial cable connected to J106 on the B board.

Step 4. Remove the cover from the harmonic filter.

Step 5. Remove the six screws that secure the harmonic filter shield to the chassis. These screws are unslotted and are accessible through openings at the edges of the printed circuit board. Do not remove the five slotted screws that secure the printed circuit board to its frame. Do not remove the two screws on the regulators. Now remove three additional screws securing the frame to the chassis. These screws are accessible from inside the power amplifier compartment. The harmonic filter module can then be lifted away from the radio chassis.

5.12 B BOARD REMOVAL

To remove the B board, perform the following steps:

Step 1. Loosen the two captive screws securing the power amplifier and pivot the amplifier away from the radio.

Step 2. Pivot the power amplifier away from the radio. Disconnect the coaxial cable originating at jack J5 from the power amplifier compartment. Disconnect the flat cable from J14 on the PA. Also disconnect the cable connected to phono jack J113, and the cable connected to coaxial jack J106.

Step 3. Disconnect the flat cable from J13 which connects the B board to the HF board. Disconnect the connection of the B board to the A board (P4 on the B board).

Step 4. Disconnect the flat cable connected to J6.

Step 5. Remove the three screws that secure the B board to the chassis.

5.13 POWER AMPLIFIER REMOVAL

Step 1. Loosen the two captive screws securing the PA and pivot it away from the radio.

Step 2. Disconnect the antenna phono plug connected to the chassis wall in the PA compartment.

Step 3. Disconnect the four coaxial plugs PA OUT (J4), PA IN (J5), V_{fwd} (J1) and V_{rev} (J2) from the PA.

Step 4. Disconnect the +A wire from J17 on the PA.

Step 5. Disconnect the flat cables connected to J6 and J14 on the PA.

Step 6. Loosen the two screws which hold the two pivots of the PA module.

Step 7. Pull the PA module out.

5.14 BATTERY REPLACEMENT

The lithium battery connected to the S board supplies the required power to the RAM memory to maintain the data of the programmed channels when the radio is turned off. To insure that no data is lost, the battery should be replaced every five years, and not later than the expiry date. The expiry date of the battery is designated by four digits. For example '9922' indicates that the battery will expire on the 22nd week of 1999.

The following instructions ensure continuity of power supply to the RAM. Their precise execution will preserve the integrity of the RAM data:

Step 1. Turn off the radio and open the bottom cover of the front panel (follow the instructions given in paragraph 5.3).

Step 2. The battery is located on the Interconnection board and mounted with two tie straps as shown in Figure 6.

Step 3. Carefully cut the tie straps and free the battery. While holding the battery make sure it does not touch any conducting element in the radio.

Step 4. Turn on the radio and then pull out the battery assembly plug 'BAT' (P4) from the S board. Carefully pull the battery assembly from the radio.

Step 5. With the radio still on and the battery assembly out of the radio, disconnect the old battery and connect a new one to the assembly. Make sure that the right polarity is kept.

Step 6. When the battery assembly is fixed, insert once again the assembly plug into the S board. Keep the battery out of the radio and turn off the radio.

Step 7. Insert new tie straps in the battery location on the Interconnection board (to ease the insertion, it is recommended to free the Interconnection board by opening the screws holding it).

Step 8. Tie the battery to the Interconnection board. Close the front panel and return the radio to its housing (this completes the battery replacement procedure).

Step 9. Turn on the radio and check that no data has been lost.

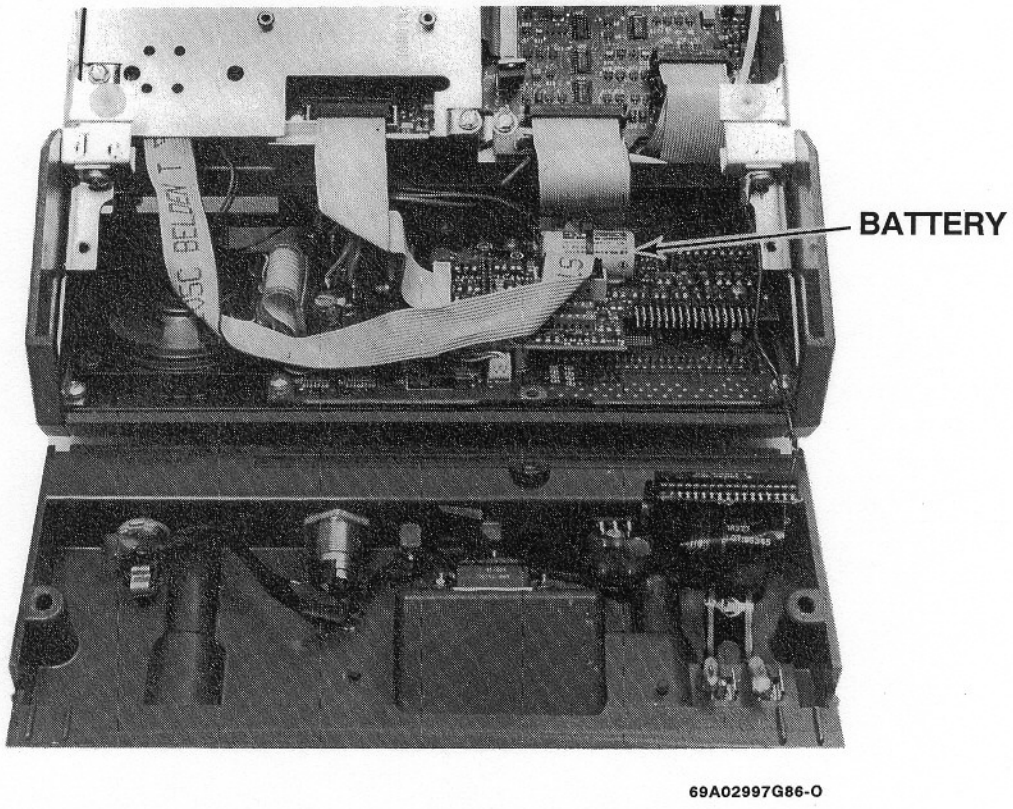


Figure 6. Battery Location

6. TROUBLESHOOTING

6.1 GENERAL

The troubleshooting procedures in this section provide the instructions for isolating faulty boards. Troubleshooting a board at component level should be performed according to the notes on the relevant schematic diagram.

The troubleshooting procedures are presented in the following three topics:

- Preliminary steps.
- Transmitter troubleshooting.
- Receiver troubleshooting.

Figure 7 shows the RF connections between the radio's units. This diagram might be very helpful for a better understanding of the instructions provided below.

6.2 PRELIMINARY STEPS

Step 1. In case of malfunction and before consulting the preliminary troubleshooting chart, make sure that:

- The DC power cable is firmly connected to the radio and the battery.
- All other cables in the system are firmly connected.
- A 7.5-A fuse is installed in the fuse holder on the green wire of the DC power cable.
- A 30-A fuse is installed in the fuse holder on the red wire of the DC power cable.
- AC power is available (in base station installation).
- The desired operating frequency is set according to the operating range of the broadband antenna (if used).

Step 2. Carefully check all operating functions (refer to the Operation section).

NOTES

a. If an invalid channel (above 120) is selected, pressing [ENTER] causes "CHANnel" to flash. You now have 30 seconds to select a valid channel number and press [ENTER]. If the 30 seconds elapse (or if [RESET] is pressed), the radio reverts to the previous operating status.

b. If, on rare occasions, a whistle is heard (not caused by a receive signal), it may be due to internal spurious. Press [ENTER] repeatedly to cycle through three variations of the IF frequency, and choose the setting which minimizes the whistle.

Step 3. In case of malfunction, refer to Table 1.

Step 4. If after performing the instructions detailed in the preliminary troubleshooting chart the problem still exists, refer to either transmitter or receiver troubleshooting section.

NOTES

a. If the problem exists in both receive and transmit modes, the common circuits such as: voltage regulators, reference oscillator, 11.4 MHz PLL, synthesizer etc., should be checked.

b. Frequency deviation of hundreds of hertz can result from failure in the heating circuit of the reference oscillator. It is recommended to check whether the oven is heated before performing any troubleshooting procedures related to receive or transmit problems.

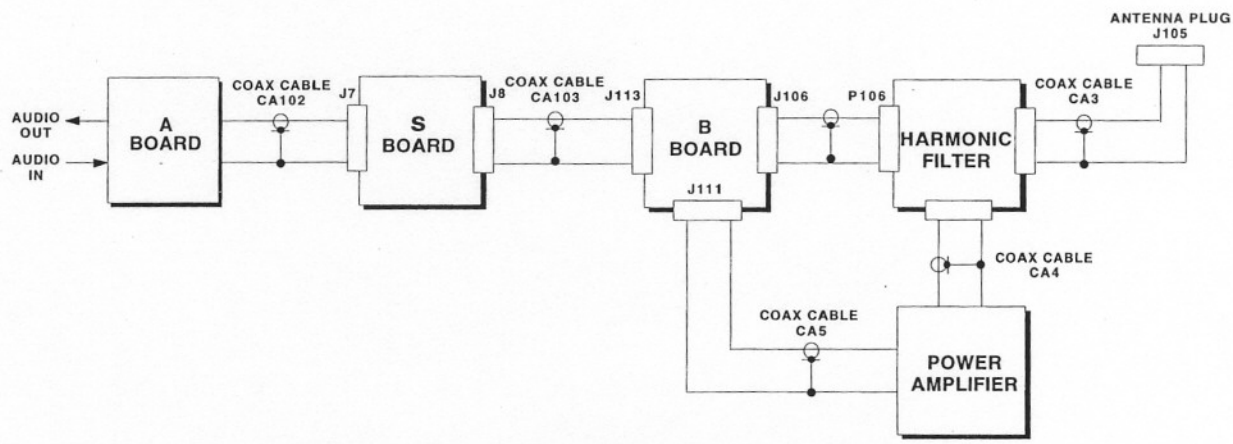


Figure 7. RF Connections between the Radio's Units

Table 1. Preliminary Troubleshooting Chart

Problem	Troubleshooting
Blank display	Check if: • The DC power cable is firmly connected to the radio and battery. • A 7.5 A fuse is installed in the fuse holder on the green wire of the DC power cable.
The display is present but there is a weak or no reception noise.	Check: • Connection of antenna-to-antenna tuner and antenna tuner-to-radio cables (loose or broken connections) • Setting of the volume control (middle) • Squelch position (OFF) • Monitor LED status (ON) • Correct programming of operating channel (frequency, mode of operation, etc.)
The engine noise is picked up by the antenna. (This can be detected by observing the difference in the quality of reception with the engine on and off.)	Make sure that the ground leads are well connected and all power wires and ground leads are as short as possible. Enable the Noise Blanker option (if installed). Install Noise Reduction Kit TLN8845. (See Instruction Manual 68P02976G35.)
Poor or no transmission	Check that a 30-A fuse is installed in the fuse holder on the red wire of the power cable. Check that proper grounding cables are connected from the radio and from the antenna tuner to the vehicle chassis. Only for MICOM•XL: If the programming module S86 is installed, ensure that the switch is set to "PROG" position. While speaking, observe the **RF power bar graph** for activity. The resultant RF power output is displayed in approximately 10-W increments (bars) being added from left to right. All bars light up when output power is above 85 W. If the antenna system is not properly tuned, the resultant reflected power is indicated by turning off bars from left to right. If three or more left-hand bars disappear, there may be a problem in the **antenna system.** If antenna cabling or antenna mast rigging has been disturbed since the radio was last used, the antenna tuner will not automatically compensate. Press [ENTER]: automatic retuning to the existing channel occurs, compensating for the changed conditions. If this procedure does not correct the situation, inspect the tuner, antenna and ground plane for loose connections or misplaced parts. If no loose connections are found, call the nearest Motorola technician or service facility for assistance. If bars are missing on the right side of the RF power bar graph, this is an indication of low transmitter power, which can be caused by a bad microphone, faulty transmitter, overheating, or defective antenna system.

6.3 TRANSMITTER TROUBLESHOOTING

NOTE

Before performing the transmitter troubleshooting procedures, make sure that the preliminary steps have been performed.

In case of poor or no transmission, follow the transmitter troubleshooting chart given in Figure 8. The numbers in parentheses appearing in the blocks indicate that additional instructions are provided in the appropriate section (number 1 in parentheses refers to section 6.3.1, number 2 – to section 6.3.2, and so on).

If the PTT dotted line does not appear on the display when the PTT is activated, proceed to paragraph 6.3.4.

6.3.1 Transmitting into a Dummy Load

Step 1. Disconnect the radio from the antenna/ antenna tuner and connect a 50-Ω dummy load to the radio's antenna connector (J105) via a serial power meter.

Step 2. Try to transmit with a microphone and note the power output. During normal speaking the output should be in the range of 20–40 W, and while whistling it should exceed 100–125 W. Note that no bars are deleted from left (deleted bars from left indicate reflected waves).

If the test has been successful, the problem may be either in the antenna/antenna tuner or in the cables (short/cut).

6.3.2 Antenna and Antenna Tuner Problems

Step 1. Check all connections between the radio and antenna tuner and between the antenna tuner and antenna. If you have any doubt about the antenna operation, replace it with a dummy load, connected with an open coax cable between the antenna tuner output and ground.

Step 2. Check if power of 3.5 ± 1 W is supplied by the radio when the tune command is applied (refer to the test instruction in paragraph 3.2.1.5 of this section).

Step 3. Check if the antenna tuner tunes according to the following steps:

a. Tune the radio to a new frequency and press [ENTER]. A tune sequence will start and PTT dotted line will be displayed. Normally, this sequence lasts for less than 2–3 seconds. When the tune sequence stops after a successful tuning, pressing [ENTER] again will result in a very short tune sequence. If a long sequence occurs again, it is an indication that no real tuning has been performed.

b. While pressing [ENTER] to initiate the tune sequence, check the signals on the lug connections of the tuner according to the following table:

Lug No.	Signal Name	Description
1	Tune	Negative pulse from 10 V to 5 V (approximately). A command from the tuner to the radio to supply tune signal (the channel frequency in a level of 3.5 ±1 W).
2	Channel Change	Pulse from 2.3V to 5V applied by radio when channel is changed or when [ENTER] is pressed.
4	A+	Supply voltage.

6.3.3 Harmonic Filter Ranges

Try to transmit in all harmonic filter ranges and notice whether the problem occurs in all ranges. If the problem appears only in one range, the harmonic filter might be faulty.

Transmit in two close frequencies from both sides of the edge of the harmonic filter range and notice whether the radio operates differently. If the transmission problem appears in only one side of the range's edge, the problem is most likely to be in that specific range of the harmonic filter.

6.3.4 9T,9R,PA Disable and Mute Lines

Step 1. Switch the radio to transmit by PTT.

Step 2. Check the 9T line – it should change from nearly 0 to approximately 8 V.

Step 3. Check the 9R line – it should change from approximately 8 V to nearly 0.

Step 4. Check the PA Inhibit line (on the A board). During PTT it should go 'low'.

6.3.5 B Board-to-Antenna Connector

Step 1. Bypass the A board and the S board.

Step 2. Try to transmit by applying a –45 dBm RF signal to the B board input. The radio must be tuned in such a way that the harmonic filter range will include the transmitted signal.

Step 3. Carefully increase the RF generator output level to –24 dBm. The power at the output must reach 125 ±10 W (if the ALC potentiometer is adjusted). Do not

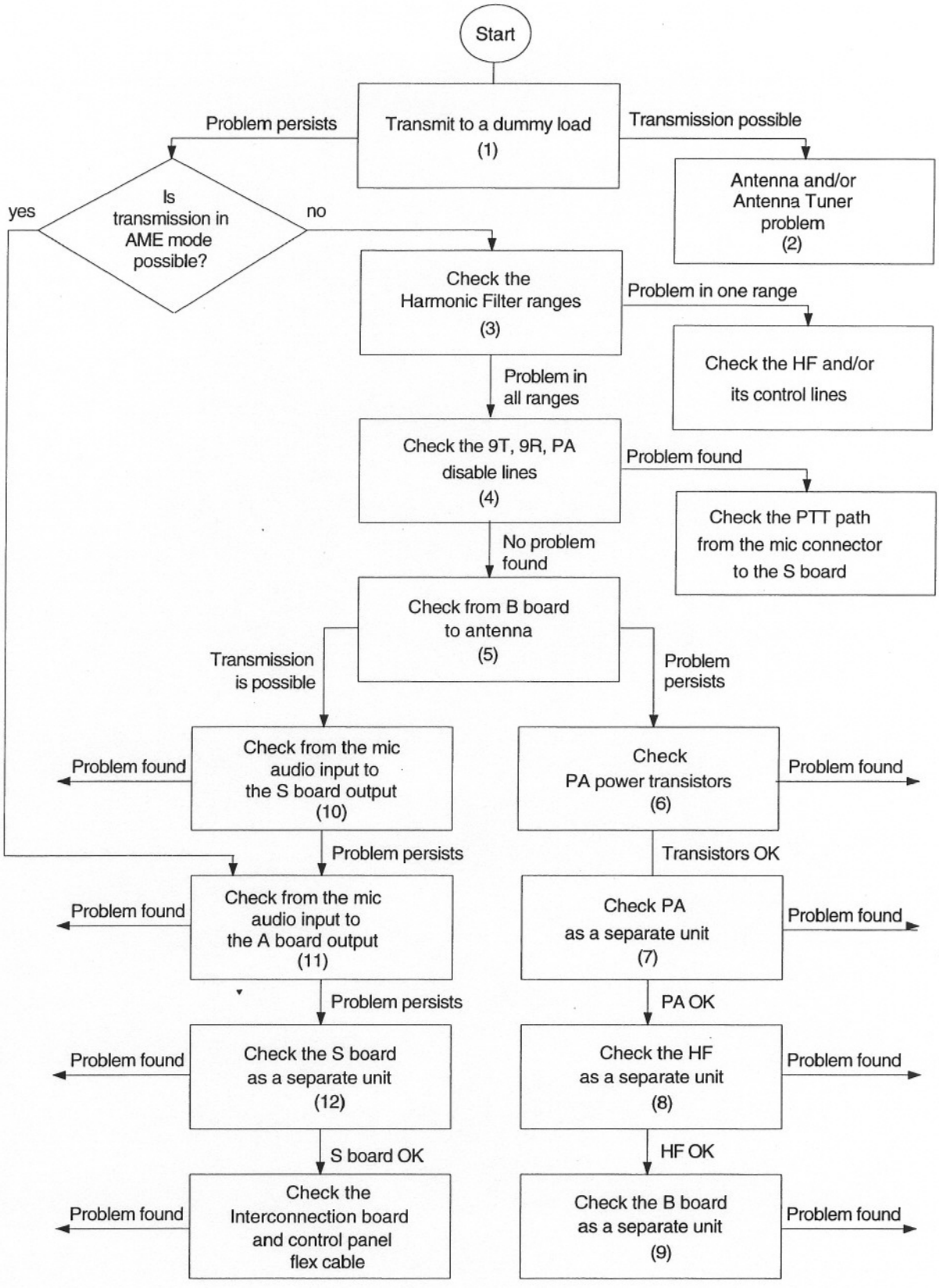


Figure 8. Transmitter Troubleshooting Chart

transmit more than 150 W. If necessary, adjust the ALC potentiometer .

6.3.6 PA Power Transistors

PA malfunction is in most cases caused by a problem in one or two of the four power transistors, consisting of the driver (Q16, Q17) and the final stages (Q18, Q19).

Step 1. Open the PA compartment.

Step 2. Check the voltage on the base of the power transistors without any input signal. When the radio is in receive mode, the voltage should not exceed 0.03 V (higher voltage on the bases of the driver indicates low RF gain or even total failure of the transistor). In transmit mode, the voltage should be in the 0.6–0.8 V range.

6.3.7 PA as a Separate Unit

Step 1. Connect an RF generator to the PA through the J5 input.

Step 2. The PA output should be directly taken from the coax connector J4. Connect J4 to a power meter via an appropriate attenuator (or to a dummy load via a power meter). Do not forget to disconnect the power latch jumper (JU1) on the PA, otherwise the PA will latch. It is recommended to start this test with a low level input signal (about –30 dBm) and to increase carefully up to +23 dBm (@ 30 MHz).

The power at the output must reach 125 ±10 W. Do not transmit more than 150 W.

6.3.8 Harmonic Filter as a Separate Unit

Step 1. Turn off the radio.

Step 2. Disconnect the power latch jumper (JU1) from the PA.

Step 3. Measure the resistance between pin 2 of J2 (V+) and the ground using an ohmmeter. The value should be in the 700-820 ohm range. If the value is very low, ensure that the screw securing the regulator does not short the regulator to ground.

Step 4. Turn on the radio. Measure the dc voltage between pin 2 of J2 and the ground. The reading should be according to the table below.

Mode		Reading
Receive	All ranges	2.25-2.35V
Transmit	Ranges 1-3	3.92-4.08V
	Ranges 4-7	2.94-3.06V

Step 5. Measure the dc voltage at pin 1 of J2 (HV). During reception, this voltage should be 11-16.6 V. During transmission at full power, this voltage should be 140-230 V (the exact value is a function of the operating frequency). If the voltage levels are not correct, there may be a malfunction in the high voltage power supply.

Step 6. Try to transmit over all harmonic filter ranges and check if the problem occurs in all of them. If a problem is observed only in a single range, there may be a failure in the harmonic filter.

Transmit on two close frequencies outside both ends of the faulty range and observe whether the radio operates in an abnormal manner. If the transmission problem occurs on a single side of the range only, the problem is most likely on that range of the harmonic filter.

6.3.9 B Board as a Separate Unit

Step 1. Apply a –20 dBm signal to the coaxial input (J113) of the B board.

Step 2. Measure the output signal at the coaxial output (J111), accessible from the PA compartment.

Step 3. Set the radio to transmit mode; the output level should be between +19 and +22 dBm (@ 30 MHz).

6.3.10 Mic Input-to-S Board Output Section

Step 1. Feed the microphone plug with a 1 kHz, 300 mV signal.

Step 2. Connect a spectrum analyzer to connector J8 of the S board.

Step 3. Set the radio to transmit mode.

Step 4. Check the output signal. The output frequency should be the frequency that the radio is tuned to. The level of the signal should be –24 ±3 dBm (if no changes were performed in the original TGC adjustment). If this level is not obtained, try to obtain it by adjusting the TGC potentiometer R38 on the A board.

6.3.11 Mic Input-to-A Board Output Section

Step 1. Feed the microphone plug with a 1 kHz, 300 mV signal.

Step 2. Disconnect coax cable CA102 from J7 of the S board and connect it to a spectrum analyzer.

Step 3. Set the radio to transmit mode (USB).

Step 4. Check the output signal. Its frequency should be 11.402 MHz and its level –19 ±3 dBm (if no changes were performed in the original TGC adjust-

ment). If this level is not obtained, try to obtain it by adjusting the TGC potentiometer R38 on the A board.

6.3.12 S Board as a Separate Unit

Step 1. Apply a 11.41 MHz, –10 dBm signal to connector J7 of the S board.

Step 2. Connect a spectrum analyzer to connector J8 of the S board.

Step 3. Set the radio to transmit mode.

Step 4. Check the output signal. Its level should be –16 ±3 dBm.

6.4 RECEIVER TROUBLESHOOTING

NOTE

Before performing the receiver troubleshooting procedures, make sure that the preliminary steps have been performed.

In case of poor or no reception, follow the receiver troubleshooting chart given in Figure 9. The numbers in parentheses appearing in the blocks indicate that additional instructions are provided in the appropriate section (number 1 in parentheses refers to section 6.4.1, number 2 – to section 6.4.2, and so on).

Set the radio's controls as follows:

- Squelch off (LED off).
- MON off (LED off).
- Clarifier off (max ccw).
- Volume maximum (cw).

NOTE

In all tests in which the RF generator has to be connected to the antenna connector of the radio, it is recommended to take precautions for protecting the RF generator from accidental transmission towards it. The preferable way is to connect the RF generator to the antenna connector of the radio through a 40-dB attenuator.

6.4.1 Any Noise at the Loudspeaker?

Check if any receiving noise is heard at the loudspeaker when the controls are set as described above. You can also transmit CW tone (with a dummy load connected to the radio's antenna connector) and notice if the side tone is heard at the loudspeaker.

6.4.2 Harmonic Filter Ranges

If the problem is poor sensitivity, perform the receive sensitivity test in all harmonic filter ranges and notice whether the problem occurs in all ranges. If the problem appears in only one range, the harmonic filter should be checked.

Perform the sensitivity test in two close frequencies on both sides of the edge of the harmonic filter range and notice if the radio operates differently. If the sensitivity problem appears in only one side of the range's edge, the problem is probably in the specific range of the harmonic filter.

6.4.3 A Board Input-to-Speaker Section

Step 1. Apply a 11.402 MHz signal at a level of –117 dBm to coax cable CA102.

Step 2. Perform the sensitivity test (make sure that the radio is in USB mode). If 10 dB (minimum) SINAD is obtained, it means that the A board-to-speaker path is operational.

6.4.4 S Board Input-to-Speaker Section

Step 1. Apply a –113 dBm signal at the frequency which the radio is tuned to (plus 1 kHz for USB reception) to coax plug J8 of the S board.

Step 2. Perform a sensitivity test (make sure that the radio is in USB mode). If 10 dB (minimum) SINAD is obtained, it means that the S board-to-speaker path is operational.

6.4.5 S Board as a Separate Unit

Step 1. Apply a –10 dBm signal at the radio's frequency to J8 of the S board.

Step 2. Connect a spectrum analyzer to connector J7 of the S board. The frequency of the signal should be 11.4 MHz and its level –15 ±3 dBm.

6.4.6 Conduction between Antenna Connector and B Board Input

Step 1. Disconnect the plug J106 from the B board.

Step 2. Set the radio to the receive mode.

Step 3. Connect an RF signal generator to the antenna plug.

Step 4. Connect a spectrum analyzer to the coaxial plug P106.

Step 5. Tune the RF generator to the same frequency which the radio is tuned to. The output signal should not be more than 0.7 dB (insertion loss level) below the RF generator level.

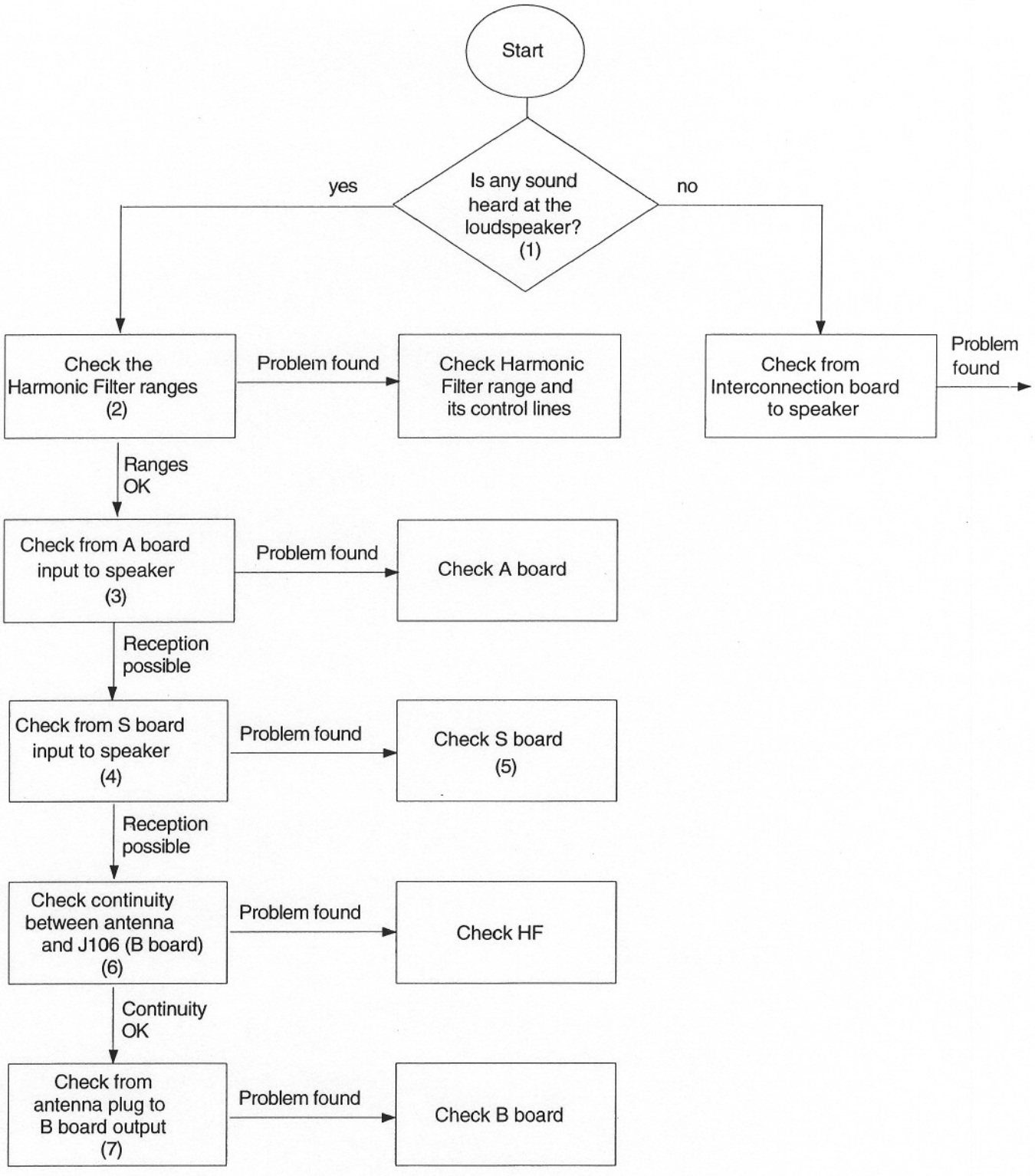


Figure 9. Receiver Troubleshooting Chart

Step 6. Repeat step 5 in all HF ranges. If the problem occurs in all ranges, the RX/TX switch in the harmonic filter should be checked.

6.4.7 Antenna Connector-to-B Board Output Section

Step 1. Connect an RF generator to the antenna connector and tune it to the frequency which the radio is tuned to at a level of –20 dBm.

Step 2. Check the output level at the coaxial plug J113 of the B board. The total gain from the antenna connector to the output of the B board should be 4-7 dB.

7. RAM INITIALIZATION

RAM initialization is required if one of the following occurs:

- The S board has been replaced.
- The 5V voltage supply to the RAM becomes faulty.

The initialization should be performed, as follows:

Step 1. *Perform this step only for a MICOM•XL radio.* Install the programming module (see Installation chapter in this manual). Set the module internal switch to PRG. Turn the keylock switch on the front panel of the control head clockwise to the open position. Turn the radio on, off and then on again.

Step 2. Press the [FUNC] key repeatedly in order to box FREQ.

Step 3. Set the radio to frequency of 0000.0 MHz.

Step 4. Press the [FUNC] key repeatedly in order to box CH STR; the box will flash.

Step 5. Press the following keys *five times each* in this order: first, the [.] key; second, the [SQ] key, and once again the [.] key.

Step 6. *Perform this step only for a MICOM•XL radio.* Remove the programming module and turn the keylock switch counterclockwise.

Now, the RAM is initialized. The display is cleared of any invalid segments and the radio returns to FUNC mode.