MAINTENANCE

5.1 INTRODUCTION

This maintenance section contains test and alignment procedures for an operational BK Radio DPH Flex•Mode Series handheld VHF radios. This section also contains troubleshooting and assembly/disassembly procedures. An understanding of the theory of operation is recommended before maintenance is attempted. All LAA kits and programming items are available from BK Radio.

5.2 TEST EQUIPMENT REQUIRED

A. RF Signal Generator:	HP8640B or equivalent
B. Distortion Analyzer:	HP334A or equivalent
C. RF Voltmeter (optional):	Boonton 92C or equivalent
D. RF Power Meter:	HP435B with 30 dB pad or equivalent
E. Service Monitor:	HP8920A Service Monitor or equivalent
F. Digital Multimeter:	Fluke 8012A or equivalent
G. Computer	IBM PC or compatible, with an RS-232 serial port LAA0725 programming cable LAA0738 programming software DPH Editor Software
H. Portable Radio Tool Kit:	LAA0600
I. Test Cable Kit for E-Series Portable Radios:	LAA0608

5.3 OVERHAUL

5.3.1 ACCESSORIES

This section contains instructions to assist in determining, by inspection, the condition of DPH assemblies. Defects resulting from wear, physical damage, deterioration, or other causes can be found by these inspection procedures.

A. Capacitors, Fixed

Inspect capacitors for case damage, body damage, and cracked, broken or charred insulation. Check for loose, broken, or corroded terminal studs, lugs, or leads. Inspect for loose, broken, or improperly soldered connections. On surface mounted capacitors, be especially alert for hairline cracks in the body and broken terminations.

B. Capacitors, Variable

Inspect trimmers for chipped and cracked bodies, damaged dielectrics, and damaged contacts.

C. Chassis

Inspect the chassis for deformation, dents, punctures, badly worn surfaces, damaged connectors, damaged fastener devices, loose or missing hardware, component corrosion, and damage to the finish.

D. Coils

Inspect all coils for broken leads, loose mountings, and loose, improperly soldered, or broken terminal connections. Check for crushed, scratched, cut, or charred windings. Inspect the windings, leads, terminals, and connections for corrosion or physical damage. Check for physical damage to forms and tuning slug adjustment screws.

E. Connectors

Inspect connectors for broken parts and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed, or out of alignment. Also, check for corroded or damaged plating on contacts and for loose, improperly soldered, broken, or corroded terminal connections.

F. Covers and Shields

Inspect covers and shields for punctures, deep dents, and badly worn surfaces. Also, check for damaged fastener devices, corrosion, and damage to finish.

G. Flex Circuits

Inspect flex circuits for punctures and badly worn surfaces. Check for broken traces, especially near the solder contact points.

H. Fuse

Inspect for blown fuse and check for loose solder joints.

I. Insulators

Inspect insulators for evidence of damage, such as broken or chipped edges, burned areas and presence of foreign matter.

J. Jacks

Inspect all jacks for corrosion, rust, deformations, loose or broken parts, cracked insulation, bad contacts, or other irregularities.

K. Potentiometers

Inspect all potentiometers for evidence of damage or loose terminals, cracked insulation, or other irregularities.

L. Resistors, Fixed

Inspect the fixed resistors for cracked, broken, blistered, or charred bodies, and loose, broken, or improperly soldered connections. On surface mount resistors, be especially alert for hairline cracks in the body and broken terminations.

M. Terminal Connections Soldered

1. Inspect for cold-soldered or resin joints. These joints present a porous or dull, rough appearance. Check for strength of bond using the points of a tool.
2. Examine the terminals for excess solder, protrusions from the joint, pieces adhering to adjacent insulation, and particles lodged between joints, conductors, or other components.
3. Inspect for insufficient solder and unsoldered strands of wire protruding from conductor at the terminal. Check for insulation that is stripped back too far from the terminal.
4. Inspect for corrosion at the terminal.

N. Wiring/Coaxial Cable

Inspect wiring in chassis for breaks in insulation, conductor breaks, cut or broken lacing, and improper dress in relation to adjacent wiring or chassis.

5.3.2 CLEANING

A. Using a clean, lint-free cloth, lightly moistened with soap and water only, and remove the foreign matter from the equipment case and unit front panel. Wipe dry using a clean, dry, lint-free cloth.

B. Using a hand controlled dry-air jet (not more than 15 psi), blow the dust from inaccessible areas. Care should be taken to prevent damage by the air blast.

C. Clean the receptacles and plugs with a hand-controlled dry-air jet (not more than 25 psi), and a clean, lint-free cloth lightly moistened with soap and water only. Wipe dry with a clean, dry, lint-free cloth.

5.3.3 REPAIR

This section describes the procedure along with any special techniques for replacing damaged or defective components.

A. Connectors

When replacing a connector, refer to the appropriate PC board assembly drawing and follow the notes to ensure correct mounting and mating of each connector.

B. Crystal

The use of any other than a BK Radio crystal is considered an unauthorized modification.

C. Diodes

Use caution when soldering since excessive heat can damage the diode. Note the diode polarity before removal.

D. Integrated Circuits

Refer to Appendix B for mounting and soldering instructions.

E. Wiring/Coaxial Cable

When repairing a wire that has broken from its terminal, remove all old solder and pieces of wire from the terminal, restrip the wire to the necessary length, and resolder the wire to the terminal. Replace a damaged wire or coax with one of the same type, size, and length.

5.4 DISASSEMBLY/ASSEMBLY

5.4.1 BATTERY REMOVAL

To remove the battery pack, turn the radio off. Press up the metal tab on the side of the case while turning the pack approximately 30°. Remove the pack from the radio.

5.4.2 UNIT DISASSEMBLY

A. Covers

1. Remove the four screws from the radio rear cover (the side opposite the speaker grill).
2. Remove the two screws holding the heat sink shield to the rear cover, and remove the heat sink shield.
3. Loosen the PTT housing screw and separate the front cover from the main frame.

B. Options Board and Keyboard

1. Disconnect the zero insertion force connector J10 from the Options board by sliding the connector sleeve toward the top of the radio. This allows the flex cable to be unplugged.
2. Remove the five screws that secure the Options board to the keyboard and the front cover, and unplug the keyboard.

C. RX/TX Board

1. Unfasten the three retaining clip screws that secure the RXITX board to the main frame.
2. Carefully remove the antenna coax from the RX/TX connector.
3. Lift up on the RX/TX board until it is disconnected from the systems board.

D. Synthesizer and VCO

Remove the screw and unsolder the five tabs that secure the Synthesizer shield to the systems board. Remove the shield halves from both sides of the systems board.

E. Top Plate and Switch Board

1. Remove the channel select, volume, and the squelch knobs.
2. Remove the retaining fasteners from the channel select switch, volume control, and the squelch control.
3. Remove the bezel and inlay, retaining the channel select stop pins (if used).
4. Unfasten the four screws that secure the top frame assembly to the main frame (the screws are located on the side of the frame, two screws beside the channel select switch and two screws below the PTT housing).
5. Unsolder the audio jack wire from systems board location **E13**.

5.4.3 ASSEMBLY

To assemble the unit, complete the disassembly procedure in reverse order.

5.5 ALIGNMENT PROCEDURES

The DPH radio uses manual alignment for receiver front end tuning, receiver IF alignment, squelch, and VCO adjustment. Electronic tuning is provided for all other adjustments. You will need the DPH Editor software and programming cable, available from BK Radio. Refer to the DPH Editor Manual for more complete details on using the program.

5.5.1 TEST SETUP

Mount the radio in a suitable fixture containing an adapter for supplying 10 VDC from a negative ground power supply. Turn off any radio features assigned to the keypad function menu and set the manual controls as follows:

Channel Selector:	Channel 1
Channel Group:	Group 1
On/Off Volume:	On, volume minimum
Monitor / Squelch	Unsquelched, fully clockwise
Radio Top Switches	Off (Toward front of radio)

Refer to figures 5-1 and 5-3 for transmitter and receiver test setup. These figures show the interface between test equipment and the radio. See figures 5-2 and 5-4 for location of the various adjustment components.

5.5.2 ALIGNMENT ORDER

When more than one adjustment is necessary, follow the order listed:

1. VCO Adjustment
2. Transmit Power
3. Reference Oscillator Voltage Sensitivity
4. Reference Oscillator Frequency
5. Transmit Deviation
6. Receiver Front End Tuning
7. Receiver IF Alignment
8. Receiver Front End Slope
9. Squelch

5.5.3 VCO ADJUSTMENT

The frequency range of the VCO must be tuned. If components in the VCO are replaced, this adjustment may be necessary.

As the inductance value of the VCO resonator is manually tuned, the synthesizer U12 (system board) changes the voltage applied to varactor CR4 (system board) to maintain the programmed frequency.

Connect a suitable attenuator and frequency counter to the antenna output of the radio. The attenuator must be capable of handling the full power output of the radio and protecting the input of the frequency counter. A 30 dB attenuator capable of 10 Watts is recommended.

To perform the adjustment:

1. Program 148 and 174 MHz receive frequencies.
2. Set the radio to receive at 148 MHz.
3. Connect a digital voltmeter between Test Point E16 (system board) and ground.
4. Adjust T1 (system board) for a reading of 2.0 VDC.
5. Set the radio to receive at 174 MHz. The voltage at Test Point E16 should be less than 7.6 VDC.

5.5.4 TRANSMIT POWER

The high and low transmit power settings control the RF output of the transmitter. If components on the RT board are replaced, this adjustment may be necessary.

Microprocessor U1 (system board) sets the transmitter power control voltage using DA converter U17 (System board). High and low power settings are stored in non-volatile memory.

Connect a suitable 50Ω power meter to the antenna output of the radio.

Follow the instructions for Transmit High Power and Transmit Low Power Adjustment in the DPH Editor software. Check the power at low (148 MHz), mid (161 MHz), and high (174 MHz) frequencies. If any high power reading is below 5 Watts, readjust to obtain 5 Watts. If any low power reading is below 2 Watts, readjust to obtain 2 Watts.

5.5.5 REFERENCE OSCILLATOR VOLTAGE SENSITIVITY

The DPH radio adjusts the reference oscillator slightly to allow operation on channels that are not integer multiples of 5 kHz. The pull sensitivity of the reference oscillator must be calibrated. This value may require adjustment if components in the reference oscillator circuit are replaced, to maintain proper receive and transmit frequency on non-5 kHz channels.

To calibrate the reference oscillator voltage sensitivity, the operating frequency is measured while applying test voltages to the varactors CR1 and CR2 (system board). The microprocessor U1 (system board) controls the voltage using DA converter U17 (system board). The computed reference oscillator voltage sensitivity is stored in non-volatile memory.

Connect a suitable attenuator and frequency counter to the antenna output of the radio. The attenuator must be capable of handling the full power output of the radio and protecting the input of the frequency counter. A 30 dB attenuator capable of 10 Watts is recommended.

NOTE: The Reference Oscillator Frequency adjust value must be set to zero during this adjustment.

Follow the instructions for Reference Oscillator Voltage Sensitivity Adjustment in the DPH Editor software.

5.5.6 REFERENCE OSCILLATOR FREQUENCY

The DPH radio's transmit and receive frequencies are derived from the reference oscillator. The reference oscillator may require adjustment due to crystal aging or if components in the reference oscillator circuit are replaced.

Changing the reference oscillator frequency setting causes the voltage applied to varactors CR1 and CR2 (system board) to be varied, in turn altering the oscillation frequency of the reference crystal circuit slightly. The microprocessor U1 (system board) controls the voltage using DA converter U17 (system board). The final setting is stored in non-volatile memory.

Connect a suitable attenuator and frequency counter to the antenna output of the radio. The attenuator must be capable of handling the full power output of the radio and protecting the input of the frequency counter. A 30 dB attenuator capable of 10 Watts is recommended.

Follow the instructions for Reference Oscillator Frequency Adjustment in the DPH Editor software.

5.5.7 TRANSMIT DEVIATION

This adjustment controls the maximum FM deviation of the transmitter. If components in the VCO or transmit audio amplifier or filter are changed, this adjustment may be necessary to maintain an FM deviation below 5 kHz (2.5 kHz for narrowband).

The level of the transmit audio is controlled using a digital potentiometer U18 (system board).

Connect a suitable attenuator and service monitor to the antenna output of the radio. Connect the modulation output of the service monitor to the Mic High input of the radio. Adjust the service monitor modulation output to a level of 0.15 Vrms and a frequency of 1 kHz.

Follow the instructions for Transmit Deviation Adjustment in the DPH Editor software.

5.5.8 REFERENCE MODULATION

This adjustment is not required on the DPH radio.

5.5.9 RECEIVER FRONT END TUNING

Bandpass filters in the receiver front end are manually tuned to optimize reception at 174 MHz. if components in the bandpass filters, RF amplifier, or mixer are replaced this adjustment may be necessary to maintain specified RF sensitivity.

As the inductors of the bandpass filters are manually tuned, the passband is aligned with the incoming RF carrier, optimizing sensitivity.

To perform the adjustment:

1. Program 174 MHz receive frequency, wideband (25/30 kHz) mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.
2. Connect an RF signal generator tuned to 174 MHz to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 3 kHz deviation.
3. Connect a distortion analyzer to the radio speaker output.
4. Adjust the RF signal generator level to obtain a SINAD reading between 6 and 12 dB on the distortion analyzer.
5. Adjust L2, L3, L4, and L5 alternately to obtain the best SINAD reading. If necessary reduce the signal generator level to maintain a SINAD reading between 6 and 12 dB.

5.5.10 RECEIVER IF ALIGNMENT

Coupling transformers in the IF section are manually tuned to optimize receiver distortion. If components in the mixer of IF circuitry are replaced this adjustment may be necessary to maintain specified receiver distortion.

As the transformers are manually tuned, the IF filter passband shape is affected.

To perform the adjustment:

1. Program 174 MHz receive frequency, wideband (25/30 kHz) mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.
2. Connect an RF signal generator tuned to 174 MHz to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 3 kHz deviation. Set the output RF level to 1 mVrms.
3. Connect a distortion analyzer to the radio speaker output.
4. Adjust T1, T2, and T3 for the lowest audio distortion. Preset the cores to the top of the coil before making the adjustment. When adjusted for the lowest distortion, the top of the core should be in the upper half of the coil to prevent coil breakage.

5.5.11 RECEIVER FRONT END SLOPE

Bandpass filters in the receiver front end are electronically tuned to optimize reception below 174 MHz. The tuning is customized using the receiver front end slope adjustment. If components in the bandpass filters, RF amplifier, or mixer are replaced this adjustment may be necessary to maintain specified RF sensitivity.

Four varactors are used in the receiver front end bandpass filters. The control voltage for these varactors changes to accommodate different receiver frequencies. The proper value is determined by microprocessor U1 (system board) using data stored in non-volatile memory. The voltage from DA converter U17 (system board) is amplified and applied to the varactors.

To perform the adjustment:

1. Program 148 MHz receive frequency, wideband (25/30 kHz) mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.
2. Connect an RF signal generator tuned to 148 MHz to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 3 kHz deviation.
3. Connect a distortion analyzer to the radio speaker output.
4. Adjust the RF signal generator level to obtain a SINAD reading between 6 and 12 dB on the distortion analyzer.
5. Adjust the Receiver Front End Slope using the DPH Editor tuning software. If necessary reduce the signal generator level to maintain a SINAD reading between 6 and 12 dB.

5.5.12 SQUELCH

With preset squelch (monitor/squelch control fully counterclockwise) the DPH audio should turn on at approximately 8 dB SINAD. If components in the IF filter or squelch filter are replaced, adjustment of the squelch may be necessary.

As the preset squelch is manually adjusted, the signal level into the squelch filter is changed.

To perform the adjustment:

1. Program a receive frequency with no Code Guard, wideband (25/30 kHz) mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.
2. Connect an RF signal generator tuned to the programmed receive frequency to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 3 kHz deviation.
3. Connect a distortion analyzer to the radio speaker output.
4. Adjust the RF signal generator level to obtain an 8 dB SINAD reading on the distortion analyzer.
5. Set the monitor/squelch control fully counterclockwise (on the detent).
6. Turn R28 on the RX/TX board clockwise until the audio turns off.
7. Turn R28 slowly counterclockwise until the audio turns on.

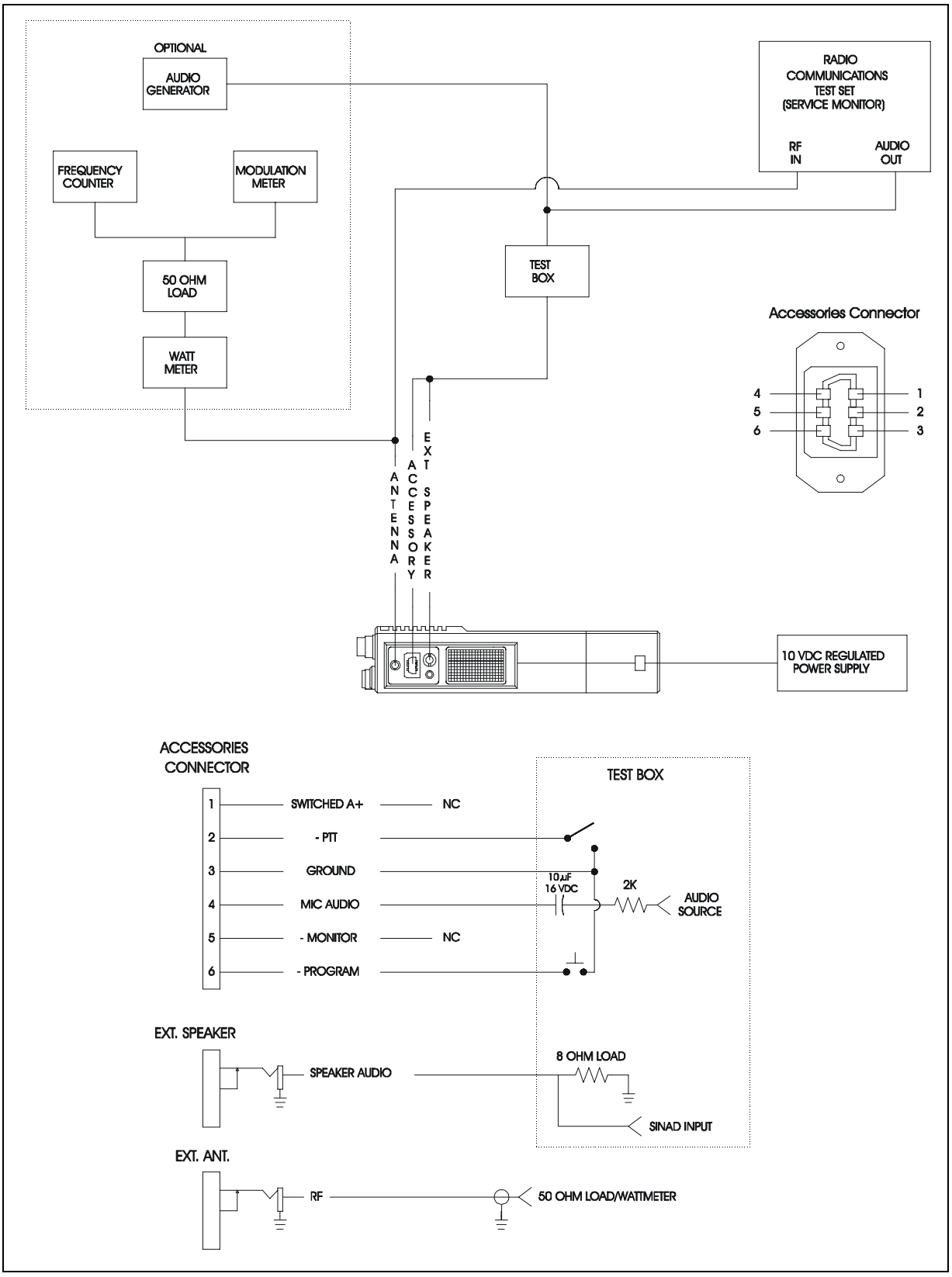

Figure 5-1 Transmitter test setup

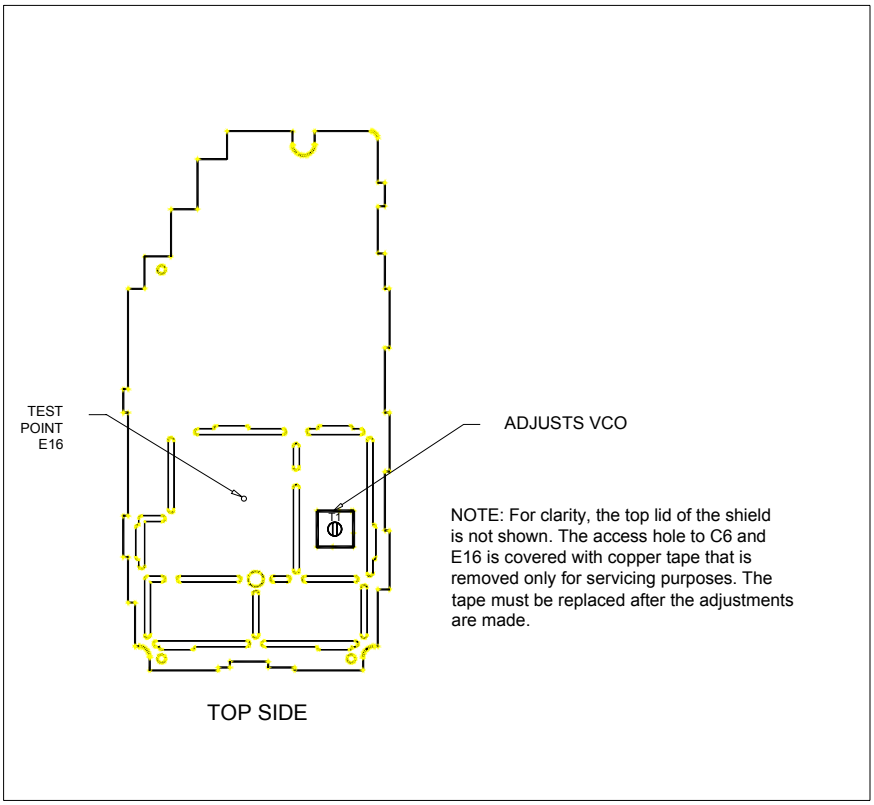

Figure 5-2 Systems board adjustments

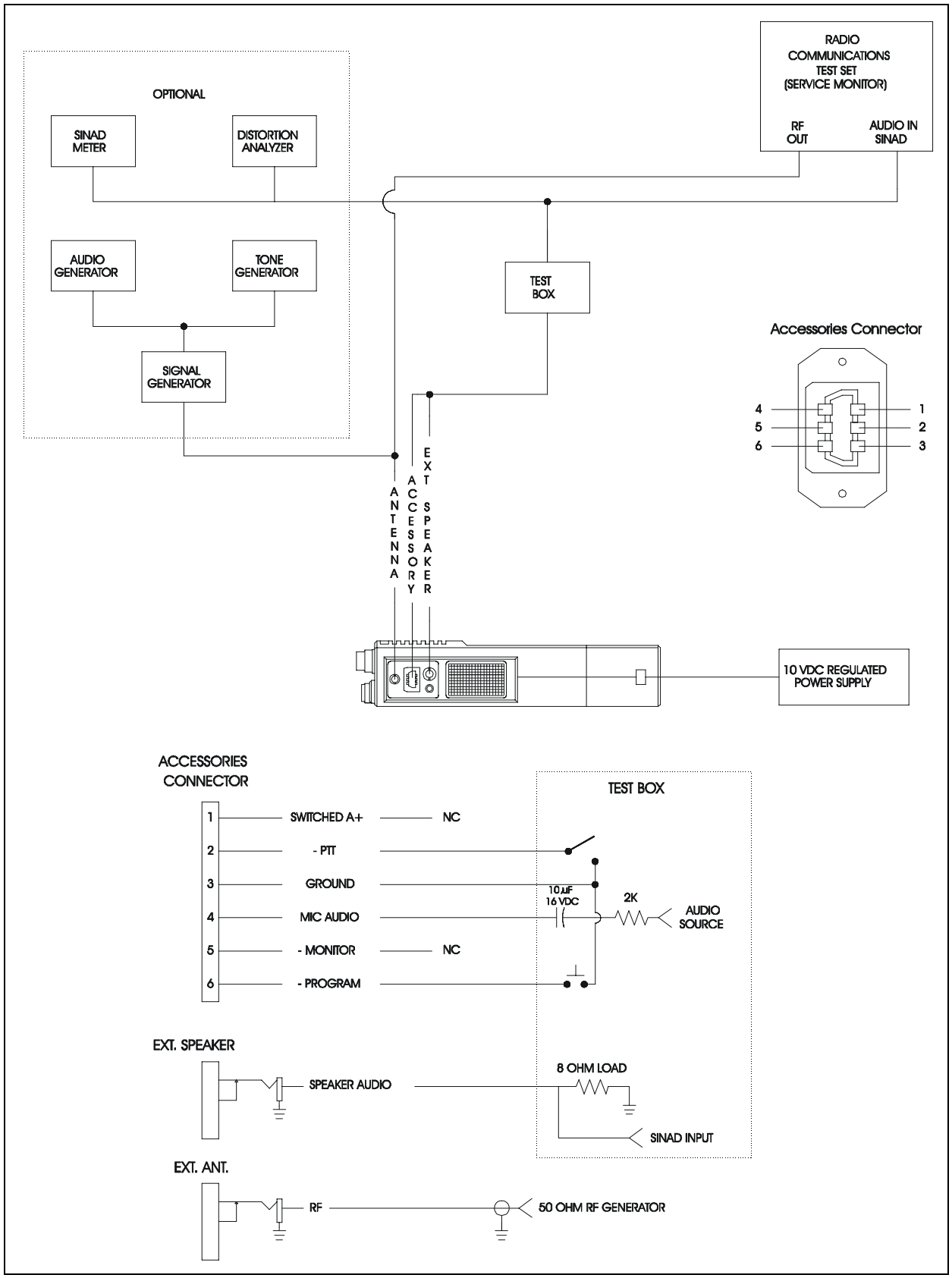

Figure 5-3 Receiver test setup

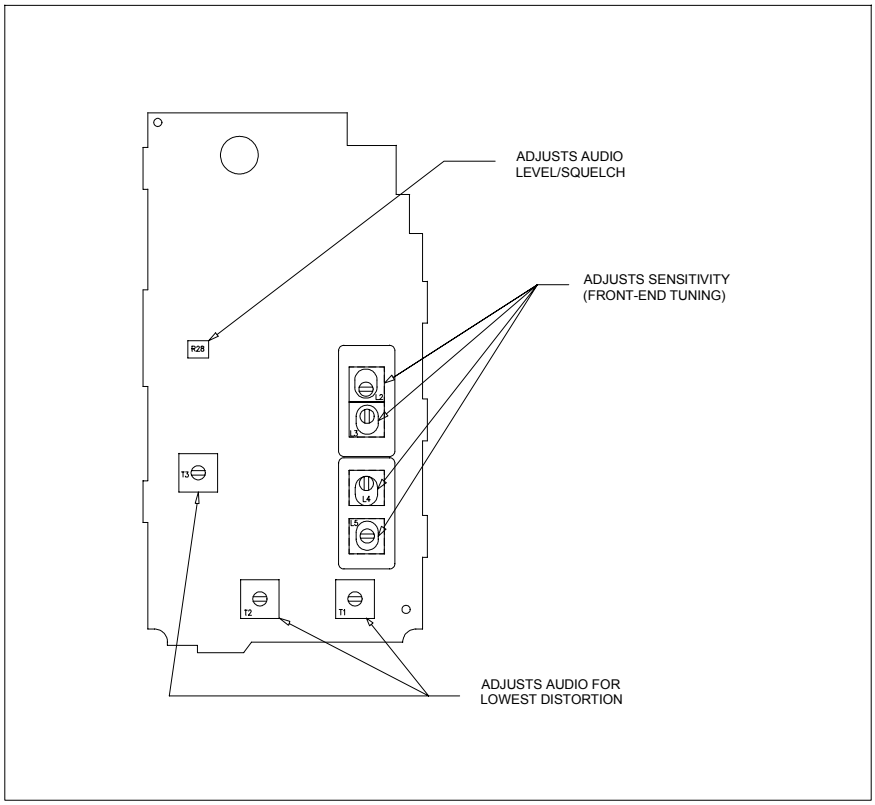

Figure 5-4 RX/TX board adjustments

5.6 TROUBLESHOOTING

Radio will not transmit Red LED does not light	Invalid TX frequency programmed Weak battery VCO TX bandshift circuit failing Open PTT path to microprocessor Broken PTT switch
Radio will not turn on	Exhausted battery Open fuse Broken ON/OFF switch Failing 5-volt regulator Improper information in EEPROM
Radio will not unmute	Invalid RX frequency programmed Internal squelch trimmer adjusted improperly CAR PRES signal to microprocessor shorted or open Audio amplifier failing DISC AUDIO path open or shorted RX AUDIO path open or shorted
Transmit power below specification	Software power adjustment incorrect RF side connector jack failing Harmonic filter failing Power amplifier failing Power control circuit failing Antenna switch failing VCO buffer failing
Code Guard signal not being transmitted	No Code Guard signal programmed on transmit channel Code Guard buffer (U4, U14, RNI) failing
Poor battery life	Transmitter power adjusted too high Audio amplifier not switching off Weak or defective battery
Radio unmutes with no carrier present when in preset condition	Squelch trimmer adjusted improperly Open or shorted CAR PRES signal
Radio does not unmute when proper Code Guard signal is present	Tone filter on Options board failing Code Guard filter or limiter failing
Sensitivity does not meet specification	Front-end filters misaligned or failing Software front-end tuning adjusted improperly RF amplifier failing IF filter or amplifier failing VCO buffer failing
Receiver distortion out of specification	IF transformers mistuned Audio amplifier failing Receiver audio filter on Options board failing
Low or no transmitter audio modulation	TX audio trimmer misadjusted Microphone failing TX audio amplifier/filter chain on Options board failing VCO modulation circuit failing

5.6 TROUBLESHOOTING (cont.)

Transmitter audio modulation is too high	Software transmit deviation adjusted improperly VCO modulation circuit failing
Audio output power does not meet specification	Squelch trimmer on RX/TX board adjusted improperly Audio power amplifier failing Audio filter on Options board failing FM demodulator IC failing
Radio always gives low battery indication ("**Lobatt**" message displayed)	Failing or shorted 8.2 volt regulator
Radio will not function properly at band edges	VCO tuning voltage (**T1**) misadjusted Shorted or open HI BAND signal to synthesizer loop amplifier
Transmitter frequency out of 3 PPM specification	XTAL frequency misadjusted Failing temperature compensation circuit on systems board Failing XTAL
Audio opening without receiving the programmed Code Guard	Monitor switch failing Monitor switch buffer (U5 on systems board) failing
Insufficient transmit range	Improper or defective antenna Open antenna jack Failing antenna match circuit
ANI or DTMF tones not being transmitted	Radio not programmed for ANI or DTMF Tone path from RN1 to modulator open or shorted
Transmitted Digital Code Guard will not unsquelch other radios	DCG not programmed or not set for proper polarity
Will not enter keyboard programming mode	Improper password being entered Open or shorted -PROGRAM signal