SECTION V
MAINTENANCE

5.1 INTRODUCTION

This section contains test and alignment procedures for an operational BK Radio DMH APCO Project 25 digital mobile radio. This section also contains disassembly and assembly procedures. An understanding of the theory of operation is recommended before maintenance is attempted.

5.1.1 Test Equipment Required

RF Signal Generator	HP8640 or equivalent
Distortion Analyzer	HP334A or equivalent
Power Meter	HP435B with 30 dB pad or equivalent
Service Monitor	HP8920A Service Monitor or equivalent
Digital Multimeter	Fluke 8012A or equivalent
Computer	IBM PC or compatible, with an RS-232 serial port
	LAA 0725 programming cable
	DMH Editor Software
DMH Tool/Cable Kit	LAA 0621, P/N 050-03152-0000

5.2 OVERHAUL

5.2.1 Visual Inspection

This section contains instructions to assist in determining, by inspection, the condition of DMH assemblies. Defects resulting from wear, physical damage, deterioration, or other causes can be found by these inspection procedures. To aid inspection, detailed procedures are arranged in alphabetical order.

5.2.1.1 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 chip caps be especially alert for hairline cracks in the body and broken terminations.

5.2.1.2 Capacitors, Variable

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

5.2.1.3 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.

5.2.1.4 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.

5.2.1.5 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.

5.2.1.6 Flex Circuits

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

5.2.1.7 Fuse

Inspect for blown fuse and check for loose solder joints.

5.2.1.8 Insulators

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

5.2.1.9 Jacks

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

5.2.1.10 Resistors, Fixed

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

5.2.1.11 RF Coils

Inspect all RF 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.

5.2.1.12 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.

5.2.2 Cleaning

A. Using a clean, lint-free cloth lightly moistened with soap and water only, 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 15psi), 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 25psi), and a clean, lint-free cloth lightly moistened with soap and water only. Wipe dry with a clean, dry, lint-free cloth.

5.2.3 Repair

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

5.2.3.1 Connectors

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

5.2.3.2 Crystal

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

5.2.3.3 Diodes

Use long nose pliers as a heat sink under normal soldering conditions. Note the diode polarity before removal.

5.2.3.4 Integrated Circuits

Refer to Appendix A for removal and replacement instructions.

5.2.3.5 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.

5.3 DISASSEMBLY & ASSEMBLY

The DMH radio has three major assemblies which contain the following circuit boards:

- Control Head Assembly (at the front of the radio)
  - Switch Board
  - Control Board
  - Options Board
- Core assembly (in the extruded housing)
  - System Board
  - RX/TX Board
  - VCO Board
  - PA Flex Circuit
- PA Assembly (in the heatsink casting)
  - Filter Board
  - PA Board
  - Accessory Board

5.3.1 Unit Disassembly

1. Remove the four corner screws from the back of the heatsink casting.
2. Carefully pull the heatsink casting from the Core assembly.
3. Disconnect the two flex cables and two coaxial cables from the PA board.

   NOTE: The black-end coax is the RX input to the receiver. The white-end coax is the exciter input to the PA.
4. Place both thumbs on the back of the Core assembly and push it out of the extruded housing.

5.3.2 The Control Head Assembly

1. Remove the PA Assembly.
2. Remove the 6 flat-head screws around the Control Head housing.
3. Carefully pull the Control Head from the Core assembly.
4. Disconnect the two flex cables from the Options board.
5. Remove the 2 flat-head screws from the audio amplifier and 2 pan-head screws that hold the unit together.
6. Remove the audio heat sink.
7. Remove the Options board.

5.3.2.1 Control Board

1. Pull off the two rotary knobs from the front of the radio and remove rubber resistance washer behind volume knobs.
2. Using the spanner tool, remove the nuts holding the rotary switches in place.

   NOTE: The spanner tool (076-01475-0000) has been modified for use with DMH radios. Older spanner tools may not have sufficient depth.

   NOTE: These 2 nuts do not have the same thread pitch and are not interchangeable. During reassembly, replace each nut in its original location.
3. Carefully remove the Control board by prying it up.

   NOTE: During reassembly, check that the microphone jack is seated properly in the housing before tightening the nuts on the rotary switches.

5.3.2.2 Display Board

1. Remove the Control board.
2. Remove the flat spring clip by prying the end with the tab toward the top of the housing.
3. Lift out the Display board.

   NOTE: During reassembly, check that the flex cable does not block the display by folding between the display and window.

5.3.2.3 Pushbutton Labels

1. Pull out a pushbutton from the front of the radio.
2. Remove the old label by pushing from the back.
3. Insert the new label.
4. Insert the pushbutton in its original location.

5.3.2.4 Reconnect Control Head

1. Attach flex cables before placing control head onto the Core assembly.
2. Check that coax cables are not on the lid of the harmonic filter.
3. Attach control head to Core assembly with 6 flat-head screws.

   NOTE: Use care to prevent breaking the 6 Control Head tabs when tightening the flat-head screws.

5.3.3 The Core Assembly

5.3.3.1 VCO and RX/TX Boards

1. Remove the sheet metal shield from the RX/TX board by prying it up with a flat-blade screwdriver.
2. Remove the 4 screws from the VCO cover and lift off the VCO cover.
3. Carefully remove the VCO by lifting it from the center or prying it up evenly around the sides.
4. Remove the 7 screws from the RX/TX board, pull both coax leads (one at a time) through the ferrite bead, and carefully lift out the RX/TX board.

5.3.3.2 VCO and RX/TX Reassembly

1. Insert the RX/TX board into the housing, pulling the two coax cables through the hole in the housing. Pull the coaxes snug and make certain they clear the 12-pin connector between the RX/TX board and the System board. Thread each coax through the ferrite bead.

   NOTE: Check that connectors are properly aligned with the System board before seating them firmly.
2. Insert the VCO, using care to not bend the pins.
3. Attach the VCO cover and snug down the screws.
4. Fasten the RX/TX board to the housing with the seven screws.
5. Insert the flex cables.

5.3.3.3 System Board

1. Remove the 4 screws and lift off the synthesizer cover.
2. Remove the 3 screws from the System board.
3. Disconnect the front flex cable.
4. Lift out the System board by lifting the front of the board first, then pulling the back flex through the casting.

5.3.3.4 System Board Reassembly

1. Insert the System board in the housing, carefully threading the back flex through the casting.
2. Attach the Synthesizer cover with the 4 screws. Insure that the rubber tubing is in the cavity above the large rectangular capacitor C119.

   NOTE: When reassembling the Synthesizer and VCO, snug down the screws on the covers or malfunctions may occur.
3. Attach the System board with the 3 screws.
4. Insert the other flex cable.

5.3.4 The PA Assembly

1. Using a 7/16" deepwell socket, remove the hex nut from the antenna connector on the back of the heatsink housing.
2. Remove the 13 screws from the PA board.
3. Remove the PA board from the heatsink housing by pushing the power connector and antenna connector.
4. Remove the Accessory board by removing the one screw on the back.

   NOTE: During reassembly, press the heatsink housing evenly against the Core assembly while inserting the 4 screws. Tighten screws at diagonal corners to seat the heatsink housing firmly. Install the remaining screws.

5.3.5 Unit Assembly

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

5.4 ALIGNMENT PROCEDURES

The DMH radio uses all electronic tuning with no manual adjustments. Use the DMH Editor software when alignment or adjustment is required. You will need an IBM or compatible computer with a disk drive and an RS-232 serial port. You will also need the DMH Editor software (LAA0742CD) and an RS-232 interface cable (LAA0725), available from BK Radio.

5.4.1 Test Setup

Mount the radio in a suitable fixture containing an adapter for supplying 13.8 VDC from a negative ground power supply. Turn off any radio features assigned to the microphone keypad function menu and set the manual controls as follows:

Channel Selector:	Channel 1
On/Off Volume:	On, volume minimum

5.4.2 Alignment Order

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

1. Synthesizer Calibration
2. Reference Oscillator Frequency
3. Transmit Power Curve
4. Transmit Power Adjustment
5. VCO Modulation Sensitivity
6. Receiver Tuning
7. Squelch Adjust

5.4.3 Synthesizer Calibration

This calibration records the required VCO pretuning voltage across the RF frequency band. This adjustment may be necessary if VCO components are replaced.

No additional setup is required for this procedure.

During the automatic calibration, the synthesizer will attempt to acquire several receive and transmit frequencies. For each test frequency, the pretune D/A converter voltage will be varied to determine the optimum value. The LCKDTECT signal is monitored to determine if synthesizer lock occurs. The D/A voltages that result in proper operation will be recorded in the radio's EEPROM memory.

5.4.4 Reference Oscillator Frequency

This procedure allows the reference TCXO frequency to be corrected. Transmit and receive frequencies are derived from the reference oscillator. The reference oscillator may require adjustment due to crystal aging or if the reference oscillator module is replaced.

To set up for this procedure, 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 50 Watts is recommended.

Transmit frequency must be measured and entered into the alignment software. Once these frequencies are obtained, proper settings for Frequency Adjustment are automatically computed and recorded in the radio's EEPROM memory.

5.4.5 Transmit Power Curve

Note: The transmitter should not be keyed for extended periods while setting transmitter power. Prolonged transmitting will cause the thermal protection circuitry of the radio to decrease the transmitter power.

This setting is used to help maintain a constant transmitter output power of 50 Watts across the RF frequency band. If components on the PA board are replaced, this adjustment may be necessary.

To set up for this procedure, connect a suitable 50Ω power meter to the antenna output of the radio.

Output power must be observed while interactively adjusting the power at several frequencies. The final settings are recorded in the radio's EEPROM memory.

5.4.6 Transmit Power Adjustment

Note: The transmitter should not be keyed for extended periods while setting transmitter power. Prolonged transmitting will cause the thermal protection circuitry of the radio to decrease the transmitter power.

This setting allows customization of transmit high and low power output levels. If components in the transmitter power circuit are replaced, this procedure may be necessary.

To set up for this procedure, connect a suitable 50Ω power meter to the antenna output of the radio.

Output power must be observed while interactively adjusting the power. The final setting is recorded in the radio's EEPROM memory.

5.4.7 VCO Modulation Sensitivity

This adjustment controls the maximum analog and digital mode 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 or digital mode).

To set up for this procedure, connect a suitable attenuator and service monitor to the antenna output of the radio. Disconnect any modulation source from the MIC HIGH input of the radio. Configure the service monitor to read peak FM deviation.

Follow the software instructions for each alignment frequency. Observe the service monitor reading while interactively adjusting the peak FM deviation to 3.0 kHz. The final settings are recorded in the radio's

EEPROM memory.

5.4.8 Tune Receiver

Varactor controlled bandpass filters in the receiver front end provide spurious response rejection. If components in the bandpass filters, RF amplifier, or mixer are replaced this adjustment may be necessary to maintain specified RF sensitivity.

To set up for this procedure, connect an RF signal generator to the radio antenna input. Set the generator FM modulation to a frequency of 1 kHz and a deviation of ±3 kHz. Connect a SINAD meter to the radio audio output.

For each alignment frequency, retune the RF signal generator and adjust the generator output level to obtain a SINAD reading of approximately 12 dB. Optimize reception at each frequency by interactively adjusting the varactor voltages to obtain the greatest SINAD reading. If necessary reduce the signal generator level to maintain a SINAD reading between 12 and 18 dB. The final settings are recorded in the radio's EEPROM memory.

5.4.9 Squelch Adjust

With preset squelch the DMH audio should turn on at approximately 12 dB SINAD. If components in the receiver IF or squelch filter are replaced, adjustment of the squelch may be necessary.

To set up for this procedure, connect an RF signal generator to the radio antenna input. Set the generator FM modulation to a frequency of 1 kHz and a deviation of ±3 kHz for wide band squelch adjustment, or ±1.5 kHz for narrow band squelch adjustment.

For both wide and narrow mode, set the signal generator modulation and adjust the output level to obtain a SINAD reading of approximately 8 dB. The proper setting for Squelch Adjust is automatically computed and recorded in the radio's EEPROM memory.