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EX500™
EX600™
EX600•XLS™

Expert Series
Two-Way Radio Basic Service Manual

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Glossary of Terms

PRODUCT SAFETY AND RF EXPOSURE COMPLIANCE

Caution

Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 68P81095C98) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: http://www.motorola.com/cgiss/index.shtml.

Chapter 1

Introduction

1.1 Scope of Manual

This manual is intended for use by service technicians familiar with similar types of equipment. It contains service information required for the equipment described in this document and is current as of the printing date. Changes which occur after the printing date will be incorporated in a complete Manual Revision or alternatively as additions.

NOTE Before operating or testing these units, please read the Safety Information Section at the beginning of this manual.

1.2 Warranty and Service Support

Motorola offers support which includes: full exchange and/or repair of the product during the warranty period; and service/repair or spare parts support out of warranty. Any “return for exchange” or “return for repair” to an authorized Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are available from Authorized Motorola Dealers.

1.2.1 Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Dealer, Distributor or Reseller contract. These conditions may change from time to time, and the following subsections are for guidance purposes only.

In instances where the product is covered under a “return for replacement” or “return for repair” warranty, a check of the product should be performed prior to shipping the unit back to Motorola. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radio back to the appropriate Motorola warranty depot, please contact Customer Resources. (See section 1.2.4 on page 1-3 of this chapter.) All returns must be accompanied by a Warranty Claim Form available from your Customer Resources representative. Products should be shipped back in the original packaging, or correctly packaged to ensure that no damage occurs in transit.

1.2.2 After Warranty Period

After the Warranty period, Motorola continues to support its products in two ways:

1. Motorola's Radio Parts and Service Group offers repair service to users and dealers at competitive prices.
2. The Motorola Accessories and Aftermarket Division (AAD) supplies individual parts and modules that can be purchased by dealers who are capable of performing fault analysis and repair.

1.2.3 Piece Parts Availability

Some replacement parts, spare parts, and/or product information can be ordered directly.

If...	It Means That...
A complete Motorola part number is assigned to the part, and it is not identified as Depot ONLY	The part is available from AAD.
No part number is assigned	The part is not normally available from Motorola.
The part number is appended with an asterisk,	The part is serviceable by a Motorola Depot only.
A parts list is not included	Generally, no user-serviceable parts are available for that kit or assembly.

Parts Order Entry:

7:00 A.M. to 7:00 P.M. (Central Standard Time)
Monday through Friday (Chicago, U.S.A.)

To Order Parts:

1-800-422-4210, or 847-538-8023
1-800-826-1913, or 410-712-4907 (U.S. Federal Government)
TELEX: 280127
FAX: 1-847-538-8198
FAX: 1-410-712-4991 (U.S. Federal Government)
(U.S.A.) after hours or weekends:
1-800-925-4357

Motorola Parts

Accessories and Aftermarket Division
(United States and Canada)
Attention: Order Processing
2200 Galvin Dr.
Elgin, IL 60123

Parts Identification

1-800-422-4210 Menu 3

1.2.4 Technical Support

Technical support is available to assist the dealer/distributor in resolving any malfunction which may be encountered. Initial contact should be by telephone to Customer Resources wherever possible. When contacting Motorola Technical Support, keep the product **model number** and the unit's **serial number** handy.

For service, contact one of the following Depots. Please call and confirm your return before sending the unit to the depot for service.

Motorola Radio Support Center

3761 South Central Avenue
Rockford, IL 61102-4294
1-800-227-6772
1-815-489-1000

Motorola Toronto Service Center

400 Matheson Blvd. W
Mississauga, Ontario, Canada L5R 3M1
1-800-543-3222
1-416-756-5841
1-888-331-9872 (Fax)

Motorola U.S. Federal Government Depot

4395 Nicole Drive
Lanham, MD 20706
1-800-969-6680
1-301-731-6676

1.3 Radio Model Information

The model number and serial number are located on a label attached to the back of your radio. You can determine the RF output power, frequency band, protocols, and physical packages. The example below shows one portable radio model number and its specific characteristics.

Table 1-1: Radio Model Number (Example: AAH38KDC9AA3)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level	Model Revision	Model Package
AA = Motorola Internal Use ← **AA**	**H** ↑ Portable	**38**	**K** VHF (136-174MHz)	**D** 4-5W	**C** EX500 No display	**9** Program-mable	**AA** Conven-tional	**3** EX500	**A**	**N**
			R UHF1 (403-470MHz)		**H** EX600 / EX600•XLS Full Keypad with display		**DU** LTR	**6** EX600 / EX600•XLS		
			S UHF2 (450-512 MHz)							

Chapter 2

Intrinsically Safe Radio Information

2.1 FMRC Approved Equipment

Anyone intending to use a radio in a location where hazardous concentrations of flammable material exist (hazardous atmosphere) is advised to become familiar with the subject of intrinsic safety and with the National Electric Code NFPA 70 (National Fire Protection Association) Article 500 (hazardous [classified] locations).

An Approval Guide, issued by Factory Mutual Research Corporation (FMRC), lists manufacturers and the products approved by FMRC for use in such locations. FMRC has also issued a voluntary approval standard for repair service (“Class Number 3605”).

FMRC Approval labels are attached to the radio to identify the unit as being FM Approved for specified hazardous atmospheres. This label specifies the hazardous Class/Division/Group along with the part number of the battery that must be used. Depending on the design of the portable unit, this FM label can be found on the back or the bottom of the radio housing. The FM Approval mark is shown below:

WARNING: Do not operate radio communications equipment in a hazardous atmosphere unless it is a type especially qualified for such use (e.g., FMRC Approved). An explosion or fire may result.

WARNING: Do not operate an FMRC Approved Product in a hazardous atmosphere if it has been physically damaged (e.g., cracked housing). An explosion or fire may result.

WARNING: Do not replace or charge batteries in a hazardous atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion or fire.

WARNING: Do not replace or change accessories in a hazardous atmosphere. Contact sparking may occur while installing or removing accessories and cause an explosion or fire.

WARNING: Do not operate an FMRC Approved Product unit in a hazardous location with the accessory contacts exposed. Keep the connector cover in place when accessories are not used.

WARNING: Turn a radio off before removing or installing a battery or accessory.

WARNING: Do not disassemble an FMRC Approved Product unit in any way that exposes the internal electrical circuits of the unit.

Radios must ship from the Motorola manufacturing facility with the hazardous atmosphere capability and FM Approval labeling. Radios will not be “upgraded” to this capability and labeled in the field.

A modification changes the unit's hardware from its original design configuration. Modifications can only be made by the original product manufacturer at one of its FMRC-audited manufacturing facilities.

WARNING: Failure to use an FMRC Approved Product unit with an FMRC Approved battery or FMRC Approved accessories specifically approved for that product may result in the dangerously unsafe condition of an unapproved radio combination being used in a hazardous location.

Unauthorized or incorrect modification of an FMRC Approved Product unit will negate the Approval rating of the product.

2.2 Repair of FMRC Approved Products

REPAIRS FOR MOTOROLA PRODUCTS WITH FMRC APPROVAL ARE THE RESPONSIBILITY OF THE USER.

You should not repair or relabel any Motorola- manufactured communication equipment bearing the FMRC Approval label ("FMRC Approved Product") unless you are familiar with the current FMRC Approval standard for repairs and service ("Class Number 3605").

You may want to consider using a repair facility that operates under 3605 repair service approval.

WARNING: Incorrect repair or relabeling of any FMRC Approved Product unit could adversely affect the Approval rating of the unit.

WARNING: Use of a radio that is not intrinsically safe in a hazardous atmosphere could result in serious injury or death.

FMRC's Approval Standard Class Number 3605 is subject to change at any time without notice to you, so you may want to obtain a current copy of 3605 from FMRC. Per the December 1994 publication of 3605, some key definitions and service requirements are as follows:

2.2.1 Repair

A repair constitutes something done internally to the unit that would bring it back to its original condition—Approved by FMRC. A repair should be done in an FMRC Approved facility.

Items not considered as repairs are those in which an action is performed on a unit which does not require the outer casing of the unit to be opened in a manner which exposes the internal electrical circuits of the unit. You do not have to be an FMRC Approved Repair Facility to perform these actions.

2.2.2 Relabeling

The repair facility shall have a method by which the replacement of FMRC Approval labels are controlled to ensure that any relabeling is limited to units that were originally shipped from the Manufacturer with an FM Approval label in place. FMRC Approval labels shall not be stocked by the repair facility. An FMRC Approval label shall be ordered from the original manufacturer as needed to repair a specific unit. Replacement labels may be obtained and applied by the repair facility providing satisfactory evidence that the unit being relabeled was originally an FMRC Approved unit. Verification may include, but is not limited to: a unit with a damaged Approval label, a unit with a defective housing displaying an Approval label, or a customer invoice indicating the serial number of the unit and purchase of an FMRC Approved model.

2.2.3 Do Not Substitute Options or Accessories

The Motorola communications equipment certified by Factory Mutual is tested as a system and consists of the FM Approved portable, FM Approved battery, and FM Approved accessories or options, or both. This FM Approved portable and battery combination must be strictly observed. There must be no substitution of items, even if the substitute has been previously Approved with a different Motorola communications equipment unit. Approved configurations are listed in the FM Approval Guide published by FMRC, or in the product FM Supplement. This FM Supplement is shipped from the manufacturer with the FM Approved radio and battery combination. The Approval Guide, or the Approval Standard Class Number 3605 document for repairs and service, can be ordered directly from Factory Mutual Research Corporation located in Norwood, Massachusetts, USA.

Notes

Chapter 3

Maintenance

3.1 Introduction

This chapter provides details about the following:

- Preventive maintenance (inspection and cleaning)
- Safe handling of CMOS and LDMOS devices
- Disassembly and reassembly of the radio
- Repair procedures and techniques

3.2 Preventive Maintenance

The radios do not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

3.2.1 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. It is not recommended to inspect the interior electronic circuitry.

3.2.2 Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the front cover, housing assembly and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

NOTE Internal surfaces should be cleaned only when the radio is disassembled for service or repair.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (70% by volume).

CAUTION: The effects of certain chemicals and their vapors can have harmful results on certain plastics. Avoid using aerosol sprays, tuner cleaners, and other chemicals.

Cleaning External Plastic Surfaces

Apply the 0.5% detergent-water solution sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. Use a soft, absorbent, lintless cloth or tissue to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

Cleaning Internal Circuit Boards and Components

Isopropyl alcohol (70%) may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. After completing of the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

NOTE Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

3.3 Safe Handling of CMOS and LDMOS Devices

Complementary metal-oxide semiconductor (CMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS circuits and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the following CAUTION statement.

CAUTION: This radio contains static-sensitive devices. Do not open the radio unless you are properly grounded. Take the following precautions when working on this unit:

- Store and transport all CMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS devices into conventional plastic “snow” trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS device. We recommend using the Motorola Static Protection Assembly (part number 0180386A82), which includes a wrist strap, two ground cords, a table mat, and a floor mat.
- Wear a conductive wrist strap in series with a 100k resistor to ground. (Replacement wrist straps that connect to the bench top covering are Motorola part number RSX-4015.)
- Do not wear nylon clothing while handling CMOS devices.
- Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

3.4 Repair Procedures and Techniques — General

Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number and order the part from the nearest Motorola Communications parts center listed in section 1.2.3 on page 1-2 of this manual.

Rigid Circuit Boards

This family of radios uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed-through holes may interconnect multiple layers of the printed circuit. Therefore, exercise care to avoid pulling the plated circuit out of the hole.

When soldering near the 20-pin and 40-pin connectors:

- Avoid accidentally getting solder in the connector.
- Be careful not to form solder bridges between the connector pins.
- Examine your work closely for shorts due to solder bridges.

Flexible Circuits

The flexible circuits are made from a different material than the rigid boards, and require different soldering techniques. Excessive prolonged heat on a flexible circuit can damage the material. Therefore, avoid excessive heat and excessive bending.

For parts replacement, use the ST-1087 Temperature-Controlled Solder Station with a 600-700 degree F tip, and use small diameter solder such as ST-633. The smaller size solder will melt faster and require less heat to be applied to the circuit.

To replace a component on a flexible circuit:

1. Grasp with seizers (hemostats) the edge of the flexible circuit near the part to be removed.
2. Pull gently.
3. Apply the tip of the soldering iron to the component connections while pulling with the seizers.

NOTE Do not attempt to puddle-out components. Prolonged application of heat may damage the flexible circuit.

Chip Components

Use either the RLN-4062 Hot-Air Repair Station or the Motorola 0180381B45 Repair Station for chip component replacement. When using the 0180381B45 Repair Station, select the TJ-65 mini-thermojet hand piece. On either unit, adjust the temperature control to 700 degrees F. (370 degrees C), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- To remove a chip component, select a hot-air hand piece and position the nozzle of the hand piece approximately 1/8” above the component to be removed. Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers. Using solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.
- To replace a chip component using a soldering iron, select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads. Using a pair of tweezers, position the new chip component in place while heating the fresh solder. Once solder wicks onto the new component, remove the heat from the solder. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.

- To replace a chip component using hot air, select the hot-air hand piece and reflow the solder on the solder pads to smooth it. Apply a drop of solder paste flux to each pad. using a pair of tweezers, position the new component in place. Position the hot-air hand piece approximately 1/8” above the component and begin applying heat. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

Shields

Removing and replacing shields will be done with the R-1070 station with the temperature control set to approximately 415°F (215°C); 445°F (230°C) max.

- To remove the shield, place the circuit board in the R-1070’s holder. Select the proper heat focus head and attach it to the heater chimney. Add solder paste flux around the base of the shield. Position the shield under the heat-focus head. Lower the vacuum tip and attach it to the shield by turning on the vacuum pump. Lower the focus head until it is approximately 1/8” (0.3cm) above the shield. Turn on the heater and wait until the shield lifts off the circuit board. Once the shield is off, turn off the heat, grab the part with a pair of tweezers, and turn off the vacuum pump. Remove the circuit board from the R-1070’s circuit board holder.
- To replace the shield, add solder to the shield if necessary, using a micro-tipped soldering iron. Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board. Place the circuit board back in the R1070’s circuit board holder. Place the shield on the circuit board using a pair of tweezers. Position the heat-focus head over the shield and lower it to approximately 1/8” above the shield. Turn on the heater and wait for the solder to reflow. Once complete, turn off the heat, raise the heat-focus head and wait approximately one minute for the part to cool. Remove the circuit board and inspect the repair. No cleaning should be necessary.

3.5 Disassembling and Reassembling the Radio — General

Since these radios may be disassembled and reassembled with the use of only four (board to casting) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling the radio:

- Chassis opener
- Flat bladed screwdriver
- Philips head screwdriver

If a unit requires more complete testing or service than is customarily performed at the basic level, send this unit to a Motorola Authorized Service Center. (See Chapter 1 for a list of authorized service centers.)

The following disassembly procedures should be performed only if necessary:

- Chassis Assembly and Disassembly
- Speaker, Microphone, and Universal Connector Flex Disassembly
- Controller Board Disassembly
- Control Top Disassembly

3.6 EX500 Radio Disassembly — Detailed

3.6.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery:
    a. Pull down on the two battery-release buttons.
    b. With the buttons pulled down, the top of the battery will fall from the radio.
    c. Remove the battery from the radio.

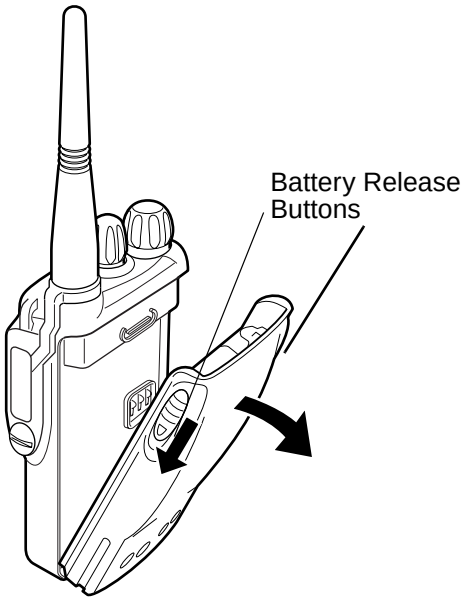

Figure 3-1 Battery Removal

3. Remove the antenna.
4. Pull the volume and channel selector knobs off of their shafts.

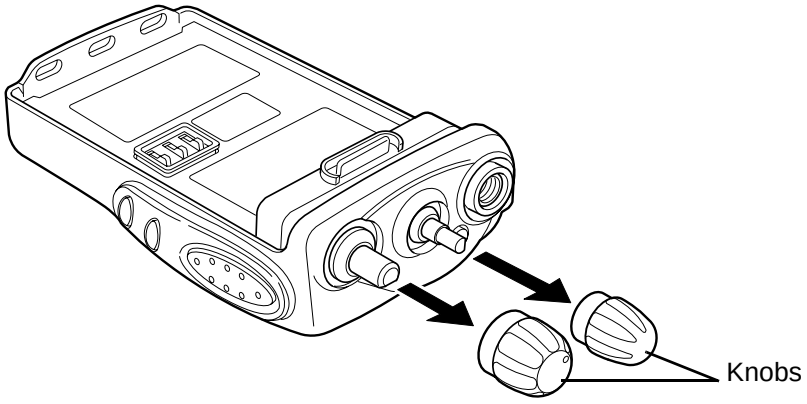

Figure 3-2 Knob Removal

NOTE Both knobs slide on and off. However, they are supposed to fit very tightly on their shafts.

5. Separate the chassis from the internal electronics front cover assembly as follows:
    a. Insert a small, flat blade screwdriver, or similar instrument, in between the thin retaining wall and the chassis at the bottom of the radio. Do not mar the O-ring sealing area on the housing.
    b. Slowly pry the bottom of the chassis from the cover by pushing the chassis opener (part number 6680702Z01) down, and prying the handle of the tool over and behind the base of the radio. This prying action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

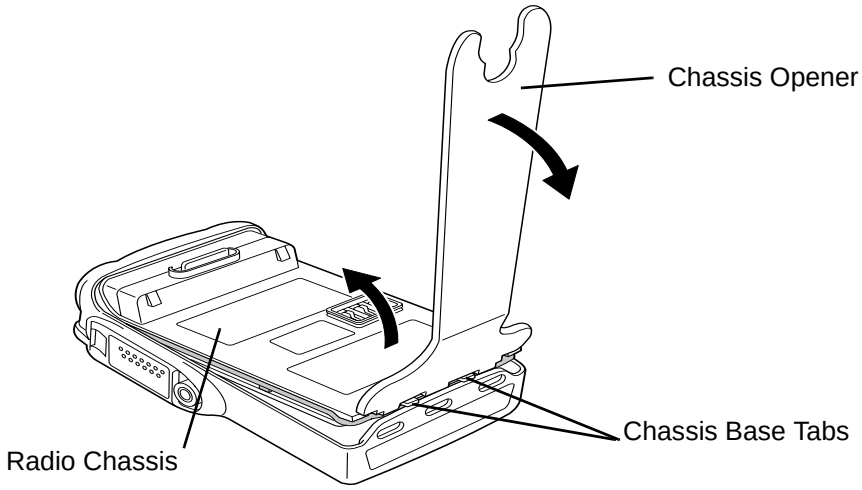

Figure 3-3 Chassis Removal

CAUTION: Marring the front cover O-ring sealing area will prevent the radio from sealing properly.

NOTE Flexible ribbon circuits (flexes) connecting the front cover assembly and the chassis prevent you from completely separating the two units.

6. Lay the chassis down. Rotate the front cover backward and slightly away from the chassis.

7. Lift the latches on the main circuit board to release the flexes from their connectors.

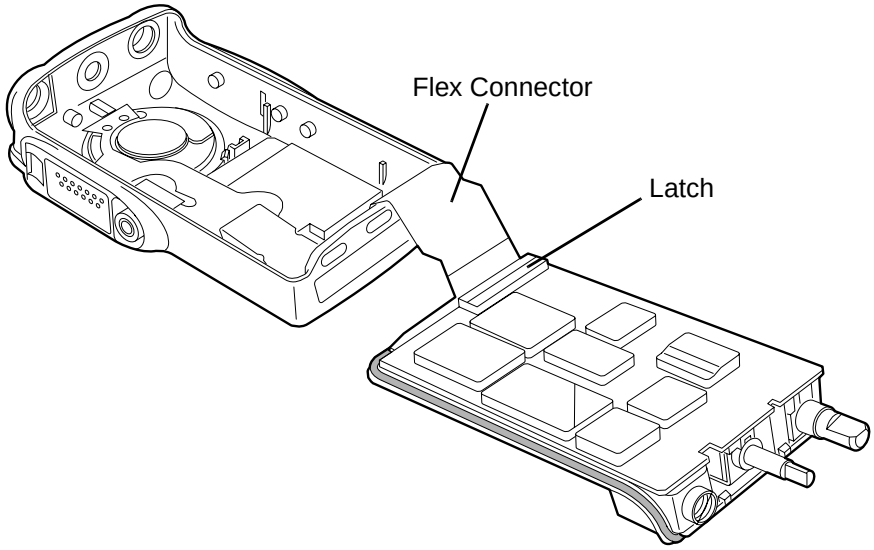

Figure 3-4 Unlatch Flex Connectors

3.6.2 Chassis Assembly Disassembly

Use a Philips head screwdriver to remove the four screws holding the main board to the chassis.

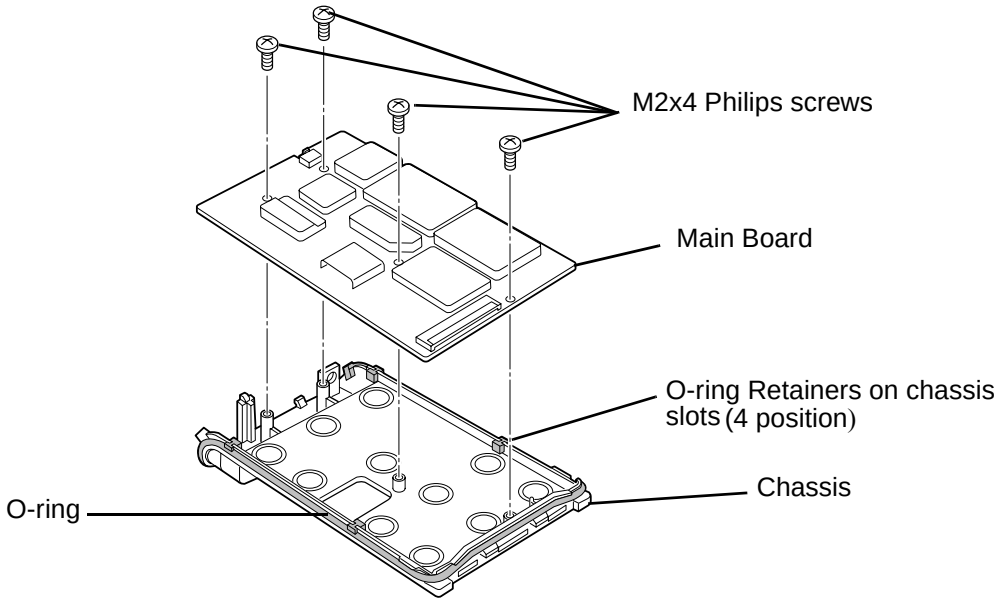

Figure 3-5 Remove Main Board from Chassis

1. Lift the main board from the chassis. (See Figure 3-5.)

CAUTION: Before removing the board, refer to the CMOS CAUTION paragraph on page 3-2. Be sure to use ESD protection when handling circuit boards.

2. Remove the four small O-ring retainers from their slots in the chassis. Note the alignment of the retainers for reassembly.

3. Remove the O-ring.
4. Slide off the ground contact from the top corner boss of the radio chassis.

3.6.3 Speaker, Microphone, and Universal Connector Flex Disassembly

1. Turn the screw at the bottom of the dustcover counterclockwise with your fingers. Lift the dustcover out of its pocket.

NOTE The dustcover must be removed to remove the speaker-microphone assembly flex circuit. The speaker is held in place with a two-legged retainer bracket. The bracket legs are secured by the front cover slots. Be careful not to damage the speaker when removing the retainer bracket.

2. Insert a flat bladed screwdriver in between the speaker and housing. Then pull up the screwdriver to remove the speaker from the housing.
3. Pull the rubber microphone boot from its seated position. Unless you are replacing the microphone, leave it in the boot.

NOTE The speaker-microphone assembly flex circuit goes through the front cover wall to the outside wall. To replace this assembly, you must peel off the universal connector escutcheon label. (See item number 3 in the exploded view diagram on page 3-20.). The existing escutcheon and speaker cannot be reassembled; a new part must be used.

4. Peel off the universal connector flex circuit escutcheon (label).
5. Pry the flex circuit (adhesive held) backer board away from the front cover, and remove the universal connector tail of the speaker-microphone assembly through its opening in the front cover.

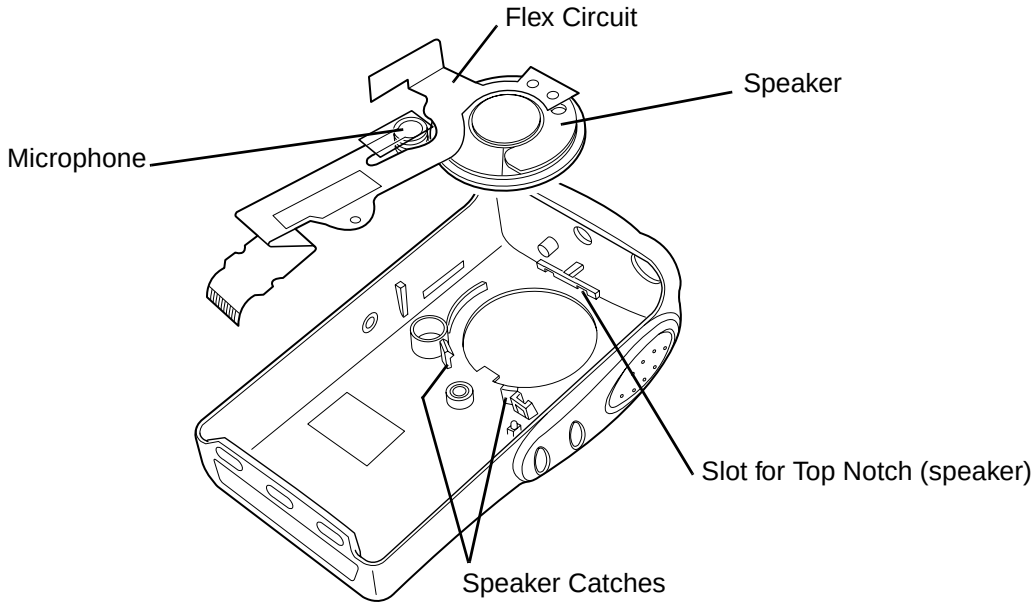

Figure 3-6 Removal of Speaker-Microphone Assembly

6. After the universal connector tail of the speaker-microphone assembly is removed, the assembly can be completely removed. If it is necessary to replace the speaker or microphone, or both, do it while the flex circuit is removed from the front cover. When reassembling the microphone in its boot, make sure the microphone port faces the round hole in the bottom of the boot.

3.6.4 Controller Board Disassembly

1. Use a Philips head screwdriver to remove the screw from its position.
2. Insert a flat bladed screwdriver in between the controller board and front cover. Pull up the screwdriver to disassemble the controller board from front cover. (See Figure 3-7.)

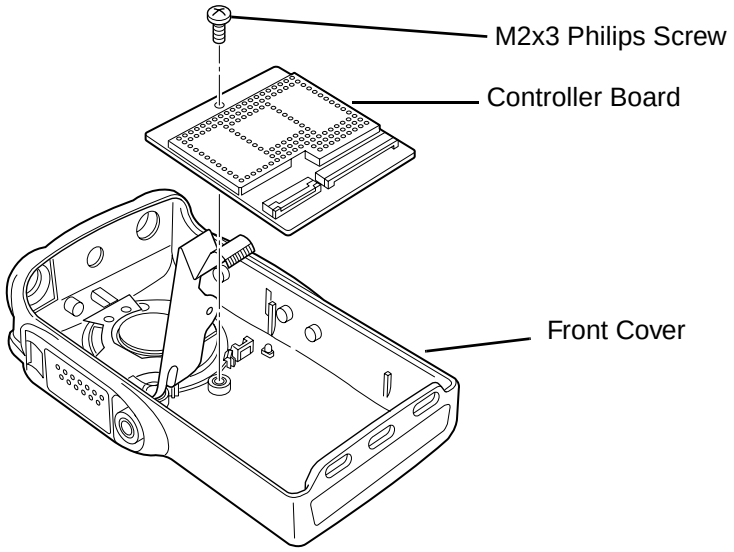

Figure 3-7 Removing the Controller Board from the Front Cover

3.6.5 Control Top Disassembly

1. To remove the control top assembly, place a screwdriver next to the antenna boss, and pry it against the control top escutcheon. This will lift the control top escutcheon away from its double-sided adhesive. Grab the double-sided adhesive near the volume potentiometer, and lift it away.
2. Remove the control top seal, emergency button, and transmit light pipe.

3.7 EX500 Radio Reassembly — Detailed

3.7.1 Control Top Reassembly

1. Replace transmit light pipe, control top seal and top adhesive.
2. Peel off the liners from a new control top escutcheon, and place it in the recess in the front cover. Press the control top escutcheon tightly against the adhesive.

3.7.2 Speaker, Microphone, and Universal Connector Flex Reassembly

1. Feed the universal connector stiffener of the speaker-microphone flex assembly through the opening in the side wall of the front cover.
2. Peel off the adhesive liner on the back of the universal connector stiffener of the flex circuit. Attach the flex stiffener to the front cover using the guide pins for correct alignment.
3. Replace the universal connector escutcheon. Make sure that all the connector openings align with the gold pads on the flex circuit.
4. Peel off the adhesive liner on the speaker rubber.
5. Align the top notch in the speaker at the twelve o'clock position with the tab on the front cover. (See Figure 3-6.) Push down the speaker until the two bottom notches fit into the catches on the housing.

3.7.3 Chassis Assembly Reassembly

1. Slide on the ground contact (if necessary) on the top corner boss of the chassis.
2. Replace the O-ring. The tabs on the O-ring should reach around the chassis and point down.
3. Stretch the O-ring to place it into the retaining pocket at the bottom end of the chassis.

NOTE When properly assembled, the retainers on the O-ring should align with the slots on the chassis. If this is not the case, remove and replace the O-ring until it is aligned with the chassis and completely seated in place around the perimeter.

4. Ensure that the antenna nut insulator is correctly replaced by pushing it all the way to the top of the antenna nut.
5. Replace the battery contact seal (if necessary) surrounding the battery contact.
6. Place the main circuit board straight down on top of the chassis.

NOTE Be sure the battery contact seal protrudes through the chassis and is not pinched under the chassis.

7. Use a Philips head screwdriver size 0 to fasten the screws holding the main board to the chassis.
8. Do not over torque. Torque limit is 3 inch lbs.

3.7.4 Chassis and Front Cover Reassembly

1. Align the chassis assembly end-to-end with the front cover assembly.
2. Insert the tails of the flex circuits into their respective connectors at the bottom of the front cover.
3. Push down the latches on the connectors to hold the flex circuits to the main board.
4. Slide volume potentiometer and frequency switch shafts into their respective holes in the front cover.
5. Push the chassis assembly completely into the top of the front cover until it settles in place.
6. Be sure the O-ring is properly seated.
7. Snap the bottom of the chassis into the front cover.

8. Reassemble the knobs, dust cover, antenna, and battery.

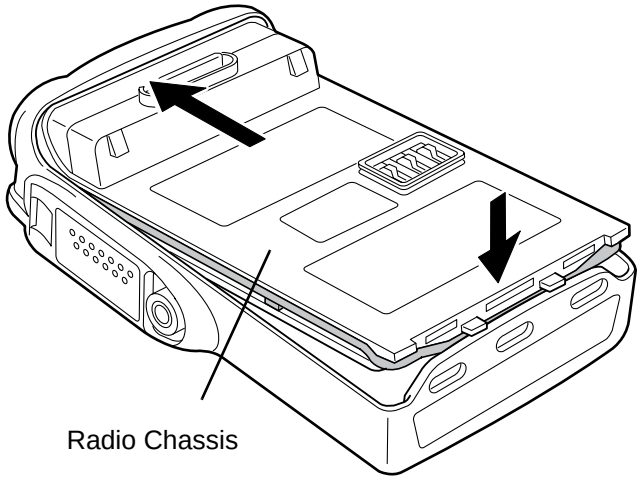

Figure 3-8 Fastening the Chassis

3.8 EX600 / EX600•XLS Radio Disassembly and Reassembly — General

Since these radios may be disassembled and reassembled with the use of only four (board to casting) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling the radio:

- Chassis opener
- Flat Bladed screwdriver
- Torx T6 screwdriver

If a unit requires more complete testing or service than is customarily performed at the basic level, send this unit to a Motorola Authorized Service Center. (See Chapter 1 for a list of authorized service centers.)

The following disassembly procedures should be performed only if necessary:

- Chassis Assembly Disassembly
- Speaker, Microphone, and Universal Connector Flex Disassembly
- Controller Board Disassembly
- Control Top Disassembly

3.9 EX600 / EX600•XLS Radio Disassembly — Detailed

3.9.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery:
    a. Pull down on the two battery-release buttons.
    b. With the buttons pulled down, the top of the battery will fall from the radio.
    c. Remove the battery from the radio.

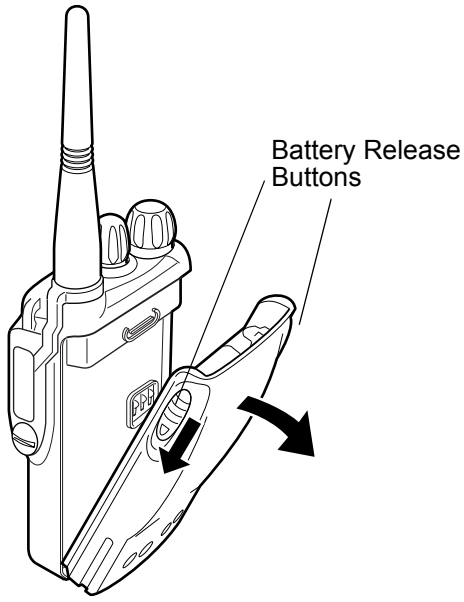

Figure 3-9 Battery Removal

3. Remove the antenna.

4. Pull the volume and channel selector knobs off of their shafts.

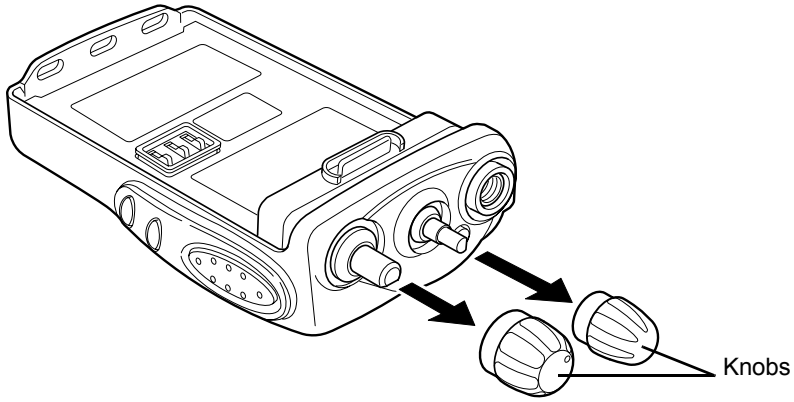

Figure 3-10 Knob Removal

NOTE Both knobs slide on and off. However, they are supposed to fit very tightly on their shafts.

5. Separate the chassis from the internal electronics front cover assembly as follows:
   a. Insert a small, flat bladed screwdriver, or similar instrument, in between the thin retaining wall and the chassis at the bottom of the radio. Do not mar the O-ring sealing area on the housing.
   b. Slowly pry the bottom of the chassis from the cover by pushing the chassis opener (part number 6680702Z01) down, and prying the handle of the tool over and behind the base of the radio. This prying action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

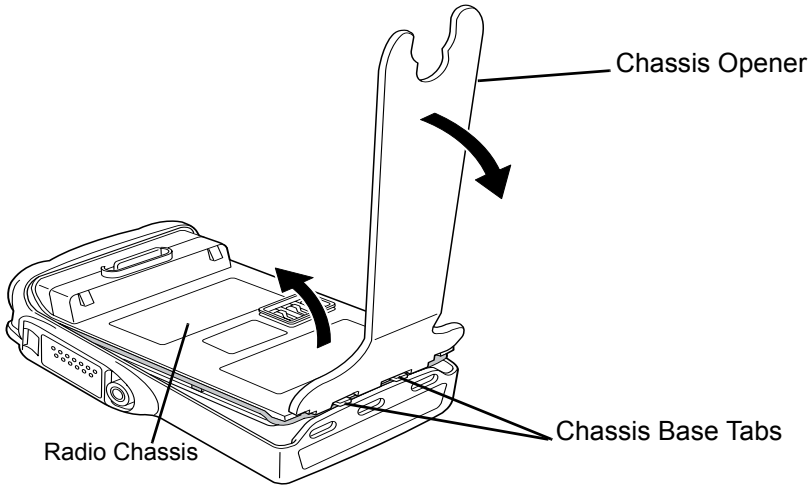

Figure 3-11 Chassis Removal

CAUTION: Marring the front cover O-ring sealing area will prevent the radio from sealing properly.

NOTE Flexible ribbon circuits (flexes) connecting the front cover assembly and the chassis prevent you from completely separating the two units.

6. Lay the chassis down. Rotate the front cover backward and slightly away from the chassis.
7. Lift the latches on the main circuit board to release the flexes from their connectors.

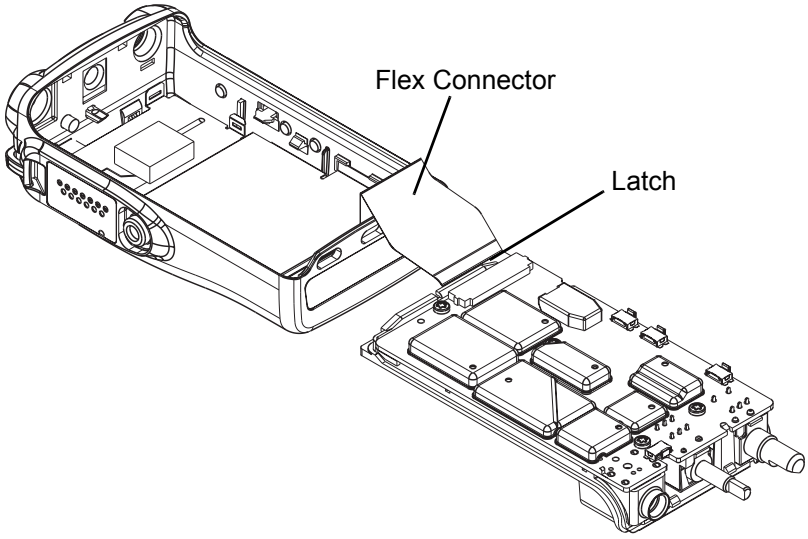

Figure 3-12 Unlatch Flex Connectors

3.9.2 Chassis Assembly Disassembly

Use a Philips head screwdriver to remove the four screws holding the main board to the chassis.

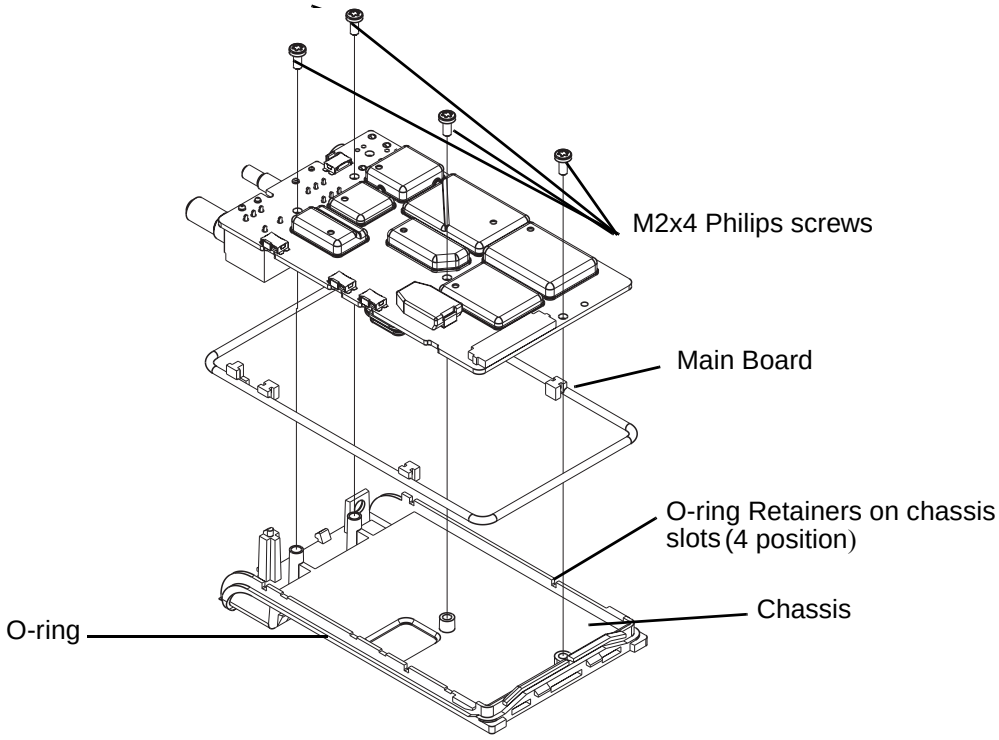

Figure 3-13 Remove Main Board from Chassis

1. Lift the main board from the chassis (See Figure 3-5).

CAUTION: Refer to the CMOS CAUTION paragraph on page 3-2 of this chapter before removing the main board. Be sure to use ESD protection when handling circuit boards.

2. Remove the four small O-ring retainers from their slots in the chassis. Note the alignment of the retainers for reassembly.
3. Remove the O-ring.

3.9.3 Speaker, Microphone, and Universal Connector Flex Disassembly

1. Turn the screw at the bottom of the dustcover counterclockwise with your fingers. Lift the dustcover out of its pocket.

NOTE The dustcover must be removed to remove the speaker-microphone assembly flex circuit. The speaker is held in place with a two-legged retainer bracket. The bracket legs are secured by the front cover slots. Be careful not to damage the speaker when removing the retainer bracket.

2. Insert a flat bladed screwdriver in between the speaker and housing. Then pull up the screwdriver to remove the speaker from the housing.
3. Pull the rubber microphone boot from its seated position. Unless you are replacing the microphone, leave it in the boot.

NOTE The speaker-microphone assembly flex circuit goes through the front cover wall to the outside wall. To replace this assembly, you must peel-off the universal connector escutcheon label. The existing escutcheon and speaker cannot be reassembled; a new part must be used. (See item number 3 on the exploded view drawing.)

4. Peel-off the universal connector flex circuit escutcheon (label).
5. Pry the flex circuit (adhesive held) backer board away from the front cover, and remove the universal connector tail of the speaker-microphone assembly through its opening in the front cover.

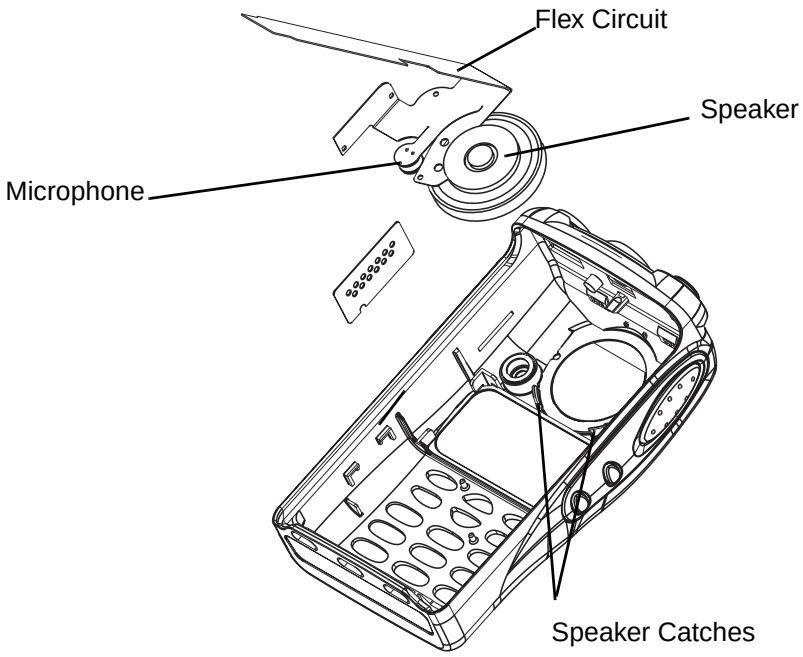

Figure 3-14 Removal Speaker-Microphone Assembly

6. After the universal connector tail of the speaker-microphone assembly is removed, the assembly can be completely removed. If it is necessary to replace the speaker or microphone, or both, do it while the flex circuit is removed from the front cover. When reassembling the microphone in its boot, make sure the microphone port faces the round hole in the bottom of the boot.

3.9.4 Controller Board, Display Module and Keypad Disassembly

1. Insert a small flat bladed screwdriver to loosen the retainer catches as shown. Remove the retainer.
2. Remove the controller board, display module, and keypad.

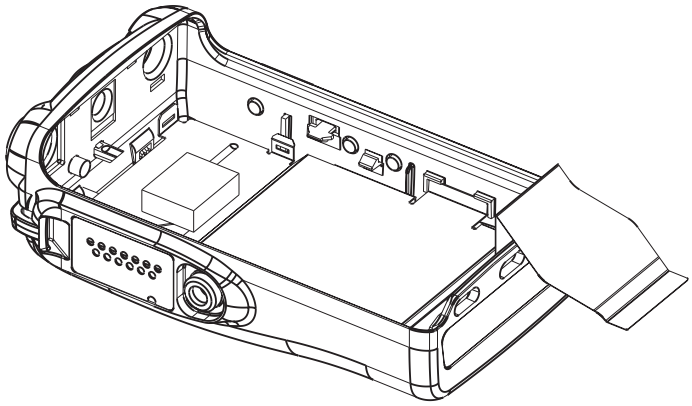

Figure 3-15 Removing the front cover

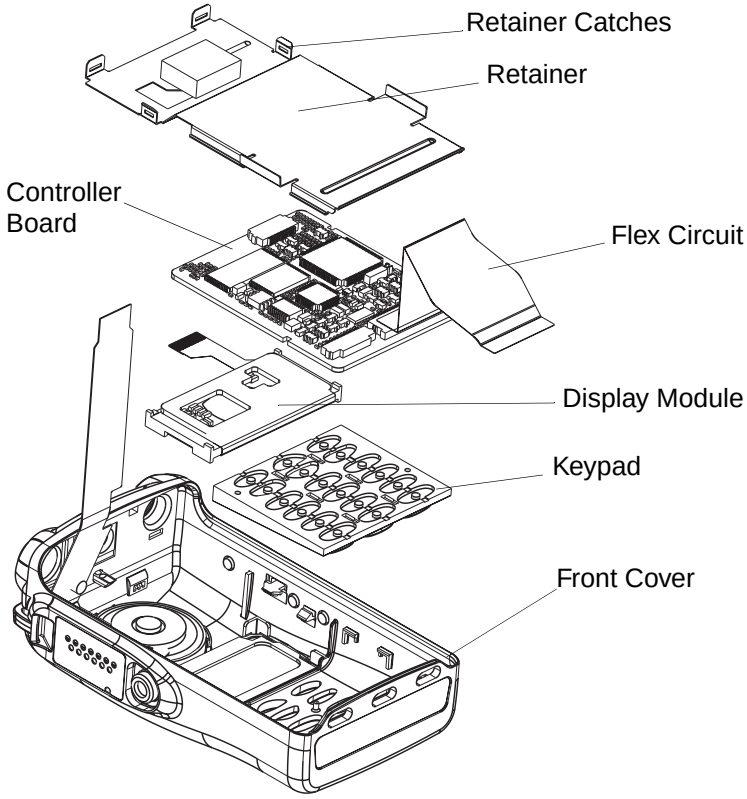

Figure 3-16 Removing the retainer, controller board, display module, and keypad from the radio body

3.9.5 Control Top Disassembly

1. To remove the control top assembly, place a screwdriver next to the antenna boss, and pry it against the control top escutcheon. This will lift the control top escutcheon away from its double-sided adhesive. Grab the double-sided adhesive near the volume potentiometer, and lift it away.
2. Remove the control top seal, emergency button, and transmit light pipe.

3.10 EX600 / EX600•XLS Radio Reassembly — Detailed

3.10.1 Control Top Reassembly

1. Replace transmit light pipe, control top seal and top adhesive.
2. Peel off the liners from a new control top escutcheon, and place it in the recess in the front cover. Press the control top escutcheon tightly against the adhesive.

3.10.2 Speaker, Microphone, and Universal Connector Flex Reassembly

1. Feed the universal connector stiffener of the speaker-microphone flex assembly through the opening in the side wall of the front cover.
2. Peel-off the adhesive liner on the back of the universal connector stiffener of the flex circuit. Attach the flex stiffener to the front cover using the guide pins for correct alignment.
3. Replace the universal connector escutcheon. Make sure that all the connector openings align with the gold pads on the flex circuit.
4. Peel off the adhesive liner on the speaker rubber.
5. Align the top notch in the speaker at the twelve o'clock position with the tab on the front cover. (See Figure 3-14.) Push down the speaker until the two bottom notches fit into the catches on the housing.

3.10.3 Chassis Assembly Reassembly

1. Slide on the ground contact (if necessary) on the top corner boss of the chassis.
2. Replace the O-ring. The tabs on the O-ring should reach around the chassis and point down.
3. Stretch the O-ring to place it into the retaining pocket at the bottom end of the chassis.

NOTE When properly assembled, the retainers on the O-ring should align with the slots on the chassis. If this is not the case, remove and replace the O-ring until it is aligned with the chassis and completely seated in place around the perimeter.

4. Ensure that the antenna nut insulator is correctly replaced by pushing it all the way to the top of the antenna nut.
5. Replace the battery contact seal (if necessary) surrounding the battery contact.
6. Place the main circuit board straight down on top of the chassis.

NOTE Be sure the battery contact seal protrudes through the chassis and is not pinched under the chassis.

7. Use the Philips head screwdriver to fasten the screws holding the main board to the chassis.

3.10.4 Chassis and Front Cover Reassembly

1. Align the chassis assembly end-to-end with the front cover assembly.
2. Insert the tails of the flex circuits into their respective connectors at the bottom of the front cover.
3. Push down the latches on the connectors to hold the flex circuits to the main board.
4. Slide the volume potentiometer and frequency switch shafts into their respective holes in the front cover.
5. Push the chassis assembly completely into the top of the front cover until it settles in place.
6. Be sure the O-ring is properly seated.
7. Snap the bottom of the chassis into the front cover.
8. Reassemble the knobs, dust cover, antenna, and battery.

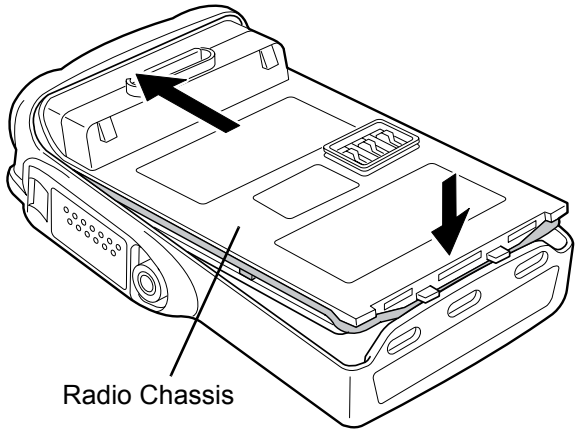

Figure 3-17 Fastening the Chassis

3.11 Mechanical Views and Parts Lists

3.11.1 EX500 Exploded View and Parts List

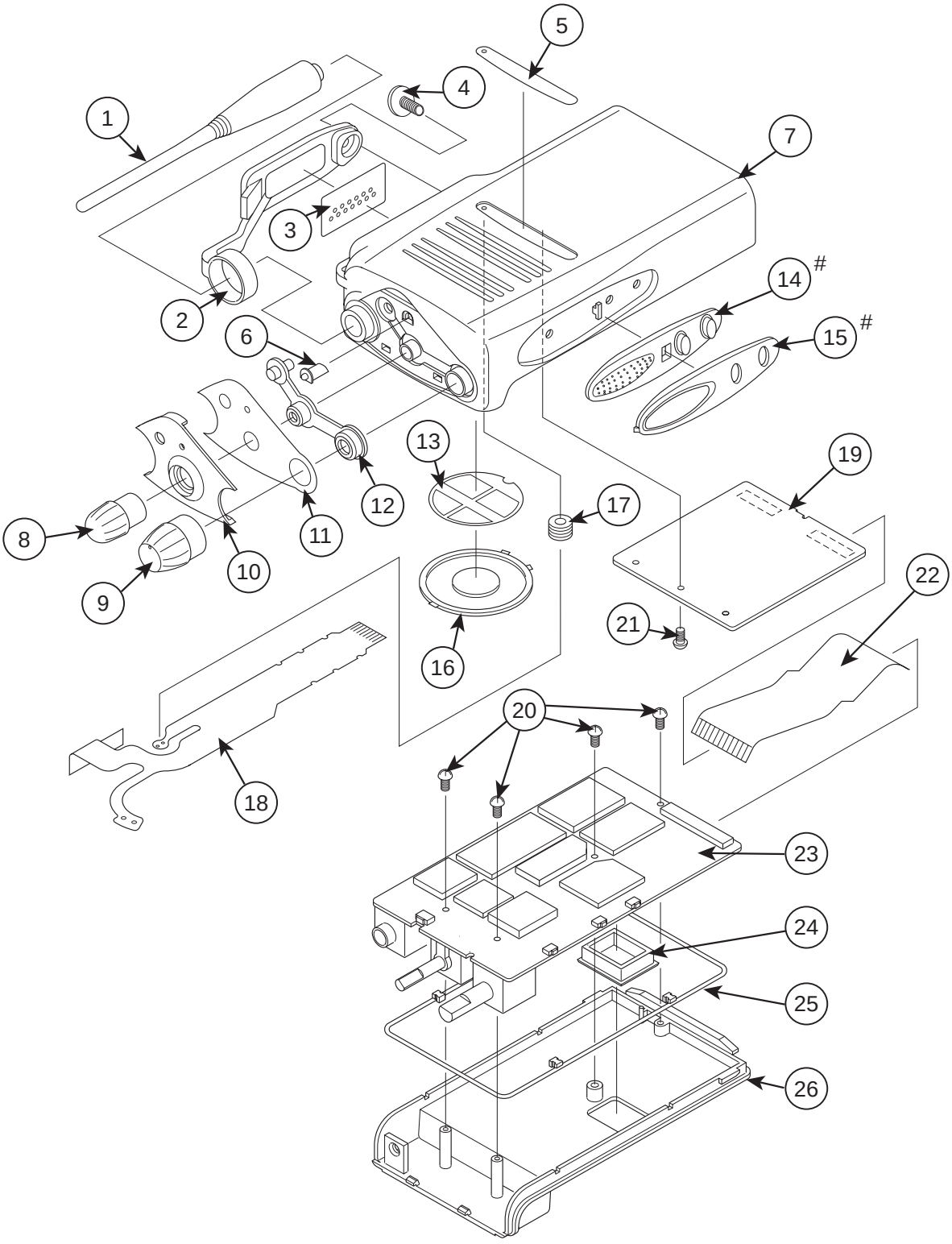

Figure 3-18 EX500 Radio Exploded View

Table 3-1 EX500 Radio Parts List

Item	Motorola Part Number	Description
1	See Chapter 7	Antenna
2	JMLN4638_	Dust Cover
3	1385905Z01	Universal Connector Seal
4	0302020P03	Screw for Dust Cover
5	HKLN4054	EX500 Name Plate
6	6102001P10	Light Pipe
7	0104031G98	EX500 Non Key Housing
8	3680530Z02	Channel Selector Knob
9	3680529Z01	Volume Knob
10	1302012P06	Top Plastic Plate
11	3385906Z01	Top Sheet
12	3202000P15	Control Top Seal
13	3502416P03	Speaker Mesh
14#	Part of Item 7	PTT Rubber
15#	Part of Item 7	PTT Plastic Cover
16	5005679X01	Speaker
17	1480577C01	Boot Microphone
18	8404079G01	Flex PCB Universal
19	See Chapter 8	Controller Board (must order front cover kit)
20	0385913Z01	4 M2X4 Philips Screws
21	0302020P05	1 M2X1 Philips Screws
22	8404078G01	Flex PCB RF Controller
23	See Chapter 8	RF Board (must order back cover kit)
24	3280534Z01	Seal Contact
25	3202000P14	O-ring
26	1502001P31	Chassis

 # Not field serviceable.

3.11.2 EX600 / EX600•XLS Exploded View and Parts List

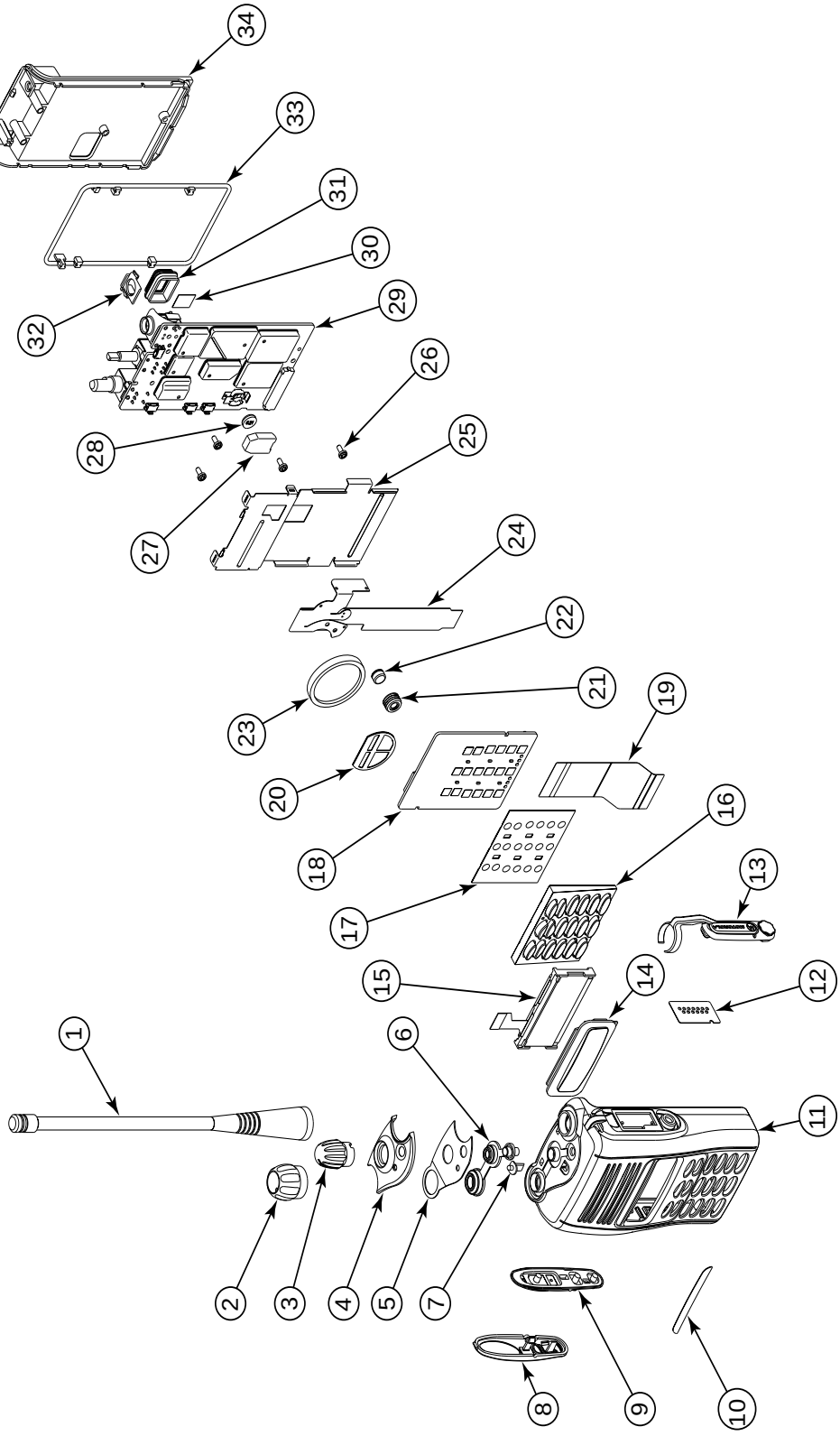

Figure 3-19 EX600 / EX600•XLS Radio Exploded View

Table 3-2 EX600 / EX600•XLS Radio Parts List

Item	Motorola Part Number	Description
1	See Chapter 7	Antenna
2	3680529Z01	Volume Knob
3	3680530Z02	Channel Selector Knob
4	1386160Z01 1386160Z02	Top Plastic Plate (EX600) Top Plastic Plate (EX600•XLS)
5	3385906Z01	Top Sheet
6	3286159Z01	Control Top Seal
7	6186158Z01	Lightpipe
8	1386091Z01	PTT Bezel
9	7586090Z01	PTT Rubber
10	HKLN4055 HKLN4187	EX600 Nameplate EX600•XLS Nameplate
11	1586088Z01	Front Cover Assembly
12	1385905Z01	Escutcheon, Universal Connector
13	JMLN4638	Dust Cover
14	7580540Z01	LCD Front Pad
15	5104949J11	LCD Module
16	7586096Z01	Main Keypad
17	4086199Z01	Keypad Polydome
18	See Chapter 8	Controller Board (must order front cover kit)
19	8404078G01	Flex RF Controller
20	3586092Z01	Speaker Felt
21	1480577C01	Microphone Boot
22	5013920A04	Microphone
23	5086094Z01	Speaker
24	8486095Z01	Flex, Universal Connector
25	4286097Z01	Keypad Retainer
26	0386104Z01	Chassis Screw
27	1480503Z01	Backup Battery Boot
28	6080656Z01	Battery Backup

Item	Motorola Part Number	Description
29	See Chapter 8	RF Board (must order back cover kit)
30	7580556Z01	Thermal Pad
31	3280534Z01	Battery Module Seal
32	1485673Z01	Antenna Nut Insulator
33	3285892Z01	Main O-Ring
34	2786154Z01	Chassis

3.12 Service Aids

The recommended service aids for the EX500, EX600 and EX600•XLS radios are listed in Table 3-3. While all of these items are available from Motorola, most are standard shop equipment items and any equivalent item capable of the same performance may be substituted for the item listed.

Table 3-3 Service Aids

Motorola Part No.	Description	Application
RLN4460	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
H5177	Customer Programming Software - Software on CD ROM	Used to program customer option and channel data.
AAJMKN4123	Programming Cable/Test Cable	Connects the radio to the RIB (RLN4008).
AAJMKN4124	Radio-to-Radio Cloning Cable	Allows data from a master radio to be duplicated by copying programmed data from the master radio to another compatible radio.
RLN4008	Radio Interface Box (RIB)	Enables communications between the radio and the computer's serial communications adapter.
AAJMKN4125	Battery Eliminator	Connects to radio via battery eliminator cable.
HHLN4134A	BNC Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
8180384M30	Housing Eliminator	Interconnects radio to power supply. Provides for troubleshooting of the radio when the housing is removed.
0180357A57	Wall-Mounted Power Supply	Used to supply power to the RIB (120 VAC).
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT. Use B71 for all other IBM models. Connects the computer's serial communications adapter to the RIB (RLN4008).
6680702Z01	Chassis/Knob Opener	Used to remove and replace surface mount devices.

3.13 Test Equipment

Table 3-4 lists test equipment required to service the EX500, EX600 and EX600•XLS radios and other two-way radios.

Table 3-4 Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2000, R2400, or R2001 with trunking option	Service Monitor	This monitor will substitute for items with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1049	Digital Multimeter		Two meters recommended for AC/DC voltage and current measurements
*S1100	Audio Oscillator	67 to 200Hz tones	Used with service monitor for injection of PL tones
*S1053, *SKN6009, *SKN6001	AC Voltmeter, Power Cable for meter, Test leads for meter	1 mV to 300 V, 10 Megaohm input impedance	Audio voltage measurements
R1053	Dual-trace Oscilloscope	20 MHz bandwidth, 5 mV/cm - 20 V/cm	Waveform measurements
*S1350, *ST1215 (VHF) *ST1223 (UHF) *T1013	Wattmeter, Plug-in Elements (VHF & UHF), RF Dummy Load	50-Ohm, ±5% accuracy 10 W, max. 0-1000 MHz, 300 W	Transmitter power output measurements
S1339	RF Millivolt Meter	100 µV to 3 VRF, 10 kHz to 1.2 GHz	RF level measurements
*R1013	SINAD Meter		Receiver sensitivity measurements
S1347 or S1348 (prog)	DC Power Supply	0-20 Vdc, 0-5 Amps	Bench supply for 7.5Vdc

3.14 Programming/Test Cable

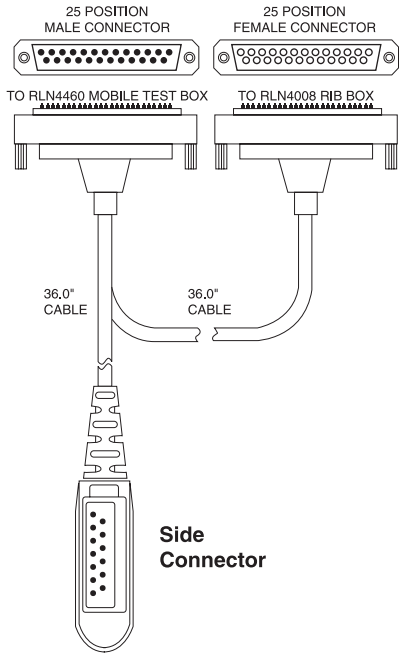

Figure 3-20 Programming/Test Cable

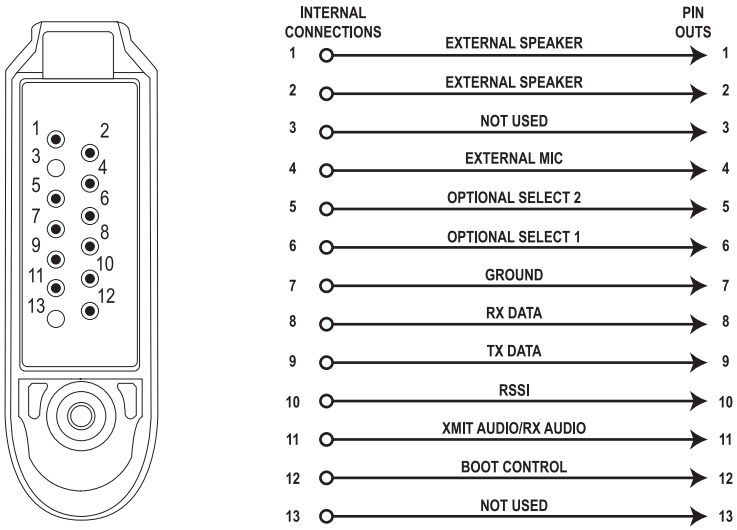

Figure 3-21 Pin Configuration of the Side Connector

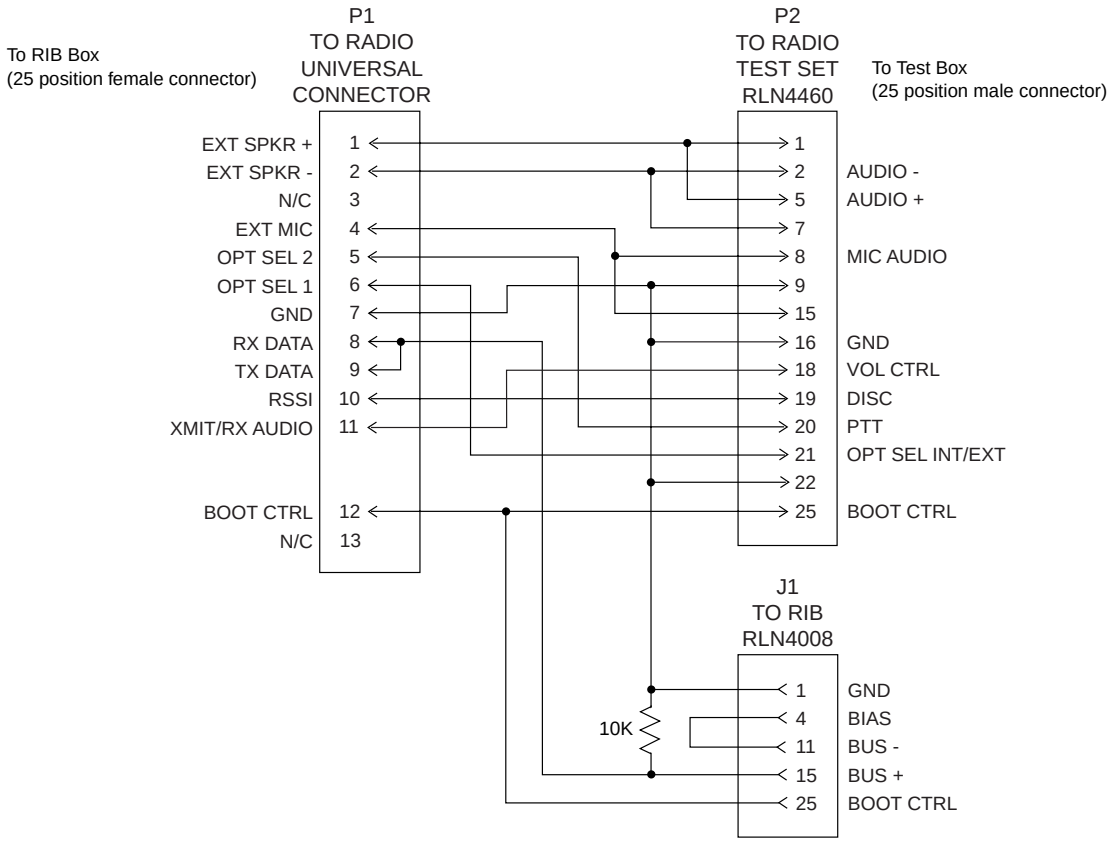

Figure 3-22 Wiring of the Connectors

Notes

Chapter 4

Transceiver Performance Testing

4.1 Introduction

These radios have been manufactured to meet published specifications through their manufacturing process, with the use of laboratory-quality test equipment of highest accuracy. The recommended field service equipment approaches the accuracy of the manufacturing equipment with a few exceptions.

Accuracy of the equipment must be maintained in compliance with the manufacturer's recommended calibration schedule.

4.2 Setup

Supply voltage can be connected from the battery eliminator. The equipment required for alignment procedures is connected as shown in the Radio Tuning diagram (Figure 5-1 on page 5-2).

Initial equipment control settings should be as indicated in the following table and should hold for all alignment procedures except as noted in Table 4-1.

Table 4-1 Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Spkr set: A	Voltage: 7.5Vdc
RF Attn: -70	Spkr/load: Speaker	DC on/standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 10V
O'scope Source: Mod O'scope Horiz: 10mSec/Div O'scope Vert: 2.5kHz/Div O'scope Trig: Auto Monitor Image: Hi Monitor BW: Nar Monitor Squelch: mid CW Monitor Vol: 1/4 CW		Current: 2.5A

4.3 Test Mode

4.3.1 RF Test Mode

When the radio is operating in its normal environment, the radio's microcontroller controls the RF channel selection, transmitter key-up, and receiver muting. However, when the unit is on the bench for testing, alignment or repair, it is removed from its normal environment. It cannot receive commands from its system and, therefore, the internal microcontroller will not key the transmitter nor unmute the receiver. This prevents the use of normal tune-up procedures. To solve this problem, a special routine called TEST MODE or "air test," has been incorporated in the radio.

To enter Test Mode:

1. Turn the radio on.
2. Within 10 seconds after the self test is complete, press side button 2, (SB2) five times in succession.
3. Press SB2 again to scroll through to the next channel spacing and so on. You will also hear a corresponding set of tones.
4. Press SB1 to scroll through and access test environments as shown in Table 4-2 below.
5. Press SB2 for 3 seconds in the Control Head Test mode to return to RF Test mode.

NOTE To access all 14 test modes on a 4-channel radio, the frequency knob and mechanical stop sleeve must be removed (see Exploded View diagrams in section 3.11 beginning on page 3-20).
XX - channel number (01 - 14)

Table 4-2 Test Environments

No. of Beeps	Description	Function
1	Carrier Squelch	RX: if carrier detected TX: mic audio
1	Tone Private-Line	RX: unsquelch if carrier and tone (192.8Hz) detected TX: mic audio + tone (192.8Hz)
2	Digital Private-Line	RX: unsquelch if carrier and digital code (131) detected TX: mic audio + digital code (131)
3	Dual-Tone multiple frequency	RX: unsquelch if carrier detected TX: selected DTMF tone pair
9	MDC1200 HSS	RX: unsquelch if carrier detected TX: 1500Hz tone
5	Unsquelch Open	RX: constant unsquelch TX: mic audio
11	CMP	RX: if carrier detected TX: mic audio
12	LLE	RX: if carrier detected TX: mic audio

Table 4-3 Test Channel Spacing

No.	Channel Spacing
1	25 KHz
2	12.5 KHz
3	20 KHz

Table 4-4 Test Frequencies

Channel Selector Switch Position	Test Channel	VHF	UHF1	UHF2
1 Low Power 8 High Power	TX#1 or #8 RX#1 or #8	136.025 136.025	403.025 403.025	450.025 450.025
2 Low Power 9 High Power	TX#2 or #9 RX#2 or #9	142.325 142.325	415.025 415.025	462.850 462.850
3 Low Power 10 High Power	TX#3 or #10 RX#3 or #10	148.625 148.625	425.025 425.025	475.675 475.675
4 Low Power 11 High Power	TX#4 or #11 RX#4 or #11	154.925 154.925	436.025 436.025	488.500 488.500
5 Low Power 12 High Power	TX#5 or #12 RX#5 or #12	161.225 161.225	449.025 449.025	501.325 501.325
6 Low Power 13 High Power	TX#6 or #13 RX#6 or #13	167.525 167.525	460.025 460.025	514.150 514.150
7 Low Power 14 High Power	TX#7 or #14 RX#7 or #14	173.825 173.825	469.975 469.975	526.975 526.975

Table 4-5 Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	PTT to continuous (during the performance check)	Frequency error to be ±200 Hz VHF ±600 Hz UHF
Rated Audio	Mode: GEN Output level: 1.0mV RF 4th channel test frequency* Mod: 1kHz tone at 3kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 4 carrier squelch	PTT to OFF (center), meter selector to Audio PA	Set volume control to 3.46Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <5.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.35µ
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1mV RF	As above	PTT to OFF (center), meter selection to Audio PA, spkr/load to speaker	Set volume control to 3.46Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	Out of TEST MODE; select a conventional system	As above	Unsquelch to occur at <0.35µV. Preferred SINAD = 9-10dB

** See Table 4-4 on page 4-3.*

Table 4-6 Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch	PTT to continuous (during the performance check)	Frequency error to be ±200 Hz VHF ±600 Hz UHF
Power RF	As above	As above	As above	Refer to Maintenance Specifications
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out Monitor: DVM, AC Volts Set 1kHz Mod Out level for 0.025Vrms at test set, 80mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: VHF, UHF: $\geq$ 4.0 kHz but $\leq$ 5.0 kHz (25 kHz Ch Sp).
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	Remove modulation input	Press PTT switch on radio. Say “four” loudly into the radio mic. Measure deviation: VHF, UHF: $\geq$ 4.0 kHz but $\leq$ 5.0 kHz (25 kHz Ch Sp)
High-Speed Data Modulation***	As above	TEST MODE, Test Channel 4 high speed output at antenna	PTT to continuous (during the performance check).	Deviation: VHF, UHF: $\geq$ 2.5 kHz but $\leq$ 3.5 kHz (25 kHz Ch Sp)
DTMF Modulation	As above, 4th channel test frequency*	TEST MODE, Test Channel 4 DTMF output at antenna	As above	Deviation: VHF, UHF: $\geq$ 3.05 kHz but $\leq$ 3.45 kHz (25 kHz Ch Sp)
PL/DPL Modulation	As above 4th channel test frequency* BW to narrow	TEST MODE, Test Channel 4 TPL DPL	As above	Deviation: VHF, UHF: $\geq$ 500Hz but $\leq$ 1000Hz (25 kHz Ch Sp).

*** MDC*

* *See Table 4-4 on page 4-3.*

Notes

Chapter 5

Radio Tuning and Programming

5.1 Introduction

This chapter provides an overview of the Customer Programming Software (CPS) and Universal Tuner which have been designed for use in a Windows 95/98/NT/2000 environment. Both these software will cover all the functions of a traditional Radio Service Software (RSS) package.

They are available in separate kits as shown below:

Description	Kit Number
Conventional/LTR Radios CPS 3-Year Subscription Package	H5177

Each kit contains an Installation instruction manual.

5.2 Radio Tuning Setup

To tune the radio, you will need a Windows 95/98/NT/2000 PC (personal computer) and a Universal Tuner. To perform the tuning procedures, the radio must be connected to the PC, RIB (Radio Interface Box) and Universal Test Set as shown in Figure 5-1.

The Tuner for Version R02.03.0 or higher provides the capability for Temperature Compensation Data Programming as well as online instructional help text.

To read the Temperature Compensation Data:

1. From the Menu, select Utilities and then select Temp Comp Data Read.
2. The values read are displayed.

To program the Temperature Compensation Data:

1. From the Menu, select Utilities and then select Temp Comp Data Write.
2. Enter the values you want to be programmed.

Refer to the CPS online help for detailed tuning procedures.

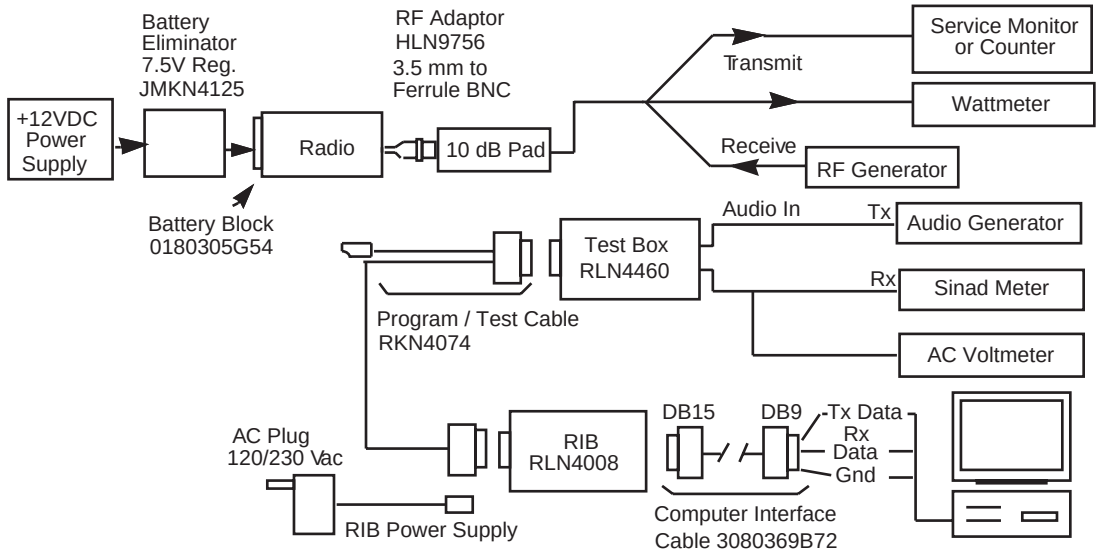

Figure 5-1 Radio Tuning Setup

5.3 CPS Programming Setup

Refer to online help files for the CPS Programming procedures.

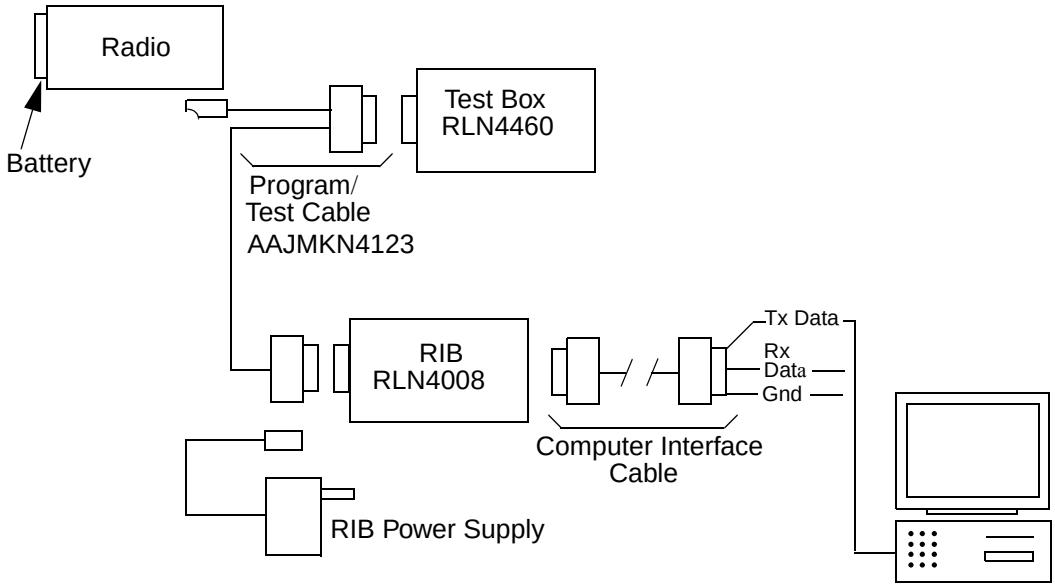

Figure 5-2 CPS Programming Setup

5.4 Cloning Information

Cloning is the process of copying the content of one radio (source radio) into another radio (target radio). Radio content refers to system-type features such as frequency, squelch type options, trunking, etc. Cloning can be performed only on radios with identical model numbers and software options.

Radio functionality inherent in one radio cannot be cloned to another radio that does not contain the same functionality. Tuning and alignment information are not transferable and are not affected by cloning.

Signaling Identification Numbers (IDs) are duplicated in the cloning process. Unique IDs may be assigned with the CPS.

Unsuccessful cloning attempts will not damage the radio.

Cloning Procedure:

1. Turn source and target radios off.
2. Connect cloning cable to side connector of both radios.
3. Turn on target radio.
4. On source radio, simultaneously press side buttons 1 and 2 (buttons above and directly below PTT); then turn radio on. Both radios will produce a “clone-entry” tone and their green LEDs will light up.
5. Release both side buttons. The electronic transfer process begins and will take approximately 1 to 3 minutes.
6. When cloning is completed, the radios will be reset and their green LEDs will turn off. The source radio produces a “clone-exit” tone.
7. Turn both radios off.
8. Disconnect the cloning cable from both radios and turn them on for normal operation.

Notes

Chapter 6

Power Up Self-Test

6.1 Error Codes

To start the radio's self-test routine, turn the radio on using the ON/OFF volume control button. The self-test routine checks the RAM, ROM checksum, EEPROM hardware and EEPROM checksum. If these checks are successfully completed, the radio will generate the Self-Test Pass Tone. If the radio fails the self-test, it will emit a low-pitch tone.

Error Code	Explanation	Corrective Action
"RAM TST ERROR"	RAM Test Failure	Retest the radio by turning it off and turning it on again. If the message reoccurs, replace the main board or send the radio to nearest Motorola Depot.
"ROM CS ERROR"	ROM Checksum is wrong.	Reprogram FLASH Memory, then retest. If the message recurs, replace the main board or send the radio to the nearest Motorola Depot.
"EEPRM HW ERROR"	Codeplug structure mismatch, non existence of codeplug.	Reprogram the codeplug with the correct version and retest the radio. If the message recurs, replace the main board or send the radio to the nearest Motorola Depot.
"EEPRM CS ERROR"	Codeplug checksum is wrong.	Reprogram the codeplug.
No Display	Display module is not connected properly. Display module is damaged.	Check the connection between the main board and the display module. Replace with a new display module.

Notes

Chapter 7

Accessories

7.1 Antennas

VHF	**136 -174 MHz, Ferrule Connector**
NAD6502_R	146-174 MHz, VHF Heliflex
PMAD4012	136 - 155 MHz, 9cm Stubby Red Code
PMAD4013	155 - 174 MHz, 9cm Stubby Black Code
PMAD4014	136 - 155 MHz, 14cm Standard Length Red Code
PMAD4015	155 - 174 MHz, 14cm Standard Length Black Code
PMAD4023	150 - 161 MHz, 14cm
PMAD4025	150 - 161 MHz, 9cm Stubby
UHF 1	**403-470 MHz, Ferrule Connector**
PMAE4002	403-433 MHz
PMAE4003	430-470 MHz, Stubby
NAE6483	403-520 MHz, Whip
UHF 2	**450-512 MHz, Ferrule Connector**
PMAE4006	470-510 MHz, 9 cm Helical
PMAE4007	490-512 MHz, 9cm
PMAE4008	470-512 MHz, Monopole Whip
NAE6483	403-512 MHz, Whip

7.2 Carry Cases for EX500 / EX600 / EX600•XLS

HLN9985	Waterproof Bag
JMZN4020	Radio Hand Strap
JMZN4023	Plastic Holster with Swivel Belt Clip
For EX500 Models Only:	
PMLN4421	Soft Leather Carry Case with Fixed Swivel Clip
PMLN4471	Hard Leather Carry Case with Swivel & D-Rings
PMLN4470	Nylon Carry Case with Belt Loop & D-Rings
For EX600/EX600•XLS Models Only:	
PMLN4521	Soft Leather Carry Case with Fixed Swivel Clip & D-Rings
PMLN4520	Hard Leather Carry Case with Fixed Swivel Clip & D-Rings

7.3 Chargers

AAHTN3000	120V Single Unit Rapid Charger, U.S. Plug w/English Manual
AAHTN3003	Multi Unit Rapid Charger, U.S. Plug w/English Manual
HTN9000	Single Unit Pocket Only
NLN7967	Wall Mount Kit for Multi-Unit Charger

7.4 Batteries

JMNN4023_R	Slim Li-Ion, 1000 mAh, 7.5V Battery
JMNN4024_R	Li-Ion, 1300 mAh, 7.5V Battery
JMNN4025	NiMH, 700 mAh, 7.5V Battery, Intrinsically Safe (FM)

7.5 Audio Accessories

PLMN4519	Earbud with Microphone and PTT Combined, Transmit & Receive, Black (2-wire)
BDN6780	Earbud with Microphone and PTT Combined, Transmit & Receive, Black (2-wire) (EX500/EX600/EX600•XLS - requires PLMN4455 adapter)
BDN6719	Flexible Ear Receiver, Black - Earpiece without Volume Control - (flexible earloop & speaker which rests external to ear) (EX500/EX600/EX600•XLS - requires PLMN4455 adapter)
BDN6781	Earbud, Receive Only, Black (single wire) (EX-500/EX600/EX600•XLS - requires PMLN4455 adapter)
NTN8370	Extreme Noise Earpiece Adapter Kit, Noise Reduction Rating = 24dB (requires PMLN4455 adapter if used with BDN6667, BDN6729, BDN6668 & BDN6730)
NTN8371	Low Noise Earpiece Adapter Kit (clear comfortable earpieces can be added for extra comfort - must be ordered separately through AAD) (requires PMLN4455 adapter for use with surveillance kits)

7.6 Microphones

JMMN4073	Remote Speaker Microphone with Swivel Clothing Clip
PMLN4393	Flexible Ear Receiver with 2.5mm Plug (for use with Remote Speaker Microphone JMMN4073) - contains a flexible earloop and speaker which rests external to the ear

7.7 Ear Microphone System

JMMN4064	Ear Microphone VOX/PTT Radio Interface Module
BDN6768	Ear Microphone, Black (for noise levels up to 95dB) - requires Interface Module

BDN6769	Ear Microphone, Beige (for noise levels up to 95dB) - requires Interface Module
BDN6770	Ear Microphone, Gray (for high noise levels up to 105dB) - requires Interface Module
0180300E83	Body Switch Push to Talk for Ear Microphone System
0180358B38	Finger Push to Talk Switch for Ear Microphone System

7.8 Manuals

6881093C98	User Guide, EX500, English/French
6881094C70	User Guide, EX600, English/French
6881095C10	User Guide, EX600•XLS, English/French
6881094C00	EX500, EX600, EX600•XLS Service Manual, Level 1 and 2, Basic, English
6881094C21	EX500, EX600, EX600•XLS Service Manual, Level 3, Detailed, English

Notes

Chapter 8

Model Chart and Test Specifications

8.1 136-174 MHz

EX500/EX600/EX600•XLS, VHF, 136-174 MHz				
Model				**Description**
AAH38KDH9DU6_N				EX600•XLS 136-174 MHz, LTR/Conv., 5W, 160 Ch.
	AAH38KDC9AA3_N			EX500 136-174 MHz 5W 16CH
		AAH38KDH9AA6_N		EX600 136-174 MHz 5W 128 CH Display/DTMF
			Item	**Description**
	X		PMUD1673	EX500 Super Tanapa 136-174 MHz 5W 16CH
		X	PMUD1674	EX600 Super Tanapa 136-174 MHz 5W 128CH
X			PMUD1770	EX600•XLS Super Tanapa 136-174 MHz 5W 160CH
	X		JMHD4005	EX500 B/C Kit 136-174 MHz 5W 16CH
		X	PMHD4006	EX600 B/C Kit 136-174 MHz 5W 128CH
X			PMHD4015	EX600•XLS B/C Kit 136-174 MHz 5W 160CH
	X		PMHD4000	EX500 Front Housing Kit 16CH
		X	PMHD4001	EX600 Front Housing Kit 128CH Display/DTMF
X			PMHD4013	EX600•XLS Front Housing Kit 160CH Display/DTMF
X	X	X	PMAD4012	Antenna, 136-155 MHz Stubby
X	X	X	PMAD4013	Antenna,155-174 MHz Stubby
X	X	X	PMAD4014	Antenna, 136-155 MHz 14 cm
X	X	X	PMAD4015	Antenna, 155-174 MHz 14 cm
X	X	X	PMAD4023	Antenna, 150-161 MHz 14 cm
X	X	X	PMAD4025	Antenna, 150-161 MHz Stubby
	X		6881093C98	EX500 User Guide (English/French)
		X	6881094C70	EX600 User Guide (English/French)
X			6881095C10	EX600•XLS User Guide (English/French)

x = Indicates one of each is required.

NOTE: *If ordering a back cover kit or front housing kit, please refer to section 5.2.*

8.2 403-470 MHz

EX500/EX600/EX600•XLS, UHF Band 1, 403-470 MHz				
Model				**Description**
AAH38RDH9DU6_N				EX600•XLS 403-470 MHz LTR/Conv. 4W 160CH
	AAH38RDC9AA3_N			EX500 403-470 MHz 4W 16 CH
		AAH38RDH9AA6_N		EX600 403-470 MHz 4W 128CH Display/DTMF
			Item	**Description**
	X		PMUE1699	EX500 Super Tanapa 403-470 MHz 4W 16CH
		X	PMUE1700	EX600 Super Tanapa 403-470 MHz 4W 128CH
X			PMUE1876	EX600•XLS Super Tanapa 403-470 MHz 4W 160CH
	X		JMHE4001	EX500 B/C Kit 403-470 MHz 4W 16CH
		X	PMHE4010	EX600 B/C Kit 403-470 MHz 4W 128CH
X			PMHD4016	EX600•XLS B/C Kit 403-470 MHz 4W 160CH
	X		PMHE4000	EX500 Front Housing Kit 16CH
		X	PMHE4001	EX600 Front Housing Kit 128CH Display/DTMF
X			PMHE4018	EX600•XLS Front Housing Kit, 160CH Display/DTMF
X	X	X	NAE6483	Monopole (Whip) antenna (403-470 MHz)
X	X	X	PMAE4002	UHF 9 cm antenna (403-433 MHz) Stubby
X	X	X	PMAE4003	UHF 9 cm antenna (430-470 MHz)
	X		6881093C98	EX500 User Guide (English/French)
		X	6881094C70	EX600 User Guide (English/French)
X			6881095C10	EX600•XLS User Guide (English/French)

x = Indicates one of each is required.

NOTE: *If ordering a back cover kit or front housing kit, please refer to section 5.2.*

8.3 450-512 MHz

EX500/EX600/EX600•XLS, UHF Band 2, 450-512 MHz				
Model				**Description**
AAH38SDH9D46_N				EX600•XLS 450-512 MHz LTR/Conv. 4W 160CH
	AAH38SDC9AA3_N			EX500 450-512 MHz 4W 16 CH
		AAH38SDH9AA6_N		EX600 450-512 MHz 4W 128CH Display/DTMF
			Item	**Description**
	X		PMUE1701	EX500 Super Tanapa 450-512 MHz 4W 16CH
		X	PMUE1702	EX600 Super Tanapa 450-512 MHz 4W 128CH
	X		PMHE4004	EX500 B/C Kit 450-512 MHz 4W 16CH
		X	PMHE4011	EX600 B/C Kit 450-512 MHz 4W 128CH
	X		PMHE4002	EX500 Front Housing Kit 16CH
		X	PMHE4003	EX600 Front Housing Kit 128CH Display/DTMF
	X	X	NAE6483	Monopole (Whip) antenna (403-470 MHz)
	X	X	PMAE4008	Monopole (Whip) antenna (470-512 MHz)
	X	X	PMAE4006	UHF 9 cm antenna (465-495 MHz)
	X	X	PMAE4007	UHF 9 cm antenna (490-512 MHz)
	X		6881093C98	EX500 User Guide (English/French)
		X	6881094C70	EX600 User Guide (English/French)
X			6881095C10	EX600•XLS User Guide (English/French)
X			PMUE1877	EX600•XLS Super Tanapa 450-512 MHz 4W 160CH
X			PMHD4017	EX600•XLS B/C Kit 450-512 MHz 4W 160CH
X			PMHE4019	EX600•XLS Front Housing Kit 160CH Display/DTMF

x = Indicates one of each is required.

NOTE: *If ordering a back cover kit or front housing kit, please refer to section 5.2.*

8.4 Specifications

General			
	VHF	**UHF 1**	**UHF 2**
Frequency:	136-174 MHz	403-470 MHz	450-512 MHz
Channel Capacity:	EX500: 16 Channels/EX600: 128 Channels		
Power Supply:	7.5 Volts ±20%		
Dimensions Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery:	101.5mm x 55.5mm x 30.5mm 101.5mm x 55.5mm x 35.5mm		
Weight: Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery:	250 g 270 g		
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery:	Low Power >10 hrs >14 hrs	High Power >7 hrs >10 hrs	
Sealing:	Passes rain testing per IPX4		
Shock:	Meets MIL-STD-810-C,D & E and TIA/EIA 603		
Vibration:	Meets MIL-STD-810-C,D & E and TIA/EIA 603		
Dust:	Meets MIL-STD-810-C,D & E and IPX4		
Humidity:	Meets MIL-STD-810-C,D & E and TIA/EIA 603		

All specifications are subject to change without notice.

Transmitter			
	VHF	**UHF 1**	**UHF 2**
RF Output Li Ion @ 7.5V:	Low 1W High 5W	Low 1W High 4W	
Frequency	136-174 MHz	403-470 MHz	450-512 MHz
Channel Spacing	12.5/20/25 kHz		
Freq. Stability (-30°C to +60°C)	0.00025%		
Spurs/Harmonics:	-36 dBm < 1GHz -30 dBm > 1 GHz		
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	+1, -3 dB		
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%		
FM Noise:	-40 dB		

All specifications are subject to change without notice.

Receiver						
	VHF		UHF 1		UHF 2	
	12.5 kHz	20/25 kHz	12.5 kHz	20/25 kHz	12.5 kHz	20/25 kHz
Frequency	136-174 MHz		403-470 MHz		450-512 MHz	
Sensitivity 12dB EIA SINAD:	0.35 μV					
Adjacent Channel Selectivity ETS	-60 dB	-70 dB	-60 dB	-70 dB	-60 dB	-70 dB
Intermodulation ETS	-65 dB					
Freq. Stability (-30°C to +60°C):	0.00025%					
Spur Rejection:	-70 dB					
Image Rejection:	-70 dB					
Audio Output @ <5% Distortion	500 mW					

All specifications are subject to change without notice.

Notes

Glossary of Terms

Term	Definition
ALC	Automatic Level Control: a circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR (Voltage Standing Wave Ratio).
ASFIC	Audio Signaling Filter Integrated Circuit
CD	Compact Disk
CMP	Compression
CPS	Customer Programming Software
CSQ	Carrier Squelch
DTMF	Dual-Tone Multi-Frequency
DPL	Digital Private-Line™
EEPROM	Electronically Erasable/Programmable Read-Only Memory: used by the radio to store its personality
Firmware	Software, or a software/hardware combination of computer programs and data, with a fixed logic configuration stores in a read-only memory. Information cannot be altered or reprogrammed.
FGU	Frequency Generation Unit.
GaAs	Gallium Arsenide: a type of crystalline material used in some semiconductors.
ISW	Inbound Signalling Word: data transmitted on the control channel from a subscriber unit to the central control unit.
LCD	Liquid Crystal Display: a module used to display the radio's current operating channel or system and scan status.
LH DATA	Longhorn Data: a bidirectional 0-5V, RS-232 line that uses the Microcontroller's integrated RS-232 asynchronous serial communications interface (SCI) peripheral.
LLE	Low Level Expander: slight amount of volume expansion; used to improve the signal to noise ratio.
LSH	Low-Speed Handshake: 150 baud digital data sent to the radio during trunked operation while receiving audio.
MDC	Motorola Digital Communication
MRTI	Motorola Radio-Telephone Interconnect: a system that provides a repeater connection to the Public Switched Telephone Network (PSTN). The MRTI allows the radio to access the telephone network when the proper access code is received.
MSK	Minimum-Shift Keying
OMPAC	Over-Molded Pad-Array Carrier: a Motorola custom package, distinguished by the presence of solder balls on the bottom pads.
OSW	Outbound Signaling Word: data transmitted on the control channel from the central controller to the subscriber unit.
PC Board	Printed Circuit Board

Term	Definition
PL	Private-Line® tone squelch: a continuous sub-audible tone that is transmitted along with the carrier.
PLL	Phase-Locked Loop: a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PTT	Push-To-Talk: the switch located on the left side of the radio which, when pressed, causes the radio to transmit.
RAM	Random Access Memory: the radio's RAM is loaded with a copy of the EEPROM data.
Registers	Short-term data-storage circuits within the Microcontroller.
Repeater	Remote transmit/receive facility that retransmits received signals to improve communications coverage.
RESET	Reset line: an input to the Microcontroller that restarts execution.
RF PA	Radio Frequency Power Amplifier
RIB	Radio Interface Box
ROM	Read Only Memory
RSSI	Received Signal-Strength Indicator: a DC voltage proportional to the received RF signal strength.
RPT/TA	Repeater/Talk-Around
Softpot	Software Potentiometer: a computer-adjustable electronic attenuator
Software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
SPI (clock and data lines)	Serial Peripheral Interface: how the Microcontroller communicates to modules and ICs through the CLOCK and DATA lines.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value.
Standby Mode	An operating mode in which the radio is muted but continues to receive data
System Central Controller	Main control unit of the trunked dispatch system; handles ISW and OSW messages to and from subscriber units (see ISW and OSW).
System Select	The act of selecting the desired operating system with the system-select switch. (Also, the name given to this switch.)
TOT	Time-Out Timer: a timer that limits the length of a transmission.
TPL	Tone Private-Line
µC	Microcontroller
UHF	Ultra High Frequency
µP	Microprocessor
VCO	Voltage-Controlled Oscillator: an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.
VCOBIC	Voltage-Controlled Oscillator Buffer Integrated Circuit
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

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