

CDM™ Series

Professional Series
Two-Way Mobile Radios

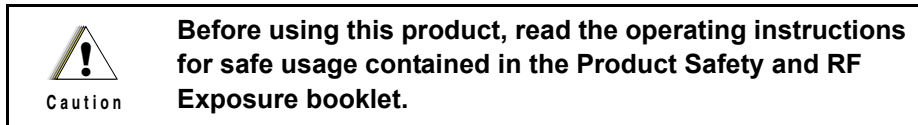
Basic Service Manual



Foreword

This manual provides sufficient information to enable qualified service technicians to troubleshoot and repair CDM Series mobile radios to the component level.

Product Safety and RF Exposure Compliance



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 (Motorola Publication part number 6881095C99) 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>.

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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.

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 Customer Care and Services Division (CCSD) 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 the Customer Care and Services Division.*
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.

*The Customer Care and Services Division (CCSD) was formerly known as the Accessories and Aftermarket Division (AAD).

Motorola Online:

Motorola Online users can access our online catalog at

<https://www.motorola.com/businessonline>

To register for online access, please call 800-422-4210 (for U.S. and Canada Service Centers only).

International customers can obtain assistance at <https://www.motorola.com/businessonline>

Mail Orders:

Mail orders are only accepted by the US Federal Government Markets Division (USFGMD).

Motorola

7031 Columbia Gateway Drive

3rd Floor - Order Processing

Columbia, MD 21046

U.S.A.

Telephone Orders

The Radio Products and Solutions Organization*

(United States and Canada)

7:00 AM to 7:00 PM (Central Standard Time)

Monday through Friday (Chicago, U.S.A.)

1-800-422-4210

1-847-538-8023 (United States and Canada)

U.S. Federal Government Markets Division (USFGMD)

1-800-826-1913 Federal Government Parts - Credit Cards Only

8:30 AM to 5:00 PM (Eastern Standard Time)

Fax Orders

Customer Care and Services Division*
1-800-622-6210
847-576-3023 (International)
USFGMD
(Federal Government Orders)
1-800-526-8641 (For Parts and Equipment Purchase Orders)

Parts Identification

Customer Care and Services Division*
(United States and Canada)
1-800-422-4210, menu 3

Product Customer Service

Customer Response Center*
(Non-technical Issues)
1-800-247-2346
FAX:1-800-247-2347

***The Customer Care and Services Division (CCSD) was formerly known as the Accessories and Aftermarket Division (AAD).**

1.2.4 Technical Support

Technical support is available to assist the dealer/distributor in resolving any malfunction which may be encountered. For service, contact the Service Depot in your area. If your area does not have a depot, please contact your Business Development Manager, Distributor, or contact Motorola Technical Support. 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 Service Center

1220 Don Haskins Drive
Suite A
El Paso, TX 79936
Tel: 915-872-8200

Motorola Canadian Technical Logistics Center

Motorola Canada Ltd.
8133 Warden Avenue
Markham, Ontario, L6G 1B3
Tel: 1-800-543-3222
Fax: 1-888-331-9872 or 1-905-948-5970

Motorola Federal Technical Center

10105 Senate Drive
Lanham, MD 20706
Tel: 1-800-969-6680
Fax: 1-800-784-4133

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 mobile model number and its specific characteristics.

Example: AAM25RHC9AA1AN

Table 1-1: Radio Model Number

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level	Model Revision	Model Package	
AA = Motorola Internal Use ↑	M = Mobile ↑	25	K VHF (136-174MHz)	H 1-25W	A No Display, No Keypad	9 Programmable	AA Conventional	1 4 Chan.	A	N	
			R UHF1 (403-470MHz)	K 25-40W	C No Display Basic Key- pad			DU LTR			2 64 Chan.
			S UHF2 (450-512MHz)		D 1-Line Display, Limited Keypad			DP PassPort			5 128 Chan.
			B Low Band, R1 (29.7-36.0MHz)		F 1-Line Display, Standard Keypad						6 160 Chan. LTR/ Passport w/MDC on Conv.
			C Low Band, R2 (36.0-42.0MHz)								8 160 Chan.
			D Low Band, R3 (42.0-50.0MHz)								

Chapter 2

Maintenance

2.1 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
- Installation of optional retrofit kit
- Installation of option boards

2.2 Preventive Maintenance

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

2.2.1 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.

2.2.2 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 (100% by volume).

**Caution**

Use all chemicals as prescribed by the manufacturer. Be sure to follow all safety precautions as defined on the label or material safety data sheet.

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 Surface

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 (100%) 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 housing or back housing..

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

2.3 Safe Handling of CMOS and LDMOS Devices

Complementary metal-oxide semiconductor (CMOS) and Laterally Diffused Metal Oxide Semiconductor (LDMOS) 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/LDMOS circuits and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the CMOS CAUTION paragraph in the Disassembly and Reassembly section of the manual.



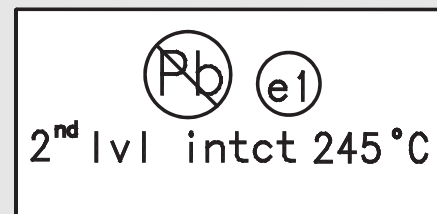
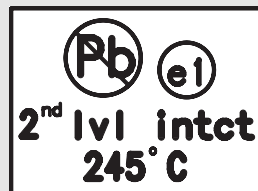
Caution

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/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS 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/LDMOS 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 4280385A59).
- Do not wear nylon clothing while handling CMOS/LDMOS devices.
- Do not insert or remove CMOS/LDMOS devices with power applied. Check all power supplies used for testing CMOS/LDMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS/LDMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS/LDMOS 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.

2.4 Repair Procedures and Techniques — General

NOTE Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards — examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union’s **Restriction of Hazardous Substances (ROHS) Directive 2002/95/EC** and **Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC**. To maintain product compliance and reliability, use only the Motorola specified parts in this manual.



Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and lead-free solder paste as stated in the following table:

Table 2-1. Lead Free Solder Wire Part Number List

Motorola Part Number	Alloy	Flux Type	Flux Content by Weight	Melting Point	Supplier Part number	Diameter	Weight
1088929Y01	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7-3.2%	217C	52171	0.015"	1lb spool

Table 2-2. Lead Free Solder Paste Part Number List

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
1085674C03	NC-SMQ230	900-1000KCPs Brookfield (5rpm)	Type 3 (-325/+500)	(95.5%Sn-3.8%Ag-0.7%Cu) 89.3%	217°C

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 parts from the nearest Motorola Communications parts center listed in Chapter 1, Introduction.

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 a connector:

- 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.

For soldering components with Hot-Air or infra red solder systems, please check your user guide of the solder system to get information on solder temperature and time for the different housings of the integrated circuits and other components

2.5 Disassembling and Reassembling the Radio — General

Since these radios may be disassembled and reassembled with the use of only six (board to casting) screws (nine for LowBand), 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:

- Small flat blade screwdriver
- TORX™ T20 screwdriver
- Dismantling Tool

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

The following disassembly procedures should be performed only if necessary.

2.6 Radio Disassembly — Detailed

The procedure to remove and replace a control head is similar for all models of radio. A typical procedure is therefore shown followed by specific disassembly procedures for the different control heads.

2.6.1 Control Head Removal

1. Insert the dismantling tool in the groove between the control head and the radio assembly as shown in Figure 2-1, on page 2-21.
2. Press on the dismantling tool until the snap connectors on the side of the control head release from the radio assembly.

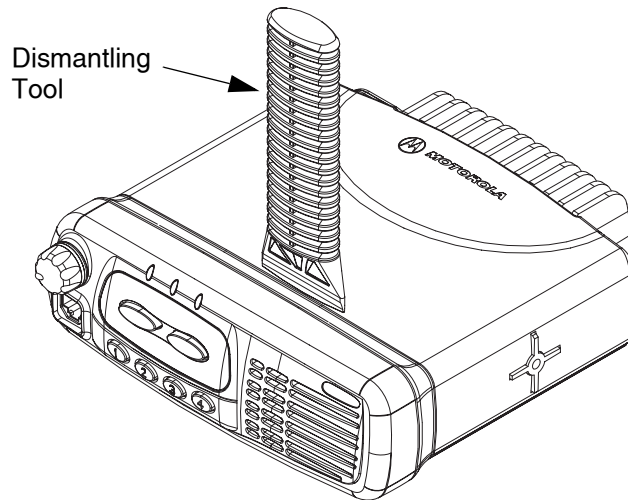


Figure 2-3: Typical Control Head Removal

3. Pull the control head away from the radio assembly as shown in Figure 2-4.

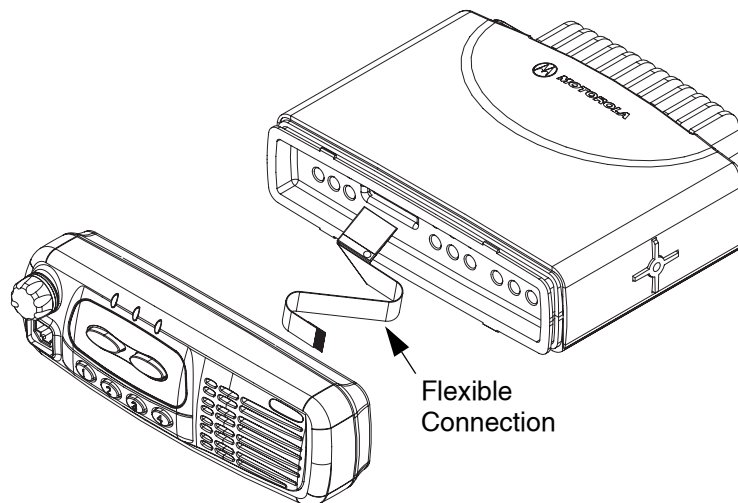


Figure 2-4: Flexible Connection Removal

4. Remove the flexible connection from the socket on the control head board.

2.6.2 Top Cover Removal

1. Insert the dismantling tool in the middle of the radio assembly side groove as shown in Figure 2-5.
2. Press on the dismantling tool until the snap connectors on the side of the cover release from the radio chassis.

3. Lift the top cover from the chassis.

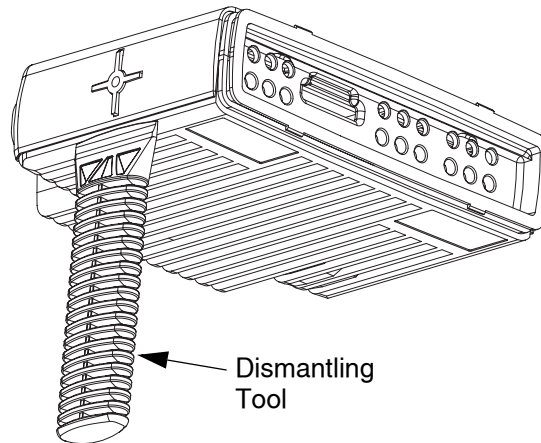


Figure 2-5: Top Cover Removal

2.6.3 Transceiver Board Removal

1. Remove six screws (nine for LowBand) from the diecast cover using the T20 TORX™ driver as shown in Figure 2-6.
2. Lift the cover from the chassis.

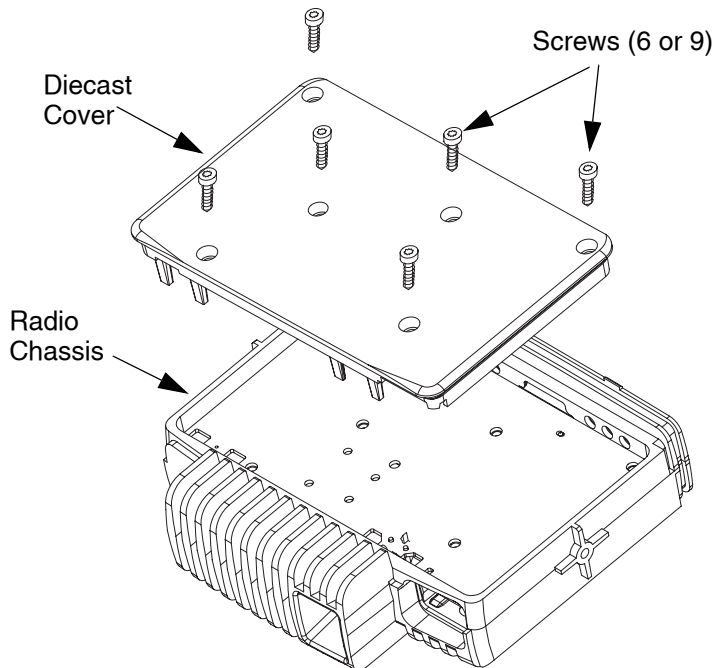


Figure 2-6: Diecast Cover Removal

3. Slowly lift the transceiver board on the edge at the front of the radio (the edge that mates with the control head) and pull gently toward the front of the radio as shown in Figure 2-7. Take care to slide the antenna connector and power connector out of the chassis towards the front.

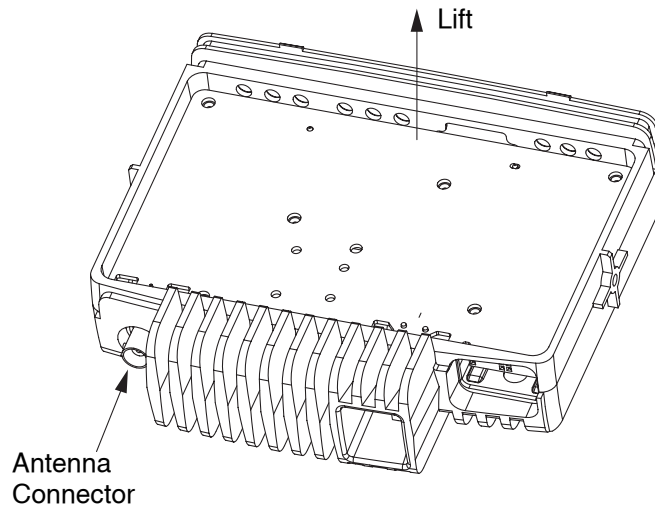


Figure 2-7: Transceiver Board Removal

2.6.3.1 LowBand Transceiver Board Removal

1. Remove the Control Head and Top Cover as directed in Sections 2.6.1 and 2.6.2 of this Manual.
2. Using the T20 TORX™ driver, remove the nine screws holding the die cast cover to the radio chassis.
3. Remove the 20-pin accessory connector from the rear of the radio by pulling on it away from the radio chassis with one hand while holding the radio chassis with the other.
4. Remove the plastic protective cover over the opening at the front of the radio chassis that allows access to the 18-pin flex connector.
5. With the chassis sitting on the tabletop, insert one side of the dismantling tool, 6686119B01, into the bottom of the opening at the front of the radio chassis. With the tool inserted between the bottom of the 18-pin flex connector and the radio chassis, use it to gently pry the transceiver board up from the radio chassis. The transceiver board may stick to the radio chassis as a result of the thermal material that is used between the heat dissipating devices and the radio chassis. Continue applying an up and down force to the transceiver board until the various components become unstuck, and the transceiver board becomes loose enough to remove from the radio chassis.

Note: If removing the transceiver board from the radio chassis causes the traces of the board to lift up away from the board, most noticeably around the final devices (Q1402, Q1403), the transceiver board must be scrapped and a new replacement transceiver board is required.

6. Once the transceiver board is removed from the radio chassis, handle it per the procedure for “Safe Handling of CMOS and LDMOS Devices”, Section 2.3. In addition, take care not to disturb the thermal pad material that may adhere to the devices that mate with the thermal pads located on the radio chassis. Do not disturb the thermal pad on the radio chassis as well. Also, do not disrupt the conductive bead gasket that is applied to the radio chassis walls.

2.6.3.2. Removing and Replacing Defective LDMOS Devices (Q1402 and Q1403)

1. Note that if one of the two Final stage devices (Q1402 or Q1403) is defective (i.e., TP1402 or TP1403 resistance to ground is less than 25 kOhms), replace both devices, since the other

device may have been over-stressed as well. Handle the transceiver board per the procedure for “Safe Handling of CMOS and LDMOS Devices”, Section 2.3.

2. If removing the transceiver board, the thermal pad material under the two Final stage devices (Q1402 and Q1403) on the radio chassis has been pulled up such that the radio chassis is exposed through the thermal pad, then the defective thermal pads must be removed and replaced. This is only true for the case when the Final stage devices are being replaced. To remove the thermal pads, use a plastic scraper to prevent scratching of the radio chassis. Use a 0.5% detergent-water solution to remove any residue left on the radio chassis.
3. Remove the defective Final stage LDMOS devices from the transceiver board with a heat gun. Care should be taken not to cause displacement of any other parts.
4. Clean any excess solder from the device pads so that new devices can sit flush with the board.
5. Hand solder on a replacement LDMOS device, with a suitable size soldering iron, by applying solder to one lead and pad. Press the replacement LDMOS device with a dismantling tool from the top and reheat the lead and pad to cause the solder to reflow. Applying slight pressure on the device with the dismantling tool will avoid gaps between the lead and the board. Continue this approach and solder the remaining leads on one side of the LDMOS device. Once one side of the device leads are soldered continue with the other side while pressing the LDMOS device to the board with the dismantling tool. Finish soldering all leads taking care not to cause any shorts to nearby components or shorts across the device leads.

Note: DO NOT use a heat gun to solder a replacement LDMOS device to the board. This may cause damage to the LDMOS device.

6. This step is necessary only if Step (2) from above was required, that is, if the thermal pad was required to be scraped off the radio chassis. If so, replace the thermal pad(s) from a 0.9 inch wide roll of Bergquist “Soffface” replacement material, 3280384M34. Cut the material to a 0.25 inch length.

Note: Exceeding the 0.25 inch length may result in an electrical short of any component that comes in contact with the thermal pad.

Remove the clear plastic backing from the replacement pad and stick the side from which the backing was removed to the bottom side of the Final device(s) requiring a new pad. Press the pad firmly to the bottom of the device making sure that it properly adheres to the device.

7. Reassemble the radio per Section 2.7.3.1, LowBand Radio Chassis and Transceiver Board Assembly.
8. Using the radio’s Customer Programming Software (CPS), reset the Bias Voltage for each of the Final devices and retune the radio’s power output.

2.6.4 CDM750 Control Head Disassembly

1. To dismount the control head housing from the back housing, insert the dismantling tool in the groove between the two housings as shown in Figure 2-8.

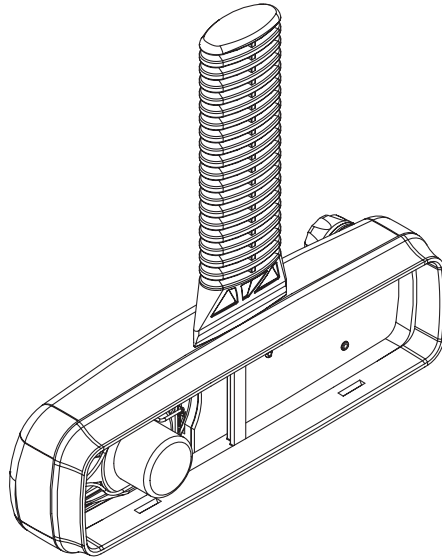


Figure 2-8: Control Head Back Housing Removal

2. Press the dismantling tool until the snap connectors on the side of the back housing release from the control head.
3. Disconnect the speaker socket.

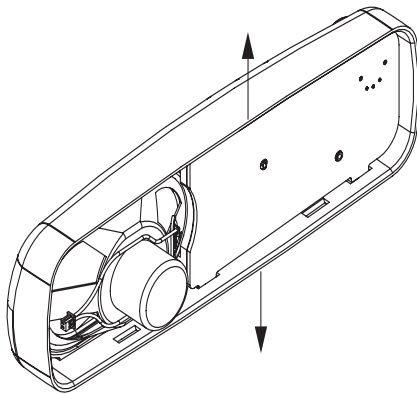


Figure 2-9: Control Head Board Knob Removal

4. Remove the board from the control head housing by stretching the control head housing and pulling up on the board as shown in Figure 2-9 and Figure 2-10.
5. Remove the keypad from the control head housing by lifting up the rubber keypad.

Note: **DO NOT touch or contaminate the conductive pads on the under side of the keypad or the conductive contacts on the printed circuit board.**

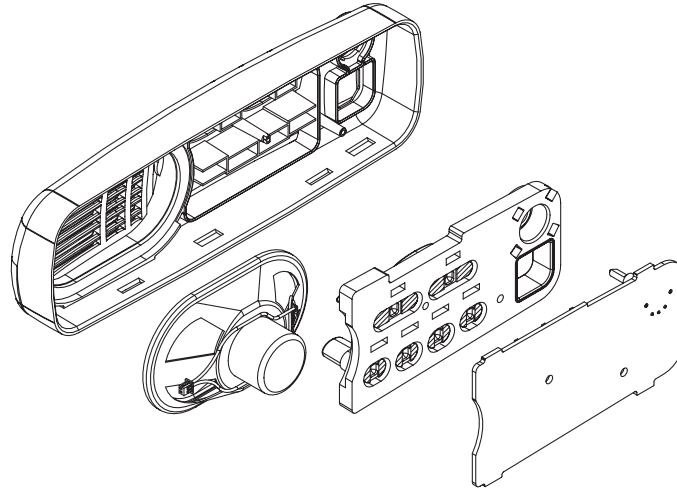


Figure 2-10: Board, Keypad and Speaker Removal

6. Remove the speaker from the control head housing.

2.6.5 CDM1250, CDM1550, CDM1550•LS, and CDM1550•LS⁺ Control Head Disassembly

1. Dismount the control head housing from the back housing as described for control head CDM750, Figure 2-8.
2. Disconnect the speaker socket and remove the speaker (Figure 2-11) with tube by stretching the control head housing and pulling out the tube.

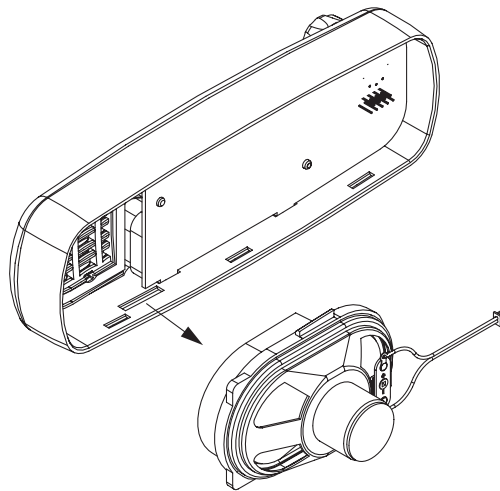


Figure 2-11: Speaker and Speaker Tube Removal

3. Remove the board from the control head housing by stretching the control head housing and pulling up on the board as described for control head CDM750, Figure 2-10.
4. Remove the keypad from the control head housing by lifting up the rubber keypad.

5. Remove the display from the control head housing.

Note: DO NOT touch or contaminate the conductive pads on the under side of the keypad or the conductive contacts on the printed circuit board.

2.7 Radio Assembly

2.7.1 CDM750 Control Head

1. Locate the speaker in the control head and press it into place as shown in Figure 2-10.
2. Insert the keypad into the control head ensuring that the keypad keys and connector cut-out fit correctly.

Note: DO NOT touch or contaminate the conductive pads on the underside of the keypad.

3. On the board, rotate the on/off control spindle fully counter-clockwise.
4. Rotate the volume knob on the housing fully counter-clockwise
5. Align the board with the control head and insert the on/off control spindle through the hole in the keypad.
6. Locate the two snap tags on the board in the grooves in the control head and press the board into place until all of the tags snap into place.
7. Connect the speaker connector to the connector on the board.

2.7.2 CDM1250, CDM1550, CDM1550•LS, and CDM1550•LS⁺ Control Heads

1. Locate the display in the control head ensuring that the two cut-outs in the display are aligned with their corresponding indentations, then press the display into place.

Note: DO NOT touch or contaminate the conductive pads on the underside of the display.

2. Fit the rubber keypad onto the board ensuring that the on/off control and accessory connector on the board locate correctly with the cut-outs in the keypad.
3. On the board, rotate the on/off control spindle fully counter-clockwise.
4. Rotate the volume knob on the front housing counter-clockwise.
5. Align the board (with the rubber keypad attached) with the control head, inserting the on/off control spindle and accessory connector through the holes in the control head.
6. Ensure that the keypad, on/off control spindle and microphone connector are aligned with the control head then press the board into place until it clicks.
7. Insert the speaker and speaker tube with speaker into the control head and press it in until it clicks.
8. Connect the speaker connector to the board.

2.7.3 Radio Chassis and Transceiver Board

1. Inspect the transceiver board and if required reapply thermal grease to the heatsink area on the chassis and heat dissipating devices. You may have to scrap existing thermal pad from the chassis prior to applying the grease.
2. Insert the transceiver board at an angle (approximately 30°) into the chassis taking care to slide the antenna connector and accessory connector into their cut-outs in the chassis.
3. Lower the transceiver board onto the chassis and align the two locating holes in the board with the locating pins in the chassis.
4. Secure the cover to the chassis with the six screws previously removed.

5. Torque the six screws to 17 in lbs. (1.9 NM) using the T20 TORX™ driver. Begin with the two screws located in the middle of the chassis followed by the four outer screws. Since the screws usually take a set, torque the screws a second time (1.9 NM) in the same order.
6. Refit the top cover over the assembled radio chassis. Press the cover down until it snaps into place.

2.7.3.1 LowBand Radio Chassis and Transceiver Board Assembly

1. Inspect the transceiver board. If the LDMOS final devices (Q1402 and Q1403) were replaced, see Section 2.6.3.2 as how to replace the thermal pad if necessary.

Note: Thermal grease used with the chassis eliminator, 8180384J61, must be completely removed from all devices. DO NOT USE THERMAL GREASE on the radio chassis. This may cause instability of the transmitter under certain load conditions.

2. Insert the transceiver board at an angle (approximately 30°) into the radio chassis taking care to slide the antenna connector and accessory connector into their cut-outs in the radio chassis.
3. Lower the transceiver board onto the radio chassis and align the two locating holes in the transceiver board with the locating pins in the radio chassis.
4. Replace the 20-pin accessory connector. Make sure the connector is fully engaged in its opening before replacing the die cast cover.
5. Replace the die cast cover over the radio chassis making sure the black carbon on the bottom of the pressure pad is positioned properly over the switch printed on the transceiver board.

Note: The B02 version of the die cast cover will have locating pins to hold the pressure pad in place on the die cast cover. This will automatically align the pressure pad on the switch.

6. Secure the die cast cover to the radio chassis with the nine screws previously removed.
7. Torque the nine screws to 17 in lbs (1.9 NM) using the T20 TORX™ driver. Tighten the die cast cover screws in the sequence labeled on the top of the cover or as shown in Figure 2-12. Since the screws take a set it is importance to torque the screws a second time (17 in lbs) in the same order.
8. Insert the plastic protective cover into the 18-pin connector located at the front of the radio chassis.
9. Refit the top cover over the assembled radio chassis. Press the cover down until it snaps into place.
10. Replace the Control Head per Section 2.7.4.

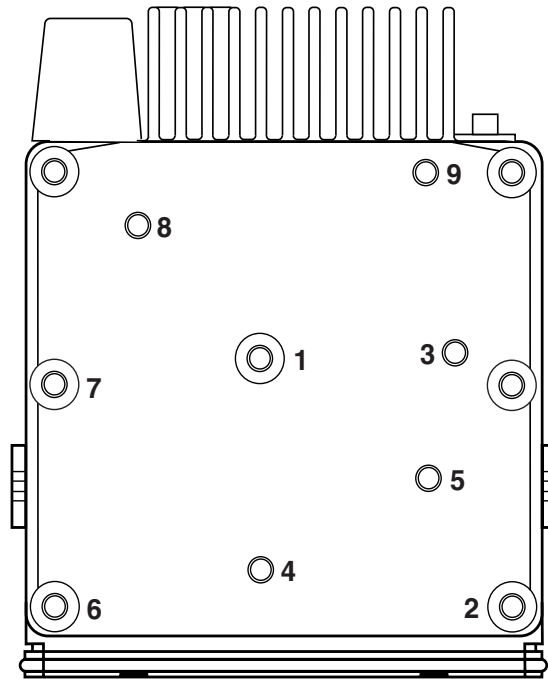


Figure 2-12: Top view of the LowBand radio chassis and die cast cover showing the screw sequence

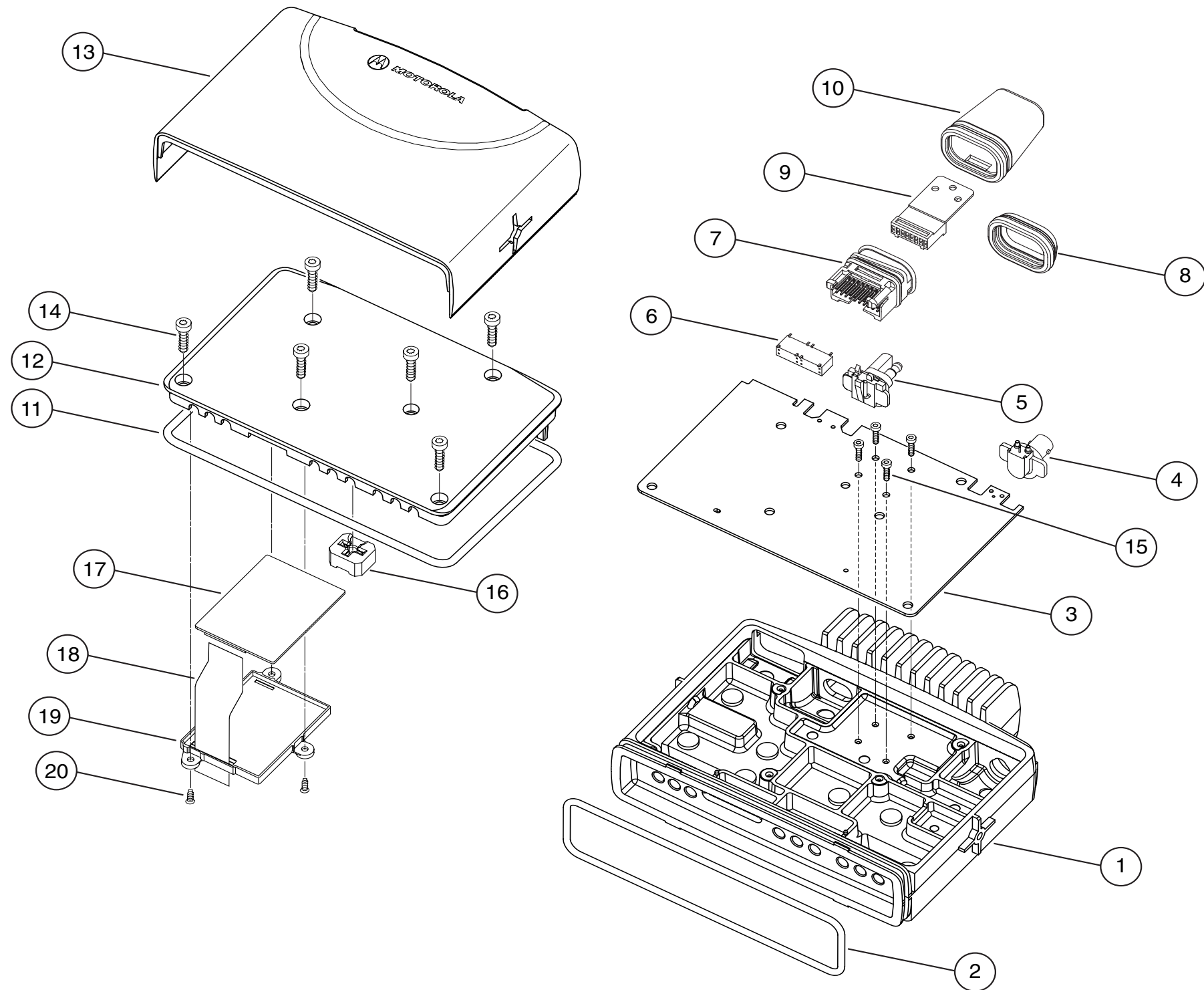
2.7.4 Control Head Fitting

1. Align the "0" mark on the flex with the "0" mark on the chassis to the socket on the radio assembly as shown in Figure 2-4.
2. Check that the back housing o-ring seal is undamaged and fitted in the groove. Replace the seal if it is damaged (for more information, please see the exploded view diagrams and parts list beginning in section "2.9 CDM750 Radio Control Head Exploded Mechanical View and Parts List" on page 16 of this chapter).
3. Fit the back housing to the control head. Ensure that the tags on the back housing align with the snap catch grooves on the control head. Press the back housing into place until it snaps into place.
4. Check that the radio chassis o-ring seal is undamaged and fitted in the groove on the chassis assembly. Replace the seal if it is damaged.

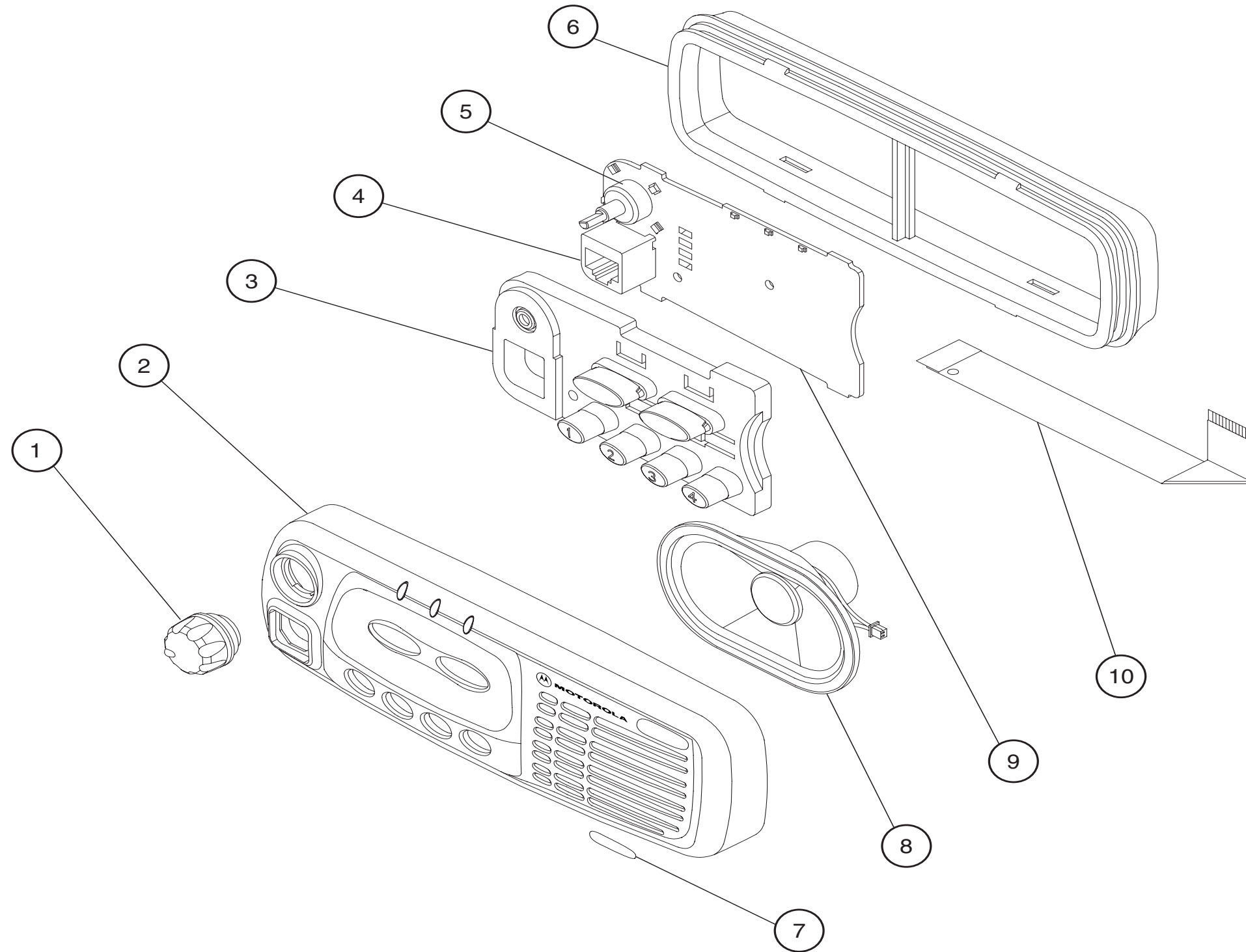
Notes

2.8 Radio Assembly Exploded Mechanical View and Parts List

Item	Motorola Part Number	Description
1	2786082B02	Chassis 25W
	2786168B01	Chassis 45W
	2786149B01	Chassis 60W
2	3202620Y01	Gasket, Controlhead
3		Main PCB (items 4, 5, and 8 included)
4		Antenna Connector with Gasket BNC
	0986166B01	Mini UHF
	0986165B01	Power Connector with Gasket
5	0986105B01	Connector, 20-Pin
6	2886122B02	Connector Assembly
7	3202607Y01	Gasket, Cover
8	1580922V01 (optional)	Connector, Housing
	3202606Y01 (optional)	Gasket, Accessory Connector
	3286085B01 (part of item 12, 25W)	Gasket, Cover 25W
9	3286095B01 (part of item 12, 45W)	Gasket, Cover 45W
	3286152B01 (part of item 12, 60W)	Gasket, Cover 60W
	12	1586084B01
13	1586169B01	Cover, 45W
	1586150B01	Cover, 60W
	13	1586083B01
14	1586170B01	Cover, Plastic 45W
	1586151B01	Cover, Plastic 60W
	14	0310911A30 (M4)
15	0310911A30	Screw T20, 9x (60W)
	0310911A12	Screw, M3, 4x (45W)
16	7586187B01	Silicon Pressure Pad for LDMOS Power Devices (25W)
	7585918Z01 (part of item 12, 60W)	Silicon Pressure Pad for LDMOS Power Devices (60W)
17	0104016J92	PassPort Board
18	8480475Z03	Flex Controller - Keypad
19	0786183B01	Frame Option Board
20	0310943R55	Screw TT3x10 - 5x8



2.9 CDM750 Radio Control Head Exploded Mechanical View and Parts List



Item	Motorola Part Number	Description
1	3686098B02	Knob, Volume
2	1586086B01	Housing, Front
3	7586089B01 [‡]	Keypad
4	2864287B01	10-Pin Microphone Jack
5	1805911V02	Potentiometer
6	1586092B02 [†]	Back housing
	3286094B01	Back housing O-ring
7	HLN9888A	Label
8	5086126B01	Speaker
9	GLN7350B	PCB
10	8486127B01	Flex 12-Position Connector

[‡] Please refer to section 6.1.11 on page 6-4 in Chapter 6, Accessories for a complete list of part numbers for Keypad Buttons.

[†] When using Back housing (1586092B02) for Control Head GCN6112A with PCB - GLN7350A (8486146B06), the grounding clips must be removed.

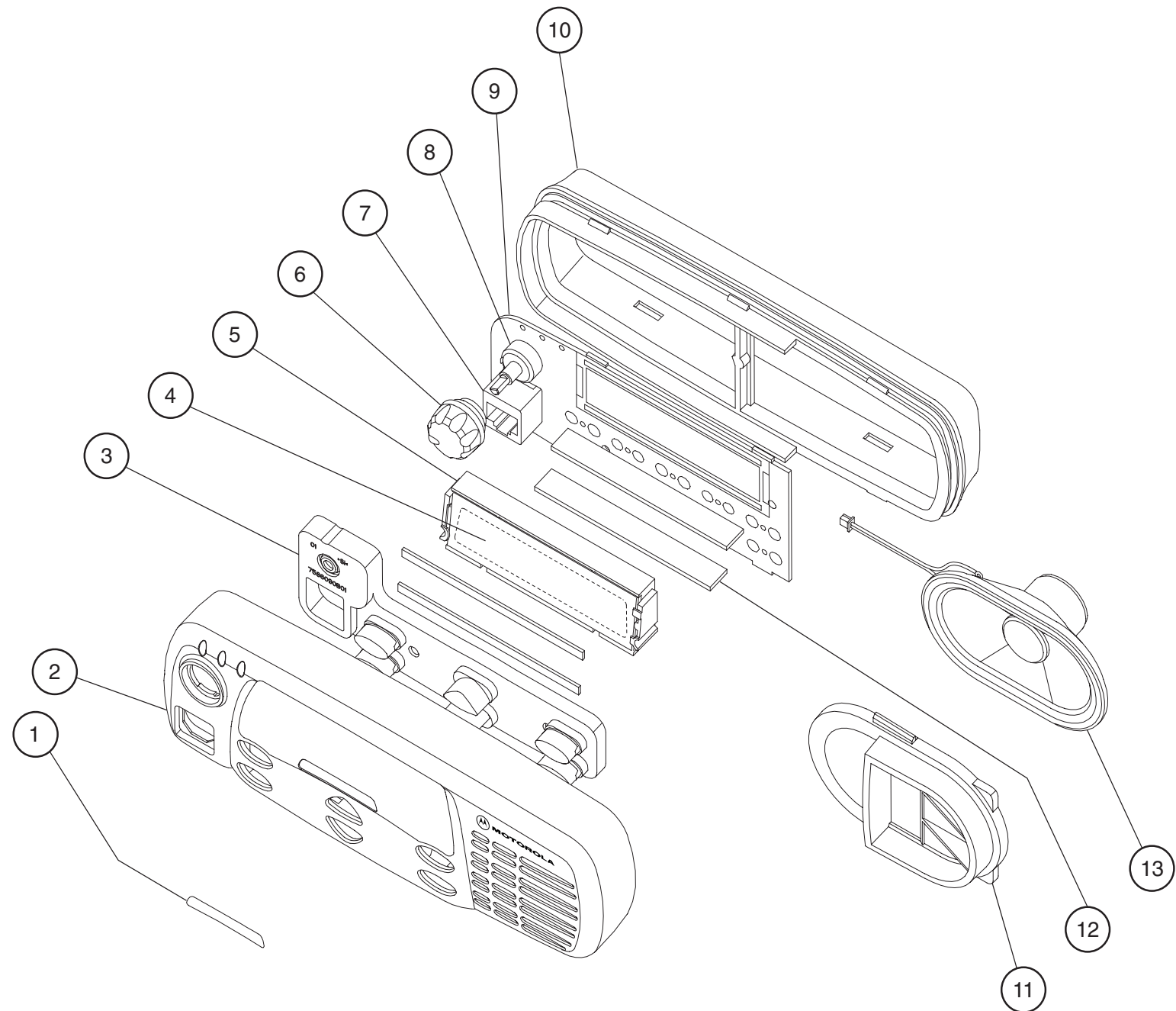
2.10 CDM1250 Radio Control Head Exploded Mechanical View and Parts List

Item	Motorola Part Number	Description
1	HLN9889A	Label
2	1586087B01	Housing Front
3	7586090B01*	Keypad
4	7286104B01	LCD Glass
5	0786099B01	Frame LCD
6	3686098B02	Knob, Volume
7	2864287B01	10-Pin, Microphone Jack
8	1805911V02	Potentiometer
9	GLN7352A	PCB
10	1586093B02‡	Back Housing
	3986218B01	Including Ground Clip
	3286094B01	Including O-ring
11	3786107B01†	Tube, Speaker
12	2886130B01	Connector, Elastomeric
	2886130B02	Connector, Elastomeric
13	5086126B01†	Speaker
	8486127B01	Flex, 12-Position Connector (not shown)

* Please refer to section 6.1.11 on page 6-4 in Chapter 6, Accessories for a complete list of part numbers for Keypad Buttons.

‡When using Back housing (1586093B02) for Control Head GCN6113A with PCB - GLN7352A (8486155B05), the grounding clips must be removed.

† Speaker (13) and Tube (11) are glued together using self-adhesive material. If replacement is required, it is recommended that both parts are ordered.



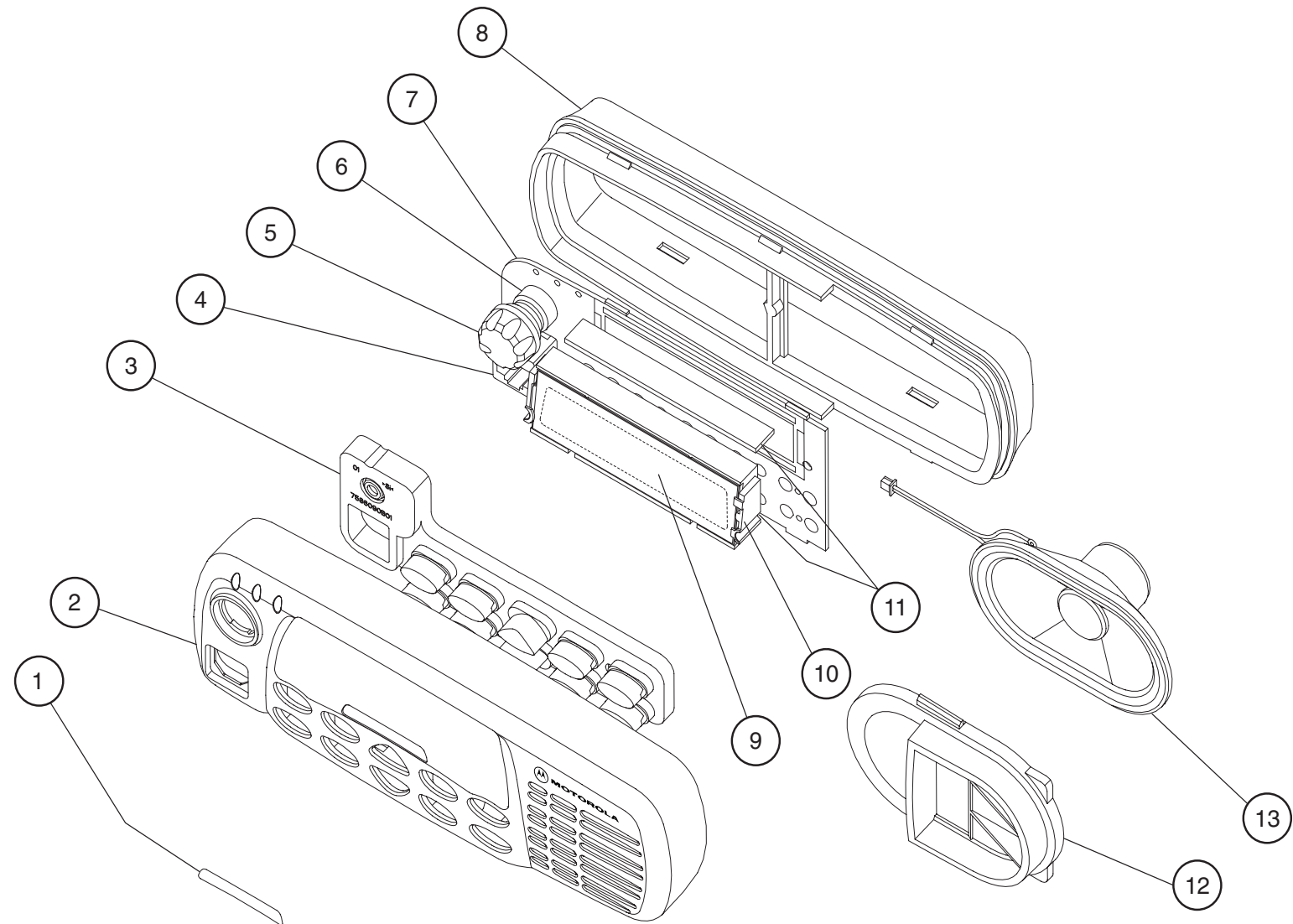
2.11 CDM1550 Radio Control Head Exploded Mechanical View and Parts List

Item	Motorola Part Number	Description
1	HLN9890A	Label
2	1586088B01	Housing Front
3	7586091B01*	Keypad
4	2864287B01	10-Pin, Microphone Jack
5	3686098B02	Knob, Volume
6	1805911V01	Potentiometer
7	GLN7353A	PCB
8	1586093B02‡	Back Housing
	3986218B01	Including Ground Clip
	3286094B01	Including O-ring
9	7286104B01	LCD Glass
10	0786099B01	Frame LCD
11	2886130B01	Connector, Elastomeric
	2886130B02	Connector, Elastomeric
12	3786107B01†	Tube, Speaker
13	5086126B01†	Speaker
	8486127B01	Flex, 12-Position Connector (not shown)

* Please refer to section 6.1.11 on page 6-4 in Chapter 6, Accessories for a complete list of part numbers for Keypad Buttons.

‡ When using new Back housing (1586093B02) for Control Head GCN6114A with PCB - GLN7353A (8486155B05), the grounding clips must be removed.

† Speaker (13) and Tube (12) are glued together using self-adhesive material. If replacement is required, it is recommended that both parts are ordered.



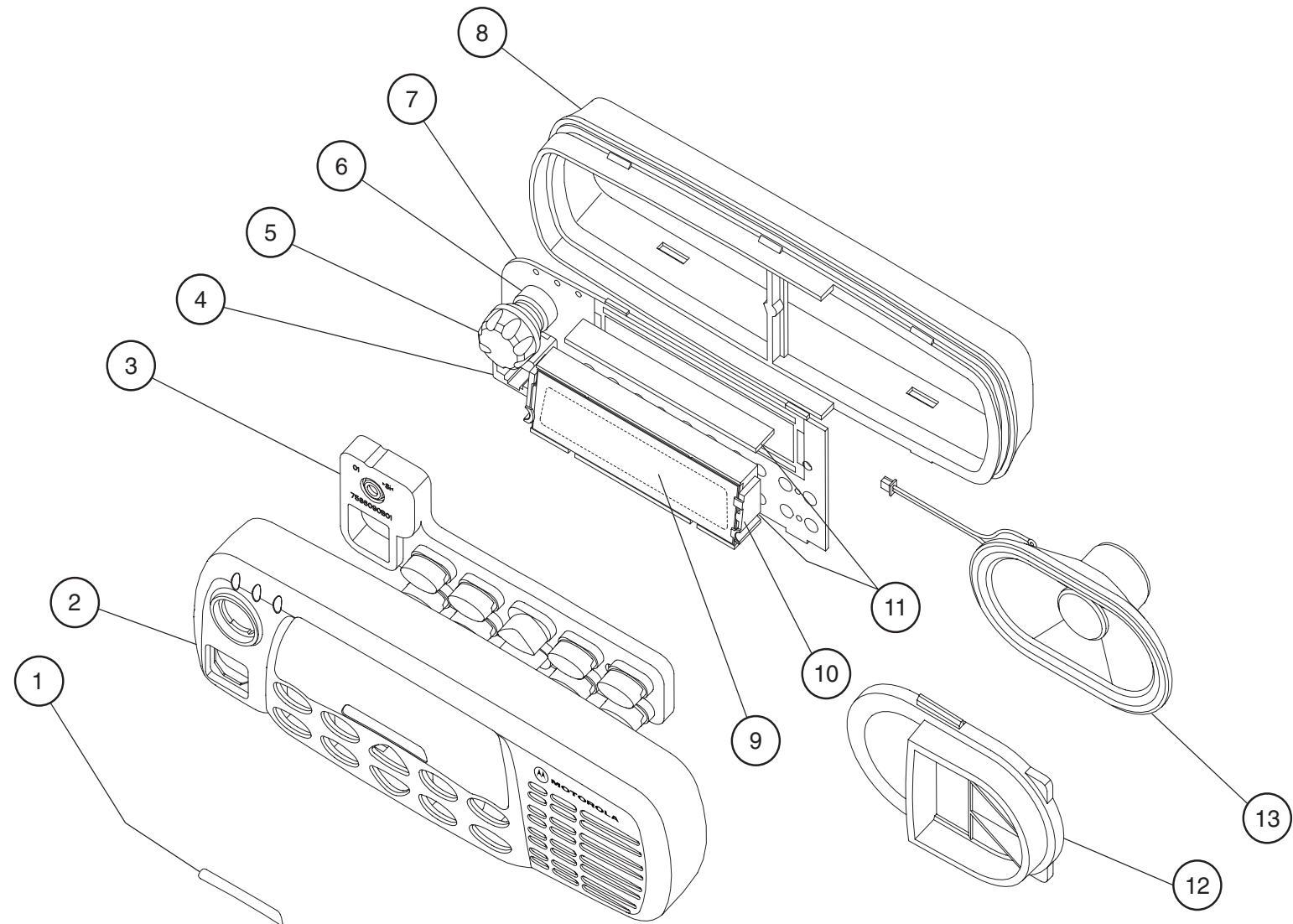
2.12 CDM1550•LS and CDM1550•LS⁺ Radio Control Head Exploded Mechanical View and Parts List

Item	Motorola Part Number	Description
1	HLN9891A	Label - CMD1550 LS
	HKLN4005A	Label - CDM1550•LS ⁺
	5486132823	CDM1550•LS ⁺ VHF Label
2	1586088B01	Housing Front
3	7586091B02 [*]	Keypad
4	2864287B01	10-Pin, Microphone Jack
5	3686098B02	Knob, Volume
6	1805911V01	Potentiometer
7	GLN7353A	PCB
8	1586093B02 [‡]	Back Housing
	3986218B01	Including Ground Clip
	3286094B01	Including O-ring
9	7286104B01	LCD Glass
10	0786099B01	Frame LCD
11	2886130B01	Connector, Elastomeric
	2886130B02	Connector, Elastomeric
12	3786107B01 [†]	Tube, Speaker
13	5086126B01 [†]	Speaker
	8486127B01	Flex, 12-Position Connector (not shown)

^{*} Please refer to section 6.1.11 on page 6-4 in Chapter 6, Accessories for a complete list of part numbers for Keypad Buttons.

[‡] When using new Back housing (1586093B02) for Control Head GCN6114A with PCB - GLN7353A (8486155B05), the grounding clips must be removed.

[†] Speaker (13) and Tube (12) are glued together using self-adhesive material. If replacement is required, it is recommended that both parts are ordered.



Notes

2.13 Service Aids

Table 2-1 lists service aids recommended for radio maintenance.

Table 2-1: Service Aids

Motorola Part No.	Description	Application
RLN4460	Portable Test Set	Enables connection to audio/accessory jack. Allows switching for radio testing.
HVN9025	Customer Programming Software (CPS) Tuner CD ROM. Includes PPCPS (PassPort Customer Programming Software).	Programs customer option and channel data. Tunes hardware parameters, front end, power, deviation, etc. Conventional, LTR, and PassPort products.
HVN9016	Customer Programming Software (CPS) and Tuner CD.ROM.	Programs customer option and channel data. Tunes hardware parameters, front end, power, deviation, etc. Conventional products.
AARKN4081	Programming Cable with Internal RIB	Includes radio interface box (RIB) capability.
RLN4853	10 to 20 Pin Adapter	Used with RKN4081.
AARKN4083	Mobile Programming/Test Cable	Connects radio to RIB (RLN4008).
RLN4008	Radio Interface Box	Enables communications between radio and computer's serial communications adapter.
HLN8027	Mini UHF to BNC Adaptor	Adapts radio antenna port to BNC cabling of test equipment.
8180384J59	Chassis Eliminator, 25W	
8180384J60	Chassis Eliminator, 45W	
8180384J61	Chassis Eliminator, 60W	
6686119B01	Dismantling Tool	Assists in the removal of radio control head.

2.14 Test Equipment

Table 2-2 lists test equipment required to service these and other two-way radios.

NOTE 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 2-2: Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2000, R2600 R2400, or R2001 with trunking option for Pri- vacy Plus™ and Smartnet Sys- tems™ †	Service Monitor	This monitor will substitute for items listed below with an asterisk *	Frequency/deviation meter and sig- nal generator for wide-range trouble- shooting and alignment
*R1049	Digital Multimeter		Two meters recommended for AC/ DC voltage and current measure- ments
*S1100	Audio Oscillator	67 to 200Hz tones	Used with service monitor for injec- tion of PL tones
*S1053, *SKN6009, *SKN6001	AC Voltmeter, Power Cable for meter, Test leads for meter	<ul style="list-style-type: none"> • 1 mV to 300 V • 10 MΩ input imped- ance 	Audio voltage measurements
R1053	Dual-trace Oscillo- scope	20 MHz bandwidth, 5 mV/cm - 20 V/cm	Waveform measurements
R1443A	Broadband Watt- meter		Transmitter power output measure- ments
S1339	RF Millivolt Meter	100 μV to 3 VRF, 10 kHz to 1.2 GHz	RF level measurements
*R1013	SINAD Meter		Receiver sensitivity measurements
S1348 (prog)	DC Power Supply	0-20 Vdc, 0-20 Amps	Bench supply for 13.2Vdc

† For those customers that need to test the LTR functioning of their radio instead of the R2600, purchase the HP8920 with LTR option. Please see your local Hewlett Packard representative for this item.

2.15 Programming Test Cable Configuring and Wiring

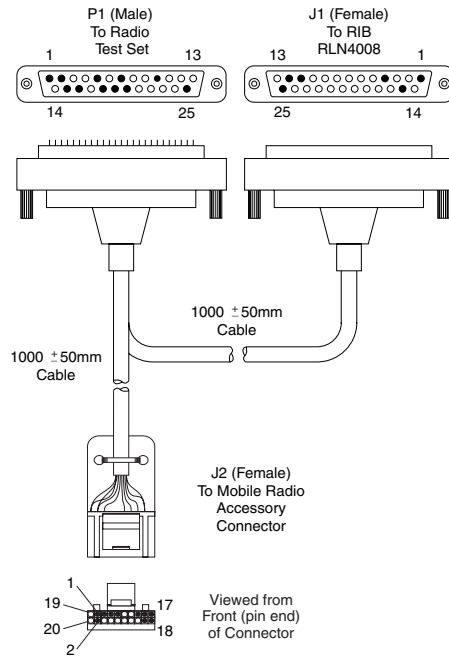
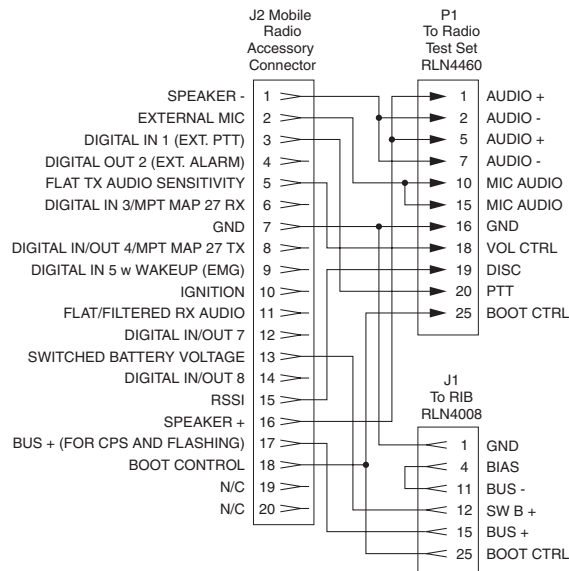


Figure 2-11: Programming/Test Cable AARKN4083_



FL0830307O

Figure 2-12: Pin Configuration of the Cable Side Connector

Notes

Chapter 3

Transceiver Performance Testing

3.1 General

These radios meet published specifications through their manufacturing process by utilizing high-accuracy, laboratory-quality test equipment. The recommended field service equipment approaches the accuracy of the manufacturing equipment with few exceptions. This accuracy must be maintained in compliance with the manufacturer's recommended calibration schedule.

3.2 Setup

Supply voltage is provided using a 13.2Vdc power supply. The equipment required for alignment procedures is connected as shown in the Radio Tuning Test Equipment Setup Diagram, Figure 4-4, on page 4-3.

Initial equipment control settings should be as indicated in Table 3-1. The remaining tables in this chapter contain the following related technical data:

Table 3-1: Table Chart

Table Number	Title
3-2	Initial Equipment Control Settings
3-3	Test Environments
3-4	Test Channel Spacing
3-5	Test Frequencies
3-6	Transmitter Performance Checks
3-7	Receiver Performance Checks

Table 3-2: Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Spkr set: A	Voltage: 13.2Vdc
RF Attn: -70	Spkr/load: Speaker	DC On/Standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 10V
Oscilloscope Source: Mod Oscilloscope Horiz: 10mSec/Div Oscilloscope Vert: 2.5kHz/Div Oscilloscope Trig: Auto Monitor Image: Hi Monitor BW: Nar Monitor Squelch: mid CW Monitor Vol: 1/4 CW		Current: 2.5A

3.3 RF Test Mode

This test mode is for display radios only. 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 and cannot receive commands from its system. Therefore, the internal microcontroller does not key the transmitter or unmute the receiver. This prevents the use of a normal tuning procedure. To solve this problem, a special "test mode" is incorporated into the radio.

Note: The test mode procedure that follows assumes that the Customer Programming Software front panel access (FPA) screen has both the FPA and RF TEST boxes selected. Select from the programming screen to enable or disable certain features of the radio RF test mode.

- FPA entry not selected blocks all test modes.
- FPA entry selected and RF TEST not selected blocks RF test mode.
- FPA entry selected and RF TEST selected enables all test modes.

To enter test mode:

1. Turn the radio on.
2. Within ten seconds after the self test is complete, press button **P2**, five times in succession.
3. After “CSQ CHXX SP25” appears in the display, the radio is on channel XX*, carrier squelch mode, 25 kHz channel spacing.
4. Each additional press of **P2** scrolls through to the next channel spacing and a corresponding set of tones are sounded.
5. Pressing **P1** scrolls through and accesses test environments as shown in Table 3-2.
6. Pressing **P2** for three seconds switches the radio to the control head test mode. ‘**LCD Test**’ appears on the display.
7. Pressing **P1** causes the radio to turn on all the dots of the first character. Another **P1** press turns on all the dots of the next character and so on until the last character (character 14).
8. Pressing **P1** at the end of the LCD test activates the ‘Icon Test’. The next **P1** press turns on the first icon.
9. Pressing **P1** at the end of the Icon test activates the button test. Pressing any button (except P1) or any keypad button during the LCD test or Icon test immediately activates this test.
10. Pressing **P2** for 3 seconds in the control head test mode causes the radio to return to the RF test mode.

*XX = channel number (01 - 14)

Table 3-3: 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 detected TX: mic audio

Table 3-4: Test Channel Spacing

Number of Beeps	Channel Spacing
1	25 kHz
2	12.5 kHz
3	20 kHz

Table 3-5: Test Frequencies

Test Mode	Test Channel Low Power	Test Channel High Power	LowBand Range 1 29.7 - 36 MHz	LowBand Range 2 36 - 42 MHz	LowBand Range 3 42 - 50 MHz	VHF	UHF 403-470 MHz	UHF 450-520 MHz (VMOS)	UHF 450-527 MHz (LDMOS)
TX	1	8	29.725	36.025	42.025	136.025	403.025	450.025	450.025
RX	1	8	29.750	36.050	42.050	136.050	403.050	450.050	450.050
TX	2	9	30.225	37.125	43.225	142.325	414.150	461.650	462.825
RX	2	9	30.325	37.225	43.125	142.350	414.175	461.675	462.850
TX	3	10	31.025	38.225	44.525	148.625	425.325	473.325	475.650
RX	3	10	31.125	38.325	44.425	148.650	425.350	473.350	475.675
TX	4	11	32.125	39.125	46.125	154.975	436.475	484.975	488.475
RX	4	11	32.225	39.225	46.025	155.025	436.525	485.025	488.525
TX	5	12	33.025	40.225	47.525	161.225	447.650	496.650	501.325
RX	5	12	33.125	40.325	47.425	161.250	447.300	496.675	501.350
TX	6	13	34.225	41.025	48.125	167.525	458.825	508.325	514.125
RX	6	13	34.325	41.125	48.025	167.550	458.850	508.350	514.150
TX	7	14	35.950	41.950	49.950	173.950	469.950	519.950	526.950
RX	7	14	35.975	41.975	49.975	173.975	469.975	519.975	526.975

Table 3-6: Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comment
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: ±150 Hz VHF, ±150 Hz UHF ±100 Hz LowBand
Power RF	As above	As above	As above	Low Power: 25-30W. High Power: 45-54W (VHF). High Power: 40-47W (403-470 MHz) 60-70W (LowBand)
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 800mVrms at test set, 800mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: 2.5 kHz Max. (12.5 kHz Ch. Sp). 4 kHz Max. (20 kHz Ch. Sp). 5 kHz Max. (20 kHz Ch. Sp. LowBand) 5 kHz Max. (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	Deviation: 2.5 kHz Max. (12.5 kHz Ch. Sp.). 4 kHz Max. (20 kHz Ch. Sp.). 5 kHz Max. (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: 1.6–1.9 kHz (12.5 kHz Ch. Sp.). 2.5–3.0 kHz (20 kHz Ch. Sp.). 3.2–3.8 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: 1.4 –1.9 kHz (12.5 kHz Ch. Sp.). 2.3 – 3.0 kHz (20 kHz Ch. Sp.). 2.9 – 3.8 kHz (25 kHz Ch. Sp.).

Table 3-6: Transmitter Performance Checks (Continued)

Test Name	Communications Analyzer	Radio	Test Set	Comment
PL/DPL Modulation	As above 4th channel test frequency* BW to narrow	TEST MODE, Test Channel 4 TPL DPL	As above	Deviation: 0.25 – 0.5 kHz (12.5 kHz Ch. Sp.). 0.4 – 0.8 kHz (20 kHz Ch. Sp.). 0.5 – 1.0 kHz (25 kHz Ch. Sp.).

* See Table 3-4

** MDC

Table 3-7: Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comment
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 ± 150 Hz VHF ± 150 Hz UHF ± 100 Hz LowBand
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 8.12Vrms
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 <0.3 μ V
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 3.16Vrms
	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 <0.25 μ V. Preferred SINAD = 9-10dB

* See Table 3-4

Chapter 4

Radio Programming and Tuning Procedures

4.1 Introduction

This chapter provides an overview of the Customer Programming Software (CPS) and tuner program designed for use in a Windows 95/98/NT environment. An installation instruction manual is also included with each kit.

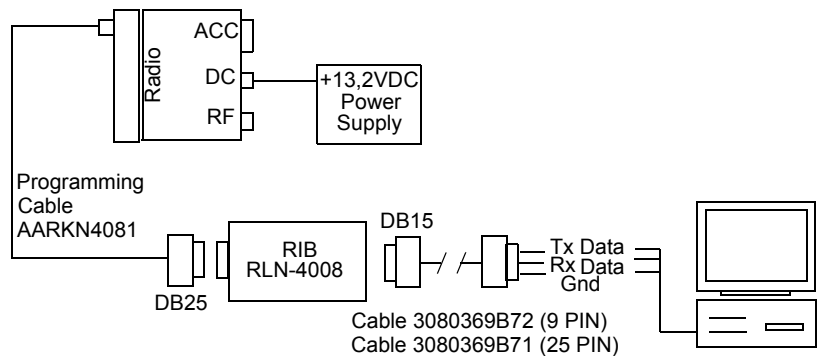
Table 4-1: Software Installation Kit Radio Tuning Setup

Description	Kit Number
Customer Programming Software (CPS ⁺) CD Includes CPS and PPCPS	HVN9025_

4.2 CPS Programming Setup

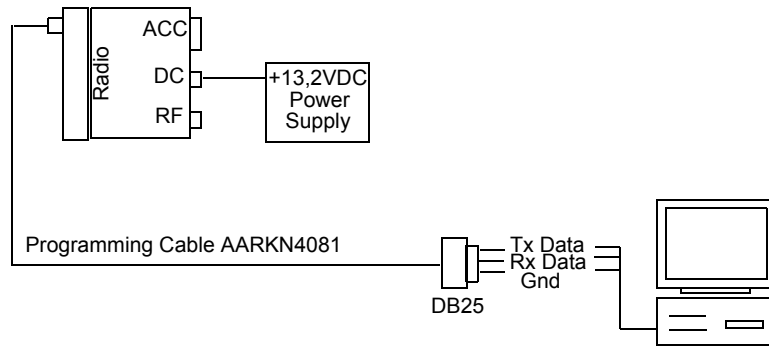
The CPS programming setups, shown in Figure 4-1 through Figure 4-3, are used to program the radio.

Note: Refer to the appropriate program on-line help files for detailed programming procedures.



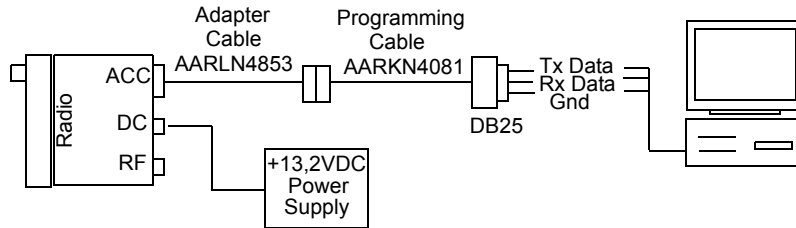
ZWG0130338-0

Figure 4-1: CPS Programming Setup with RIB



ZWG0130339-0

Figure 4-2: CPS Programming Setup Cable with Internal RIB

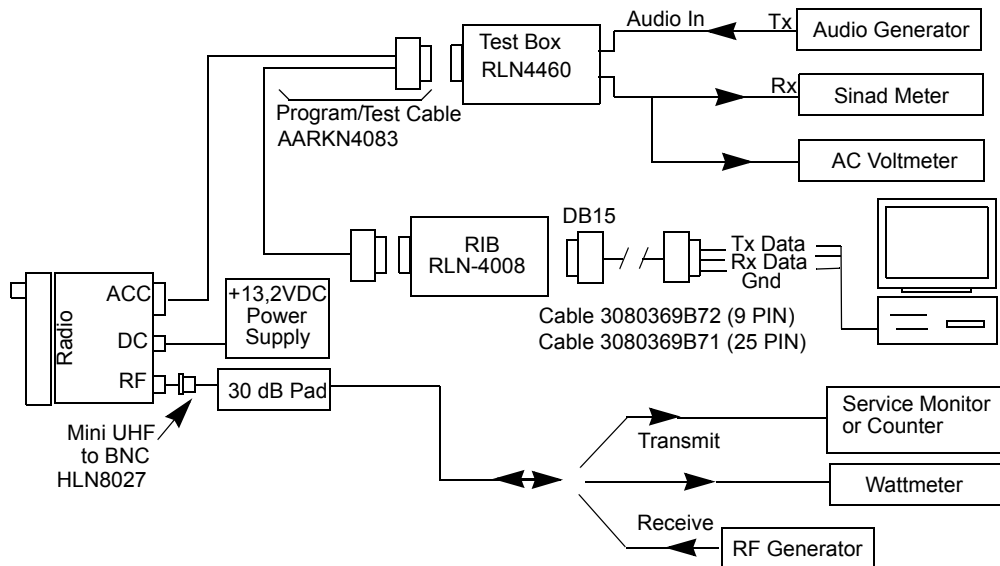


ZWG0130340-0

Figure 4-3: CPS Programming Setup Cable with Internal RIB and Rear Adapter Cable

4.3 Radio Tuning Setup

A personal computer (PC), Windows 95/98/NT, and a tuner program are required to tune the radio. To perform the tuning procedures, the radio must be connected to the PC, radio interface box (RIB), and test equipment setup as shown in Figure 4-4.



ZWG0130336-0

Figure 4-4: Radio Tuning Test Equipment Setup with External RIB

4.3.1 Initial Test Equipment Control Settings

The initial test equipment control settings are listed in Table 4-2.

Table 4-2: Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Speaker set: A	Voltage: 13.2Vdc
RF Attenuation: -70	Speaker/load: Speaker	DC on/standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 20V
Oscilloscope Source: Mod Oscilloscope Horizontal: 10mSec/Div Oscilloscope Vertical: 2.5 kHz/Div Oscilloscope Trigger: Auto Monitor Image: Hi Monitor BW: Nar Monitor Squelch: mid CW Monitor Volume: 1/4 CW		Current: 20A

4.4 Transmitter Tuning

The following sub-sections contain the procedures to tune the radio transmitter. These procedures include:

- Power Amplifier (PA) Bias Tuning
- Battery Threshold Tuning
- Reference Oscillator Warp
- DAC Tuning (LowBand radios only)
- Transmit Power Tuning
- Power Amplifier (PA) Voltage Limit Tuning (VHF 1-25W and UHF 1-25W LDMOS radios only)
- Modulation Balance Attenuation
- VCO Attenuation
- DTMF Deviation
- MDC1200 Deviation

4.4.1 Power Amplifier (PA) Bias Tuning

- Note:**
1. If using the regulated power supply RLN4510 to measure the current drawn by the radio, remember that the current meter terminals only measure the voltage drop across a 0.1ohm shunt resistor. Calculate the actual current being drawn by the radio by dividing the voltage drop across the resistor by 0.1. ($V= I*R$).
 2. Tuning must be performed only for High Power. The tuning screen will show up to three Toggle Bias buttons numbered 1, 2 and 3. Tuning must be started with the lowest bias number and continued until all bias points have been tuned.

Perform the PA Bias tuning procedure as follows:



Caution

CAUTION: To prevent damage to the PA, ensure that the antenna output is always terminated into a 50 Ohm load

1. Under the **Tx Align** menu, select **PA Bias**, and then **High Power**.
2. Measure/read the DC current drawn from the radio (varies from radio to radio). This value should typically range from 100-700mA. Record this value as **X**.
3. Press **Toggle Bias** button for the first bias to enable the PA bias softpot.
4. Increase softpot value to obtain **Y** until **Y - X** is within the range given for PA current in Table 4-3.
5. Press **Toggle Bias** for the first bias again to disable the PA bias softpot.
6. Repeat Steps 5-7 for the remaining **Toggle Bias** buttons.
7. Program the bias softpot values into the radio by pressing the **Program** button.
8. Exit the PA bias high power function.

Table 4-3: PA Bias Specifications*

RF Band	PA Type	Voltage Value	Bias 1 Current	Bias 2 Current	Bias 3 Current
UHF (403-470 MHz)	25-40W	95	100-150mA	130-170mA	Not Used
UHF (403-470 MHz)	1-25W	95	Not Used	130-170mA	Not Used
UHF (450-512 MHz)	25-40W	95	100-150mA	130-170mA	Not Used
UHF (450-512 MHz) (VMOS)	1-25W	95	100-150mA	130-170mA	Not Used
UHF (450-512 MHz) (LDMOS)	1-25W	22	Not Used	370-430mA	Not Used
VHF (136-174 MHz)	25-45W	85	100-150mA	100-150mA	Not Used
VHF (136-174 MHz)	1-25W	55	Not Used	80-120mA	Not Used
LowBand (29.7-36 MHz)	40-60W	63	100-150mA	100-150mA	100-150mA
LowBand (36-42 MHz)	40-60W	63	100-150mA	100-150mA	100-150mA
LowBand (42-50 MHz)	40-60W	63	100-150mA	100-150mA	100-150mA

*These values are up-to-date as of the print date. For the latest values and procedures, refer to the Tuner online help.

4.4.2 Reference Oscillator Warp

This procedure affects all deviation values such as DTMF and MDC1200 signaling as the frequency will drift if not warped properly.

- Note:**
1. Tuning of the PA BIAS must be performed first.
 2. This operation should be performed prior to all other transmit tuning operations to minimize heating and the impact of warp on signaling operations.
 3. If the output power level is too low to measure the frequency, tune the transmit power for the highest frequency first. However, if this is done, a wait period is required to allow the radio chassis to cool down to approximately 25 °C before setting the Reference Oscillator Warp.

Perform the oscillator warp procedure as follows:

1. Under the **Tx Align** menu, select **Reference Oscillator Warp**.
2. There is only one frequency point shown. This is always the last frequency point (F7).
3. Click on the slider thumb. Press **PTT Toggle** to key up the radio at the corresponding frequency point.
4. Monitor the transmit frequency.
5. Adjust the slider, spin, or edit control until the frequency is as close as possible to the indicated transmit frequency. Refer to values listed in Table 4-4. Press **ENTER** to confirm the selection.
6. Dekey the radio by pressing **PTT Toggle**.
7. Program the warp value into the radio by pressing the **Program** button.
8. Exit the reference oscillator warp function.

Table 4-4: Reference Oscillator Warp Specifications*

RF Band	Target
UHF (450-527 MHz)	±30 Hz
UHF (450-512 MHz)	±30 Hz
UHF (403-470 MHz)	±30 Hz
VHF (136-174 MHz)	±30 Hz
LowBand (29.7-36 MHz)	±30 Hz
LowBand (36-42 MHz)	±30 Hz
LowBand (42-50 MHz)	±30 Hz

*These values are up-to-date as of the print date. For the latest values and procedures, refer to the Tuner online help.

4.4.3 DAC Tuning (LowBand radios only)

- Note:**
1. Tuning of the PA BIAS must be performed first.
 2. This procedure must be performed before tuning the transmitter power.
 3. If any of the DAC values exceeds the range 20-200 or the value of DAC1 is greater than the value of DAC2, a warning message will be displayed.
 4. The DAC values will only be updated when the radio is keyed up. If the radio is not keyed up, any DAC value change will be ignored.

Perform the DAC tuning procedure as follows:

1. Under the **Tx Align** menu, select Transmit Power, then select **DAC**.
2. Press the **PTT Toggle** button to key up the radio.
3. Select **DAC1** by clicking on it's slider bar.
4. Measure the transmit power and compare it with the specification limits for **DAC1 Power** as defined in Table 4-5.
5. If the measured transmit power is outside the specification limits, adjust the slider, spin, or edit control until the transmit power is within the specification limits.
6. Repeat Steps 3 - 5 for **DAC2**.
7. Press **PTT Toggle** again to dekey the radio.
8. Exit the DAC tuning function.

Table 4-5: DAC1 & DAC2 Power Specifications*

DAC1	DAC2
30-40W	70-80W

*These values are up-to-date as of the print date. For the latest values and procedures, refer to the Tuner online help.

4.4.4 Transmit Power Tuning

- Note:**
1. **Tuning of the PA BIAS must be performed first.**
 2. **DAC Tuning must be performed first (LowBand radios only).**
 3. **IMPORTANT: To set the transmitter power for customer applications use the Customer Programming Software (CPS). The following procedure should only be performed if transmitter components have been changed or the radio does not transmit with the power set via the CPS. This tuning method is performed for multiple Transmit Power Tuning Channels.**
 4. **The power values displayed after opening the screen may have a small rounding offset.**
 5. **When checking the RF power output of the radio with a test set, always use a pad of at least 30dB attached to the radio end of the RF cable. This will avoid any RF mismatch and ensure a stable RF reading that will not change with varying lengths of connecting cable.**

Perform the transmit high power tuning procedure as follows:

1. Under the **Tx Align** menu, select **Transmit Power**, then select **K and M Tuning**.
2. Select the **Power 1** box for the first frequency (F1).
3. Press **PTT Toggle** to key up the radio.
4. Observe the power level (W) displayed on the power meter. Record this value as **X**.
5. Key in the value **X** in the **Power 1** box.
6. Select the **Power 2** box for the first frequency (F1).
7. Observe the power level (W) displayed on the power meter. Record this value as **Y**.
8. Key in the value **Y** in the **Power 2** box.
9. Press **PTT Toggle** again to dekey the radio.
10. Repeat Steps 2-9 for frequency points 2 to 7.
11. Press **Program** to store all keyed in values into the radio.
12. Exit the K and M tuning function.

4.4.5 Power Amplifier (PA) Voltage Limit Tuning (VHF 1-25W and UHF 1-25W LDMOS radios only)

- Note:**
1. **Tuning of the transmit power must be performed first.**
 2. **This method automatically tunes all PA Voltage Limit Tuning Channels.**

Perform the PA voltage limit tuning procedure as follows:

1. Under the **Tx Align** menu, select **PA Voltage Limit**.
2. Press **Auto Tune** and wait until all PA voltage limit softpots have been tuned.
3. Exit the PA voltage limit tuning function.

4.4.6 Modulation Balance Attenuation

- Note:**
1. When using test box RLN4460B/C, inject the signal into the radio at the **METER IN** terminal and set the **METER IN** selector switch to “VOL”.
 2. Tuning of the transmit power and reference oscillator warp must be performed first.
 3. This tuning method is performed for multiple Modulation Balance Attenuation Tuning Channels.
 4. Compensation alignment balances the modulation sensitivity of the VCO and reference modulation (synthesizer low frequency port) lines. The compensation algorithm is critical to the operation of signaling schemes that have very low frequency components (i.e. DPL) and could result in distorted waveforms, if not adjusted properly.

Perform the modulation balance attenuation procedure as follows:

1. Under the **Tx Align** menu, select **Mod Balance Attn**.
2. Begin with the lowest frequency, i.e., the first frequency point from the top. Press **PTT Toggle** without selecting any slider control at the corresponding frequency point. This keys the radio up at the first frequency point.
3. Inject 80 Hz at 100mVrms.
4. Record the deviation obtained. Typical values should range from 3.5-5.5 kHz.
5. Inject 3 kHz at 100mVrms.
6. Change the modulation balance attenuation setting until the Tx deviation is as recorded in Step 4.
7. Inject 80 Hz at 100mVrms, and check the deviation again. If Tx deviation changes, note the reading and repeat Steps 5, 6, and 7 until the Tx deviation remains the same.
8. Press **PTT Toggle** to dekey the radio. Choose the next frequency, key up, then repeat Steps 3 to 7 until all seven tuning points are completed.
9. Program the softpot value by pressing the **Program** button.
10. Exit the modulation balance function.

4.4.7 VCO Attenuation

- Note:**
1. Tuning of the modulation balance must be accomplished first. The transmit deviation Limit softpot sets the maximum deviation of the carrier. Tuning is performed for 12.5 kHz, 20 kHz, and 25 kHz channel spacing. Tuning for 25 kHz channel must be done first for all frequency points. Tuning for 12.5 and 20 kHz channel spacing determines only the offset to the previously tuned deviation for 25 kHz tuning channel spacing. For 12.5, 20 kHz channel spacing, only F7 is used for tuning. The 30 kHz channel spacing which uses 5.0 kHz maximum system deviation are covered by the 25 kHz tuning.
 2. When using test box RLN4460, set the METER OUT toggle switch to the "MIC PORT" position and METER OUT selector switch to "MIC". Inject 1 kHz tone, and 800mVrms to AUDIO IN. The 800mVrms should be measured at the AC/DC METER.
 3. Depending on the radio model and the customer settings, the signal injected in accessory connector Pin 5 or the signal from an option board may be transmitted simultaneously with other signals, for example from the microphone or internally generated signaling. In this case the peak signal level is the sum of the individual signal's peak levels and can exceed the maximum allowed transmit deviation level. To prevent over deviation, the maximum deviation must be measured with both signals present and if the deviation still exceeds the range defined in Table 4-6, the VCO Attenuation must be re-tuned, so that the deviation stays in the tuning range with both signals present.
 4. Tuning of the modulation balance attenuation must be performed first.

Table 4-6: Deviation Specifications for UHF/VHF/LowBand Radios*

Band	Channel Spacing	Rated System Deviation	Deviation (kHz)
UHF/VHF/LowBand	25 kHz	5 kHz	4.4 – 4.6
LowBand (20 kHz systems in North America)	20 kHz	5 kHz	4.4 – 4.6
UHF/VHF	20 kHz	4 kHz	3.4 – 3.6
UHF/VHF/LowBand	12.5 kHz	2.5 kHz	2.2 – 2.3

*These values are up-to-date as of the print date. For the latest values and procedures, refer to the Tuner online help.

4.4.8 VCO Attenuation (25 kHz)

Perform the 25 kHz VCO attenuation procedure as follows:

1. Under the Tx Align menu, select **VCO Attn. 25 kHz**.
2. Begin with the lowest frequency. Select the thumb of the slider at the lowest frequency point, then press the **PTT Toggle** button to key up the radio at the corresponding frequency point. The spin control can also be toggled via its up/down arrow buttons. The softpot value can also be typed into the edit control. Press **ENTER** to confirm the selection.
3. Inject 1 kHz at 800mVrms to the external microphone audio path.

4. Note the deviation obtained.
5. Adjust the slider, adjust the spin control or key in softpot values for the frequency point until the deviation is within the range as defined in the Table 4-6 on page 4-9. Press **ENTER** to confirm the selection.
6. Press the **PTT Toggle** button to dekey radio. Choose the next frequency, key up, then repeat Steps 3-5 until all seven tuning points are completed.
7. Program the softpot value by pressing the **Program** button.
8. Exit the VCO attenuation 25 kHz function.

4.4.9 VCO Attenuation (20 kHz)

Note: Tuning of modulation balance attenuation and VCO attenuation for 25kHz channel spacing must be accomplished first.

Perform the 20 kHz VCO attenuation procedure as follows:

1. Under the **Tx Align** menu, select **VCO Attn. 20 kHz**.
2. Press **PTT Toggle** to key up the radio at F7.
3. Inject 1 kHz at 800mVrms to the external microphone audio path.
4. Note the deviation obtained.
5. Adjust the slider, adjust the spin control or key in softpot values for the frequency point until the deviation is within the range as defined in Table 4-6 on page 4-9. Press **ENTER** to confirm the selection.
6. Press **PTT Toggle** to dekey the radio.
7. Program the softpot value by pressing the **Program** button.
8. Exit the VCO attenuation 20 kHz function.

4.4.10 VCO Attenuation (12.5 kHz)

Note: Tuning of modulation balance attenuation and VCO attenuation for 25kHz channel spacing must be accomplished first.

Perform the 12.5 kHz VCO attenuation procedure as follows:

1. Under the **Tx Align** menu, select **VCO Attn. 12.5 kHz**.
2. Press **PTT Toggle** to key up the radio at F7.
3. Inject 1 kHz at 800mVrms to the external microphone audio path.
4. Note the deviation obtained.
5. Adjust the slider, adjust the spin control or key in softpot values for the frequency point until the deviation is within the range as defined in the Table 4-6. Press **ENTER** to confirm the selection.
6. Press **PTT Toggle** to dekey the radio.
7. Enter the softpot value into the radio by pressing the **Program** button.
8. Exit the VCO attenuation 12.5 kHz function.

4.4.11 DTMF Deviation Tuning

This tuning option controls the dual-tone, multi-frequency (DTMF) deviation.

Note: Modulation balancing and VCO attenuation must be performed prior to this tuning operation. Not doing so will result in the wrong deviation value being obtained while tuning the DTMF.

Perform the DTMF deviation tuning procedure as follows:

1. Under the **Tx Align** menu, select **DTMF Deviation**.
2. Press **PTT Toggle** to key the radio up. Monitor the deviation obtained.
3. Adjust the slider, spin, or edit control until a deviation of 3.1-3.4 kHz is obtained. Press **ENTER** to confirm the selection.
4. Press **PTT Toggle** again to dekey the radio.
5. Program the softpot value into the radio by pressing the **Program** button.
6. Exit the DTMF deviation function.

4.4.12 MDC1200 Deviation Tuning (MDC radios only)

This tuning option controls the MDC1200 Signaling deviation.

Note: Modulation balancing and VCO attenuation tuning must be performed prior to this tuning operation. Not doing so will result in the wrong deviation value being obtained while tuning this feature.

Perform the MDC1200 deviation tuning procedure as follows:

1. Under the **Tx Align** menu, select **MDC1200 Signaling**.
2. Press **PTT Toggle** to key the radio up. Monitor the deviation obtained.
3. Adjust the slider, spin or edit control until a deviation of about 3.3 – 3.7kHz is obtained. Press **ENTER** to confirm the selection.
4. Press **PTT Toggle** again to dekey the radio.
5. Program the softpot value into the radio by pressing the **Program** button.
6. Exit the MDC1200 deviation function.

4.5 Receiver Tuning

The following sub-sections contain the procedures to tune the radio receiver. These procedures include:

- Front End Filter Tuning
- Rated Volume
- Squelch Tuning Front End Filter Tuning

4.5.1 Front End Filter Tuning

- Note:**
1. Tuning is normally not required. It should only be performed if a radio has poor sensitivity or pre-selector parts have been replaced. Radios are only tuned at one softpot frequency (See Table 4-7 through Table 4-12). The values for the untuned frequencies are determined by adding the offset, calculated by subtracting the default softpot value for tuned frequency from the tuned softpot value for the tuned frequency.
 2. When using the test box RLN4460, measure the RSSI voltage with a DC voltmeter connected to the METER OUT terminals of the test box. Select "DISC" on the METER OUT rotary switch.
 3. Tuning is only performed for 25kHz channel spacing.
 4. Warping of the reference oscillator must be accomplished first.
 5. LowBand radios do not require tuning of the front end filter.

The following values in Table 4-7 through Table 4-12 are up-to-date as of the print date. For the latest values and procedures, refer to the Tuner online help.

Table 4-7: Default Softpot Values for VHF (136-174 MHz)

Frequency Point	Softpot Value (Decimal)
F1	45
F2	56
F3	66
F4	76
F5	85
F6	95
F7	102

Table 4-8: Default Softpot Values for UHF (403-470 MHz/ 25W)

Frequency Point	Softpot Value (Decimal)
F1	43
F2	49
F3	57
F4	63
F5	67
F6	77
F7	89

Table 4-9: Default Softpot Values for UHF (403-470 MHz/ 40W)

Frequency Point	Softpot Value (Decimal)
F1	63
F2	67
F3	75
F4	77
F5	81
F6	91
F7	101

Table 4-10: Default Softpot Values for UHF (450-512 MHz/ 40W)

Frequency Point	Softpot Value (Decimal)
F1	61
F2	65
F3	71
F4	85
F5	95
F6	101
F7	109

Table 4-11: Default Softpot Values for UHF (450-512 MHz/ 25W - VMOS)

Frequency Point	Softpot Value (Decimal)
F1	61
F2	65
F3	71
F4	83
F5	95
F6	101
F7	107

Table 4-12: Default Softpot for UHF (450-512 MHz/ 25W - LDMOS)

Frequency Point	Softpot Value (Decimal)
F1	53
F2	59
F3	65
F4	73
F5	75
F6	79
F7	87

Perform the front end filter tuning procedure as follows:

1. Under the **Rx Align** menu, select the **Front End Filter** option.
2. Select the thumb of the slider of the frequency point given under “Frequency Point” for the radio’s frequency band from one of the Table 4-7 through Table 4-12.
3. Inject a **-87dBm RF** signal with the frequency selected in Step 2, modulated with 1kHz tone at 60% rated deviation of values listed in Table 4-13. A 1kHz tone must be audible to make sure that the radio is receiving. Switch off the modulation.
4. Set the softpot to the start value given specified in one of the Table 4-7 through Table 4-12 by adjusting the slider, keying in the softpot values in the edit box (press **ENTER** to confirm the selection) or using the spin control.
5. Measure the RSSI voltage with a DC voltmeter capable of 1mV resolution. It is recommended that an RCA filter (1.5K-47uF) be added at the input of the voltmeter to reduce RSSI noise. Call this **V1**.
6. Change the softpot value by the “Step Value” specified in one of the Table 4-7 through Table 4-12. A positive step value must be added, while a negative value must be subtracted from the current softpot value. Call this **SP**.
7. Re-measure the RSSI voltage. Call this **V2**.
8. Calculate the RSSI voltage change in percent using the formula $100 * (V2/V1 - 1)$. If the calculated value is negative or lower than the target value given from one of the Table 4-7 through Table 4-12, continue with Step 9. Otherwise repeat Steps 6 through 8.
9. Calculate the softpot offset using formula **SP – Default SP**. For **Default SP**, use the default softpot value specified in Table 4-7 through Table 4-12 for the tuning frequency given in Table 4-14. Add the calculated offset to all default values given in the table for the radio’s frequency range and enter the results in the edit boxes for the appropriate softpot frequencies.
10. Program the softpot values into the radio by pressing the **Program** button.
11. Exit the front end filter tuning function.

Table 4-13: Front End Filter Deviation Values

Channel Spacing	Rated System Deviation	Signal Generator Deviation
12.5 kHz	2.5 kHz	1.5 kHz
20 kHz	4.0 kHz	2.4 kHz
25 kHz	5.0 kHz	3.0 kHz
30 kHz	5.0 kHz	3.0 kHz

Table 4-14: Front End Tuning Parameters*

RF Band	Frequency Point	RF Level	Start Value	Step Value	Target Value
UHF (403-470 MHz) (40W)	F1	-87dBm	69	-2	0.17% of RSSI Voltage
UHF (403-470 MHz) (25W)	F1	-87dBm	61	-2	0.17% of RSSI Voltage
UHF (450-512 MHz)	F4	-87dBm	85	-2	0.20% of RSSI Voltage
UHF (450-512 MHz) (LDMOS)	F4	-87dBm	85	-2	0.20% of RSSI Voltage
VHF (136-174 MHz)	F4	-87dBm	64	+3	0.17% of RSSI Voltage

*These values are up-to-date as of the print date. For the latest values and procedures, refer to the Tuner online help.

4.5.2 Rated Volume Tuning

Note: When using test box RLN4460B/C, the received audio output is taken from the AC/DC METER OUT terminals with the METER OUT rotary switch set to RX.

Perform the rated volume tuning procedure as follows:

1. Under the **Rx Align** menu, select **Rated Volume**.
2. Inject a -47dBm rf signal modulated with 1 kHz tone at the 60% rated deviation listed in Table 4-15.
3. Adjust the softpot value by using the slider, keying in the edit box (press **ENTER** to confirm the selection or send a softpot value), or via the spin controls. Repeat this until 3W(8Vrms) audio power is obtained. Press **Program** to commit the softpot value into the radio.
4. Exit the rated volume tuning function.

Table 4-15: Rated Volume Deviation Values

Channel Spacing	Rated System Deviation	Signal Generator Deviation
12.5 kHz	2.5 kHz	1.5 kHz
20 kHz	4.0 kHz	2.4 kHz
20 kHz (LowBand 20 kHz systems in North America)	5.0 kHz	3.0 kHz
25 kHz	5.0 kHz	3.0 kHz
30 kHz	5.0 kHz	3.0 kHz

4.5.3 Squelch Tuning

- Note:**
1. Squelch tuning can only be accomplished after front end filter tuning and reference oscillator warping.
 2. When using the test box RLN4460, the received audio output is taken from the AC/DC METER OUT terminals with the METER OUT rotary switch set to RX. It is recommended that rated volume tuning is performed so the correct 10dB SINAD level can be obtained.
 3. This tuning method is performed for multiple squelch tuning channels and multiple channel spacings.

Perform the squelch tuning procedure as follows:

1. Under the Rx **Align** menu, select **Squelch Atten**. Select either **Squelch Atten 12.5 kHz**, **Squelch Atten 20 kHz** or **Squelch Atten 25 kHz** channel spacing variations.
2. Apply an RF signal modulated with a 1 kHz tone at 60% rated deviation listed in Table 4-16 for current frequency point (F1 being the first) of 10dB SINAD. That is, adjust the reference signal level until 10dB SINAD is obtained at the SINAD meter. Squelch tuning can either be done manually (see page 17 for procedure) or by auto squelch (see page 17 for procedure). To obtain 10dB, unmute the radio first by dragging the corresponding slider value to 1.

Table 4-16: Squelch Deviation Values

Channel Spacing	Rated System Deviation	Signal Generator Deviation
12.5 kHz	2.5 kHz	1.5 kHz
20 kHz	4.0 kHz	2.4 kHz
20 kHz (LowBand 20 kHz systems in North America)	5.0 kHz	3.0 kHz
25 kHz	5.0 kHz	3.0 kHz
30 kHz	5.0 kHz	3.0 kHz

Manual Squelch Tuning:

1. Under the Rx **Align** menu, select **Squelch Atten**. Select either **Squelch Atten 12.5 kHz**, **Squelch Atten 20 kHz** or **Squelch Atten 25 kHz** channel spacing variations.
2. Apply an RF signal modulated with a 1 kHz tone at 60% rated deviation listed in Table 4-16 for current frequency point (F1 being the first) of 10dB SINAD. That is, adjust the reference signal level until 10dB SINAD is obtained at the SINAD meter. Squelch tuning can either be done manually (see page 17 for procedure) or by auto squelch (see page 17 for procedure). To obtain 10dB, unmute the radio first by dragging the corresponding slider value to 1.
3. Set softpot to its maximum value to mute the radio.
4. Adjust the softpot value by using the slider, keying in the edit box or using the spin controls. Press **ENTER** to confirm the selection. Do this until the radio is totally unmuted. Verify the squelch closing by inputting a signal level of 4dB lower than that of the 10dB SINAD level.
5. Repeat Step 2 and Steps 3-4 of Manual Squelch Tuning, for frequency points F2-F7.
6. Press **Program** to commit the softpot values into the radio.
7. Exit the squelch tuning function.

Auto Tune:

Note: Proceed with caution since this procedure automatically programs the softpot value into your radio.

When you press the **Auto Tune** button, the radio automatically returns an optimum squelch value.

After you press the button, the radio may need time to produce an optimal setting for the squelch attenuation. The following steps describe the auto tune process:

Auto Tuning:

1. Under the Rx **Align** menu, select **Squelch Atten**. Select either **Squelch Atten 12.5 kHz**, **Squelch Atten 20 kHz** or **Squelch Atten 25 kHz** channel spacing variations.
2. Apply an RF signal modulated with a 1 kHz tone at 60% rated deviation listed in Table 4-16 for current frequency point (F1 being the first) of 10dB SINAD. That is, adjust the reference signal level until 10dB SINAD is obtained at the SINAD meter. Squelch tuning can either be done manually (see page 17 for procedure) or by auto squelch (see page 17 for procedure). To obtain 10dB, unmute the radio first by dragging the corresponding slider value to 1.
3. Select current frequency point (F1 being the first), then press **Auto Tune**.
4. Repeat Steps 2 and 3 of the Auto Tune section for frequency points F2-F7.

Notes

Chapter 5

Power Up Self-Test

5.1 Error Codes - Conventional Radios

Turning on the radio starts a self-test routine that checks the RAM, ROM checksum, EEPROM hardware, and EEPROM checksum. If these checks are successful, the radio generates two high-pitched self-test pass tones, or a musical tone (selected in CPS). If the self-test is not successful, one low-pitched tone is heard. Radios with displays are able to display the error codes. The displayed error codes and related corrections are listed in Table 5-1.

Table 5-1: Power Up Error Codes

If the error code displayed is...	then, there is a...	To correct the problem...
"RAM TST ERROR"	RAM test failure.	Retest the radio by turning it off and turning it on again. If message reoccurs, replace RAM (U0122).
"EEPROM HW ERROR"	Codeplug structure mismatch or non existence of codeplug.	Reprogram codeplug with correct version and retest radio. If message reoccurs, replace EEPROM (U0111).
"EEPROM CS ERROR"	Wrong codeplug checksum.	Reprogram codeplug.
No Display	Bad display module connection or damaged display module.	Check connection between main board and display module or replace with new display module.

5.2 CDM1550-LS⁺ PassPort Tone Options

In order to provide more detailed information about the radio's state to a user or service technician various tones and display options are available.

One Tone option is a short low pitched tone that sounds whenever the radio loses contact for any reason with its registered PassPort site and begins to search for another site. This tone is enabled by the "Enable LOS Search Start Tone" option.

Service technicians who are determining system coverage and RSSI settings may want to be able to discriminate between the LOS (Loss of System) for complete loss of data from the site or when the site RSSI drops below required levels. A second tone following the first LOS Tone indicating that LOS was caused by complete LOS of PassPort data from the site and not low.

RSSI can be activated with the "Enable LOS CRC Search start tone" option.

Enable just the "Enable LOS Search start tone" option. Allow the radio to register. Turn off the Home repeater. The radio will sound a single tone and start to search. Turn on the Home repeater. Allow the radio to register. Remove the antenna. The radio will sound a single tone and start to search. Replace the antenna.

Enable the "Enable LOS CRC Search start tone" option. Allow the radio to register. Turn off the Home repeater. The radio will sound two tones and start to search. Turn on the Home repeater. Allow the radio to register. Remove the antenna. The radio will sound a single tone and start to search.

5.3 CDM1550-LS⁺ Special Diagnostic Functions

Some special diagnosis functions can be turned on "as needed" by accessing the "Service Menu". In order to enter this menu please proceed as follows

- 1) Press the Menu Key. (You don't need to be registered).
- 2) Quickly press the v then the w key.
- 3) Service Menu appears on the screen.
- 4) Press) to select it.

A series of functions then become available to you as you scroll up and down. They are as follows:

PassPort ESN: Enter the Service Menu and using the Up/Dn keys scroll to "**PassPort ESN**". Press the Select key. Use the Up/Dn and Select Keys to activate or deactivate this function. This function momentarily displays the radio's PassPort Electronic Serial Number.

PassPort Information Report - Enter the Service Menu and using the Up/Dn keys scroll to "Report". Press the Select key. The display will sequentially show, the search method preference, the number of Near Neighbors from the last registered site neighbor list, All Neighbors, the total number of unique stored Neighbor frequencies and then display the known list of Neighbor Frequencies. The report will complete and the radio will search and re-register.

Monitor - This Service Menu option defeats PassPort coded squelch and allows a technician to hear all transmissions on the system. This function can be enabled or disabled using the PassPort CPS (PPCPS).

Show RSSI - Enter the Service Menu and using the Up/Dn keys scroll to "**Show RSSI**". Press the Select key. Use the Up/Dn and Select Keys to activate or deactivate this function. This diagnostic momentarily displays the ASID and RSSI of all received site IDLE messages in the format " WXXX-YYY-ZZZ " where W is a "-" on an Idle channel and a "+" on a busy one, XXX is the ASID of the site, YYY is the RSSI of the message just received and ZZZ is the current running average RSSI. This can be helpful in determining RSSI roaming settings. Also while this feature is enabled and the radio is searching, each new search frequency is momentarily displayed in order to track the radio's progress through the known frequencies.

Search Freq-(Enter Search Frequencies) - Enter the Service Menu and using the Up/Dn keys scroll to "**Search Freq**". Press the Select key. Using the numeric keys and Left (P1) key for backup/delete and the "*" key for the decimal point, enter the desired Search Frequency in MHz. Press the Select key when the entry is complete or the Escape/Exit Key to exit the function without entering a search frequency. After pressing the Select key the radio will exit the Menu mode and begin searching the entered frequency for a period of time equal to twice the initial search delay. This utility allows a new radio or a radio with an empty Neighbor List Almanac to search an initial frequency other than its Home Frequency or a Seed List Frequency. This can be helpful when programming and delivering a new radio to a customer in an area not served by a site on his Home Frequency.

Clear Almanac – (Clear Neighbor list Almanac): Enter the Service Menu and using the Up/ keys scroll to "**Clear Almanac**". Press the Select key. The stored Neighbor frequencies will be erased. This utility allows clearing obsolete Neighbor frequencies collected.

5.4 CPS/PPCPS Programming Setup

The CPS/PPCPS programming setup, shown in Figure 5-1:, is used to program the radio codeplug.

Note: Refer to appropriate program on-line help files for the codeplug programming procedures.

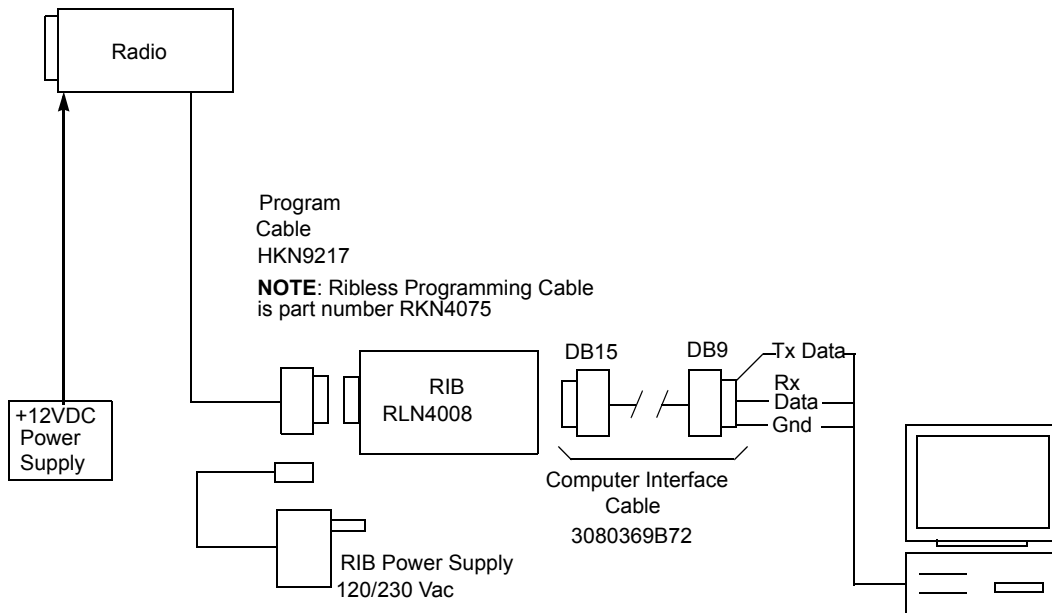


Figure 5-1: CPS/PPCPS Programming Setup

Chapter 6

Accessories

6.1 Accessories

To order, contact the Motorola Customer Care and Services Division. For Contact Information, please see section 1.2.3 on page 2 of Chapter 1, Introduction.

6.1.1 Antennas

VHF	(136 -174 MHz)
HAD4006	136 - 144 MHz, 1/4 Wave Roof Mount (Mini U)
HAD4007_R	146 - 150.8 MHz , 1/4 Wave Roof Mount (Mini U)
HAD4008_R	150.8 - 162 MHz, 1/4 Wave Roof Mount (Mini U)
HAD4009_R	162 - 174 MHz, 1/4 Wave Roof Mount (Mini U)
HAD4014_R	146 - 172 MHz, 3dB Gain Roof Mount (Mini U)
UHF 1	(403-470 MHz)
HAE4002	403-430 MHz, 1/4 Wave Roof Mount (Mini U)
HAE4010	406-420 MHz, 3.5 dB Gain Roof Mount (Mini U)
UHF 2	(450-520 MHz) (ferrule connector)
HAE4003_R	450-570 MHz, 1/4 Wave Roof Mount (Mini U)
HAE4004	470-512 MHz, 1/4 Wave Roof Mount (Mini U)
HAE4011_R	450-470 MHz, 3.5 dB Gain Roof Mount (Mini U)
HAE4012	470-494 MHz, 3.5 dB Gain Roof Mount (Mini U)
HAE4013	494 - 512 MHz, 5.0 dB Gain Roof Mount (Mini U)
LowBand 1	(29.7 - 36 MHz)
RAB4002_RB	29.7 - 36 MHz, 1/4 Wave Base Loaded (Mini U)
LowBand 2	(36 - 42 MHz)
RAB4003_RB	36 - 42 MHz, 1/4 Wave Base Loaded (Mini U)
LowBand 3	(42 - 50 MHz)
RAB4004_RB	42 - 50 MHz, 1/4 Wave Base Loaded (Mini U)

6.1.2 Mounting

RLN4774	3-Point Mounting Tray (LowBand)
GLN7317	Trunnion, High Profile Mounting
GLN7324_R	Trunnion, Low Profile Mounting
HLN8097	Slide Mount, Removable
RLN4779	Key Lock Mount (UHF/VHF)
RLN4781	DIN Mounting Kit

6.1.3 Remote Mount

RLN4801	Remote Mount Kit, Control Head, CDM750
RLN4802	Remote Mount Kit, Control Head, CDM1250/CDM1550
RKN4077	Remote Mount Cable, 3m
RKN4078	Remote Mount Cable, 5m
RKN4079	Remote Mount Cable, 7m
HKN4137	12V 10-Foot Cable to Battery, 1-25W
HKN4192	12V 20-Foot Cable to Battery (VHF, UHF, and LowBand), 1-45W
HKN9402_R	12V LowBand Cable to Battery, 40-60W

6.1.4 Loudspeaker

RSN4001	External Speaker, 13W
HSN8145	External Speaker, 7.5W

6.1.5 Audio

AARMN4025	Microphone, Enhanced Compact
AARMN4026	Microphone, Enhanced Keypad
AARMN4038	Microphone, Heavy Duty
HMN3000	Microphone, Black Desk
AAREX4617	Handset, Telephone Style

6.1.6 Hands Free Operation

AARMN4027	Microphone, Visor Mounted
RLN4856	Footswitch PTT
RLN4857	Push-button PTT
RLN4858	Gooseneck PTT
RLN4836	Emergency Footswitch

6.1.7 Base Control

L3144	Control, Local, C200 Basic Extended
L3145	Control, Remote, C200 Basic DC
L3146	Control, Remote, C200 Basic
L3147	Control, Local, C200 Advanced Extended
L3148	Control, Remote, C200 Advanced DC
L3149	Control, Remote, C200 Advanced Tone
HKN9019	Connector, Enhanced
GKN8266	Cable, Mini-UHF/BNC to PL259
HLN9557	Cable, Mini-UHF (M) to PL259
AARMN4030	Desktop Microphone Base Control

6.1.8 Desktop

HPN4002	Power Supply and Cable, Desktop, 1-25W Non EMC
HPN4001	Power Supply and Cable, Desktop, 25-60W Non EMC
GLN7318	Tray, Desktop without Speaker
GLN7326	Tray, Desktop with Speaker
NTN7373_R	Linecord, US, (3060665A04) Packaged

6.1.9 Installation




GKN6272	Relay Alarm and Cable, External
HLLN9457	Accessory Connector Kit (includes 16 connector pins, [5] 8-inch wires with pins attached, and an extra housing)
6686119B01	Control Head Removal Tool



























6.1.10 Option Boards




















AAHLN9725B*	Voice Storage Option Board (field installation only)
AAHHLN4182	DTMF Mobile Option Board (field installation only) (CDM1250 and CDM1550 compatible only)
RLN5499	PassPort Upgrade Kit (PassPort Board, Installation Instructions, Label)

* Voice Storage included in the PassPort board.

6.1.11 Buttons

Customer Specific:	
RLN4829	Button Kit: Mon, Scan (CDM750 compatible only)
RLN4830	Button Kit (CDM1250 and CDM1550 compatible only) 
RLN4831	Button Kit: Mon, Scan, Call, Home, Phone (CDM1250 and CDM1550 compatible only)
RLN5324	Button Kit: (CDM1550•LS ⁺): Site, Roam, Mon, Scan, Call, Home, Phone.
CDM750	
3886133B02	
3886133B03	

3886133B05	
3886133B06	
3886133B11	
3886133B12	
3886133B14	
3886133B15	
3886133B16	
3886133B35	
CDM1250/CDM1550/CDM1550•LS/CDM1550•LS ⁺	
3886134B03	
3886134B04	
3886134B05	
3886134B06	
3886134B08	
3886134B09	
3886134B10	
3886134B12	
3886134B13	
3886134B14	
3886134B15	
3886134B16	
3886134B17	
3886134B18	
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3886134B37	
3886134B38	
3886134B39	
3886134B40	
3886134B42	
3886134B46	
3886134B54	
3886134B57	
3886134B80	
3886134B81	

6.2 Error Codes - PassPort

For the purpose of this document the phrase “PassPort Trunking Controller Board” and its acronym “PTCB” are used.

Table 6-1: Power-up Display Codes (PassPort Trunking Controller Board)

If the error code displayed is...	then, there is a...	To correct the problem...
ESN BAD	PTCB Defective.	Replace PTCB.
AppCode Fail	PTCB Firmware Defective.	Reprogram PTCB FLASH-ROM.
BackDoor		Turn radio off and restart.
ERR:Watchdog	Firmware Failure Resulted in Watchdog Timer Interrupt.	Restart radio.
Unprogrammed	Programming is not correct	Use CPS and PPCPS to properly program radio and PTCB.
ERROR: NO PTG		Use PPCPS to program that Zone with a Primary Talk Group.

Notes

Chapter 7

Model Chart and Test Specifications

7.1 UHF 403-470 MHz (Conventional)

CDM Series, UHF, 403-470 MHz							
Model					Description		
AAM25RHC9AA1_N					CDM750, 403-470 MHz, 1-25W, 12.5/20/25 kHz		
AAM25RKC9AA1_N					CDM750, 403-470 MHz, 25-40W, 12.5/20/25 kHz		
AAM25RHD9AA2_N					CDM1250, 403-470 MHz, 1-25W, 12.5/20/25 kHz		
AAM25RKD9AA2_N					CDM1250, 403-470 MHz, 25-40W, 12.5/20/25 kHz		
AAM25RHF9AA5_N					CDM1550, 403-470 MHz, 1-25W, 12.5/20/25 kHz		
AAM25RKF9AA5_N					CDM1550, 403-470 MHz, 25-40W, 12.5/20/25 kHz		
					Item	Description	
X	X				GCN6112	Control Head, CDM750	
		X	X		GCN6113	Control Head, CDM1250	
				X	X	GCN6114	Control Head, CDM1550
X		X		X		IMUE6027	Tanapa, UHF 403-470 MHz, 1-25W, 12.5/20/25 kHz
X		X		X		IMUE6027_S	Replacement Board, UHF 403-470 MHz, 1-25W, 12.5/20/25 kHz
	X		X		X	IMUE6024	Tanapa, UHF 403-470 MHz, 25-40W, 12.5/20/25 kHz
	X		X		X	IMUE6024_S	Replacement Board, UHF 403-470 MHz, 25-40W, 12.5/20/25 kHz
X	X	X	X	X	X	HAE4002	Antenna, 403-430 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	X	X	HAE4010	Antenna, 406-420 MHz, 3.5dB Gain Roof Mount (Mini U)
X	X					6881091C54	User Guide, CDM750
		X	X			6881091C55	User Guide, CDM1250
				X	X	6881091C56	User Guide, CDM1550

"X" Indicates one of each is required.

7.2 UHF 450-512 MHz (Conventional)

CDM Series, UHF, 450-512 MHz							
Model					Description		
AAM25SKC9AA1_N					CDM750, 450-512 MHz, 25-40W, 12.5/20/25 kHz		
AAM25SHC9AA1_N					CDM750, 450-512 MHz, 1-25W, 12.5/20/25 kHz		
AAM25SHD9AA2_N					CDM1250, 450-512 MHz, 1-25W, 12.5/20/25 kHz		
AAM25SKD9AA2_N					CDM1250, 450-512 MHz, 25-40W, 12.5/20/25 kHz		
AAM25SHF9AA5_N					CDM1550, 450-512 MHz, 1-25W, 12.5/20/25 kHz		
AAM25SKF9AA5_N					CDM1550, 450-512 MHz, 25-40W, 12.5/20/25 kHz		
Item					Description		
X	X				GCN6112	Control Head, CDM750	
		X	X		GCN6113	Control Head, CDM1250	
				X	X	GCN6114	Control Head, CDM1550
	X	X		X		IMUE6028	Tanapa, UHF 450-512 MHz, 1-25W, 12.5/20/25 kHz
	X	X		X		IMUE6028_S	Replacement Board, UHF 450-512 MHz, 1-25W, 12.5/20/25 kHz
X			X		X	IMUE6025	Tanapa, UHF 450-512 MHz, 25-40W, 12.5/20/25 kHz
X	X	X	X	X	X	HAE4003_R	Antenna, 450-570 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	X	X	HAE4011_R	Antenna, 450-570 MHz, 3.5dB Gain Roof Mount (Mini U)
X	X					6881091C54	User Guide, CDM750
		X	X			6881091C55	User Guide, CDM1250
				X	X	6881091C56	User Guide, CDM1550

"X" Indicates one of each is required.

7.3 UHF 403-470 MHz (Conventional, LTR)

CDM Series, UHF, 403-470 MHz (LTR)			
Model		Description	
AAM25RHF9DU5_N		CDM1550•LS, 403-470 MHz, 1-25W, 12.5/20/25 kHz	
AAM25RKF9DU5_N		CDM1550•LS, 403-470 MHz, 25-40W, 12.5/20/25 kHz	
	Item	Description	
X	X	GCN6114	Control Head, CDM1550•LS
X		IMUE6027	Tanapa, 403-470 MHz, 1-25W, 12.5/20/25 kHz
X		IMUE6027_S	Replacement Board, UHF 403-470 MHz, 1-25W, 12.5/20/25 kHz
	X	IMUE6024	Tanapa, 403-470 MHz, 25-40W, 12.5/20/25 kHz
	X	IMUE6024_S	Replacement Board, UHF 403-470 MHz, 25-40W, 12.5/20/25 kHz
X	X	HAE4002	Antenna, 403-430 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	HAE4010	Antenna, 406-420 MHz, 3.5dB Gain Roof Mount (Mini U)
X	X	6881093C32	User Guide, CDM1550•LS

"X" Indicates one of each is required.

7.4 UHF 450-512 MHz (Conventional, LTR)

CDM Series, UHF, 450-512 MHz (LTR)			
Model		Description	
AAM25SHF9DU5_N		CDM1550•LS, 450-512 MHz, 1-25W, 12.5/20/25 kHz	
AAM25SKF9DU5_N		CDM1550•LS, 450-512 MHz, 25-40W, 12.5/20/25 kHz	
	Item	Description	
X	X	GCN6114	Control Head, CDM1550
X		IMUE6028	Tanapa, 450-512 MHz, 1-25W, 12.5/20/25 kHz
X		IMUE6028_S	Replacement Board, UHF 450-512 MHz, 1-25W, 12.5/20/25 kHz
X	X	HAE4003_R	Antenna, 450-470 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	HAE4004	Antenna, 470-512 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	6881093C32	User Guide, CDM1550•LS

"X" Indicates one of each is required.

7.5 UHF 403-470 MHz (Conventional, LTR/PassPort)

CDM Series, UHF, 403-470 MHz (LTR/PassPort)					
Model					Description
AAM25RHF9DP6_N					CDM1550•LS ⁺ , 403-470 MHz, MDC/Conventional, 1-25W
AAM25RKF9DP6_N					CDM1550•LS ⁺ , 403-470 MHz, MDC/Conventional, 25-40W
AAM25RHF9DP5_N					CDM1550•LS ⁺ , 403-470 MHz, 1-25W
AAM25RKF9DP5_N					CDM1550•LS ⁺ , 403-470 MHz, 25-40W
Item					Description
X	X	X	X	GCN6114	Control Head, CDM1550•LS ⁺
		X	X	GCN6116	Data Control Head, CDM1550•LS ⁺
		X		PMUE1754	Tanapa LS ⁺ , CDM1550•LS ⁺ , 403-470 MHz, 1-25W, 12.5/20/25 kHz
		X		PMUE1754_S	Service Kit CDM1550•LS ⁺ , 403-470 MHz, 1-25W
			X	PMUE1756	Tanapa LS ⁺ , CDM1550•LS ⁺ , 403-470 MHz, 25-40W, 12.5/20/25 kHz
			X	PMUE1756_S	Service Kit CDM1550•LS ⁺ , 403-470 MHz, 25-40W
X				PMUE1939	Tanapa LS ⁺ , CDM1550•LS ⁺ , 403-470 MHz, MDC/Conventional, 1-25W, 12.5/20/25 kHz
	X			PMUE1940	Tanapa LS ⁺ , CDM1550•LS ⁺ , 403-470 MHz, MDC/Conventional, 25-40W, 12.5/20/25 kHz
X				PMUE1939A_S	Service Kit CDM1550•LS ⁺ , 403-470 MHz, MDC/Conventional, 1-25W
	X			PMUE1940A_S	Service Kit CDM1550•LS ⁺ , 403-470 MHz, MDC/Conventional, 25-40W
X	X	X	X	HAE4002	Antenna, 403-430 MHz, 1/4 Wave Roof Mount
X	X	X	X	HAE4010	Antenna, 406-420 MHz, 3.5dB Gain Roof Mount
X	X	X	X	6881094C79	User Guide, CDM1550•LS ⁺

"X" Indicates one of each is required.

7.6 UHF 450-512 MHz (Conventional, LTR/PassPort)

CDM Series, UHF, 450-512 MHz (LTR/PassPort)					
Model				Description	
AAM25SKF9DP6_N				CDM1550•LS ⁺ , 450-512 MHz, MDC/Conventional, 25-40W	
AAM25SHF9DP6_N				CDM1550•LS ⁺ , 450-512 MHz, MDC/Conventional, 1-25W	
AAM25SHF9DP5_N				CDM1550•LS ⁺ , 450-512 MHz, 1-25W	
AAM25SKF9DP5_N				CDM1550•LS ⁺ , 450-512 MHz, 25-40W	
				Item	Description
X	X	X	X	GCN6114	Control Head, CDM1550 •LS ⁺
		X	X	GCN6116	Data Control Head, CDM1550 •LS ⁺
		X		PMUE1755	Tanapa, 450-512 MHz, 1-25W
		X		PMUE1755_S	Service Kit CDM1550•LS ⁺ , 450-512 MHz, 1-25W
			X	PMUE1757	Tanapa, 450-512 MHz, 25-40W
			X	PMUE1757_S	Service Kit CDM1550•LS ⁺ , 450-512 MHz, 25-40W
	X			PMUE1941	Tanapa, 450-512 MHz, MDC/Conventional, 1-25W
X				PMUE1942	Tanapa, 450-512 MHz, MDC/Conventional, 25-40W
	X			PMUE1941A_S	Service Kit CDM1550•LS ⁺ , MDC/Conventional, 1-25W
X				PMUE1942A_S	Service Kit CDM1550•LS ⁺ , MDC/Conventional, 25-40W
X	X	X	X	HAE4003	Antenna, 450-470 MHz, 1/4 Wave Roof Mount
X	X	X	X	HAE4004	Antenna, 470-512 MHz, 1/4 Wave Roof Mount
X	X	X	X	6881094C79	User Guide, CDM1550•LS ⁺

"X" Indicates one of each is required.

7.7 LowBand 29.7-36 MHz

CDM Series, LowBand, 29.7-36 MHz				
Model			Description	
AAM25BKC9AA1_N			CDM750, 29.7-36 MHz, 40-60W, 20 kHz	
AAM25BKD9AA2_N			CDM1250, 29.7-36 MHz, 40-60W, 20 kHz	
AAM25BKF9AA5_N			CDM1550, 29.7-36 MHz, 40-60W, 20 kHz	
			Item	Description
X			GCN6112	Control Head, CDM750
	X		GCN6113	Control Head, CDM1250
		X	GCN6114	Control Head, CDM1550
X	X	X	IMUB6000	Tanapa, 29.7-36 MHz, 40-60W, 20 kHz
X	X	X	IMUB6000_S	Replacement Board, 29.7-36 MHz, 40-60 W, 20 kHz
X	X	X	RAB4002_RB	Antenna, 29.7-36 MHz, 1/4 Wave Base Loaded (Mini U)
X			6881091C54	User Guide, CDM750
	X		6881091C55	User Guide, CDM1250
		X	6881091C56	User Guide, CDM1550

"X" indicates one of each is required

7.8 LowBand 36-42 MHz

CDM Series, LowBand, 36-42 MHz				
Model			Description	
AAM25CKC9AA1_N			CDM750, 36-42 MHz, 40-60W, 20 kHz	
AAM25CKD9AA2_N			CDM1250, 36-42 MHz, 40-60W, 20 kHz	
AAM25CKF9AA5_N			CDM1550, 36-42 MHz, 40-60W, 20 kHz	
			Item	Description
X			GCN6112	Control Head, CDM750
	X		GCN6113	Control Head, CDM1250
		X	GCN6114	Control Head, CDM1550
X	X	X	IMUB6001	Tanapa, 36-42 MHz, 40-60W, 20 kHz
X	X	X	IMUB6001_S	Replacement Board, 36-42 MHz, 40-60 W, 20 kHz
X	X	X	RAB4003_RB	Antenna, 36-42 MHz, 1/4 Wave Base Loaded (Mini U)
X			6881091C54	User Guide, CDM750
	X		6881091C55	User Guide, CDM1250
		X	6881091C56	User Guide, CDM1550

"X" Indicates one of each is required.

7.9 LowBand 42-50 MHz

CDM Series, LowBand, 42-50 MHz			
Model			Description
AAM25DKC9AA1_N			CDM750, 42-50 MHz, 40-60W, 20 kHz
AAM25DKD9AA2_N			CDM1250, 42-50 MHz, 40-60W, 20 kHz
AAM25DKF9AA5_N			CDM1550, 42-50 MHz, 40-60W, 20 kHz
		Item	Description
X		GCN6112	Control Head, CDM750
	X	GCN6113	Control Head, CDM1250
		X GCN6114	Control Head, CDM1550
X	X	X IMUB6002	Tanapa, 42-50 MHz, 40-60W, 20 kHz
X	X	X RAB4004_RB	Antenna, 42-50 MHz, 1/4 Wave Base Loaded (Mini U)
X		6881091C54	User Guide, CDM750
	X	6881091C55	User Guide, CDM1250
		X 6881091C56	User Guide, CDM1550

"X" Indicates one of each is required.

7.10 VHF 136-174 MHz

CDM Series, VHF, 136-174 MHz (Conventional/LTR)											
Model										Description	
AAM25KHC9AA1_N										CDM750, 136-174 MHz, 1-25W, 12.5/20/25 kHz	
AAM25KKC9AA1_N										CDM750, 136-174 MHz, 25-45W, 12.5/20/25 kHz	
AAM25KHD9AA2_N										CDM1250, 136-174 MHz, 1-25W, 12.5/20/25 kHz	
AAM25KKD9AA2_N										CDM1250, 136-174 MHz, 25-45W, 12.5/20/25 kHz	
AAM25KHF9AA5_N										CDM1550, 136-174 MHz, 1-25W, 12.5/20/25 kHz	
AAM25KKF9AA5_N										CDM1550, 136-174 MHz, 25-45W, 12.5/20/25 kHz	
AAM25KHF9DU5_N										CDM1550•LS, 136-174 MHz, 1-25W, 12.5/20/25 kHz, MDC1200 on LTR	
AAM25KKF9DU5_N										CDM1550•LS, 136-174 MHz, 25-45W, 12.5/20/25 kHz, MDC1200 on LTR	
AAM25KHF9DU6_N										CDM1550•LS, 136-174 MHz, 1-25W, 12.5/20/25 kHz, MDC1200 on Conv. and LTR, QCII	
AAM25KKF9DU6_N										CDM1550•LS, 136-174 MHz, 25-45W, 12.5/20/25 kHz, MDC1200 on Conv. and LTR, QCII	
										Item	Description
X	X									GCN6112	Control Head, CDM750
		X	X			X	X	X	X	GCN6113	Control Head, CDM1250
				X	X					GCN6114	Control Head, CDM1550
X		X		X		X		X		IMUD6014	Tanapa, VHF 136-174 MHz, 1-25W, 12.5/20/25 kHz
X		X		X		X		X		IMUD6014_S	Replacement Board, VHF 136-174 MHz, 1-25W, 12.5/20/25 kHz
	X		X		X		X		X	IMUD6015	Tanapa, VHF 136-174 MHz, 25-40W, 12.5/20/25 kHz
X	X	X	X	X	X	X	X	X	X	HAD4006	Antenna, 136-144 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	X	X	X	X	X	X	HAD4007	Antenna, 146-150.8 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	X	X	X	X	X	X	HAD4008	Antenna, 150.8-162 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	X	X	X	X	X	X	HAD4009	Antenna, 162-174 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	X	X	X	X	X	X	HAD4014	Antenna, 146-172 MHz, 3dB Gain Roof Mount (Mini U)
X	X									6881091C54	User Guide, CDM750
		X	X							6881091C55	User Guide, CDM1250
				X	X	X	X	X	X	6881091C56	User Guide, CDM1550

"X" Indicates one of each is required.

7.11 VHF 136-174 MHz (LTR and PassPort)

CDM Series, VHF, 136-174 MHz (LTR and Passport)					
Model				Description	
AAM25KHF9DP5_N				CDM1550·LS ⁺ , 136-174 MHz, 25W, 16CH	
AAM25KHF9DP6_N				CDM1550·LS ⁺ , 136-174 MHz, 25W, 160CH w/MDC	
AAM25KKF9DP5_N				CDM1550·LS ⁺ , 136-174 MHz, 45W, 16CH	
AAM25KKF9DP6_N				CDM1550·LS ⁺ , 136-174 MHz, 45W, 160CH w/MDC	
Item				Description	
X	X	X	X	GCN6114	CDM1550·LS / CDM1550·LS ⁺ , Control Head
X		X		GCN6116	Data CDM1550·LS / CDM1550·LS ⁺ , Control Head
X	X	X	X	PMLD4288	CDM1550·LS ⁺ , VHF R1 25W PASSPORT Main Board
X	X	X	X	PMLD4289	CDM1550·LS ⁺ , VHF R1 45W PASSPORT Main Board
X				PMUD2076A	Tanapa, VHF 136-174 MHz, 25W, 16CH
	X			PMUD2077A	Tanapa, VHF 136-174 MHz, 25W, 160CH w/ MDC
		X		PMUD2078A	Tanapa, VHF 136-174 MHz, 45W, 16CH
			X	PMUD2079A	Tanapa, VHF 136-174 MHz, 45W, 160CH w/ MDC
X	X	X	X	HAD4006	Antenna, 136-144 MHz, ¼ Wave Roof Mount (Mini U)
X	X	X	X	HAD4007	Antenna, 146-150.8 MHz, ¼ Wave Roof Mount (Mini U)
X	X	X	X	HAD4008	Antenna, 150.8-162 MHz, ¼ Wave Roof Mount (Mini U)
X	X	X	X	HAD4009	Antenna, 162-174 MHz, ¼ Wave Roof Mount (Mini U)
X	X	X	X	HAD4014	Antenna, 146-172 MHz, 3dB Gain Roof Mount (Mini U)
X	X	X	X	6881094C79	User Guide, CDM1550.LS / CDM1550.LS ⁺

"X" Indicates one of each is required.

7.12 Specifications

General			
Specification	LowBand	VHF	UHF
Model Numbers:	AAM25BKC9AA1_N AAM25CKC9AA1_N AAM25DKC9AA1_N AAM25BKD9AA2_N AAM25CKD9AA2_N AAM25DKD9AA2_N AAM25BKF9AA5_N AAM25CKF9AA5_N AAM25DKF9AA5_N	AAM25KHC9AA1_N AAM25KKC9AA1_N AAM25KHD9AA2_N AAM25KKD9AA2_N AAM25KHF9AA5_N AAM25KKF9AA5_N AAM25KHF9DU6_N AAM25KKF9DU6_N AAM25KHF9DP5_N AAM25KHF9DP6_N AAM25KKF9DP6_N AAM25KKF9DP6_N	AAM25RHC9AA1_N AAM25RKC9AA1_N AAM25RHD9AA2_N AAM25RKD9AA2_N AAM25RHF9AA5_N AAM25RKF9AA5_N AAM25SHC9AA1_N AAM25SKC9AA1_N AAM25SHD9AA2_N AAM25SKD9AA2_N AAM25SHF9AA5_N AAM25SKF9AA5_N AAM25RHF9DU5_N AAM25RKF9DU5_N AAM25SHF9DU5_N AAM25SKF9DU5_N AAM25RHF9DP5_N AAM25SHF9DP5_N AAM25RKF9DP5_N AAM25SKF9DP5_N AAM25RHF9DP6_N AAM25RKF9DP6_N AAM25SHF9DP6_N AAM25SKF9DP6_N
Frequency Range:	29.7-36 MHz 36-42 MHz 42-50 MHz	136-174 MHz	403-470 MHz 450-512 MHz
Frequency Stability (-30°C to +60°C, 25°C Ref.)	±5 PPM	±2 PPM	
Channel Capacity:	4, 64, 128		
Channel Spacing:	20 kHz	12.5/20/25 kHz	
Power Supply:	13.2Vdc (10.8 - 15.6 Vdc) negative vehicle ground		

General			
Specification	LowBand	VHF	UHF
Dimensions (L X W X H) Low power (1-25W): CDM750		6.97" X 6.93" X 2.2" (177mm X 176mm X 56mm)	
CDM1250		7.32" X 7.05" X 2.34" (186mm X 179mm X 59mm)	
CDM1550		7.4" X 7.28" X 2.83" (188mm X 185mm X 72mm)	
CDM1550•LS CDM1550•LS ⁺		7.4" X 7.28" X 2.83" (188mm X 185mm X 72mm)	
High power: (25-45W) CDM750		7.44" X 6.93" X 2.2" (189mm X 176mm X 56mm)	
CDM1250		7.8" X 7.05" X 2.34" (198mm X 179mm X 59mm)	
CDM1550		7.87" X 7.28" X 2.83" (200mm X 185mm X 72mm)	
High power: (40-60W) CDM750	9.47" X 6.93" X 2.3" (240mm X 176mm X 58mm)		
CDM1550•LS CDM1550•LS ⁺		7.87" X 7.28" X 2.83" (200mm X 185mm X 72mm)	
CDM1250	9.84" X 7.05" X 2.36" (250mm X 179mm X 60mm)		
CDM1550	10.02" X 7.28" X 2.83" (255mm X 185mm X 72mm)		
Weight: Low power (1-25W) High power (25-45W) High power (40-60W)	4.5 lbs. (2.04 kg)	3.15 lbs (1.43 kg) 3.5 lbs (1.59 kg)	

General			
Specification	LowBand	VHF	UHF
FCC Description:	AZ492FT1627 (40-60W, 29.7-36 MHz) AZ492FT1628 (40-60W, 36-42 MHz) AZ492FT1626 (40-60W, 42-50 MHz)	AZ492FT3796 (25W) AZ492FT3795 (45W)	AZ492FT4835 (25W, 403-470 MHz) AZ492FT4830 (40W, 403-470 MHz) AZ492FT4829 (25W, 450-512 MHz) AZ492FT4836 (40W, 450-512 MHz)
Operating Temperature	-30 to 60 ° C		
Storage Temperature	-55 to 85 ° C		
Thermal Shock	-40 to 85 ° C		
Humidity	95% RH @ 8 Hr.		
ESD	IEC 801-2 KV		
Water Intrusion	IP54		
Packing Test	Impact Test		

Transmitter			
Specification	LowBand	VHF	UHF
Power Output:	40-60W	1-25W 25-45W	1-25W 25-40W
Conducted/Radiated Emissions:	-26 dBm	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	TIA603 and ETS300 / CEPT 84 Annex 2		
Audio Distortion: @ 1000 Hz, 60% Rated Maximum Deviation:	3% Typical		
Modulation Limiting:	±5.0 kHz	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz	
FM Hum and Noise:	-45 dB	-40 dB@12.5 kHz -45 dB@25 kHz	-40 dB@12.5 kHz -45 dB@25 kHz

Receiver			
Specification	LowBand	VHF	UHF
Sensitivity (12 dB SINAD):	0.25 μ V Typical	0.23 μ V Typical	
Intermodulation:	80 dB Typical	78 dB@25 kHz VHF 75 dB@12.5 kHz VHF	75 dB@25 kHz UHF 75 dB@12.5 kHz UHF
Adjacent Channel Selectivity:	80 dB	80 dB @ 25 kHz 65 dB @ 12.5 kHz	75 dB @ 25 kHz UHF 65 dB @ 12.5 kHz UHF
Spurious Rejection:	80 dB	80 dB @ 25 kHz 75 dB @ 12.5 kHz	75 dB @ 25 kHz 70 dB @ 12.5 kHz
Rated Audio:	3W Internal 13W External		
Audio Distortion @ Rated Audio:	3% Typical		
Hum and Noise:	-45 dB	-40 dB @ 12.5 kHz -45 dB @ 25 kHz	
Audio Response:	TIA603 and ETS300 / CEPT 84 Annex 2		
Conducted Spurious Emission per FCC Part 15:	-57 dBm <1 Ghz -47 dBm >1 Ghz		

Specifications subject to change without notice. All electrical specifications and methods refer to EIA/TIA 603 standards. CDM Series radios meet or exceed requirements of MIL STD 810 C, D, E.

Notes

Glossary

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 ration).
ASF IC	Audio Signalling Filter Integrated Circuit with voice compander.
CD	Compact Disk.
CMP	Compression.
CPS	Customer Programming Software.
CSQ	Carrier Squelch.
DTMF	Dual-Tone Multifrequency.
DPL	Digital Private-Line™.
EEPROM	Electrically 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 stored 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.
LDMOS	Lateral Diffusion MOS.
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.
LTR	Trunked Signaling Protocol using low-speed data. Registered trademark of E.F. Johnson Company.
MDC	Motorola Data Communication.

Glossary of Terms

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 Signalling Word: data transmitted on the control channel from the central controller to the subscriber unit.
PassPort™	Enhanced trunking protocol developed by Trident Micro Systems that links wide area dispatch networking.
PC Board	Printed Circuit Board
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.
PPCPS	PassPort Customer Programming Software.
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.

Glossary of Terms

Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value
Standby Mode	An operating mode whereby the radio is muted but still 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

Notes



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