



Radius CM200™ / CM300™ & Motorola PM400™

Commercial Series

Mobile Radio Basic Service Manual



MOTOROLA

intelligence everywhere™

CM200/CM300/PM400

Radios

Basic Service Manual

6802966C15-A

Foreword

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

Note: Before operating or testing these units, please read the Product Safety and RF Exposure Compliance section.

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SAFETY INFORMATION

Product Safety and RF Exposure Compliance



Caution

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

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements.

Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 68P81095C99) 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

1.0 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 and is current as of the printing date. Changes which occur after the printing date may be incorporated by a complete Manual revision or alternatively as additions.

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

2.0 Warranty and Service Support

Motorola offers long term support for its products. This support 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" by an authorised Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorized Motorola Dealer.

2.1 Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes 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 (Please see page 2 and page 3 in this Chapter). All returns must be accompanied by a Warranty Claim Form, available from your Customer Services representative. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

2.2 After Warranty Period

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

1. Motorola's Radio Products and Services Division (RPSD) offers a repair service to both end users and dealers at competitive prices.
2. Radio Products and Services Division (RPSD) supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

* The Radio Products and Services Division (RPSD) was formerly known as the Accessories and Aftermarket Division (AAD)

3.0 Replacement Parts Ordering

3.1 Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. This applied to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, a sufficient description of the desired component to identify it.

3.2 Motorola Online

Motorola online users can access our on-line catalog at:

<HTTPS://WWW.MOTOROLA.COM/BUSINESSONLINE>

To register for online access, please call 800-814-0601 (for U.S. and Canada Service Centers only).

3.3 Mail Orders

Send written orders to the following addresses:

**Replacement Parts/Test
Equipment/Manuals/Crystal
Service Items:**

Motorola, Inc.
Radio Products and Services Division
Attention: Order Processing
2200 Galvin Dr.
Elgin, IL 60123
U.S.A.

Federal Government Orders:

Motorola, Inc.
U.S. Federal Government
Markets Division
Attention: Order Processing
7230 Parkway Drive
Landover, MD21076
U.S.A.

International Orders:

Motorola, Inc.
Radio Products and Services
Division
Attention: Order Processing
2200 Galvin Dr.
Elgin, IL 60123
U.S.A.

3.4 Telephone Orders

Radio Products and Services Division (RPSD)
(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

847-538-8023 (International Orders)

U.S. Federal Government Markets Division (USFGMD)

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

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

3.5 Fax Orders

Radio Products and Services Division (RPSD)
(United States and Canada)

1-800-622-6210

847-576-3023 (International)

USFGMD

(Federal Government Orders)

1-800-526-8641 (For Parts and Equipment Purchased Orders)

3.6 Parts Identification

Radio Products and Services Division (RPSD)*
 (United States and Canada)
 1-800-422-4210, menu 3

* The Radio Products and Services Division (RPSD) was formerly known as the Accessories and Aftermarket Division (AAD)

4.0 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 radio model number and its specific characteristics.

Table 1-1 Radio Model Number (Example: AAM50KNC9AA1)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level
AA ↑ AA = Country Code	M ↑ M = Mobile	50	J VHF1 (136-162 MHz)	N 1-25 W	C CM200	9 Program- mable	AA Conven- tional MDC	1 4/32 mini-U
								3 64 mini-U
			K VHF2 (146-174 MHz)	P 25-40 W	F CM300 PM400			
			R UHF2 (438-470 MHz)	Q 25-45 W				
			S UHF3 (465-495 MHz)					

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Chapter 2

MAINTENANCE

1.0 Introduction

This chapter provides details about the following:

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

2.0 Preventive Maintenance

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

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 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 and housing assembly. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

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

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



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

Cleaning External Plastic Surfaces

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

Cleaning Internal Circuit Boards and Components

Isopropyl alcohol (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 are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. After completing of the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or top cover.

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

3.0 Safe Handling of CMOS and LDMOS Devices

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

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



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

- Store and transport all CMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS devices into conventional plastic “snow” trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS device. We recommend using the Motorola Static Protection Assembly (part number 0180386A82), which includes a wrist strap, two ground cords, a table mat, and a floor mat.
- Wear a conductive wrist strap in series with a 100k resistor to ground. (Replacement wrist straps that connect to the bench top covering are Motorola part number 4280385A59)
- Do not wear nylon clothing while handling CMOS devices.
- Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

4.0 Repair Procedures and Techniques — General

Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number and order the part from the nearest Motorola Parts center listed in the “Piece Parts” section in Chapter 1 of this manual.

Rigid Circuit Boards

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

When soldering near the RF connector, potentiometer, 16-pin and 20-pin connectors:

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

5.0 Disassembling and Reassembling the Radio — General

Since these radios may be disassembled and reassembled with the use of only 14 (board to casting) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling/assembling the radio:

- Small flat blade screwdriver
- Phillips small 1# screwdriver
- TORX™ T9 screwdriver
- TORX™ T10 screwdriver
- Torque screwdriver set
- Torque spanner
- Hex tool (part no. 6680334F39)

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

The following disassembly procedures should be performed only if necessary:

6.0 Radio Disassembly - Detailed

The procedure to remove and replace a Control Head, Top Cover or Transceiver Board is similar for all models of radio. A typical procedure is therefore shown followed by specific disassembly procedures for Control Heads on radio models without a display and radio models fitted with a display.

6.1 Control Head Removal

NOTE Ensure that the volume knob is in the OFF position before disassembling the radio.

Volume Knob Removal

1. Insert the flat screwdriver between the control head plastic and the volume knob and push the volume knob upwards. See Figure 2-1.

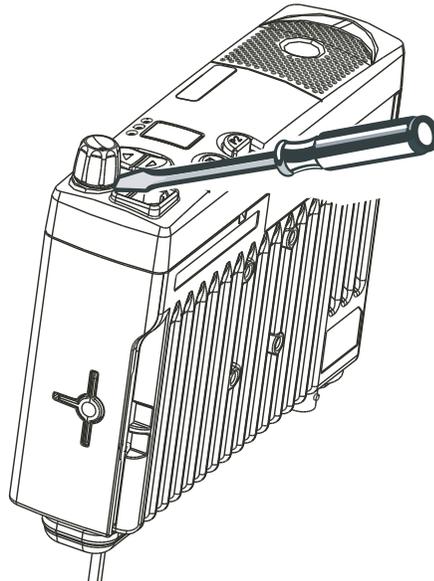


Figure 2-1 Volume Knob Removal.

2. Insert the flat screw driver (4 mm maximum) into the slot and push the plastic up. Do the same with the second slot to free the control head from the chassis assembly. See Figure 2-2.

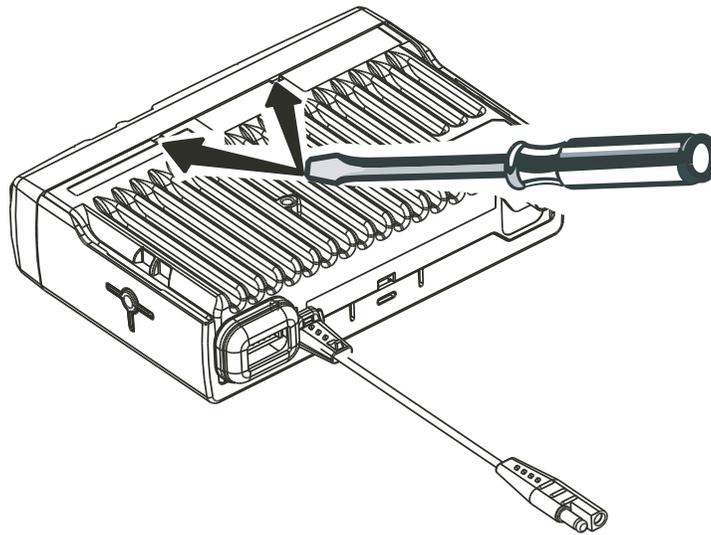


Figure 2-2 Control Head Removal

3. To free the control head, disconnect the flat cable from the chassis assembly See Figure 2-3.

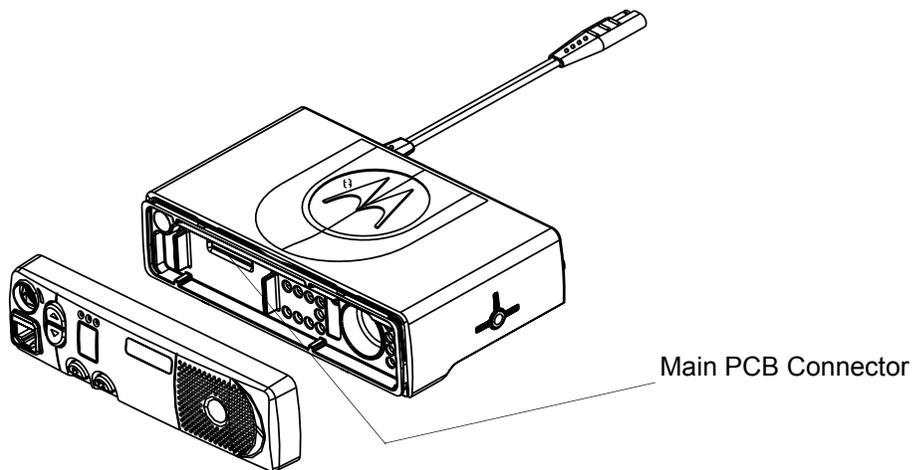


Figure 2-3 Flat Cable Removal

6.2 Top Cover Removal

1. Place the radio in a vertical position as shown in Figure 2-4.

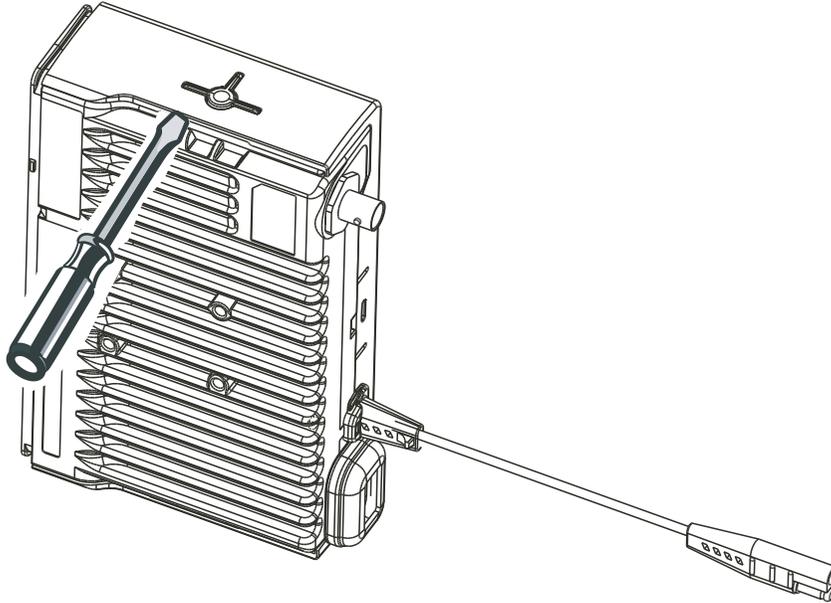


Figure 2-4 Top Cover Removal (Chassis Vertical).

2. Insert the flat screw driver near the 'T' and push the plastic cover up until it pops over the 'T' mount boss. Perform the same function on the 'T' location on the other side of the chassis.
3. Next place the radio in a horizontal position as shown in Figure 2-5 and insert the flat screw driver into the slot to release the upper cover.

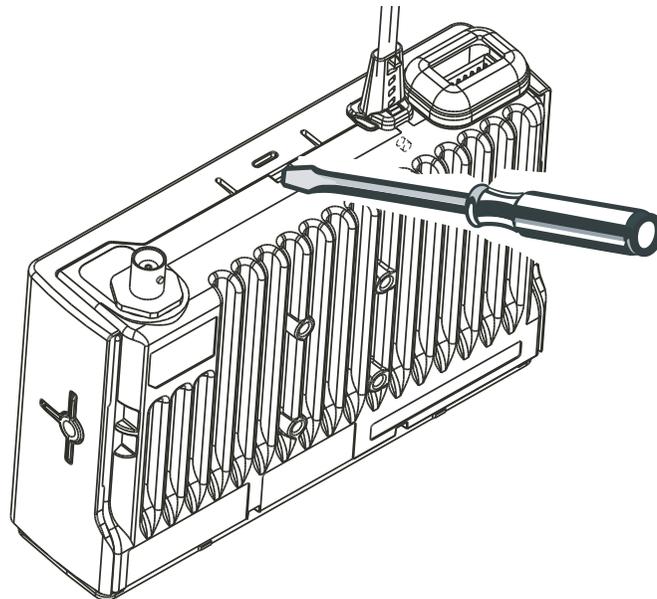


Figure 2-5 Top Cover Removal (Chassis Horizontal)

6.3 Main Shield Removal

1. Insert the screw driver in the gap between the main shield and chassis (speaker cutout area) and push the shield up. See Figure 2-6.
2. Lift the cover from the chassis.

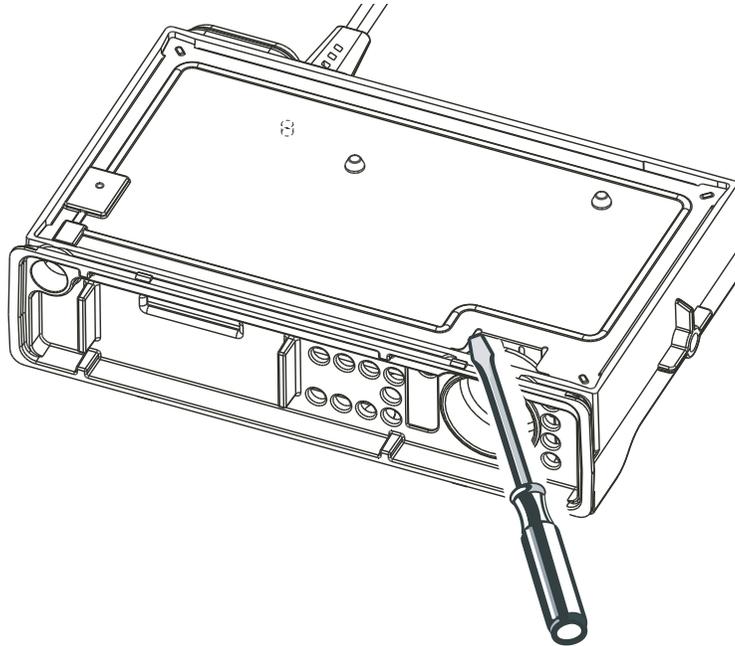


Figure 2-6 Main Shield Removal

6.4 PA Shield and DC Cable Removal

1. Remove the three screws that attach the PA shield to PCB, and remove the PA shield.
2. Remove the accessory Connector cap.
3. Remove the two screws that attach the DC power cable to the PCB and pull it out from the side.

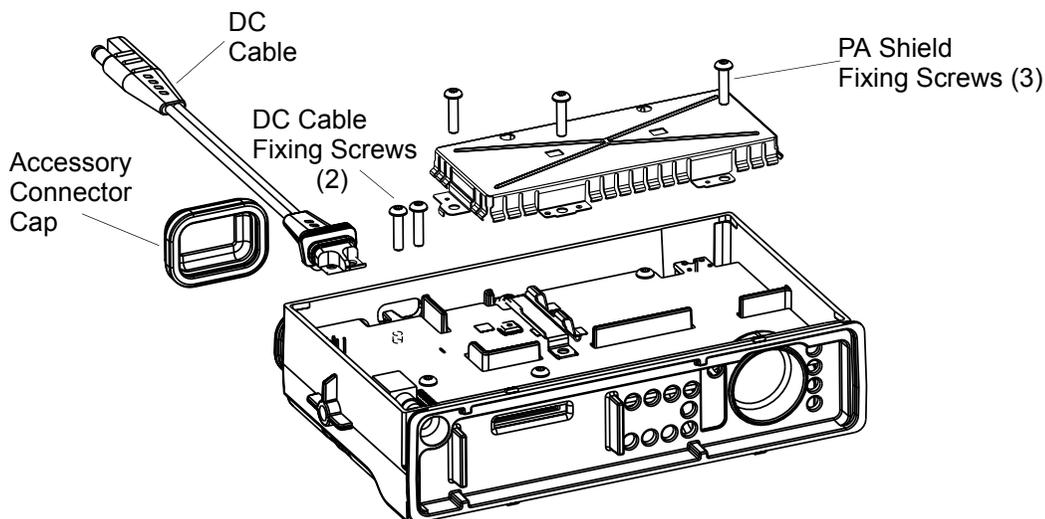


Figure 2-7 PA Shield and DC Cable Removal (for Low Power Models)

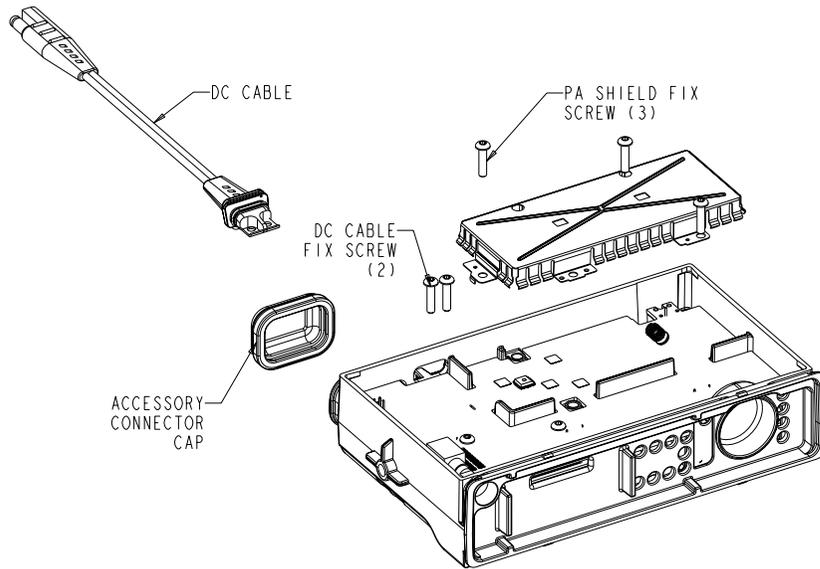


Figure 2-8 PA Shield and DC Cable Removal (for High Power Models)

6.5 PA Clip and Main PCB Removal (for Low Power Models)

1. Remove the screw that attaches the PA clip to the chassis. See Figure 2-9.
2. Remove the PA clip.
3. Remove all the screws that fix the PCB to the chassis.
4. Loosen the M2 screw (about 3 to 4 turns) on the RF connector using hex tool (Part number: 6680334F39).
5. Loosening this screw, enables you to unscrew the RF connector from outside.
6. Carefully remove the main PCB in a diagonal manner.

NOTE It is recommended to grip the volume potentiometer and remove the PCB board

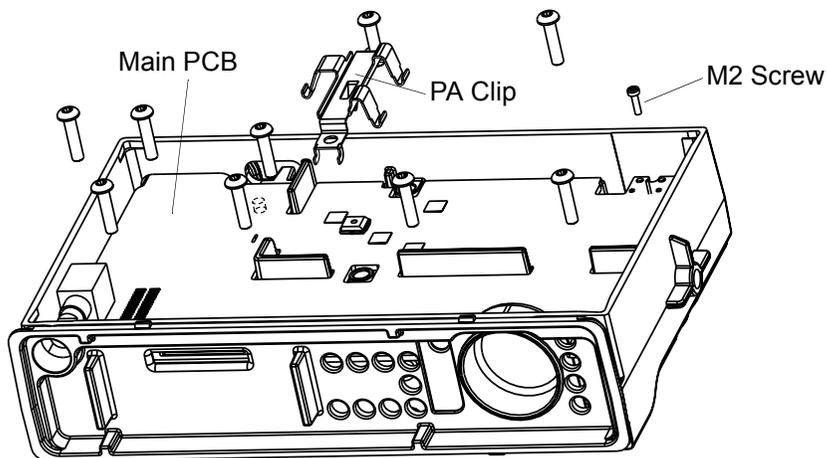


Figure 2-9 PA Clip and Main PCB Removal (for Low Power Models)

6.6 Main PCB Removal (for High Power Models)

1. Remove the PA screws. See Figure 2-10.
2. Remove all the screws that fix the PCB to the chassis.
3. Loosen the M2 screw (about 3 to 4 turns) on the RF connector using hex tool (Part number: 6680334F39).
4. Loosening this screw, enables you to unscrew the RF connector from outside.
5. Carefully remove the main PCB in a diagonal manner.

NOTE It is recommended to grip the volume potentiometer and remove the PCB board

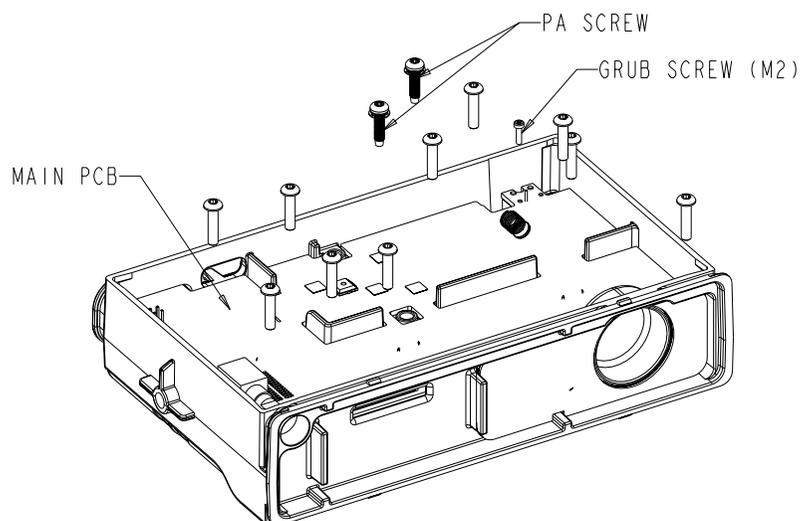


Figure 2-10 PA Clip and Main PCB Removal (for High Power Models)

6.7 Disassembly of Control Head - CM200

1. Disconnect the flat cable from the Control Head PCB connector. See Figure 2-11.
2. Remove the PCB from the keypad assembly.
3. Remove the LENSs from the rubber keypad assembly.
4. Remove the keypad assembly from the control head housing by lifting it up from the face side.
5. Disconnect the speaker socket and remove the speaker from the keypad assembly.

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.

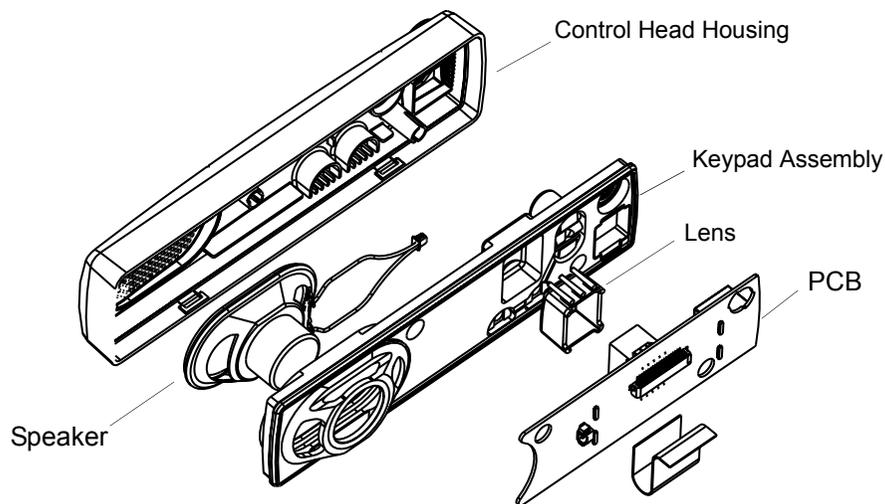


Figure 2-11 Control Head Housing Removal CM200

6.8 Disassembly of Control Heads - CM300/PM400

1. Disconnect the flat cable from the Control Head PCB connector. See Figure 2-12.
2. Remove the PCB from the keypad assembly.
3. Remove the LCD assembly from the rubber keypad assembly.
4. Remove the keypad assembly from the control head housing by lifting it up from the face side.
5. Disconnect the speaker socket and remove the speaker from the keypad assembly.

NOTE DO NOT touch or contaminate the conductive pads on the under side of the keypad, the conductive contacts on the printed circuit board or the elastomeric connector.

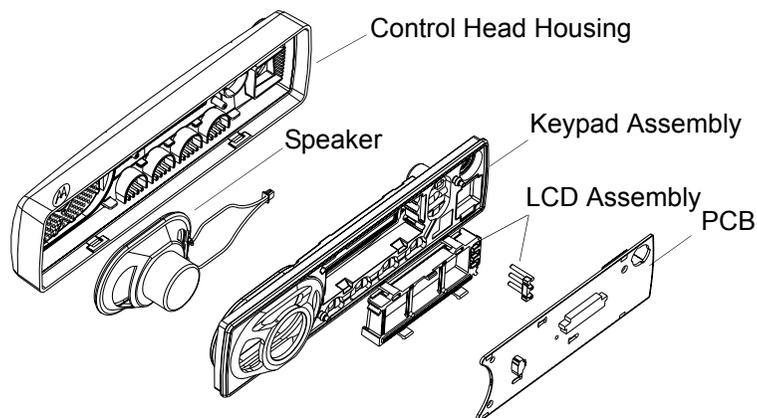


Figure 2-12 Control Head Housing Removal CM300/PM400

7.0 Radio Assembly

7.1 Chassis Assembly (for Low Power Models)

1. Ensure that the Fuji Poly Thermal Pad is on the small pedestal located on the PA compartment of the chassis.
2. Verify that the potentiometer is soldered properly.
3. Take the main PCB and smear thermal paste on LDMOS Power Amplifier, TO220, and Audio Power Amplifier.
4. Slide the main board diagonally into the chassis.
5. Tighten all eight screws (Torx T10).
6. Assemble the O-ring on the RF connector and tighten it using Torque 22 lb.in.
7. Tighten the RF connector security screw M2 using Torque 1.5 lb. (through the opening in the PCB).
8. Take the Power Amplifier Clip and insert the leg-shape side into the opening groove located on the PCB. Tighten the screw using Torque 13 lb.in
9. Take the PA Shield and place it on the PA compartment. Tighten the three screws using Torque 13 lb.in. Tighten the middle screw first, then the screw located on the left side, and lastly the screw located on the right side.
10. Insert the DC cable into the slot. Ensure that it is seated correctly on the chassis hook located below the DC cable. Attach it to the chassis and PCB by tightening the two screws using Torque 13 lb.in (Torx T10).
11. Take the main shield and place it on the chassis. Check that the corners of the main shield are seated properly on the corner supports.
12. Take the main seal and place it inside the top cover. Verify that the main seal is seated properly on its placement ribs and all around the groove.
13. Take the upper cover, place it properly on the chassis, and push it down. Three click sounds are heard from both sides and back.

7.2 Chassis Assembly (for High Power Models)

1. Verify that the potentiometer is soldered properly.
2. Take the main PCB and smear thermal paste on T0220 and Audio Power Amplifier.
3. Slide the main board diagonally into the chassis.
4. Tighten all eight screws (Torx T10).
5. Assemble the O-ring on the RF connector and tighten it using Torque 22 lb.in.
6. Tighten the RF connector security screw M2 using Torque 1.5 lb. (through the opening in the PCB).
7. Take two PA Screws and place in screw holes over PA. Tighten the screws using Torque 13 lb.in.
8. Take the PA Shield and place it on the PA compartment. Tighten the three screws using Torque 13 lb.in. Tighten the middle screw first, then the screw located on the left side, and lastly the screw located on the right side.
9. Insert the DC cable into the slot. Ensure that it is seated correctly on the chassis hook located below the DC cable. Attach it to the chassis and PCB by tightening the two screws using Torque 13 lb.in. (Torx T10).

10. Take the main shield and place it on the chassis. Check that the corners of the main shield are seated properly on the corner supports.
11. Take the main seal and place it inside the top cover. Verify that the main seal is seated properly on its placement ribs and all around the groove.
12. Take the upper cover, place it properly on the chassis, and push it down. Three click sounds are heard from both sides and back.

7.3 Control Heads Assembly

1. Assemble the Control Heads by reversing the procedure for dis-assembly..

NOTE Care should be taken not to touch or contaminate the conductive strip connectors and keypad conductors on the underside of the display and the elastomeric connectors (GM3689 only).

7.4 Control Head Fitting

1. Hold the Control Head in one hand and the chassis assembly in the other hand.
2. Insert the flat cable into the main PCB connector through the slot in the chassis.
3. Place the Control Head Assembly on the chassis assembly in a diagonal manner. Two clicking sounds are heard.
4. Insert the Volume Knob into its groove and push it in.
5. Place the cap of the accessory connector over the accessory pin.

7.5 Option Board Installation

1. Follow the disassembly procedure in paragraphs 6.1 to 6.3.
2. Remove and discard the 4xM3 screws holding the main pcb and replace with the 4 spacers provided. Torque the spacers to 10 lbs.
3. Insert the jumper flex into the connector on the option board. Notice the orientation of the right-angle flex circuit.
4. Insert the other end of the jumper flex into the connector on the main pcb.
5. Fold the flex circuit under the option board.
6. Position the option board over the spacers and retain using the 4xM2 screws provided.

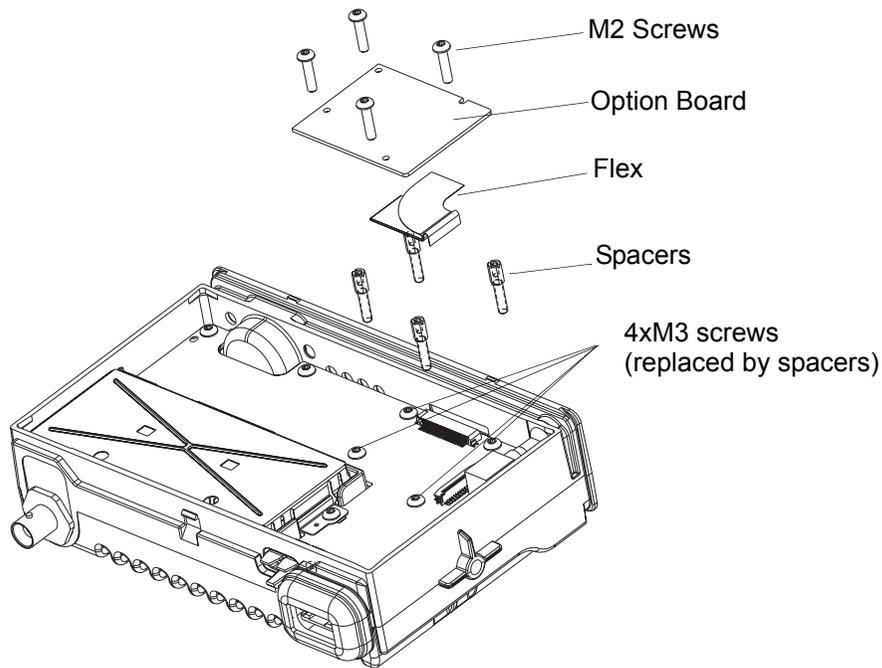


Figure 2-13 Option Board Installation

7. With the option board correctly in place, the main shield and top cover can be assembled as detailed in paragraph 7.1 steps 11 to 13.

8.0 Radio Exploded Mechanical Views and Parts Lists

8.1 Radio Assembly - 1-25 W Models

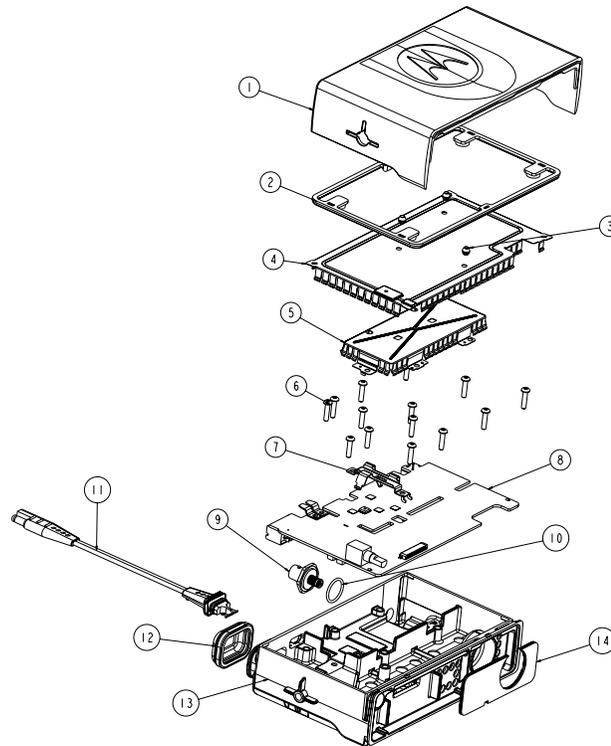


Figure 2-14 Radio Assembly - 1-25 W Models

Table 2-1 Radio Assembly Parts List - 1-25 W Models

Item No.	Description	Part Number
1	Upper Cover	1589224U01
2	Main Seal	3289329U01
3	Bumper	7587509V06
4	Main Shield	2689338U01
5	PA Shield	2689337U01
6	Screw	0310943J12
7	PA Clip	0789352U01
8	VHF Main PCB UHF Main PCB	See Chapter 7 Model Charts and Specifications.
9	Connector Jack: Mini UHF BNC	5802810C15 5802810C16
10	O-Ring	5802810C15
11	Power Cable Assembly	0189484U01
12	Cap, Accessory Connector	3202607Y01
13	Chassis 25W	2789223U01
14	Felt	3586661Z01

8.2 Radio Assembly - 25-40 W/25-45 W Models

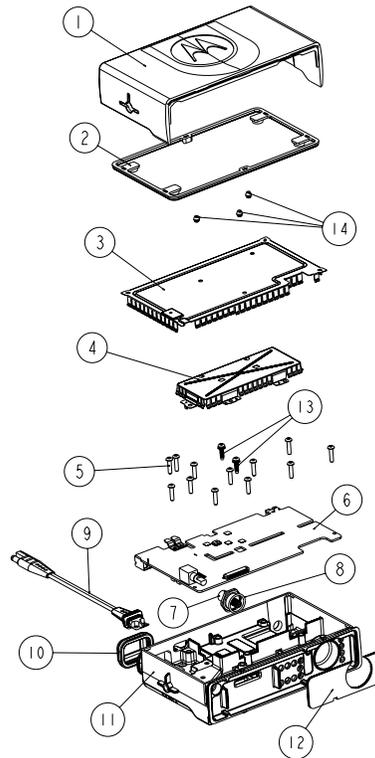


Figure 2-15 Radio Assembly - 25-40 W/25-45 W Models

Table 2-2 Radio Assembly Parts List - 25-40 W/25-45 W Models

Item No.	Description	Part Number
1	Upper Cover	1589224U01
2	Main Seal	3289329U01
3	Main Shield	2689338U01
4	PA Shield	2689337U01
5	Screw	0310943J12
6	VHF Main PCB (45W) UHF Main PCB (40W)	See Chapter 7 Model Charts and Specifications.
7	Connector Jack: Mini UHF BNC	5802810C15 5802810C16
8	O-Ring	5802810C15
9	Power Cable Assembly	0189484U01
10	Cap, Accessory Connector	3202607Y01
11	Chassis 40W	2789223U02
12	Felt	3586661Z01
13	PA Screw	0386663Z01
14	Bumper	7587509V06

8.3 Control Head - CM200

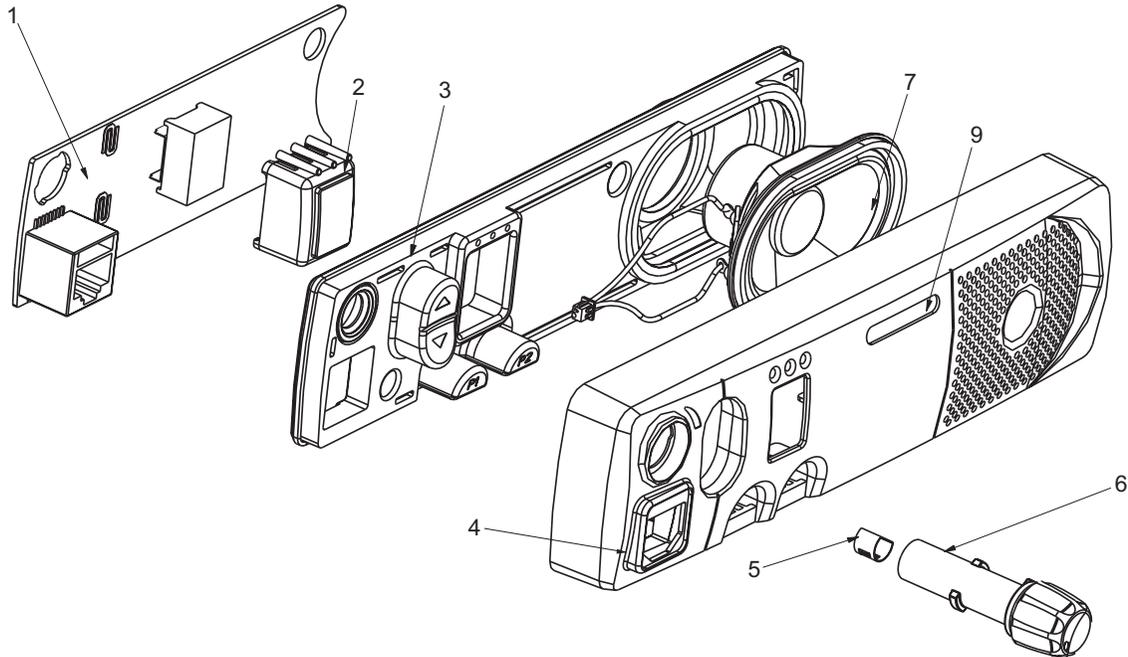


Figure 2-16 Control Head CM200

Table 2-3 Control Head CM200 Parts List

Item no	Description	Part No
1	Control Head PCB	8488998U01
2	Lens	6189338U01
3	Keypad	7589330U01
4	Control Head Plastic	1589332U01
5	Knob Spring (part of knob - item 6)	
6	Knob, Volume	3689331U02
7	Speaker	5005156Z02
8	Flat Cable (not shown)	3089305U01
9	Nameplate	5487790V03

8.4 Control Head - CM300/PM400

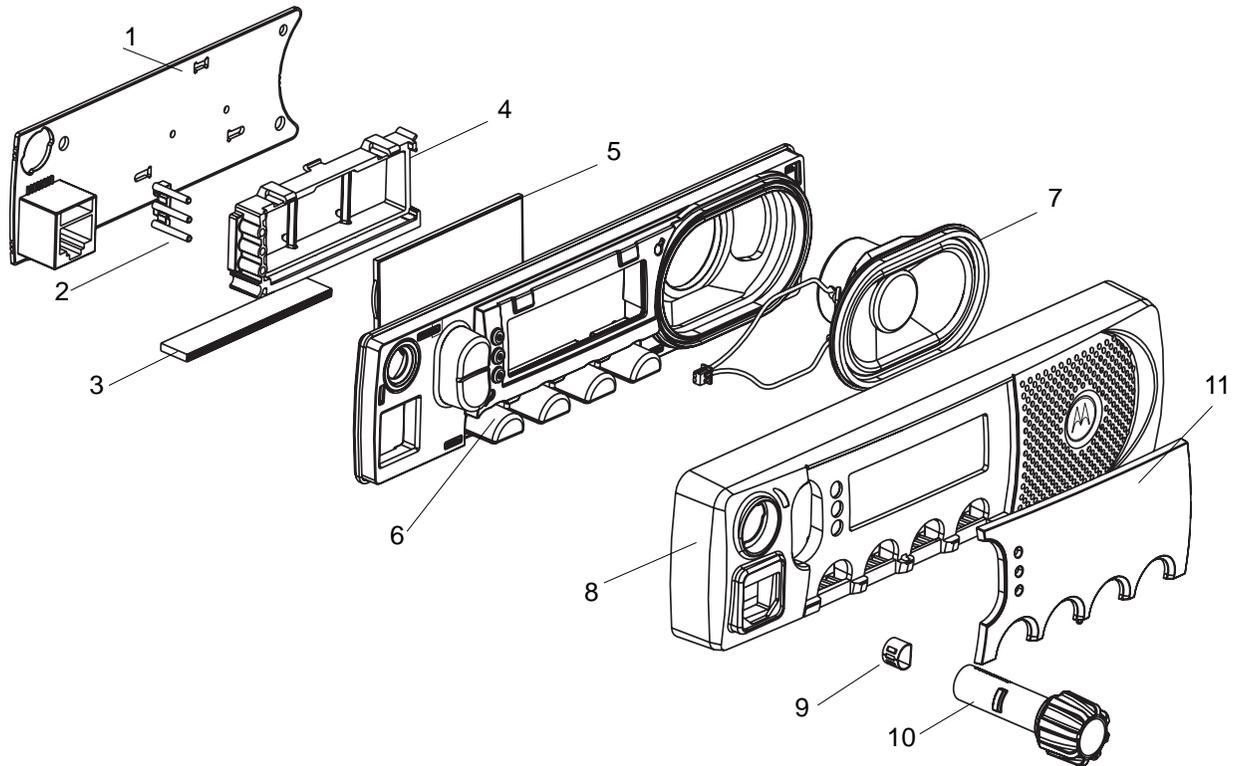


Figure 2-17 Control Head - CM300/PM400

Table 2-4 Control Head CM300/PM400 Parts List

Item no	Description	Part No.
1	Control Head PCB	8489714U01
2	Light Guide	6189624U01
3	Elastomeric Connector	2802619S03
4	LCD Holder	0789623U01
5	LCD	7202421H33
6	Keypad	7589340U01
7	Speaker	5005156Z02
8	Control Head Plastic CM300 PM400	1586605Z01 1589333U01
9	Knob Spring (part of Knob - item 10)	
10	Knob	3689331U02
11	Lens: CM300 PM400	6189339U07 6189339U04
12	Flat Cable (Not Shown)	3089305U01

9.0 Service Aids

Table 2-5 lists the service aids recommended for working on the radio. While all of these items are available from Motorola, most are standard workshop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 2-5 Service Aids

Motorola Part No.	Description	Application
RLN4460_	Portable Test Set	Enables connection to audio/accessory jack. Allows switching for radio testing.
HVN4191_	Customer Programming Software (CPS) - Software on CDROM & Global Tuner	Programs customer options and channel data.
RKN4081_	Programming Cable with Internal RIB	Includes radio interface box (RIB) capability.
FKN8096_	Data/Flash Adapter Key	Used with RKN4081 (10 to 8 pin adapter for front Telco connector with Data/Flash switch).
RKN4083_	Mobile Programming/Test Cable	Connects radio to RIB (RLN4008_) via rear accessory connector
FKN8113_	Adapter Cable	Used with RKN4083 (20 to 16 pin adapter for rear accessory connector).
GTF374_	Program Cable	Connects RIB to Radio microphone input.
RLN4008_	Radio Interface Box	Enables communications between radio and computer's serial communications adapter.
HSN9412_	Wall-Mounted Power Supply	Used to power the RIB. (120 V ac)
HLN8027_	Mini UHF to BNC Adaptor	Adapts radio antenna port to BNC cabling of test equipment.
8180384N64	Housing Eliminator (25W)	Test Fixture used to bench test the radio pcb.
3080369B71	Computer Interface Cable	Connects the RIB to the Computer (25-pin).
3080369B72	Computer Interface Cable	Connects the RIB to the Computer (9-pin) (Use for IBM PC AT - other IBM models use the B71 cable above).
6686119B01	Removal Tool	Assists in the removal of radio control head.
6680334F39	Hex Tool	Assists in the removal of antenna connector.

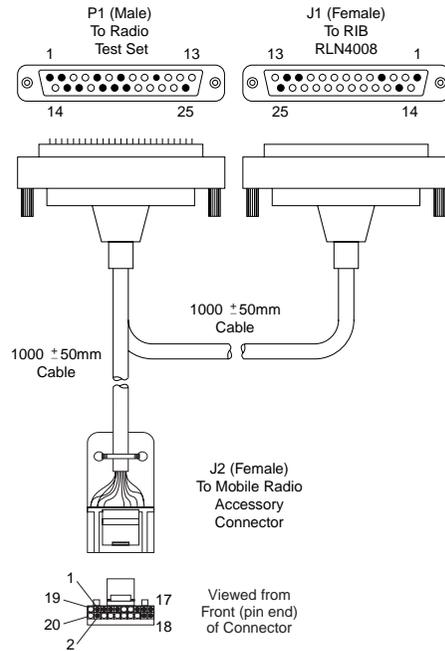
10.0 Test Equipment

Table 2-6 lists test equipment required to service the radio and other two-way radios

Table 2-6 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	• 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 13.8Vdc

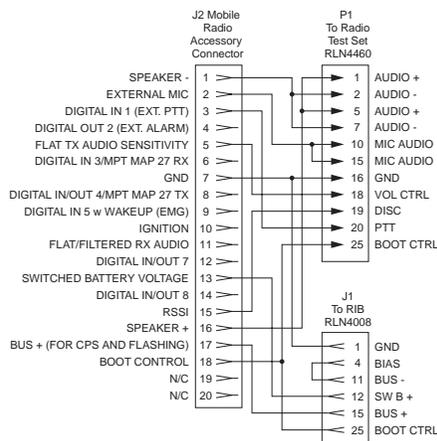
11.0 Programming/Test Cable - RKN4083_



Note: Use with Adapter Cable FKN8113_

FLO830308-0

Figure 2-18 Programming/Test Cable



FLO830307-0

Figure 2-19 Pin Configuration of RKN4083

12.0 Adapter Cable - FKN8113_

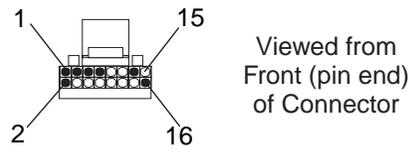
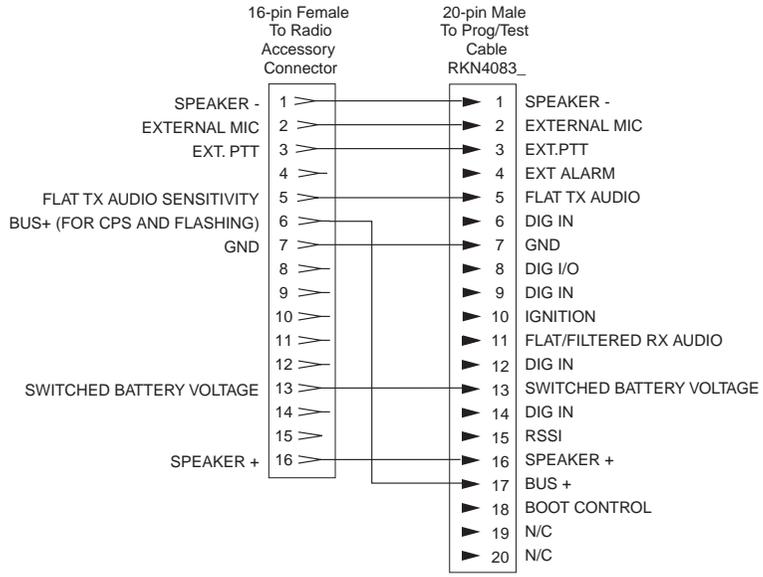


Figure 2-20 Pin Configuration of FKN8113

Chapter 3

TRANSCEIVER PERFORMANCE TESTING

1.0 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.

2.0 Setup

Supply voltage is provided using a power supply (13.8 Vdc for low power models, 13.6 Vdc for high power models). The equipment required for alignment procedures is connected as shown in the Radio Tuning Test Setup Diagram, Chapter 4, Figure 4-6.

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 Number	Title
3-2	Test Environments
3-3	Test Channel Spacing
3-4	Test Frequencies
3-5	Transmitter Performance Checks
3-6	Receiver Performance Checks

Table 3-1 Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Spkr set: A	Voltage: 13.8 Vdc (low power models) 13.6 Vdc (high power models)
RF Attn: -70	Spkr/load: Speaker	DC On/Standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 20V
Oscilloscope Source: Mod Oscilloscope Horiz: 10mSec/Div Oscilloscope Vert: 2.5 kHz/Div Oscilloscope Trig: Auto Monitor Image: Hi Monitor BW: Nar Monitor Squelch: mid CW Monitor Vol: 1/4 CW		Current: 20A

3.0 RF Test Mode

When the radio is operating in its normal environment, it is not possible to test all individual aspects of the transmitter and receiver performance. Therefore a special “test mode” is used to allow the service technician to perform certain functional tests on the product. A control head functional test mode is also available.

To enter test mode (display radios):

1. Turn the radio on.
2. Within ten seconds after the self test is complete, press button **P2**, five times in succession.
3. Channel number 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 and zero appears on the display.
7. Pressing **P1** causes the radio to display the channel number “1”. Another **P1** press causes the radio to display the next channel “2”, and so on until channel “9”.
8. Pressing **P1** at the end of the LCD test activates the ‘LED Test’. The next **P1** press turns the LEDs and dot On/Off.
9. Pressing **P1** at the end of the LED 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 - 06)

Table 3-2 Test Environments

No. of Beeps	Description	Function
1	Carrier Squelch	RX: if carrier detected TX: mic audio
1	Tone Private-Line	RX: unsquelch if carrier and tone (192.8 Hz) detected TX: mic audio + tone (192.8 Hz)
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: 1500 Hz tone
5	Unsquelch Open	RX: constant unsquelch TX: mic audio
11	CMP	RX: if carrier detected TX: mic audio

Table 3-3 Test Channel Spacing

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

Table 3-4 Test Frequencies

Channel Display	Test Channel	VHF (136-162 MHz)	VHF (146-174 MHz)	UHF (438-470 MHz)	UHF (465-495 MHz)
1 Low Power 8 High Power	TX#1 or #8 RX#1 or #8	136.125	146.025	438.025	465.225
2 Low Power 9 High Power	TX#2 or #9 RX#2 or #9	140.275	150.700	443.300	470.225
3 Low Power 10* High Power	TX#3 or #10 RX#3 or #10	144.675	155.300	448.700	475.225
4 Low Power 11* High Power	TX#4 or #11 RX#4 or #11	149.125	160.000	454.000	480.225
5 Low Power 12* High Power	TX#5 or #12 RX#5 or #12	153.475	164.700	459.300	485.225
6 Low Power 13* High Power	TX#6 or #13 RX#6 or #13	157.775	169.300	464.700	490.225
7 Low Power 14* High Power	TX#7 or #14 RX#7 or #14	161.775	173.025	469.025	494.775

* The CM200 displays only the 2nd digit and the high power indicator is illuminated.

Table 3-5 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 to be: ± 186 Hz VHF1 ± 200 Hz VHF2 ± 568 Hz UHF2 ± 600 Hz UHF3
Power RF	As above	As above	As above	1-25 W

Table 3-5 Transmitter Performance Checks (Continued)

Test Name	Communications Analyzer	Radio	Test Set	Comment
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. (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: 1.5-2.0 kHz (12.5 kHz Ch. Sp.). 2.3-3.2 kHz (20 kHz Ch. Sp.). 3.0-4.0 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.).
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.

Table 3-6 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: ± 186 Hz VHF1 ± 200 Hz VHF2 ± 568 Hz UHF2 ± 600 Hz UHF3
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 8.10Vrms
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 Tables 3-4.

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RADIO TUNING AND PROGRAMMING

1.0 Introduction

This chapter provides an overview of the Customer Programming Software (CPS) and tuner program designed for use in a Windows 98/ME/NT/2000 environment.

NOTE Refer to the CPS on-line help files for programming procedures.

Table 4-1 Software Installation Kits Radio Tuning Setup

Description	Kit Number
CPS	RVN4191_

2.0 CPS Programming/Flashing Setup with RIB

The CPS programming setup, shown in Figure 4-1 is used to program and flash the radio using the Radio front Telco connector.

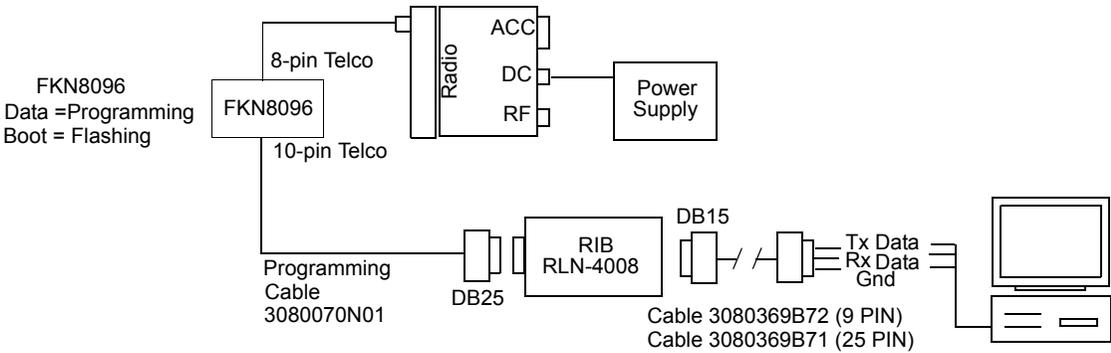


Figure 4-1 CPS Programming/Flashing Setup with RIB

3.0 CPS Programming/Flashing Setup Ribless

The CPS programming setup, shown in Figure 4-2 is used to program and flash the radio using the Radio front Telco connector.

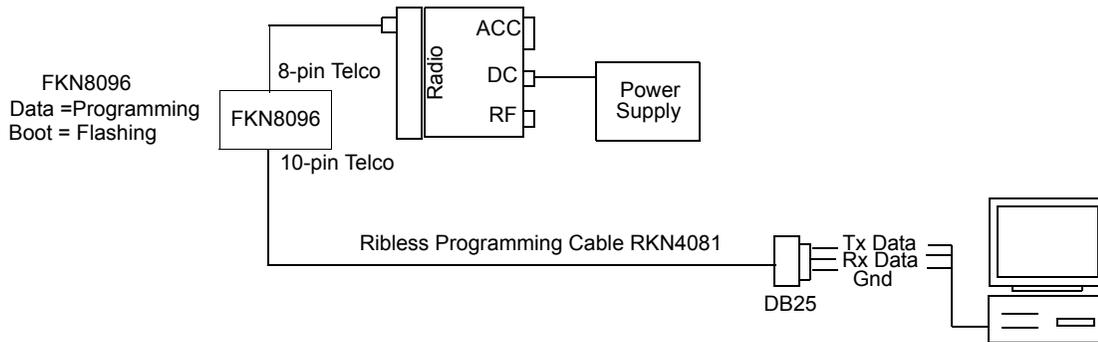


Figure 4-2 CPS Programming/Flashing Setup Cable with Internal RIB

4.0 CPS Programming Setup with RIB (with Telco Connector)

The CPS programming setup, shown in Figure 4-3 is used to program the radio using the Radio front Telco connector.

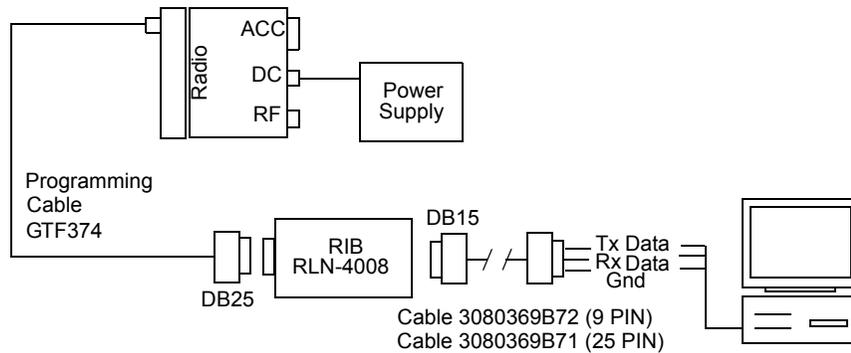


Figure 4-3 CPS Programming Setup with RIB

5.0 CPS Programming Setup with RIB (Accessory Connector)

The CPS programming setup, shown in Figure 4-4 is used to program the radio using the Radio rear accessory connector.

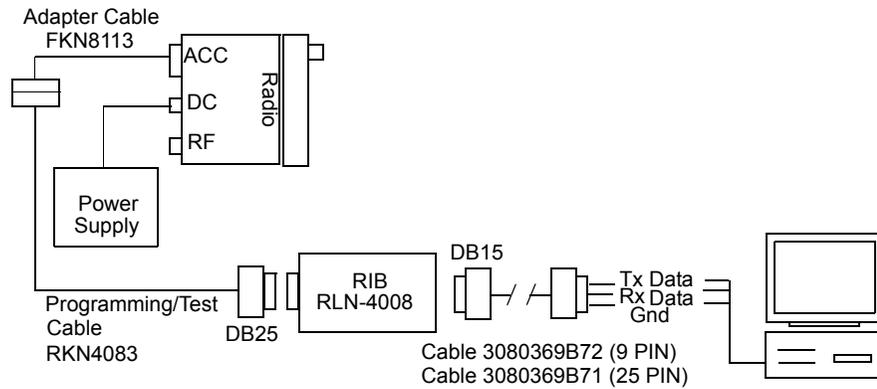


Figure 4-4 CPS Programming Setup Cable with RIB and Rear Adapter Cable

6.0 CPS Programming Setup with RIB

The CPS programming setup, shown in Figure 4-5 is used to program the radio using the Radio rear accessory connector.

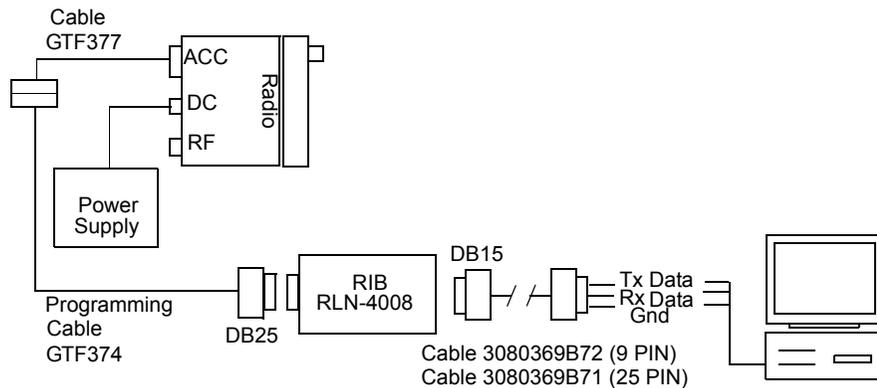


Figure 4-5 CPS Programming Setup Cable with RIB and Rear Adapter Cable

7.0 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 4-6.

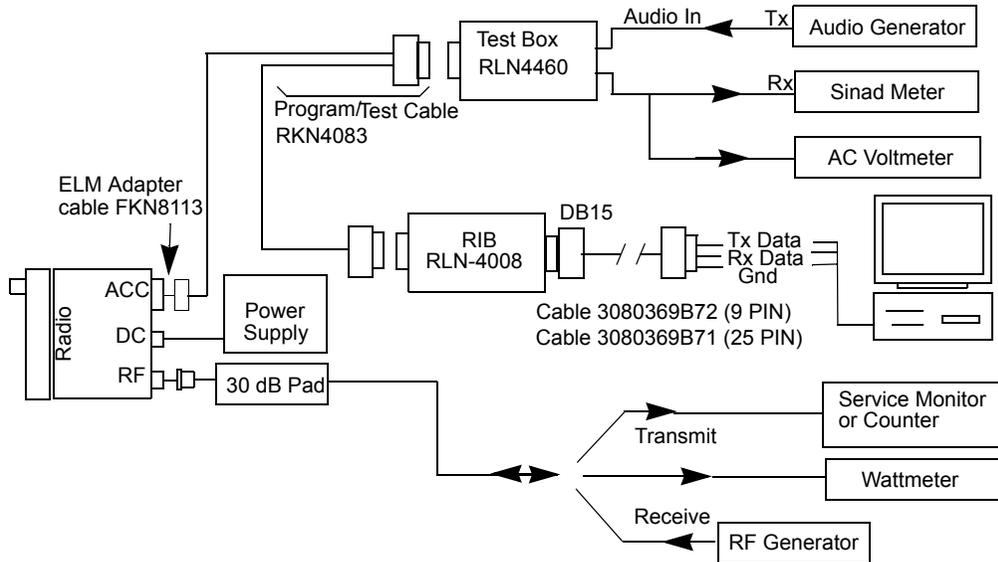


Figure 4-6 Radio Tuning Test Equipment Setup with External RIB

7.1 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: 13.8 Vdc (low power models) 13.6 Vdc (high power models)
RF Attenuation: -70	Speaker/load: Speaker	DC on/standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 20 V
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

NOTE Refer to Tuner on-line help files for tuning procedures.

Chapter 5

POWER UP SELF-TEST

1.0 Error Codes

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. If the self-test is not successful, one low-pitched tone is heard. Radios with displays are able to display the error codes. Following are the possible errors and the related connections.

Table 5-1 Power Up Error Codes

Possible Errors	To correct the problem...
RAM test failure.	Retest the radio by turning it off and turning it on again. If bad tone reoccurs, replace RAM (U0122).
Codeplug structure mismatch or non existence of codeplug.	Reprogram codeplug with correct version and retest radio. If message reoccurs, replace EEPROM (U0111).
Wrong codeplug checksum.	Reprogram codeplug.

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Chapter 6

ACCESSORIES & CONNECTOR PIN FUNCTIONS

1.0 Accessories

To order, refer to Chapter 1 (paragraph 3.0 - 'Replacement Parts Ordering') of this manual.

1.1 Antennas

VHF	
HAD4006_	136 - 144 MHz, 1/4 Wave Roof Mount
HAD4007_	144 - 150.8 MHz, 1/4 Wave Roof Mount
HAD4008_	150.8 - 162 MHz, 1/4 Wave Roof Mount
HAD4009_	162 - 174 MHz, 1/4 Wave Roof Mount
RAD4000_	136 - 174 MHz, 3 dB Gain (No Mount)
HAD4014_	140 - 174 MHz, 3.5 dB Gain Roof Mount
UHF	
HAE4002_	403 - 430 MHz, 1/4 Wave Roof Mount
HAE4003_	450 - 470 MHz, 1/4 Wave Roof Mount
HAE4004	470 - 512 MHz, 1/4 Wave Roof Mount
HAE4010_	406 - 420 MHz, 3.5 dB Gain Roof Mount
HAE4011_	450 - 470 MHz, 3.5 dB Gain Roof Mount
RAE4004_RB	445 - 470 MHz, 5 dB Gain Roof Mount
RAE4004_MB	445 - 470 MHz, 5 dB Gain Magnetic Mounts
TAE6053_	430 - 450 MHz, 1/4 Wave Roof Mount

1.2 Audio

HMN3596_	Compact Palm Microphone (Std. Mic)
HMN1035_	Heavy Duty Microphone
RMN5029_	Enhanced Keypad Microphone
RMN5018_	Mag One Microphone (Low Cost) (6 months warranty only)
RMN5019_	Mag One Keypad Microphone (Low Cost) (6 months warranty only)
AAREX4617_	Telephone Style Handset Kit
GMMN4065_	Visor Microphone (Omni Direction)
AARMN4027_	Visor Microphone - High Noise (Uni-Direction)
RSN4001_	External Speaker, 13 W
HSN8145_	External Speaker, 7.5 W
HLN9073_	Microphone Hang-up Clip (requires install)
HLN9414_	Microphone Hang-up Clip (Universal - no install required)

1.3 Alarms and Accessories

RLN4856_	Footswitch with Remote PTT
RLN4857_	Pushbutton with Remote PTT
RLN4858_	Gooseneck PTT
RLN4836_	External PTT with Emergency Footswitch
HLN9328_	External Alarm Relay (used in conjunction with GLN7282)
GLN7282_	Buzzer Kit (used in conjunction with HLN9328)

1.4 Control Station

HPN4002_	Desktop Power Supply 1-25 W
HPN4001_	Desktop Power Supply 25-60 W
HMN3000_	Black Desk Microphone
RLN5390_	Desktop Tray with Speaker
RLN5391_	Desktop Tray without Speaker
RLN5492	Low Power Control Station Kit (1-25 W) (includes power supply, desktop tray, and desk mic)
RLN5493	High Power Control Station Kit (25-60 W) (includes power supply, desktop tray, and desk mic)

1.5 Public Address

RLN5288_	Public Address Kit (includes switch box and cabling)
HKN9324_R	Speaker Cable for PA (15 ft.)
HSN1000_R	External Speaker, 6 W for public address

1.6 Cables

HKN9327_R	Ignition Switch Cable
HKN4137_	Low Power Cable to Battery (1-25 W)
HKN4191_	High Power Cable to Battery (25-60 W)

1.7 Mounting

GLN7324_	Low Profile Mounting Bracket
GLN7317_	High Profile Mounting Bracket
FTN6083_	DIN Mount
HLN8097_	Removable Slide Mount with Mini_U connector
HLN9227_	8 in. Gooseneck Trunnion
RLN4779_	Keylock Mounting Bracket

1.8 Data - CES Wireless Technologies

RDN7364_	Base Modem
RDN7367_	Mobile Display Terminal with GPS
RDN7368_	Mobile Display Terminal
RDN7369_	Stand Alone Modem with GPS
RDN7370_	Interface Cable, 3 ft
RDN7376_	Interface Cable, 15 ft
RDN7372_	Fixed Mount GPS Active Antenna
RDN7373_	Mobile Printer
RDN7374_	Programming Software for CES Equipment
RDN7380_	Mobile Programming Hardware
RDN7375_	Magnetic Mount GPS Antenna
RDN7377_	MAPS (US) Regional
RDN7378_	AVL Messaging Statue Software
RDN7371_	Credit Card Reader
RDN7738_	Serial Breakout Unit (multiple modems)
RDN7739_	Flying Lead Cable, 3 ft.
RDN7740_	Flying Lead Cable, 15 ft.

1.9 Peripherals

HLN3948	Basic RICK (Repeater Interface Comm Kit)
HLN3333	RICK (Repeater Interface Comm Kit)

2.0 Accessory Connector Pin Function

Pin	Function	Description
1	External Speaker (-)	Connect external 8 or 4 ohms speaker to pin 1 and 16. Caution: Bridge-type output. Neither pin 1 or 16 is grounded.
2	External Mic Audio	Input impedance: 500 ohms 80 mV rms at 1 kHz for 60% deviation. This path is enabled when external mic PTT is keyed.
3	External Mic PTT	Put this pin low (less than 0.66 Vdc) to key transmitter and enable external mic audio path. This path is pulled low via a diode when front panel mic PTT is pulled low to allow sensing of mic PTT by accessory. This pin pulled high to 3.3 Vdc via 3.3k ohms
4	Programmable Output	Defaults to External Alarm. Provides an active high to 13.8 Vdc battery supply, maximum current: 0.15 amps. CAUTION: Do not short to ground, this may damage the radio.
5	Flat_TX_Audio Input	Input impedance: Greater than 35k ohms. The nominal input level is 150 mV rms for 60% deviation.
6	SCI	Serial Communication Interface. This pin can be configured as a general purpose input by removing resistor R421.
7	Ground	Used as ground.
8	Programmable I/O	Input or output depending on dealer programming.
9	Emergency Input	When connecting the Emergency Footswitch between pin 9 and 7, the radio will sense the connection upon Power-up. Shorting this pin to Ground by pressing the switch when the radio is OFF, turns ON the radio in Emergency Mode. Shorting this pin to Ground by pressing the switch when the radio is ON, activates Emergency Mode. To turn OFF a radio that was turned ON by Emergency Footswitch (ON/OFF knob in OFF position) turn knob to ON and then to OFF position.
10	Ignition Sense	For optional 3-wire ignition control, connect this pin to the vehicle ignition-controlled voltage source for ignition-controlled radio ON/OFF. To resume NON ignition state, remove the battery connection for 10 seconds; remove the ignition connection from this pin and re-connect the battery connections.
11	Receive Audio Output	Programmable (using CPS in the RX Audio Type): 660mV rms (de-emphasized/muted) or 330mV rms (non de-emphasized muted). Minimum load resistance: 5k ohms
12	Programmable I/O	Input or Output
13	Switched B+	(Switched Battery Voltage) 13.8Vdc (500mA max.) when radio is ON
14	Programmable I/O	Input or Output
15	Internal Speaker	Connect to internal speaker (+) and by internal jumper to pin 16
16	External Speaker (+)	Connect external 8 or 4 ohms speaker to pins 1 and 16. CAUTION: Bridge type output. Neither pin 1 nor 16 is grounded.

3.0 Microphone Connector Pin Function

Pin	Function	Description
1	9.3V	Regulated 9.3V Supply (50mA max.)
2	Boot/DTMF Keypad Column	This pin function depends on the voltage applied to pin 3 (See pin 3, Hook description). When configured as "Boot", applying 5V to this pin will set the radio to Boot state. When configured as "DTMF Keypad Column", this pin will carry column voltages generated by the DTMF microphone (RMN5029).
3	Hook	When 0V is applied to this pin (mic on hook), pins 2 and 7 will be configured to "Column" and "Row". When no voltage is applied to this pin (mic off hook), this pin will read 2.7V, and pins 2 and 7 will be configured to "Column" and "Row". When 9.3V is applied to this pin (programming cables or Mag One mic RMN5018), pins 2 and 7 will be configured to "Boot" and "SCI".
4	Ground	Used as ground
5	Mic. Audio	Audio input impedance: 500 ohms 80 mV rms input (standard mic) or 1.8 mV rms (low cost mic) at 1 kHz for 60% deviation. This path is enabled when Mic. PTT (pin 6) is keyed
6	Mic. PTT	Microphone PTT is active low, so this port reads "0" when PTT is pressed and "1" when PTT is released. 10 K ohms internal pull up resistor to 9.3 V. Pulling low this pin will also pull low, via a diode, pin 3 (external MIC PTT) of the accessory connector.
7	SCI/DTMF Keypad Row	The function of this pin depends on the voltage applied to pin 3 (see pin 3 description). When configured as "SCI", serial communication with the radio is facilitated. When configured as "DTMF Keypad Row" this pin will carry new voltages generated by the DTMF mic (RMN5029)
8	Handset Rx Audio	Handset audio output provides de-emphasized, muted Rx audio. The source impedance is 10 ohms and the output level (open circuit) is controlled by the volume control setting.

Chapter 7

MODEL CHART AND TEST SPECIFICATION

1.0 Low Power Radios

1.1 146-174 MHz CM200/CM300/PM400 Model Chart

VHF2, 1-25 W, 146-174 MHz			
Model		Description	
	AAM50KNC9AA1AN	CM200 146-174 MHz, 1-25 W, 4 CH	
	AAM50KNF9AA1AN	CM300 146-174 MHz, 1-25 W, 32 CH	
	AAM50KNF9AA3AN	PM400 146-174 MHz, 1-25 W, 64 CH	
		Item	Description
X		PMUD1871_	CM200 Super Tanapa VHF2, 1-25 W, 4 CH
	X	PMUD1873_	CM300 Super Tanapa VHF2, 1-25 W, 32 CH
		X PMUD1904_	PM400 Super Tanapa VHF2, 1-25 W, 64 CH
X		FLD1933_	CM200 Tanapa VHF2, 1-25 W 4 CH
	X	PMUD1882_	CM300 Tanapa VHF2, 1-25 W, 32 CH
		X PMUD1882_	PM400 Tanapa VHF2, 1-25 W, 64 CH
X		PMLN4598_	Control Head
	X	PMLN4599_	Control Head
		X FLN3108_AN	Control Head
X		FLD1933_S	CM200 VHF2 Service Board
	X	PMUD1882_S	CM300 VHF2 Service Board
		X PMUD1882_S	PM400 VHF2 Service Board
X		6902966C30	CM200 User Guide (bilingual)
	X	6881096C22	CM300 User Guide (bilingual)
		X 6881096C32	PM400 User Guide (bilingual)
X	X	HKLN4220	CM200/CM300 User Guide CDROM (bilingual)
		X HKLN4219	PM400 User Guide CDROM (bilingual)

x = Indicates one of each is required.

1.2 438-370 MHz CM200/CM300/PM400 Model Chart

UHF2, 1-25 W, 438-470 MHz			
Model		Description	
	AAM50RNC9AA1A	CM200 438-470 MHz, 1-25 W, 4 CH	
	AAM50RNF9AA1AN	CM300 438-470 MHz, 1-25 W, 32 CH	
	AAN50RNF9AA3AN	PM400 438-470 MHz, 1-25 W, 64 CH	
		Item	Description
X		PMUE1996_	CM200 Super Tanapa UHF2, 1-25 W, 4 CH
	X	PMUE1998_	CM300 Super Tanapa UHF2, 1-25 W, 32 CH
		X PMUE2090_	PM400 Super Tanapa UHF2, 1-25 W, 64 CH
X		FLE1620_	CM200 Tanapa UHF2, 1-25 W, 4 CH
	X	PMUE2026_	CM300 Tanapa UHF2, 1-25 W, 32 CH
		X PMUE2026_	PM400 Tanapa UHF2, 1-25 W, 64 CH
X		PMLN4598_	Control Head
	X	PMLN4599_	Control Head
		X FLN3108_AN	Control Head
X		FLE1620_S	CM200 UHF2 Service Board
	X	PMUE2026_S	CM300 UHF2 Service Board
		X PMUE2026_S	PM400 UHF2 Service Board
X		6902966C30	CM200 User Guide (bilingual)
	X	6881096C22	CM300 User Guide (bilingual)
		X 6881096C32	PM400 User Guide (bilingual)
X	X	HKLN4220	CM200/CM300 User Guide CDROM (bilingual)
		X HKLN4219	PM400 User Guide CDROM (bilingual)

x = Indicates one of each is required.

1.3 Specifications

General		
Specification	VHF2	UHF2
Frequency Range:	146-174 MHz	438-470 MHz
Frequency Stability (-30°C to +60°C, 25°C Ref.)	±2.5 PPM	
Channel Capacity:	CM200 - 4 CM300 - 32 PM400 - 64	
Channel Spacing:	12.5/20/25 kHz	
Power Supply:	13.8 Vdc (11 Vdc - 16.6 Vdc) negative Vehicle ground	
Dimensions (L x W x H)	4.65" X 6.67" X 1.73" (118mm X 169.5mm X 44mm)	
Weight	2.25 lbs (1.01 kg)	
FCC Description	AZ492FT3805	AZ492FT4856
Operating Temperature	-30 to 60° C (Display only -20°C to 60°C)	
Storage Temperature	-40 to 85° C	
Thermal Shock	-40 to 80° C	
High Humidity	95% RH @ 50° C for 8 hrs	
ESD	15KV air discharge	
Packing Test	Impact Test	

Transmitter		
Specification	VHF2	UHF2
Power Output	1-25W	
Conducted/Radiated Emissions:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	TIA603 and CEPT	
Tx Audio Distortion	< 3%	
Modulation Limiting:	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz	
FM Hum and Noise:	-40 dB@12.5 kHz -45 dB@25 kHz	-35 dB@12.5 kHz -40 dB@25 kHz

Receiver		
Specification	VHF2	UHF2
Sensitivity (12 dB SINAD):	0.35 μ V @ 12.5 kHz 0.3 μ V @ 25 kHz	
Intermodulation:	65 dB@12.5 kHz 75 dB@25 kHz	60 dB@12.5 kHz 70 dB@25 kHz
Adjacent Channel Selectivity:	65 dB @ 12.5 kHz 75 dB @ 25 kHz	60 dB @ 12.5 kHz 70 dB @ 25 kHz
Spurious Response	75 dB	70 dB
Rated Audio Power	4 W (typ.) Internal 7.5 W @ 5 % External	
Audio Distortion	< 5 %	
Hum and Noise:	-40 dB @ 12.5 kHz -45 dB @ 25 kHz	-35 dB @ 12.5 kHz -40 dB @ 25 kHz
Audio Response	TIA603 and CEPT	
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.

2.0 High Power Radios

2.1 136-162 MHz CM300 Model Chart

VHF1, 25-45 W, 136-162 MHz			
Model		Description	
AAM50JQF9AA1AN		CM300 136-162 MHz, 25-45 W, 32 CH	
	Item	Description	
X	PMUD1946_	CM300 Super Tanapa VHF1, 25-45 W, 32 CH	
X	PMUD1962_	CM300 Tanapa VHF1, 25-45 W, 32 CH	
X	PMLN4599_	Control Head	
X	PMUD1962_S	CM300 VHF1 Service Board	
X	6881096C22	CM300 User Guide (bilingual)	
X	HKLN4220	CM300 User Guide CMROM (bilingual)	

x = Indicates one of each is required.

2.2 146-174 MHz CM200/CM300/PM400 Model Chart

VHF2, 25-45 W, 146-174 MHz			
Model		Description	
AAM50KQC9AA1AN		CM200 146-174 MHz, 25-45 W, 4 CH	
	AAM50KQF9AA1AN	CM300 146-174 MHz, 25-45 W, 32 CH	
	AAM50KQF9AA3AN	PM400 146-174 MHz, 25-45 W, 64 CH	
	Item	Description	
X	PMUD1875_	CM200 Super Tanapa VHF2, 25-45 W, 4 CH	
	X PMUD1877_	CM300 Super Tanapa VHF2, 25-45 W, 32 CH	
	X PMUD1905_	PM400 Super Tanapa VHF2, 25-45 W, 64 CH	
X	PMUD1884_	CM200 Tanapa VHF2, 25-45 W 4 CH	
	X PMUD1886_	CM300 Tanapa VHF2, 25-45 W, 32 CH	
	X PMUD1886_	PM400 Tanapa VHF2, 25-45 W, 64 CH	
X	PMLN4598_	Control Head	
	X PMLN4599_	Control Head	
	X FLN3108_AN	Control Head	
X	PMUD1884_S	CM200 VHF2 Service Board	
	X PMUD1886_S	CM300 VHF2 Service Board	
	X PMUD1886_S	PM400 VHF2 Service Board	
X	6902966C30	CM200 User Guide (bilingual)	
	X 6881096C22	CM300 User Guide (bilingual)	
	X 6881096C32	PM400 User Guide (bilingual)	
X	X HKLN4220	CM200/CM300 User Guide CDROM (bilingual)	
	X HKLN4219	PM400 User Guide CDROM (bilingual)	

x = Indicates one of each is required.

2.3 438-470 MHz CM200/CM300/PM400 Model Chart

UHF2, 25-40 W, 438-470 MHz			
Model		Description	
	AAM50RPC9AA1A	CM200 438-470 MHz, 25-40 W, 4 CH	
	AAM50RPF9AA1AN	CM300 438-470 MHz, 25-40 W, 32 CH	
	AAM50RPF9AA3AN	PM400 438-470 MHz, 25-40 W, 64 CH	
		Item	Description
X		PMUE2007_	CM200 Super Tanapa UHF2, 25-40 W, 4 CH
	X	PMUE2010_	CM300 Super Tanapa UHF2, 25-40 W, 32 CH
		X PMUE2091_	PM400 Super Tanapa UHF2, 25-40 W, 64 CH
X		PMUE2032_	CM200 Tanapa UHF2, 25-40 W, 4 CH
	X	PMUE2034_	CM300 Tanapa UHF2, 25-40 W, 32 CH
		X PMUE2034_	PM400 Tanapa UHF2,25- 40 W, 64 CH
X		PMLN4598_	Control Head
	X	PMLN4599_	Control Head
		X FLN3108_AN	Control Head
X		PMUE2032_S	CM200 UHF2 Service Board
	X	PMUE2034_S	CM300 UHF2 Service Board
		X PMUE2034_S	PM400 UHF2 Service Board
X		6902966C30	CM200 User Guide (bilingual)
	X	6881096C22	CM300 User Guide (bilingual)
		X 6881096C32	PM400 User Guide (bilingual)
X	X	HKLN4220	CM200/CM300 User Guide CDROM (bilingual)
		X HKLN4219	PM400 User Guide CDROM (bilingual)

x = Indicates one of each is required.

2.4 465-495 MHz PM400 Model Chart

UHF3, 25-40 W 465-495 MHz		
Model		Description
AAM50SPF9AA3AN		PM400 465-495 MHz, 25-40 W, 64 CH
	Item	Description
X	PMUE2092_	PM400 Super Tanapa UHF3, 25-40 W, 64 CH
X	PMUE2038_	PM400 Tanapa UHF3,25- 40 W, 64 CH
X	FLN3108_AN	Control Head
X	PMUE2038_S	PM400 UHF3 Service Board
X	6881096C32	PM400 User Guide (bilingual)
X	HKLN4219	PM400 User Guide CDROM (bilingual)

x = Indicates one of each is required.

2.5 Specifications

General				
Specification	VHF1	VHF2	UHF2	UHF3
Frequency Range:	136-162 MHz	146-174 MHz	438-470 MHz	465-495 MHz
Frequency Stability (-30°C to +60°C, 25°C Ref.)	±2.5 PPM			
Channel Capacity:	CM300 - 32	CM200 - 4 CM300 - 32 PM400 - 64		PM400 -64
Channel Spacing:	12.5/25 kHz			
Power Supply:	13.6 Vdc (10.88 Vdc - 16.32 Vdc) negative Vehicle ground			
Dimensions (L x W x H)	4.65" X 6.67" X 1.73" (118mm X 169.5mm X 44mm)			
Weight	2.25 lbs (1.01 kg)			
FCC Description	ABZ99FT3049	ABZ99FT3046	ABZ99FT4048	ABZ99FT4049
Operating Temperature	-30 to 60° C (Display only -20°C to 60°C)			
Storage Temperature	-40 to 85° C			
Thermal Shock	-40 to 80° C			
High Humidity	95% RH @ 50° C for 8 hrs			
ESD	15KV air discharge			
Packing Test	Impact Test			

Transmitter				
Specification	VHF1	VHF2	UHF2	UHF3
Power Output	25-45 W	25-40 W		
Conducted/Radiated Emissions:	-26 dBm			
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	TIA603 and CEPT			
Tx Audio Distortion	< 3%			
Modulation Limiting:	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz			
FM Hum and Noise:	-40 dB@12.5 kHz -45 dB@25 kHz		-35 dB@12.5 kHz -40 dB@25 kHz	

Receiver				
Specification	VHF1	VHF2	UHF2	UHF3
Sensitivity (12 dB SINAD):	0.35 μ V @ 12.5 kHz 0.3 μ V @ 25 kHz			
Intermodulation:	65 dB@12.5 kHz 75 dB@25 kHz		60 dB@12.5 kHz 70 dB@25 kHz	
Adjacent Channel Selectivity:	65 dB @ 12.5 kHz 75 dB @ 25 kHz		60 dB @ 12.5 kHz 70 dB @ 25 kHz	
Spurious Response	75 dB		70 dB	
Rated Audio Power	4 W (typ.) Internal 7.5 W @ 5 % External			
Audio Distortion	< 5 %			
Hum and Noise:	-40 dB @ 12.5 kHz -45 dB @ 25 kHz		-35 dB @ 12.5 kHz -40 dB @ 25 kHz	
Audio Response	TIA603 and CEPT			
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.

3.0 MIL Standards

MIL STDS 810 C, D, and E: Applicable to UHF and VHF Specifications (8.2 and 8.4)

Military Standards 810 C, D, & E: Parameters/Methods/Procedures						
Applicable MIL-STD	810C		810D		810E	
	Methods	Procedures	Methods	Procedures	Methods	Procedures
Temperature Shock	503.1	I	503.2	I	503.3	I
Solar Radiation	505.1	I	505.2	I	505.3	I
Rain	506.1	I	506.2	I	506.3	I
Salt Fog	509.1	I	509.2	I (48 hours)	509.3	I (48 hours)
Dust	510.1	I	510.2	I	510.3	I
Vibration			514.3	I, Cat. 1	514.4	I, Cat. 1
Shock	516.2	I, III	516.3	I, V	516.4	I, V

Environmental Specifications

Operating Temperature	-30 to +60 deg C
Storage Temperature	-40 to +85 deg C
Thermal Shock	-40 to +80 deg C
Humidity	95%RH @ 8 Hr.
Water Intrusion	IP 54
Packing Test	Impact test

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 Ratio).
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.
MDC	Motorola Data Communication.
MRTI	Motorola Radio-Telephone Interconnect: a system that provides a repeater connection to the Public Switched Telephone Network (PSTN). The MRTI allows the radio to access the telephone network when the proper access code is received.

OSW	Outbound Signalling Word: data transmitted on the control channel from the central controller to the subscriber unit.
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.
PTT	Push-To-Talk: the switch located on the left side of the radio which, when pressed, causes the radio to transmit.
RAM	Random Access Memory: the radio's RAM is loaded with a copy of the EEPROM data.
Registers	Short-term data-storage circuits within the microcontroller.
Repeater	Remote transmit/receive facility that retransmits received signals to improve communications coverage.
RESET	Reset line: an input to the microcontroller that restarts execution.
RF PA	Radio Frequency Power Amplifier
RIB	Radio Interface Box
ROM	Read Only Memory
RSSI	Received Signal-Strength Indicator: a dc voltage proportional to the received RF signal strength.
RPT/TA	Repeater/Talk-Around
Softpot	Software Potentiometer: a computer-adjustable electronic attenuator
Software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system
SPI (clock and data lines)	Serial Peripheral Interface: how the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value
Standby Mode	An operating mode 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

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