MOTOROLA
intelligence everywhere™

CP150™ /CP200™

Commercial Series

Two-Way Radio Basic Service Manual

Radius®

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PRODUCT SAFETY AND RF EXPOSURE COMPLIANCE

Caution

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

ATTENTION!

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

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

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Section 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 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 in the front of this manual.

1.2 Warranty

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 authorized Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorized Motorola Dealer.

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 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.

1.2.2 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 knows as the Accessories and Aftermarket Division (AAD)

1.3 Replacement Parts Ordering

1.3.1 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.

1.3.2 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).

1.3.3 Mail Orders

Send written orders to the following addresses:

Replacement Parts/Test Equipment/Manuals/Crystal Service Items:	**Federal Government Orders:**	**International Orders:**
Motorola, Inc. Radio Products and Services Division Attention: Order Processing 2200 Galvin Dr. Elgin, IL 60123 U.S.A.	Motorola, Inc. U.S. Federal Government Markets Division Attention: Order Processing 7230 Parkway Drive Landover, MD21076 U.S.A.	Motorola, Inc. Radio Products and Services Division Attention: Order Processing 2200 Galvin Dr. Elgin, IL 60123 U.S.A.

1.3.4 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)

1.3.5 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)

1.3.6 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)

1.3.7 Product Customer Service

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

1.4 Technical Support

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

Motorola Radio Support Center

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

Motorola Toronto Service Center

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

Motorola U.S. Federal Government Depot

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

1.5 Radio Model Information

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

Table 1-1 Radio Model Number (Example: AAH50KDC9AA1AN)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level	Model Revision	Model Package
AA ↑ **AA** = Motorola Internal Use	**H** ↑ **H** = Portable	**50**	**J** VHF1 (136-162 MHz) **K** VHF2 (146-174 MHz) **Q** UHF1 (403-440 MHz) **R2** UHF2 (438-470 MHz) **S** UHF3 (465-495 MHz)	**D** 4W or 5W **C** 2W	**C** No Display	**9** Program-mable	**AA** Conventional	**1=4 Ch.** **2=16 Ch.**	**A**	**N**

Section 2

MAINTENANCE

2.1 Introduction

This section 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

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 (70% by volume).

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

Cleaning External Plastic Surfaces

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

Cleaning Internal Circuit Boards and Components

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

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

2.3 Safe Handling of CMOS and LDMOS Devices

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

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

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

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

2.4 Disassembling and Reassembling the Radio — General

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

The following tools are required for disassembling the radio (see Section 2.8 for a list of service aids):

- knob remover/chassis opener
- penknife-size screwdriver
- TORX™ T6 screwdriver

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

The following disassembly procedures should be performed only if necessary:

- Chassis Disassembly
- Speaker Disassembly
- PTT Disassembly

2.5 Radio Disassembly — Detailed

2.5.1 Front Cover from Chassis Disassembly

1. Turn off the radio.

2. Remove the battery (Figure 2-1):

a. Slide the battery latch into the unlock position. Disengage by pushing downward and holding the latch towards the front of the radio.

b. With the battery latch disengaged, slide the battery down from the top of the radio about 1/2 in. Once the battery is free from the battery rails, lift it directly away from the radio.

c. Remove the battery from the radio.

3. Remove the antenna.

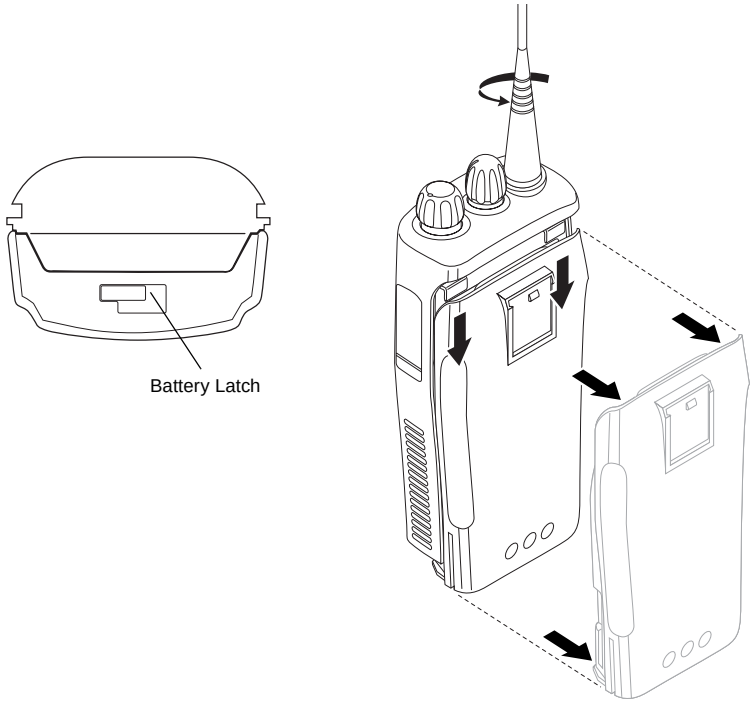


Figure 2-1. Battery Removal

4. Pry off the volume and channel selector knobs from their shafts using the knob remover/chassis opener tool (Motorola part # 6686533Z01) (Figure 2-2).

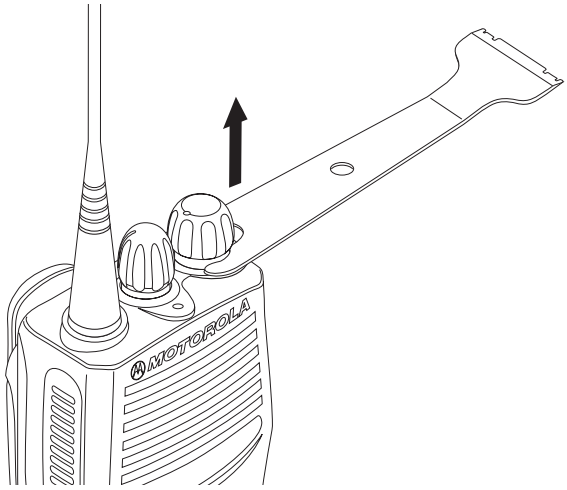


Figure 2-2. Knob Removal

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

5. Separate the chassis from the front housing assembly by using the knob remover/chassis opener tool. Place the broad side of the opener into the slots located at the base of the radio (Figure 2-3). Press the handle of the opener downwards. This pressing action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

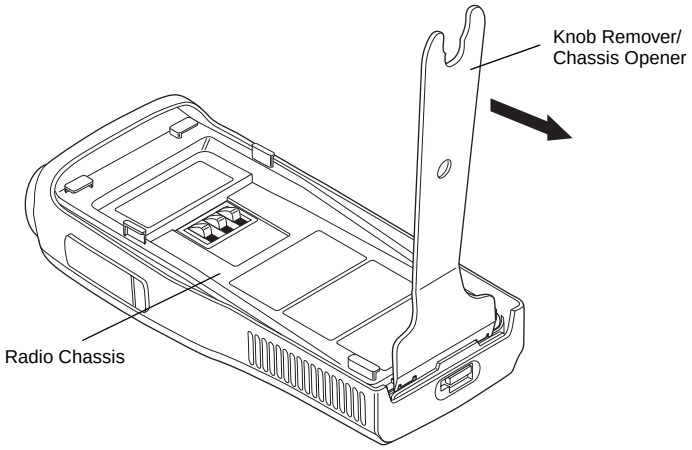


Figure 2-3. Chassis Removal

CAUTION: Marring the front cover O-ring sealing area will prevent the radio from sealing properly. If the O-ring is damaged, replace it with a new one.

NOTE: The speaker wire assembly connecting the front housing assembly, and the chassis prevent you from completely separating the two units.

6. Pull the chassis assembly out of the front cover.

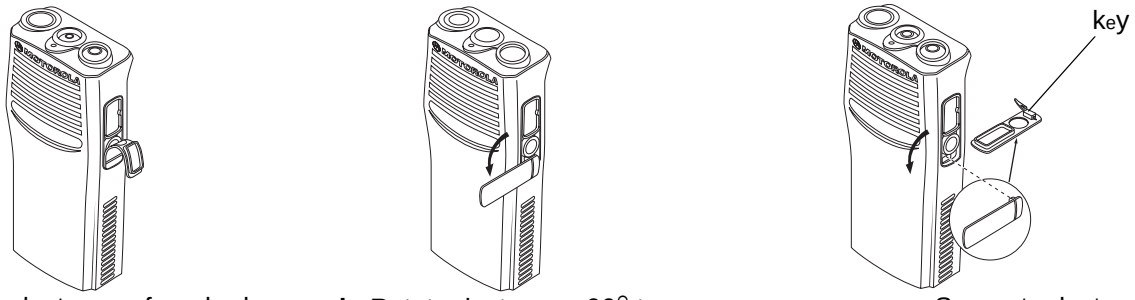
7. Unplug the speaker wire assembly from the 2-pin connector.

2.5.2 Dust Cover Disassembly

a. Gently pry the top of the dust cover away from the body of the radio. (See Figure 2-4.)

b. Rotate the dust cover 90° in a counter clockwise direction to allow the key to be removed.

c. Separate the dust cover away from the body of the radio. The dust cover key is fragile; apply only light pressure to the key while removing the dust cover.



a. Pry dust cover from body.

b. Rotate dust cover 90° to allow key to be removed.

c. Separate dust cover from body.

Figure 2-4. Dust Cover Removal

2.5.3 Speaker Disassembly

NOTE: The speaker is held in place with a retainer bracket. Be careful not to damage the speaker when removing the retainer bracket.

1. Remove the two screws from the speaker retainer using a T6 Torx screwdriver.
2. Lift the speaker out from the front housing.

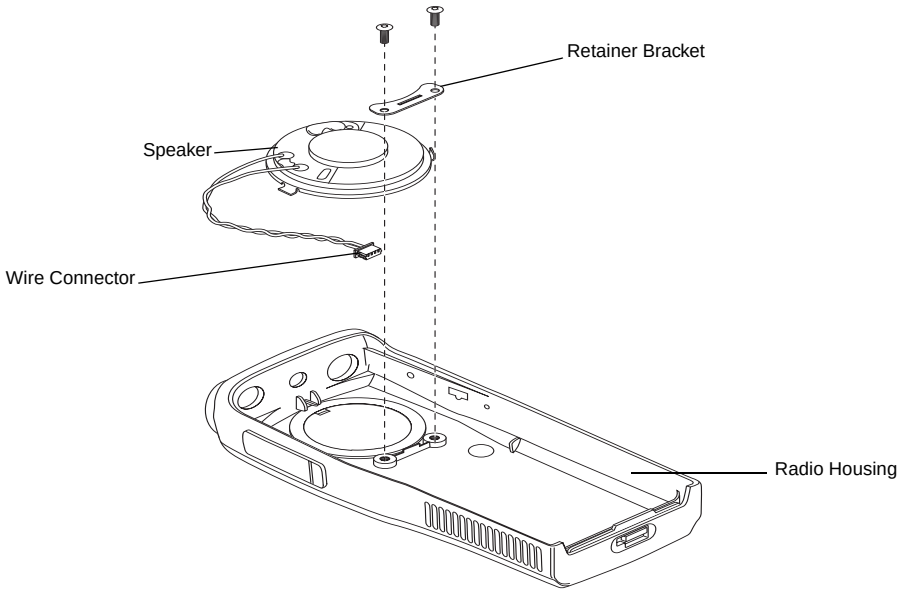


Figure 2-5. Removal Speaker-Microphone Assembly

2.5.4 PTT Disassembly

1. If required, the PTT (Figure 2-6) can be disassembled using a small screwdriver, as follows:

a. Insert the tip of a small screwdriver underneath the PTT and unsnap the top tab.

b. Pry the PTT away from the radio housing.

c. Inspect the two hooks. If bent or broken, the PTT must be replaced.

d. Remove the PTT seal.

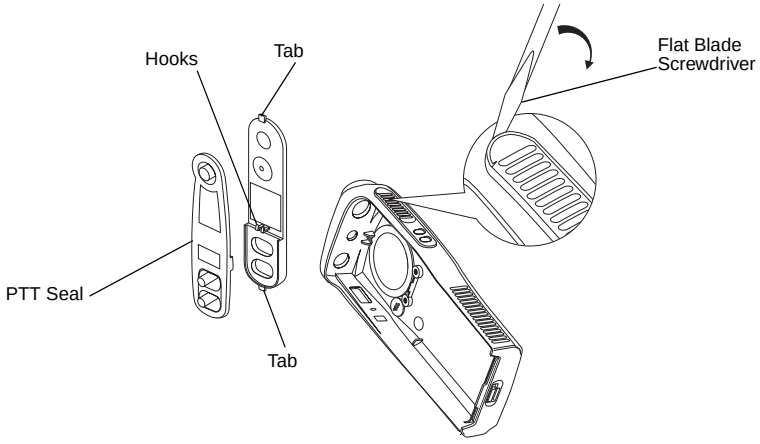


Figure 2-6. PTT Removal

2.5.5 Chassis Disassembly

CAUTION: Refer to the CMOS CAUTION paragraph (see 3.3) before removing the main board. Be sure to use Electrostatic Discharge protection when handling circuit boards.

1. Remove the O-ring.

2. Use a Torx™ screwdriver with a T6 bit to remove the four screws (Figure 2-7) holding the main board to the chassis.

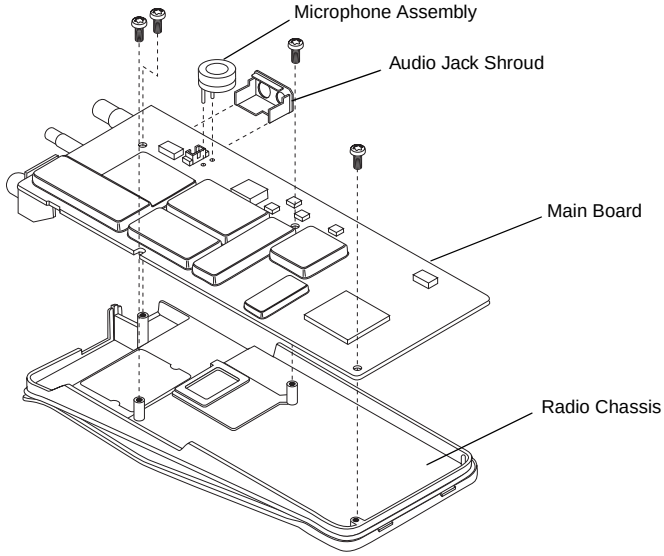


Figure 2-7. Removal of Main Board from Chassis

3. The microphone boot assembly can be unplugged from the main board. If you are replacing the microphone, remove it from the rubber boot.
4. The audio jack shroud can be removed from the main board.
5. Lift the main board from the chassis (Figure 2-7).
6. Remove the battery contact seal.

2.6 Radio Reassembly — Detailed

2.6.1 Chassis Assembly/Reassembly

1. Replace the battery contact seal (if necessary) surrounding the battery contact.
2. Remove the old Interface Pad from the chassis by scraping off the pad and adhesive with a straight razor. Use rubbing alcohol and a cloth to completely remove the adhesive from the chassis surface. With the chassis clean and dry, add a new Interface Pad to the chassis.
3. Place the main circuit board straight down on top of the chassis.

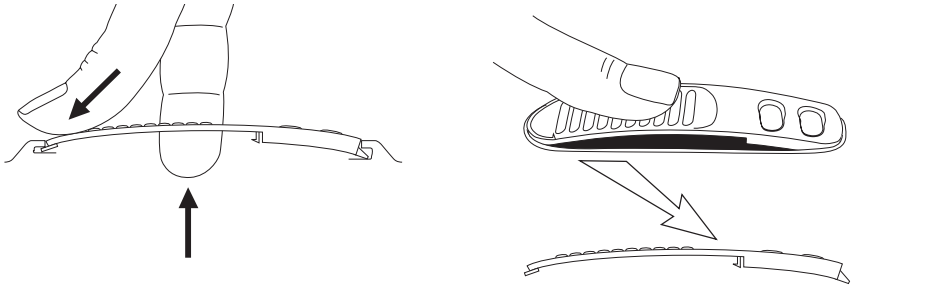
NOTE: Be sure the battery contact seal protrudes through the chassis and is not pinched under the chassis.

4. Use the T6 Torx screwdriver to fasten the screws holding the main board to the chassis. Tighten to 3 in/lb.
5. Replacing the O-ring.
    a. If you have the older chassis (2786389Z01) use the older O-ring (3286431Z02). Position the O-ring in the top groove by the volume/frequency switches. Stretch the O-ring to place it into the retaining groove at the bottom end of the chassis.
    b. If you have the newer chassis (2786389Z02) use the newer O-ring (3286431Z05). Position the O-ring with the plug on the right side (speaker connector side). Push the plug all the way into the chassis slot until it is touching the chassis flange. Repeat for the left side. Stretch the O-ring to place it into the retaining groove at the top and bottom end of the chassis.
6. Replace the audio jack shroud.
7. Replace the microphone boot assembly.

2.6.2 PTT Reassembly

1. Place the PTT seal over the ridge around the top hole. Press down to seat the seal around the ridge.
2. Place the bottom tab in the slot inside the front housing PTT opening. Slightly slide down the PTT and bow it by placing one finger under the middle of the PTT, so that the top tab can be aligned and inserted into the top slot (Figure 2-8a).

3. Press the PTT assembly against the front cover opening (Figure 2-8b).



a. Place bottom tab into bottom slot. Place top tab into top slot.

b. Push down on ribs toward bottom of radio so hooks do not get crushed.

Figure 2-8. PTT Assembly

2.6.3 Speaker Reassembly

1. Align the speaker as shown in Figure 2-9.

2. Insert the top of the speaker under the two rails in the housing.

3. Place the speaker retainer bracket onto the two screw bosses. Make sure the tab fits into the retainer bracket slot.

4. Use the T6 Torx screwdriver to fasten the screws holding the retainer bracket to the front cover. Tighten to 2 in/lb.

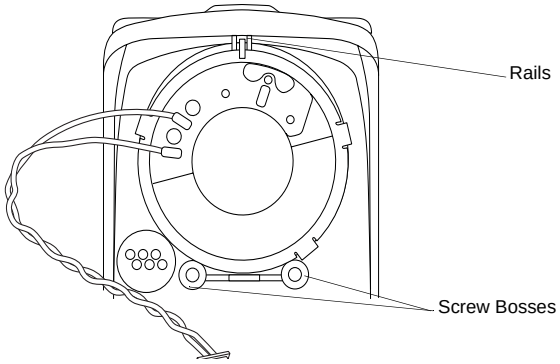


Figure 2-9. Speaker Assembly

2.6.4 Dust Cover Assembly

a. Insert the dust cover key into the housing at a 90° angle.

b. Rotate the dust cover 90° in a clockwise direction to allow the key to fully insert into the housing.

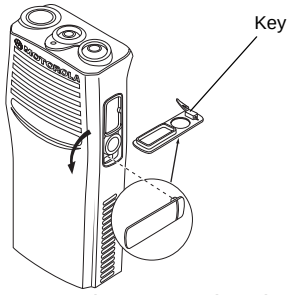
c. Press the key and dust cover into the housing.

2.6.5 Chassis and Front Cover Reassembly

1. Dress and connect the speaker wires.

NOTE: Care should be taken when dressing the speaker wires to avoid pinching them between the speaker magnet and shield, under the microphone boot or between the accessory connector and housing.

a. Form the wires into an “M” shape so it can collapse on itself like an accordion with all of the wire up in the top corner of the radio away from the shields. Place three bends in the wires spaced approximately 1cm apart to give the wire an “M” shape (Figure 2-11).



a. Insert dust cover key into housing at 90° angle.

Figure 2-10. Dust Cover Assembly

b. Bend the wires up from the speaker so the wires are positioned toward the top of the radio (Figure 2-11).

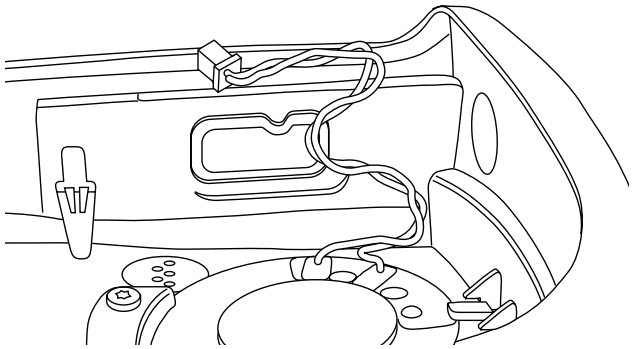


Figure 2-11. Bend the Wires into an “M” Shape

c. Connect the speaker wire assembly into the 2-pin connector on the main board and bend the wires at the board connector so the wires are positioned toward the top of the radio (Figure 2-12).

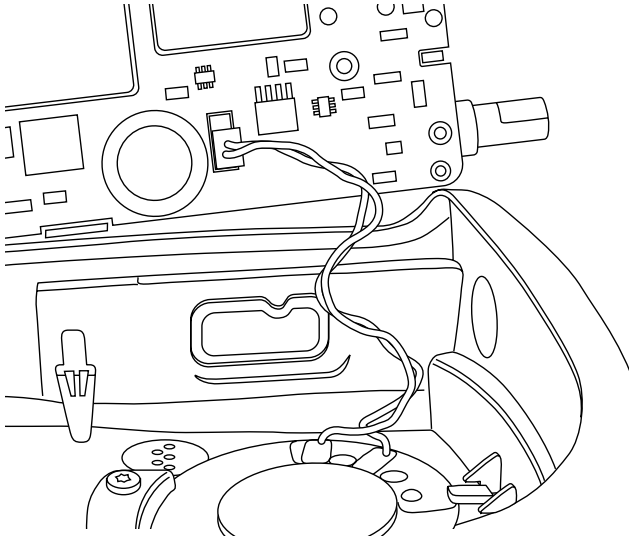


Figure 2-12. Connect Speaker Wire Assembly

2. Slide the volume potentiometer and frequency switch shafts into their respective holes in the front cover. Look through the accessory connector opening to make certain that the wires are not pinched.
3. Push the chassis assembly completely into the top of the front cover (Figure 2-13) until it settles in place.

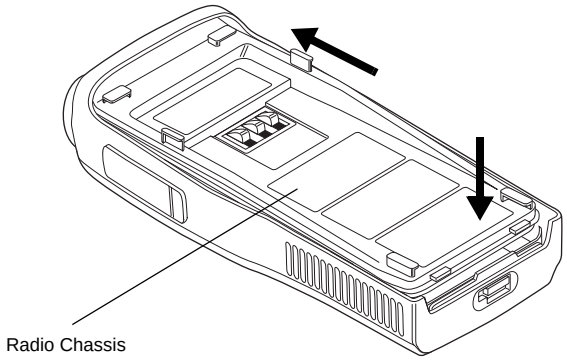


Figure 2-13. Fastening the Chassis

4. Make sure the O-ring is properly seated.
5. Snap the bottom of the chassis into the front cover.
6. Reassemble the knobs, antenna, and battery.

2.7 Mechanical View and Parts List

2.7.1 CP150/CP200 Exploded View and Parts List

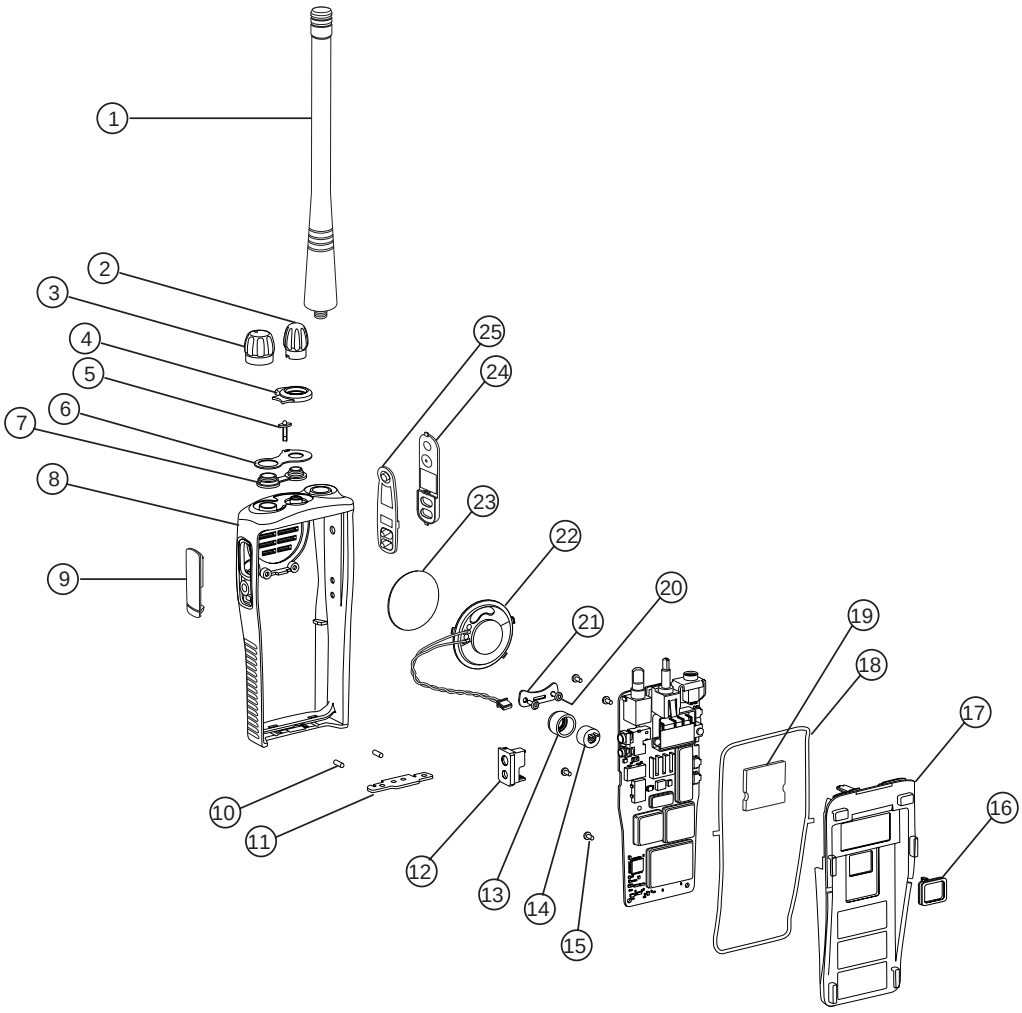


Figure 2-14. CP150/CP200 Radio Exploded View

Item	Motorola Part Number	Description
1	See Section 6	Antenna
2	3680530Z02	Knob, Frequency
3	3680529Z01	Knob, Volume
4	1386440Z01 1386440Z02	Escutcheon, Top; 4 Ch. Escutcheon, Top; 16 Ch.
5	6186446Z02	Lightpipe
6	3386443Z01	Label, Escutcheon Seal
7	3286432Z01	Seal, Control Shaft
8	1586390Z01	Housing, Front
9	3886441Z02	Cap, Dust
10	4105944K01	Spring, latch; 2 used
11	5586445Z02	Latch assembly
12	1586437Z02	Shroud, audio jack
13	0786469Z01	Boot, microphone
14	5080258E16	Microphone
15	0304726J05	Screws, chassis; 4 used
16	3286435Z01	Seal, battery contact block
17	2786389Z02	Chassis
18	3286431Z05	Seal, main O-ring
19	7586436Z02	Pad, PA interface
20	0386434Z01	Screws, speaker retainer; 2 used
21	0786433Z02	Retainer, speaker
22	5005679X04	Speaker
23	3586092Z02	Felt, speaker
24	4586439Z01	PTT, plastic
25	3886489Z01	PTT, rubber
NON-REFERENCED ITEMS		
	3386488Z01	Nameplate, Motorola
	3386409Z01	Nameplate, Radius CP200
	3386409Z02	Nameplate, Radius CP150

2.8 Test Equipment, Service Aids, and Service Tools

Table 2-1 lists test equipment recommended for working on the CP150/CP200 Radio. 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 2-1 Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2600 series	System analyzer	This item will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1074A	Fluke 87 digital multimeter	True RMS metering, 200 kHz frequency counter, 32-segment bar graph with backlit display	Digital voltmeter is recommended for AC/DC voltage and current measurements
	Fluke 85 RF probe	500 MHz, 30 VAC max	Use with Fluke 87 digital multimeter for RF voltage measurements.
*R1377A	AC voltmeter	1 mV to 300 mV, 10 megaohm input impedance	Audio voltage measurements
R1611A	Dual channel 100 MHz oscilloscope (Agillent)	Two-channel, 100 MHz bandwidth, 200 M sample rate/sec, 2 MB memory/channel	Waveform measurements
S1339A	RF millivolt meter	100 μV to 3V RF, 10 kHz to 1 GHz frequency range	RF level measurements
*R1013B or *R1370A	SINAD meter or SINAD meter with RMS	Without RMS audio voltmeter or With RMS audio voltmeter	Receiver sensitivity measurements

Table 2-2 lists service aids recommended for working on the CP150/CP200 Radio. 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 Service Aids

Motorola Part No.	Description	Application
RLN4460	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
RLN4510	Battery Interface	Regulates DC current and voltage between radio and power supply.
RVN4191	Customer Programming Software and Global Tuner Software on CD Rom	Program customer option and channel data.
AAPMKN4004	Programming Test Cable	Connects radio to RIB (PLN4008).

Table 2-2 Service Aids (Continued)

Motorola Part No.	Description	Application
AAPMKN4003	Radio-to-Radio Cloning Cable	Allows a radio to be duplicated from a master radio by transferring programmed data from the master radio to the other.
RLN4008	Radio Interface Box	Enables communications between the radio and the computer's serial communications adapter.
5886564Z01	RF Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
0180305K08	Shop Battery Eliminator	Interconnects radio to power supply.
HSN9412	Wall-Mounted Power Supply	Used to supply power to the RIB (120 VAC).
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT or newer (9-pin serial port). Use B71 for older models (25-pin serial port). Connects the computer's serial communications adapter to the RIB (PLN4008).
6686533Z01	Knob Remover/Chassis Opener	Used to remove the front cover assembly.
HKN9216	IBM Computer Interface Cable	Connection from computer to RIB.
8180384N65	Housing Eliminator	Allows testing of the radio outside of the housing.

Table 2-3 Recommended Service Tools

Motorola Part No.	Description	Application
RSX4043A	TORX screwdriver	Tighten and remove chassis screws
6680387A70	T6 TORX bit	Removable TORX screwdriver bit
R1453A	Digital readout solder station	Digitally controlled soldering iron
RLN4062A	Hot air workstation, 120 V	Tool for hot air soldering/desoldering of surface mounted integrated circuits
0180386A78	Illuminated magnifying glass with lens attachment	Illumination and magnification of components
0180302E51	Master lens system	
0180386A82	Anti-static grounding kit	Used during all radio assembly and disassembly procedures
6684253C72	Straight prober	
6680384A98	Brush	
1010041A86	Solder (RMA type), 63/67, 0.5mm diameter, 1 lb. spool	
0180303E45	SMD tool kit (included with R1319A)	

Table 2-3 Recommended Service Tools (Continued)

Motorola Part No.	Description	Application
R1319A	ChipMaster (110 V)	Surface mount removal and assembly of surface mounted integrated circuits and/or rework station shields. Includes 5 nozzles.
R1321A	ChipMaster (220 V)	
ChipMaster Nozzles:		
6680332E83	PLCC-28* nozzle	Soldering and Un-soldering IC's
6680332E82	PLCC-44* nozzle	
6680332E94	PLCC-52 nozzle	
6680332E96	PLCC-84 nozzle	
6680334E67	QFP-160 nozzle	
6680333E46	SOL-18 nozzle	
6680332E84	SOIC-20 nozzle	
6680332E87	SOL-20J nozzle	
6680333E45	SOL-24 nozzle	
6680333E55	TSOP-64 nozzle	

* Included with ChipMaster packages

Programming/Test Cable

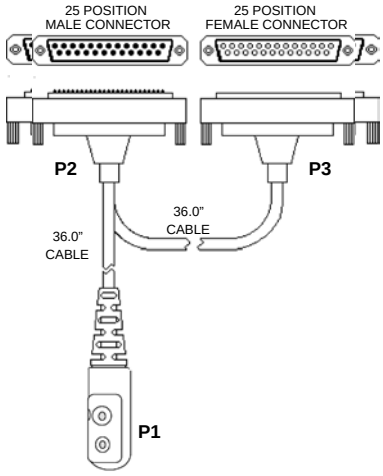


Figure 2-15. Programming/Test Cable

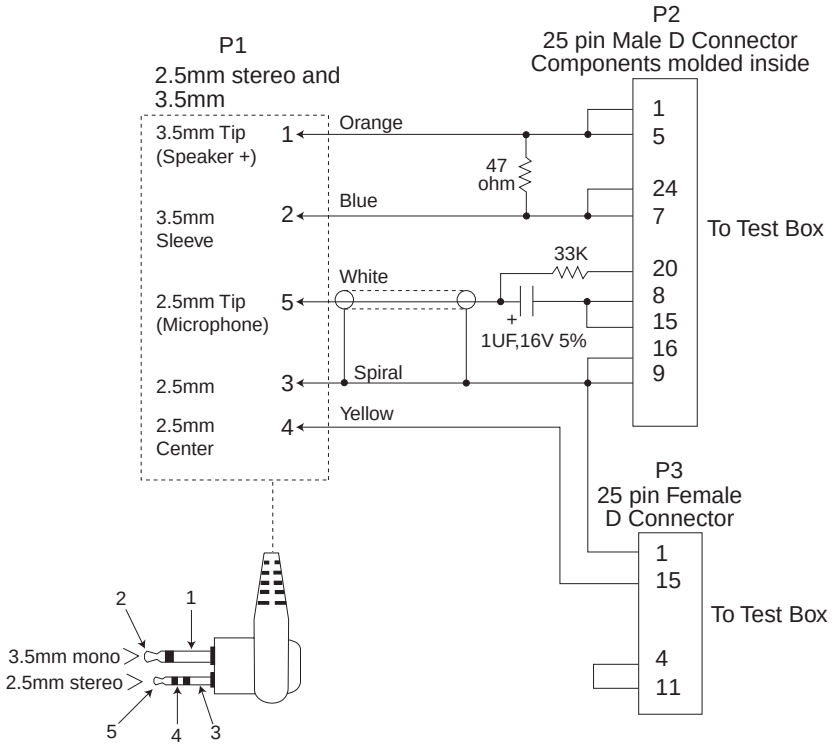


Figure 2-16. Wiring of the Connectors

Section 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.

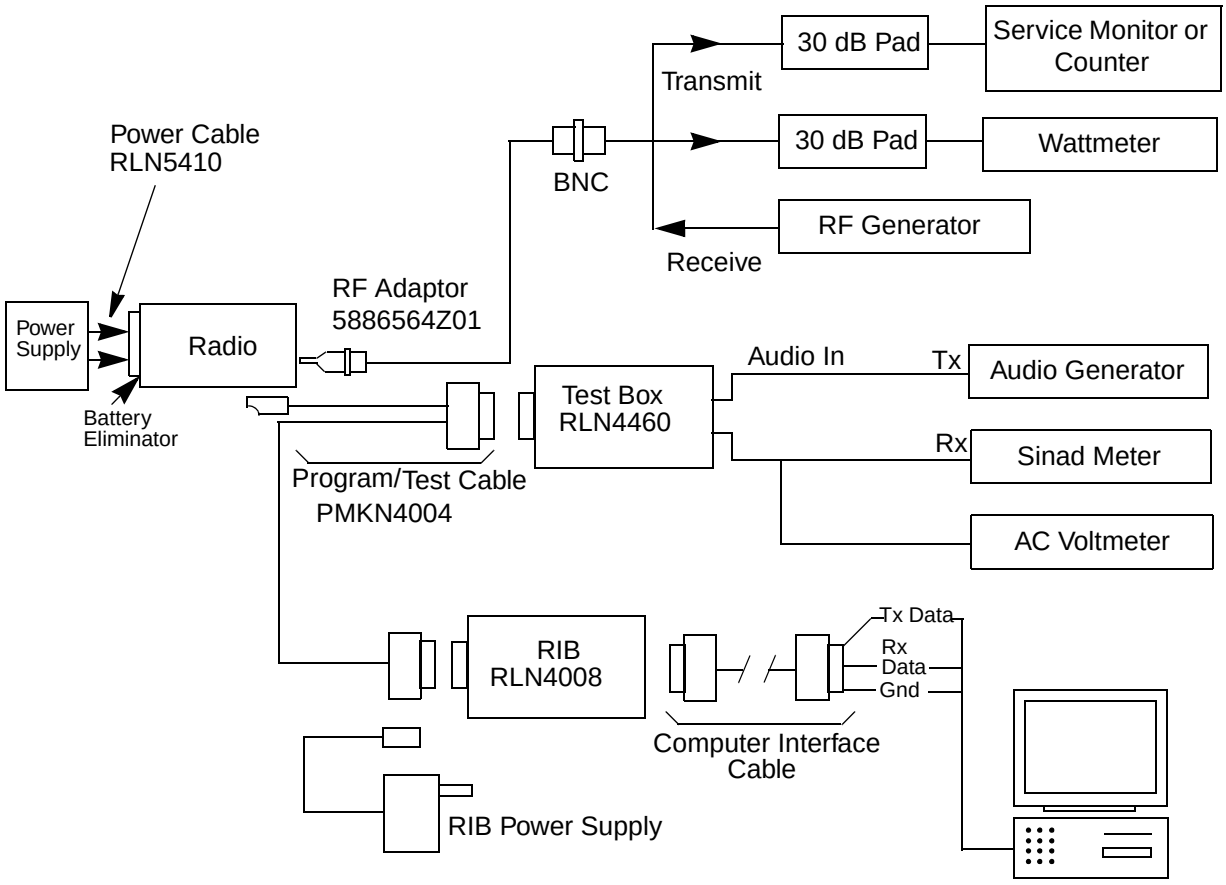


Figure 3-1 Radio Performance Checks Setup

3.2 Power-Up Self Test

Applying power to the radio by using the on/off volume control, starts a self-test routine which checks the RAM, EEPROM hardware and EEPROM checksum. Pressing and holding SB1 while turning on the radio causes the self-test routine to check for the ROM checksum as well. If these checks are successfully completed, the radio will generate the Self-Test Pass Tone. If the self-test is not successful, a Self-Test Fail Tone is heard.

Supply voltage can be connected from the battery eliminator. The equipment required for alignment procedures is connected as shown in the Radio Performance Checks Setup diagram (Figure 3-1).

Initial equipment control settings should be as indicated in the following table and should hold for all alignment procedures, except as noted in Table 3-1.

Table 3-1 Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Spkr set: A	Voltage: 7.5Vdc
RF Attenuation: -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

When the CP150/CP200 radio is operating in its normal environment, the radio's microcomputer controls the RF channel selection, transmitter key-up, and receiver muting, according to the customer codeplug configuration. However, when the unit is on the bench for testing, alignment, or repair, it must be removed from its normal environment using a special routine, called RF TEST MODE. The RF Test Mode is a special routine that has been incorporated in the radio. This mode allows bench testing of the radio at various test frequencies across the entire band, at both high and low transmit power (if applicable), at various channel spacings, and with different coded or carrier squelch types. Any customer specific programming in the radio will not be changed or affected by use of the RF Test Mode.

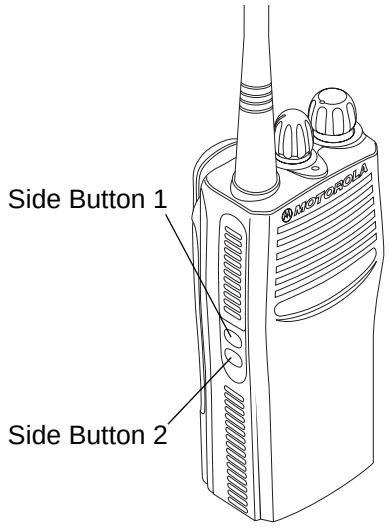


Figure 3-2 Side Button Locations

To enter test mode:

1. Turn the radio on.
2. Within ten seconds after the self test is complete (self test tone is heard), press SB2 (Side Button 2 in Figure 3-2) five times in succession. If the self test complete tone is not heard, see Error Codes information in Section 5. Entry into the test mode is indicated by a positive indicator tone followed by a good key chirp (GKC).
3. Upon entering test mode, the radio is on carrier squelch mode.
4. Press SB1 (Side Button 1) and scroll through and access test environments as shown in Table 3-2.
5. Press SB2 and scroll through the channel spacing available as shown in Table 3-3.
6. Turn the channel selector knob to change the test channel for that environment as shown in Table 3-4.
7. Press the PTT on a test channel to cause the radio to transmit at the test frequency for the channel.

Table 3-2 Test Environments

No. of Beeps	Description	Function
1 GKC*	Carrier Squelch	RX: unsquelch if carrier detected TX: mic audio
1 BKC*	Tone Private-Line	RX: unsquelch if carrier and tone (192.8Hz) detected TX: mic audio + tone (192.8Hz)
2 BKC	Digital Private-Line	RX: unsquelch if carrier and digital code (131) detected TX: mic audio + digital code (131)
3 BKC	Dual-Tone Multiple Frequency	RX: unsquelch if carrier detected TX: selected DTMF tone pair. (Available for 4W & 5W models only).
5 BKC	Unsquelch Open	RX: constant unsquelch TX: mic audio
9 BKC	High-Speed Signaling	RX: unsquelch if carrrier detected TX: 1500Hz tone
11 BKC	Companding	RX: unsquelch if carrier detected TX: mic audio

* “BKC” means Bad Key Chirp (low-pitched tone), “GKC” means Good Key Chirp (high-pitched tone).

Table 3-3 Test Channel Spacing

No. of BKC	Channel Spacing
1	25 kHz
2	12.5 kHz
3	20 kHz

Table 3-4 Test Frequencies

Channel Selector Switch Position	Test Channel	VHF 1 (136-162 MHz)	VHF 2 (146-174 MHz)	UHF 1 (403-440 MHz)	UHF 2 (438-470 MHz)	UHF 3 (465-495 MHz)
1 Low Power 8 High Power	TX#1 or #8 RX#1 or #8	136.625	146.625	403.625	438.625	465.625
2 Low Power 9 High Power	TX#2 or #9 RX#2 or #9	140.325	150.775	409.775	443.775	470.775
3 Low Power 10 High Power	TX#3 or #10 RX#3 or #10	144.525	155.275	415.275	448.275	475.275
4 Low Power 11 High Power	TX#4 or #11 RX#4 or #11	148.875	160.125	421.125	454.125	480.125
5 Low Power 12 High Power	TX#5 or #12 RX#5 or #12	153.325	164.475	427.475	459.475	485.475
6 Low Power 13 High Power	TX#6 or #13 RX#6 or #13	157.875	169.475	433.475	464.475	490.475
7 Low Power 14 High Power	TX#7 or #14 RX#7 or #14	161.975	173.875	439.875	469.875	494.875

Note: Only one power setting is supported in 2 W models. Therefore, only test channels 1 through 7 are applicable for 2 W models.

Table 3-5 Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	PTT to continuous (during the performance check)	Frequency error to be ±186 Hz VHF1 ±200 Hz VHF2 ±525 Hz UHF1 ±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 3.2Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <5%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.30µV (0.25 µV typical).

Table 3-5 Receiver Performance Checks (Continued)

Test Name	Communications Analyzer	Radio	Test Set	Comments
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 3.2Vrms
	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 <0.25µV. Preferred SINAD = 6-9 dB

See Table 3-4

Table 3-6 Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch Output at antenna	PTT to continuous (during the performance check)	Frequency error to be ±186 Hz VHF1 ±200 Hz VHF2 ±525 Hz UHF1 ±568 Hz UHF2 ±600 Hz UHF3
Power RF	As above	As above	As above	Refer to Maintenance Specifications
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/ Out Monitor: DVM, AC Volts Set 1 kHz Mod Out level for 0.025Vrms at test set, 80mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: VHF, UHF ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp).
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/ Out	TEST MODE, Test Channel 4 carrier squelch Output at antenna	Remove modulation input	Press PTT switch on radio. Say “four” loudly into the radio mic. Measure deviation: VHF, UHF ≥ 4.0 kHz but ≤ 5.0 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: VHF, UHF ≥ 3.05 kHz but ≤ 3.45 kHz (25 kHz Ch Sp)

Table 3-6 Transmitter Performance Checks (Continued)

Test Name	Communications Analyzer	Radio	Test Set	Comments
PL/DPL Modulation	As above 4th channel test frequency* BW to narrow	TEST MODE, Test Channel 4 TPL DPL	As above	Deviation: VHF, UHF ≥ 500Hz but ≤ 1000Hz (25 kHz Ch Sp).

See Table 3-4

Section 4

RADIO ALIGNMENT PROCEDURES

4.1 Introduction

This chapter provides an overview of the Commercial Series Customer Programming Software (CPS) and the Global Tuner as designed for use in a Windows® 98/NT4/2000/ME/XP environment. Both cover all the functions of the traditional Radio Service Software (RSS) package.

They are both available in the CPS and Global Tuner (CD ROM) Kit (RVN4191).

4.2 CPS Programming Setup

Refer to online help files for the CPS Programming procedures. (See Figure 4-1 for CPS Programming Setup).

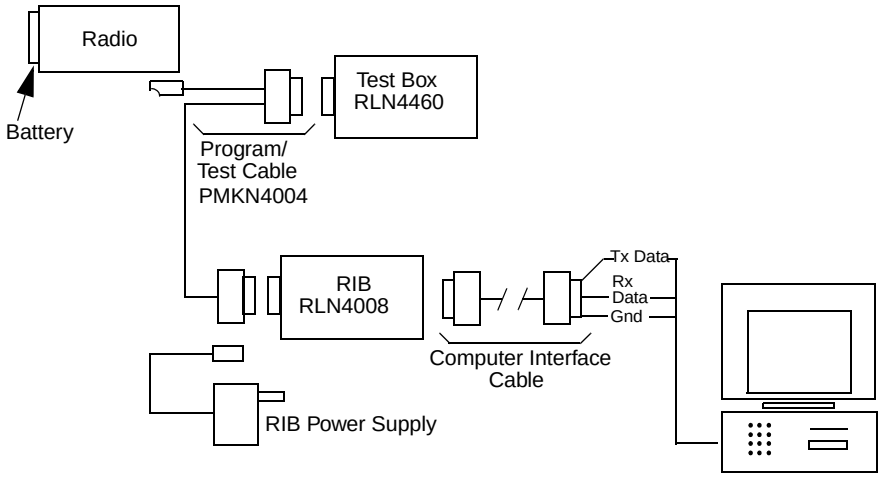


Figure 4-1. CPS Programming Setup

4.3 Radio Tuning Setup

A Windows 98/NT4/2000/ME/XP PC (personal computer) and Global Tuner are required to tune the radio. To perform the tuning procedures, the radio must be connected to the PC, RIB (Radio Interface Box) and Universal Test Set as shown in Figure 4-2. Refer to online help files for the tuning procedures.

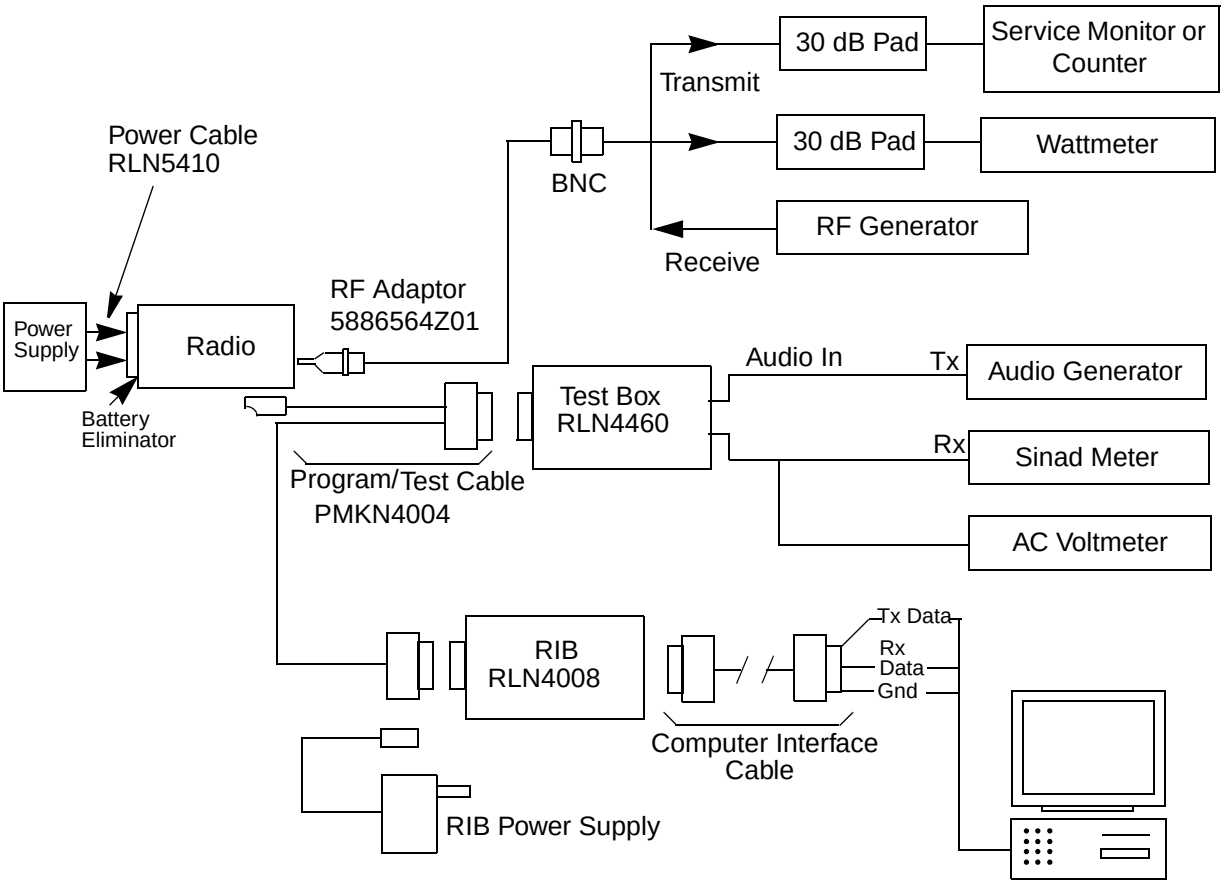


Figure 4-2. Radio Tuning Setup

4.3.1 Initial Test Equipment Control Settings

The initial test equipment control settings are listed in Table 4-1.

Table 4-1 Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Speaker set: A	Voltage: 13.2 Vdc
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: 10 mSec/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: 20 A

4.4 Transmitter Alignment Options

Note: **When checking the RF power output of the radio with a test set, always use a pad of at least 30 dB attached to the radio end of the RF cable. This will avoid an RF mismatch and ensure a stable RF reading that will not change with varying lengths of connecting cable.**

4.4.1 Reference Oscillator Warp

This is an important operation which affects all deviation values such as **DTMF, MDC1200 Signaling** etc. The frequency will drift if not warped properly. Perform this operation prior to all other transmit tuning operations in order to **minimize heating** and because of the **impact of warp on signaling operations**.

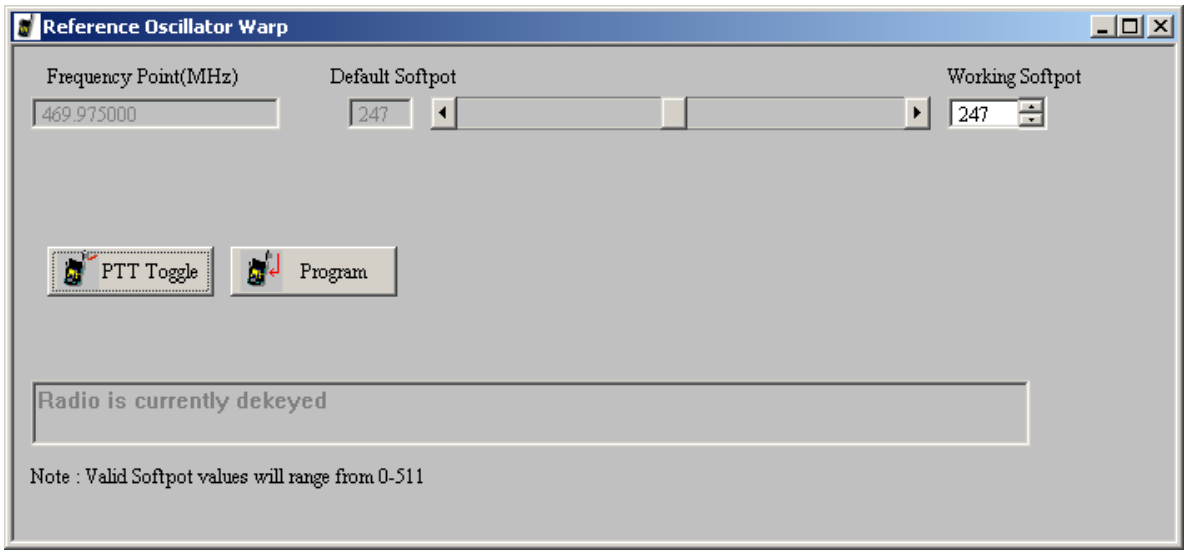


Figure 4-3. Reference Oscillator Warp Window

1. Under **Tx Align** menu, select **Reference Oscillator Warp** (Figure 4-3).
2. There is only 1 frequency point shown which is always the last non-0 transmit frequency point, which will normally be F7.
3. Click on the slider thumb and 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 (press **ENTER** to confirm selection/send a softpot value) until the frequency is as close as possible to the indicated transmit frequency. (Refer to Table 4-2).
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 4-2 Reference Oscillator Specifications

RF Band	Target
VHF 1 Band (136-162 MHz)	±162 Hz
VHF 2 Band (146-174 MHz)	±174 Hz
UHF 1 Band 1 (403-440 MHz)	±436 Hz
UHF 2 Band 2 (438-470 MHz)	±470 Hz
UHF 3 Band 3 (465-495 MHz)	±495 Hz

4.4.2 Modulation Balance Attenuation

Note: **When using test box RLN4460:**

- **Inject the signal into the radio via the METER IN terminal and**
- **Set the METER IN selector switch to "VOL".**
- **Inject the signal into the radio via the AUDIO IN terminal.**
- **Set the METER OUT toggle switch to the “MIC PORT” position**
- **Set the METER OUT selector switch to “MIC”.**

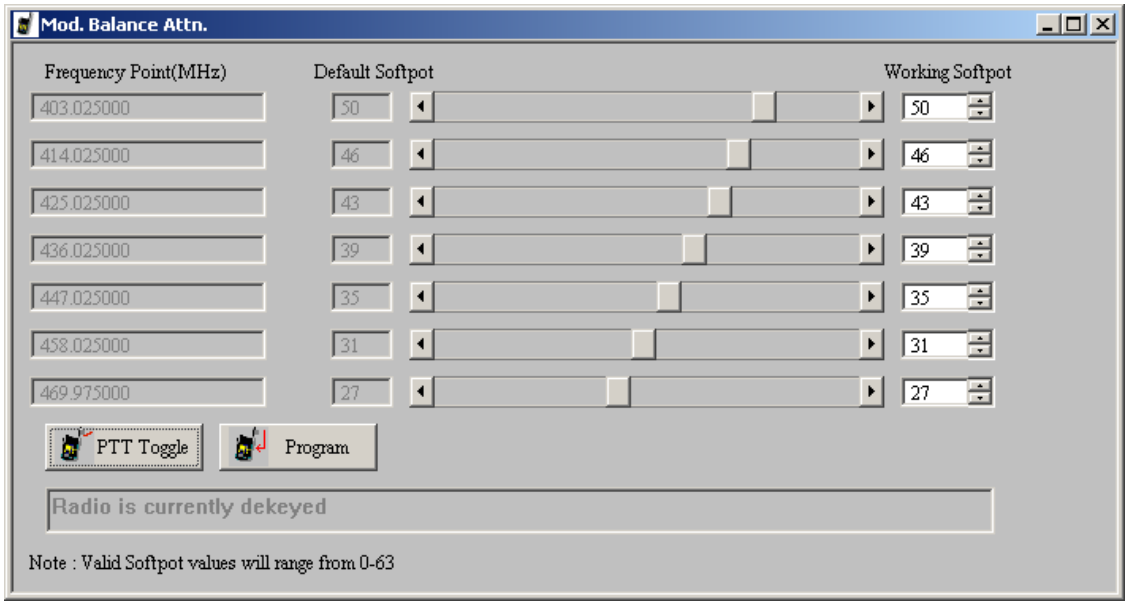


Figure 4-4. Modulation Balance Window

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 (Digital Private-Line) and could result in distorted waveforms if improperly adjusted. To perform Modulation Balance tuning, follow the following steps.

1. Under the **Tx Align** menu, select **Mod Balance Attn** (Figure 4-4).
2. Begin with the lowest frequency (i.e. the first frequency point from the top). Pressing **PTT Toggle** without selecting any slider control at the corresponding frequency point will key the radio up at the first frequency point.
3. Inject **80 Hz** at an amplitude of **1.78 V**.
4. Record the deviation obtained. Typical values should range from **[(1.70-2.30 kHz. Modulation is only tuned in the 25 kHz channel spacing mode)]**.
5. Inject **3 kHz.** Set the amplitude to **1.5 V**.
6. Change the modulation balance attenuation setting until the **Tx** deviation is as recorded in step 4.
7. Inject **80 Hz** at an amplitude of **1.78 V**.
8. Check the deviation again. If the Tx deviation changes, record the reading and repeat steps 5-8 until the Tx deviation remains the same.
9. Press **PTT Toggle** to dekey the radio. Choose the next frequency, key up and repeat steps 3 to 8 until all seven tuning points are done.
10. Program the softpot value by pressing the **Program** button.
11. Exit the Modulation Balance Function.

4.4.3 Transmit Power Tuning

Note: **The maximum available power level given in the table below must not be exceeded. There are separate alignment procedures for High and Low power.**

Note: **When checking the RF power output of the radio with a test set, always use a pad of at least 30 dB attached to the radio end of the RF cable. This will avoid an RF mismatch and ensure a stable RF reading that will not change with varying lengths of connecting cable**

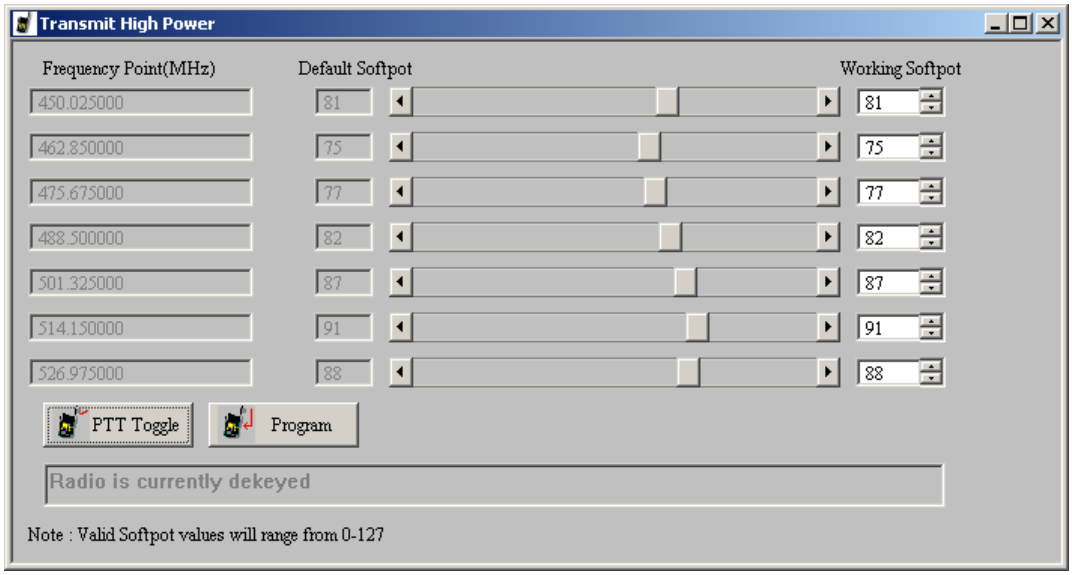


Figure 4-5. Transmit Power Window (High Power)

Table 4-3 Transmit High/Low Power Level

RF Band (MHz)	Model Number	High Power(W)	Low Power (W)
4 Channel VHF 136-162 MHz	H50JDC9AA1AN	5.2-5.5	1.1-1.3
16 Channel VHF 136-162 MHz	H50JDC9AA2AN	5.2-5.5	1.1-1.3
4 Channel VHF 146-174	H50KCC9AA1AN	2	
16 Channel VHF 146-174	H50KCC9AA2AN	2	
4 Channel VHF 146-174	H50KDC9AA1AN	5.2-5.5	1.1-1.3
16 Channel VHF 146-174	H50KDC9AA2AN	5.2-5.5	1.1-1.3
4 Channel UHF 1 403-440	H50QDC9AA1AN	4.2-4.5	1.1-1.3
16 Channel UHF 1 403-440	H50QDC9AA2AN	4.2-4.5	1.1-1.3
4 Channel UHF 2 438-470	H50RCC9AA1AN	2	
16 Channel UHF 2 438-470	H50RCC9AA2AN	2	
4 Channel UHF 2 438-470	H50RDC9AA1AN	4.2-4.5	1.1-1.3
16 Channel UHF 2 438-470	H50RDC9AA2AN	4.2-4.5	1.1-1.3
4 Channel UHF 3 465-495	H50SDC9AA1AN	4.2-4.5	1.1-1.3
16 Channel UHF 3 465-495	H50SDC9AA2AN	4.2-4.5	1.1-1.3

4.4.3.1 To Perform Transmit High Power Tuning, do the following:

1. Under the **Tx Align** menu, select **Transmit Power**, then select **High** (Figure 4-5).
2. Press **PTT Toggle**. This will key the radio up at 1st test frequency (F1).
3. Adjust the high power level to be as defined by Table 4-3. Move the slider/spin control or keying in values in the edit control (press **ENTER** to confirm your selection after typing in the softpot value).
4. Press **PTT Toggle** to dekey the radio, go to the next frequency point by selecting the slider, typing in the edit control box (press **ENTER** to confirm selection after typing in the softpot value) or toggling the softpot value using the spin control.
5. Press **PTT Toggle** again to key up the radio at the selected frequency point.
6. Repeat steps 3-5 for the remaining test frequencies (F2-7)
7. Press **Program** to store the softpot values into the radio's codeplug.
8. Exit the Transmit High Power function.
9. If the radio uses only high power channels, proceed to adjust modulation. If low power channels are used, perform Transmit Low Power Tuning as defined.

4.4.3.2 To Perform Transmit Low Power Tuning, do the following:

1. Under the **Tx Align** menu, select **Transmit Power**, and then select **Low**.
2. Press **PTT Toggle**. This will key the radio up at 1st test frequency (F1).
3. Adjust the power level to be as defined by **country power level specifications** by moving the slider/spin control or keying in values in the edit control (press **ENTER** to confirm your selection after typing in the softpot value).
4. Press **PTT Toggle** to dekey the radio, go to the next frequency point by selecting the slider, typing in the edit control box (press **ENTER** to confirm your selection) or toggling the softpot value using the spin control.

5. Press **PTT Toggle** again to key up the radio at the selected frequency point.
6. Repeat steps 3-5 for the remaining test frequencies (F2-F7).
7. Press **Program** to store the softpot values into the radio's codeplug.
8. Exit the Transmit Low Power function.

4.4.4 VCO Attenuation

Note: **Modulation Balance Tuning must be done first. The Transmit Deviation Limit softpot sets the maximum deviation of the carrier. Tuning is performed for all (12.5 kHz, 20 kHz and 25 kHz) channel bandwidths. Tuning for 25 kHz channels must be done first for all frequency points. Tuning for 12.5 and 20 kHz channels determines only the offset to the previously tuned deviation for 25 kHz tuning channel spacing. For 12.5, and 20kHz channels, only the last non-0 transmit frequency point (normally F7) is used for tuning. The 30 kHz channel bandwidths that use 5.0 kHz maximum system deviation are covered by the 25 kHz tuning.**

When using test box RLN4460:

- Set the METER OUT toggle switch to the "MIC PORT" position
- Set the METER OUT selector switch to "MIC".
- Inject a 1 kHz tone with the levels given below for each radio model to AUDIO IN.
- Measure the level at the radio input at the AC/DC meter.

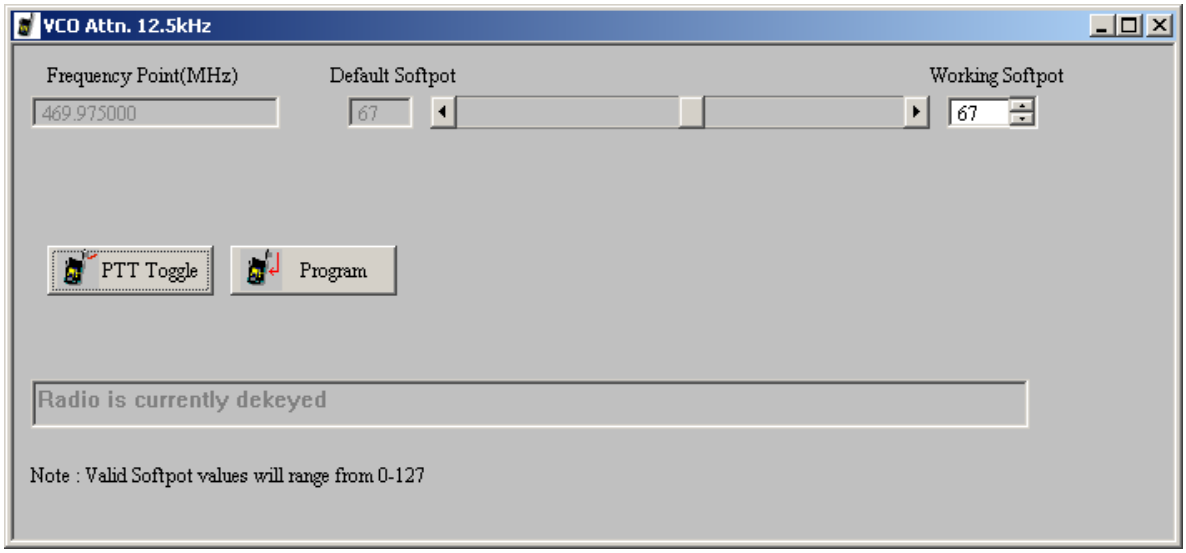


Figure 4-6. VCO Attenuation Window (12.5 kHz)

4.4.4.1 VCO Attenuation 25 kHz

1. Under the **Tx Align** menu, select **VCO Attenuation 25 kHz** (Figure 4-6).
2. Begin with the lowest frequency. Select the thumb of the slider at the lowest frequency point and 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 your selection/send a softpot value).
3. **Inject 1 kHz** at an appropriate level until **2.3 V rms** is measured at the AC/DC METER (radio input) if using test box **RLN4460**.

4. Record the deviation obtained.
5. Adjust the slider; adjust the spin control or key in softpot values (press **ENTER** to confirm) for the frequency point until the deviation is within the range **specified in** 8..
6. Dekey the radio (Press the **PTT Toggle** button). Choose the next frequency, key up and repeat steps 3 to 6 until all seven tuning points are done.
7. Program the softpot value by pressing the **Program** button.
8. Exit the VCO Attn. 25 kHz function.

4.4.4.2 VCO Attenuation 12.5 kHz

Note: Tuning of Modulation Balance Attenutation and VCO Attenuation for 25 kHz channel bandwidth must be done first.

1. Under the **Tx Align** menu, select **VCO Attenuation 12.5 kHz**.
2. Press **PTT Toggle** to key up the radio at the last non-0 transmit frequency point (normally F7).
3. Inject **1 kHz** at an appropriate level until **2.3 V rms** is measured at the AC/DC METER (radio input) if using test box **RLN4460**.
4. Record the deviation obtained.
5. Adjust the slider, adjust the spin control or key in softpot values (press **ENTER** to confirm) for the frequency point until the deviation is within the range **specified in** 8..
6. Press **PTT Toggle** to dekey the radio.
7. Program the softpot value by pressing the **Program** button.
8. Exit the VCO Attenuation 12.5 kHz function.

4.4.4.3 VCO Attenuation 20 kHz

Note: Tuning of Modulation Balance Attn. and VCO Attn. for 25 kHz channel bandwidth must be done first.

1. Under the **Tx Align** menu, select **VCO Attenuation 20 kHz**.
2. Press **PTT Toggle** to key up the radio at the last non-0 transmit frequency point (normally F7).
3. Inject **1 kHz**: at an appropriate level until **2.3 V rms** is measured at the AC/DC METER (radio input) if using test box **RLN4460**.
4. Record the deviation obtained.
5. Adjust the slider; adjust the spin control or key in softpot values (press **ENTER** to confirm) for the frequency point until the deviation is within the range **specified in** Table 4-4.
6. Press **PTT Toggle** to dekey the radio.
7. Program the softpot value by pressing the **Program** button.
8. Exit the VCO Attn. 20 kHz function.

Table 4-4 Deviation Specifications

Band	Channel Spacing	Deviation (kHz)
UHF/VHF	25 kHz	4.40 - 4.60
UHF/VHF	12.5 kHz	2.20 - 2.30
UHF/VHF	20 kHz	3.40 - 3.60

4.4.5 DTMF Deviation Tuning

This tuning option controls the **Dual Tone MultiFrequency** deviation. Please note that **Modulation Balancing** and **VCO Attenuation** have to be performed prior to this tuning operation. Not doing so will result in the **wrong deviation value being obtained** while tuning the DTMF.

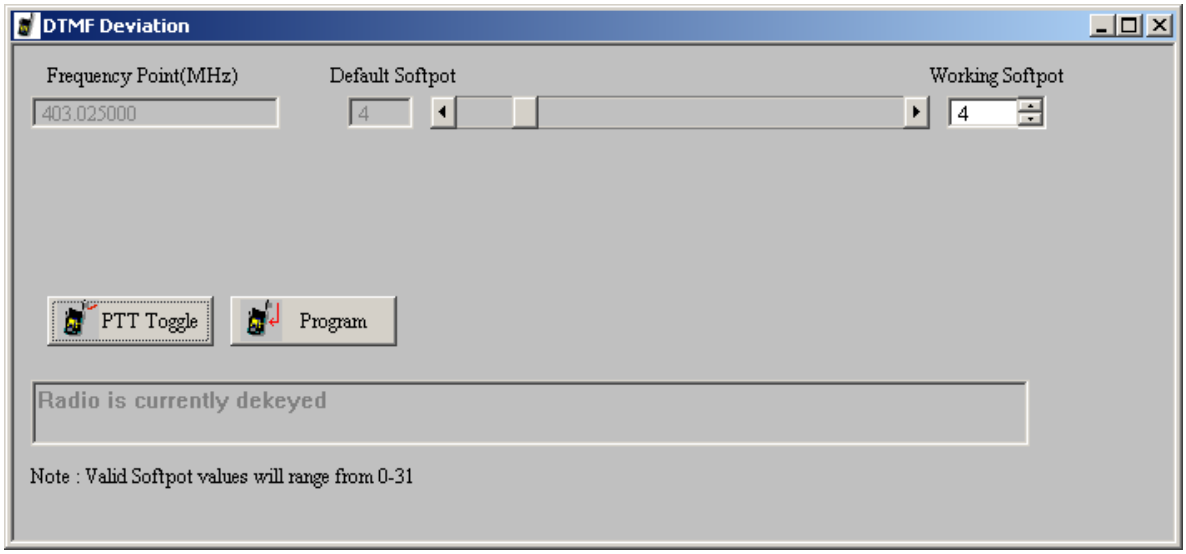


Figure 4-7. DTMF Deviation Tuning Window

1. Under **Tx Align**, select **DTMF Deviation** (Figure 4-7).
2. Press **PTT Toggle** to key the radio. Monitor the deviation obtained.
3. Adjust the slider, spin or edit control (press **ENTER** to confirm your selection/send a softpot value) until a deviation of **3.1-3.4 kHz** is obtained.
4. Press **PTT Toggle** again to dekey the radio.
5. Program the softpot value into the radio by pressing **Program**.
6. Exit the DTMF Deviation function.

4.4.6 MDC1200 Deviation Tuning (MDC radios only)

This tuning option controls the MDC1200 Signaling deviation. Please note that Modulation Balancing and VCO Attenuation have to be performed prior to this tuning operation. Not doing so will result in the wrong deviation value being obtained while tuning this feature.

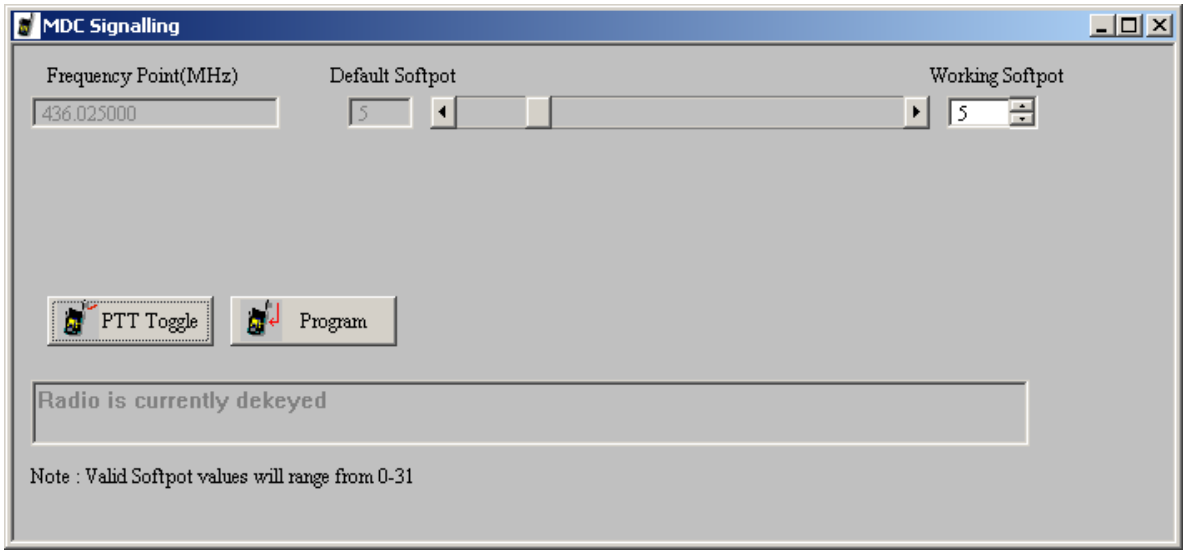


Figure 4-8. MDC1200 Deviation Tuning Window

1. Under the **Tx Align**, select **MDC1200 Signaling** (Figure 4-8).
2. Press **PTT Toggle** to key the radio up. Monitor the deviation obtained.
3. Adjust the slider, spin or edit control (press **ENTER** to confirm the selection/send a softpot value) until a deviation of **3.3-3.7 kHz** is obtained.
4. Press **PTT Toggle** again to dekey the radio.
5. Program the softpot value into the radio by pressing the **Program**.
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:

- Rated Volume
- Squelch Tuning Front End Filter Tuning

4.5.1 Rated Volume Tuning

Note: **When using 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. The rated audio tuning procedure automatically configures the radio for 25 KHz. This means that a 3 kHz (for 25 kHz channel spacing) deviation must always be used, irrespective of the radio channel bandwidth.**

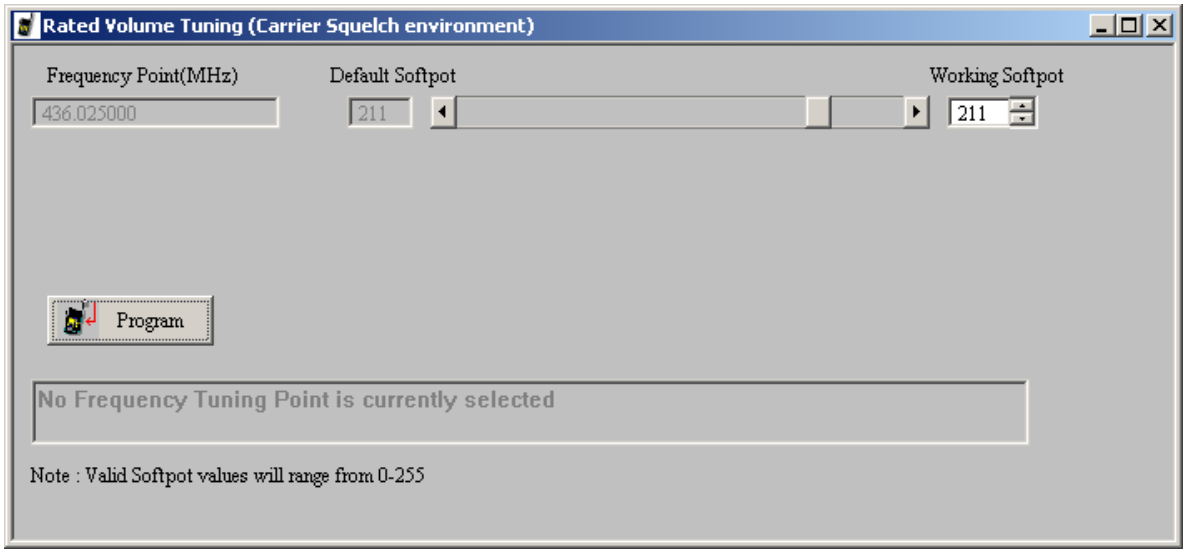


Figure 4-9. Rated Volume Tuning Window

Perform the rated volume tuning procedure as follows:

1. Under the **Rx Align** menu, select **Rated Volume** (Figure 4-9).
2. Inject a -47 dBm rf signal modulated with **1 kHz** tone at **3 KHz** (for 25 kHz channel spacing).
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 **500 mW (3.46 V)** audio power is obtained. Rated Audio tuning is only done for 25 kHz channel spacing.
4. Press **Program** to commit the softpot value into the radio.
5. Exit the rated volume tuning function.

4.5.2 Squelch Tuning

Note: **1. Squelch tuning can only be accomplished after 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 be performed so the the correct 10 dB SINAD level can be obtained.

3. This tuning method is performed for multiple squelch tuning channels and multiple channel spacings.

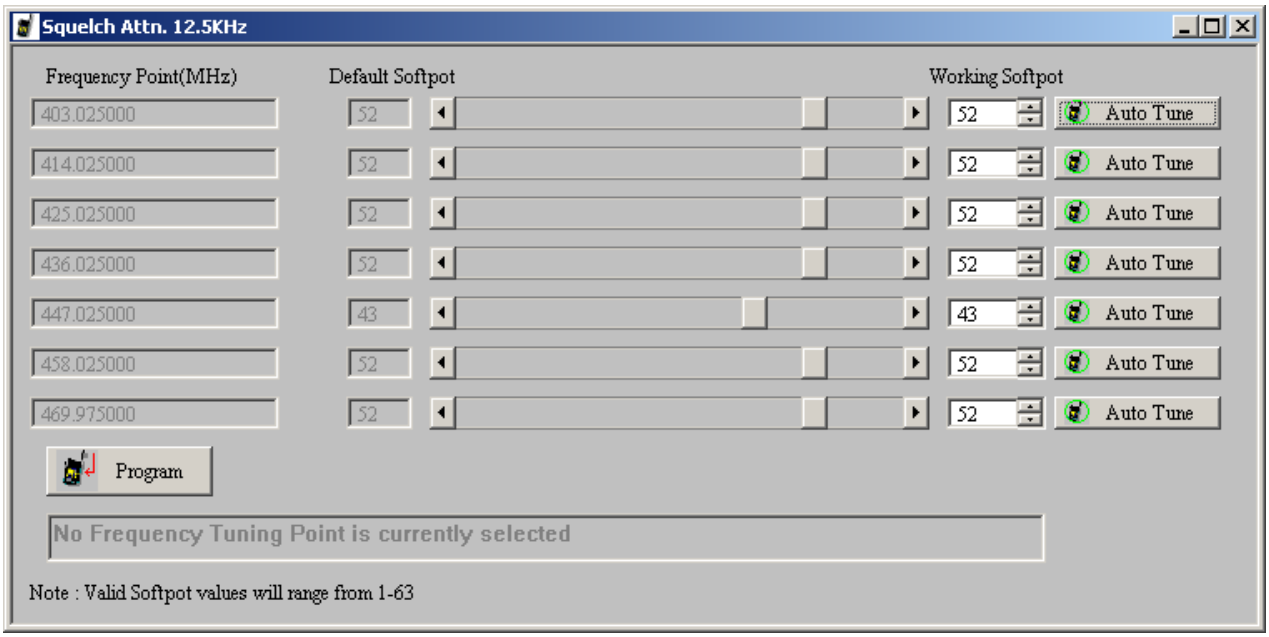


Figure 4-10. Squelch Tuning Window

4.5.2.1 Manual Squelch Tuning

Perform the squelch tuning procedure as follows:

1. Under the **Rx Align** menu, select **Squelch Attenuation**. Select **Squelch Attenuation 12.5 kHz** or **Squelch Attenuation 25 kHz** Channel Spacing variations (Figure 4-10).
2. Apply an RF signal modulated with a 1 kHz tone at 60% rated deviation listed in Table 4-5 for current frequency point (F1 being the first) of 10 dB SINAD. That is, adjust the reference signal level until 10 dB SINAD is obtained at the SINAD meter. Squelch tuning can either be done manually (see Manual Squelch Tuning for procedure) or by Auto Squelch (see Manual Squelch Tuning for procedure). To obtain 10 dB, unmute the radio first by dragging the corresponding slider value to 1.

Table 4-5 Squelch Deviation Values

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

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 or use the spin controls. Do this until the radio is totally unmuted. Verify the squelch closing by inputting a signal level of **4 dB** lower than that of the **10 dB** SINAD level.
5. Repeat Steps 2 through 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.

4.5.2.2 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:

1. Select current frequency point (F1 being the first), then press **Auto Tune**.
2. Repeat Steps 3-4 of the Manual Squelch Tuning section for frequency points F2-F7.

Note: Auto Tune will automatically update your radio's codeplug. Please be careful when using it.

4.5.3 RSSI System Level Tuning

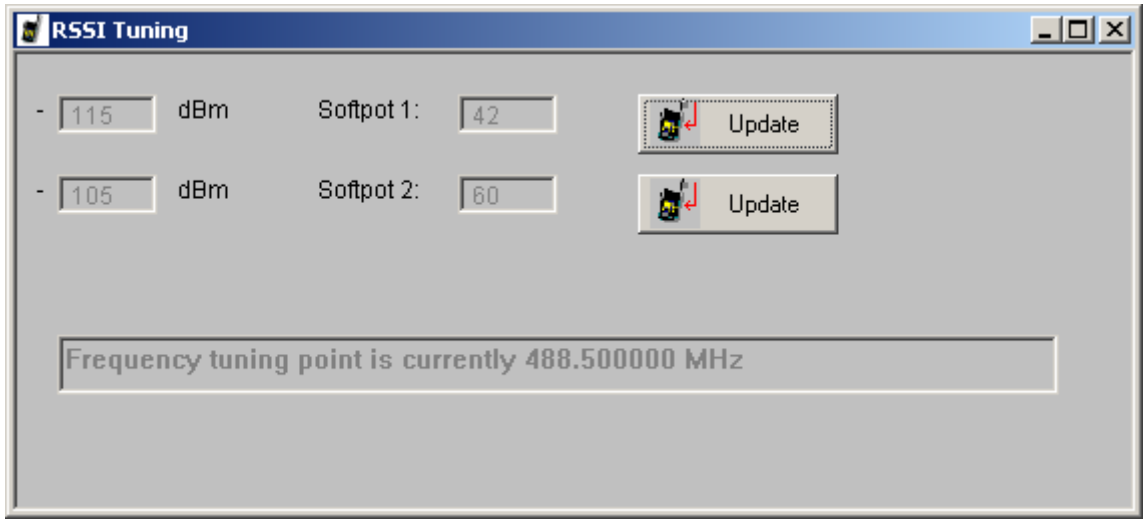


Figure 4-1. RSSI Tuning

1. Under the **Rx Align** menu, select **RSSI Tuning** (Figure 4-1).
2. Inject an on channel signal to the radio at **-47 dBm** at the frequency listed. Modulate the signal with a 1 kHz tone at 60% deviation (3 kHz) to verify that the radio is receiving the desired frequency. RSSI tuning is only done at 25 kHz channel spacing.
3. Change the level to the defined dBm level in the softpot box. (**-115 dBm or -105 dBm**).
4. Press the **Update** button for the softspot to be tuned to the RSSI value correlating to the applied level. The programmed RSSI value will be displayed.
5. Adjust the input level to reflect the next softspot value. Repeat steps 3 and 4 to tune the next value.

4.5.4 RSSI Display Tuning

1. Under the **Rx Align** menu, select **RSSI Display Tuning**.
2. Inject an on channel signal to the radio at **-47 dBm** at the frequency listed. Modulated the signal with a 1 kHz tone at 60% deviation (3 kHz) to verify the radio is receiving the desired frequency. RSSI tuning is only done at 25 kHz channel spacing.
3. Change the level to that which is needed to produce 12 SINAD (**approximately -119 dBm**).
4. Press the **Update** button for the softspot to be tuned to the RSSI value correlating to the applied level. The programmed RSSI value will be displayed.
5. Adjust the input level to **-90 dBm**.
6. Press the **Update** button for the softspot to be tuned to the RSSI value correlating to the applied level. The programmed RSSI value will be displayed.

4.6 Utilities

4.6.1 Program Serial No.

The Program Serial No. option under the Utilities heading allow the radio serial number to be programmed. However, the serial number of a particular radio can only be programmed if it was originally blank. If the serial number of the radio was not blank, then access to the screen will be denied.

4.6.2 Temp Comp Data Read

The **Temp Comp Data Read** command will read the Temp Compensation data out from the radio and then display it on a dialog screen. The data displayed is in 4-byte Hexadecimal form, i.e. 0-9,A-F. e.g. A5 E9 33 3A.

4.6.3 Temp Comp Data Write

The **Temp Comp Data Write** command will write user Temp Compensation data into the radio. The user will then be presented with a dialog screen of the temp comp data to commit/write into the radio. The Temp Comp data can be keyed in manually by the user as 4-byte Hexadecimal form.

4.7 Radio-to-Radio Cloning

1. Cloning is the process of copying the content of one radio (source radio) into another radio (destination radio). Radio content refers to system-type features such as frequency, squelch type options, trunking, etc.

Note: **The source radio's serial number cannot be blank.**

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

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

Note: **Unsuccessful cloning attempts generates a continuous tone and may be an indication that the destination radio's codeplug is corrupted.**

Procedure:

1. Turn source and target radios off.
2. Connect cloning cable (AAPMKN4003) to the side connector of both radios.
3. Turn on the destination radio.

4. Press and hold the two side buttons at the same time on the source radio and then power up the source radio (Figure 4-3). Both radios produce a “clone-entry” tone.
5. Release both side buttons, 1 and 2.
6. When cloning is completed, the source radio produce’s a “clone-exit” tone and both the source and destination radios reset.
7. Turn both radios off.
8. Disconnect the cloning cable from both radios and turn them on for normal operation.

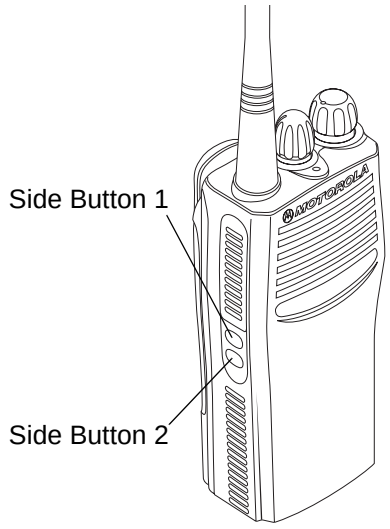


Figure 4-3. Side Button Locations

Section 5

POWER UP SELF-TEST

Turning on the radio using the on/off volume control starts a self-test routine which checks the RAM, EEPROM hardware and EEPROM checksum. Pressing and holding SB1 while turning on the radio causes the self-test routine to check for the ROM checksum as well. If these checks are successfully completed, the radio will generate the Self-Test Pass Tone. If the self-test is not successful, a Self-Test Fail Tone is heard.

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Section 6

ACCESSORIES

6.1 Antennas

NAD6502_R	VHF Heliflex Antenna 14cm (146-174 MHz)
HAD9742	VHF Stubby Antenna, 9cm (146-162 MHz)
HAD9743	VHF Stubby Antenna, 9cm (162-174 MHz)
NAE6522_R	UHF Heliflex Stubby Antenna 9cm (438-470 MHz)
8505816K26	UHF Heliflex Stubby Antenna 7.1cm (470-520 MHz)
NAE6483_R	Flexible Whip Antenna (403-520 MHz)

6.2 Carrying Accessories

HLN9701	Nylon Case with Belt Loop
RLN5383	Leather Case with Belt Loop
RLN5384	Leather Case with 2-1/2 inch Swivel
RLN5385	Leather Case with 3 inch Swivel
HLN8255	3 inch Spring Action Belt Clip
RLN5644	2 inch Spring Action Belt Clip
HLN6602	Universal Chest Pack
1505596Z02	Replacement Strap for HLN6602 Universal Chest Pack
RLN4815	Universal RadioPak
4280384F89	Replacement Belt Lengthener for RLN4815 Universal RadioPak
NTN5243	Shoulder Strap for Hard Leather Cases (attaches to D-Shaped Rings on case)
HLN9985	Waterproof Bag

6.3 Chargers

WPLN4138_R	Rapid Desktop Charger w/US NA 120 V Plug
EPN7997	10 Hour US NA 120 V Plug (plugs into radio accessory connector, used ONLY with battery NNTN4496)
WPLN4155_R	10 Hour Desktop Charger w/US NA 120 V Plug (used ONLY with battery NNTN4496)
EPNN7994	Rapid US NA 120 V Plug
WPLN4161_R	Rapid Six (6) Pocket Multi-Unit Charger w/US NA 120 V Plug

6.4 Batteries

NNTN4496_R	NiCd, 1100 mAH
NNTN4497_R	Li-Ion, 1800 mAH
NNTN4851	NiMH, 1400 mAH
NNTN4970	Slim Li-Ion, 1600 mAH

6.5 Surveillance Accessories

HMN9752	Earpiece with Volume Control, 1-Wire (plastic earloop) (Beige)
HMN9727	Earpiece without Volume Control, 1-Wire (plastic earloop) (Beige)
RLN4894	Earpiece without Volume Control, 1-Wire (plastic earloop) (Black)
HMN9754	Earpiece with Microphone & PTT Combined, 2-Wire (Beige)
RLN4895	Earpiece with Microphone & PTT Combined, 2-Wire (Black)
RLN5198	Earpiece with Microphone & PTT Combined, 2-Wire w/Low Noise Kit, NTN8371 (Beige))
BDN6720	Flexible Ear Receiver without Volume Control (Receive only)
HMN9036	Earbud with Microphone & PTT Combined, 2-Wire (Black)
HLN9132	Earbud Single Wire Receive Only (Black)
NTN8370	Extreme Noise Kit
NTN8371	Low Noise Kit
RLN4760	Small Custom Clear Earpiece, Right Ear (for use with low noise kit NTN8371)
RLN4763	Small Custom Clear Earpiece, Left Ear (for use with low noise kit NTN8371)
RLN4761	Medium Custom Clear Earpiece, Right Ear (for use with low noise kit NTN8371)
RLN4764	Medium Custom Clear Earpiece, Left Ear (for use with low noise kit NTN8371)
RLN4762	Large Custom Clear Earpiece, Right Ear (for use with low noise kit NTN8371)
RLN4765	Large Custom Clear Earpiece, Left Ear (for use with low noise kit NTN8371)
5080384F72	Replacement Noise Attenuating Plug for NTN8370
5080371E73	Replacement Ear Tip for NTN8371 (for use with low noise kit NTN8371) (Beige)
5080371E75	Replacement Ear Tip for NTN8371 (for use with low noise kit NTN8371) (Black)
7580372E11	Replacement Ear Cushion (for use with earpiece BDN6720)

6.6 Headsets

RLN5411	Ultra-Lite Breeze Behind the Head Headset
PMMN4001	Ultra-Lite Earset with Mic and PTT
HMN9013	Lightweight Headset w/o In-line PTT
RMN4016	Lightweight Headset with In-line PTT
RLN5238	Lightweight Headset with In-line PTT, NFL Style
HMN9021	Medium Weight Over the Head Dual Muff Headset
HMN9022	Medium Weight Behind the Head Dual Muff Headset
BDN6647	Medium Weight Single Speaker Headset
BDN6648	Heavy Duty Dual Muff Headset with Noise Canceling Microphone
RMN5015	Heavy Duty Dual Muff Racing Headset (requires RKN4090 Headset Adapter Cable)
RMN4051	2-Way Hard Hat Mount, Black, Noise Reduction Rating (22 dB) (requires RKN4094)
RMN4054	Receive-Only Hard Hat Mount Headset w/3.5mm Right Angle Plug

RMN4055	Receive-Only Headband Style Headset w/3.5mm Right Angle Plug
RKN4090	Adapter Cable (for use with headset RMN5015)
RKN4094	In-Line PTT Adapter (for use with headset RMN4051)
REX4648	Replacement Foam Ear Pad and Windscreen Kit (for use with headsets RMN9013 & RMN4016)
7580376E34	Replacement Ear Seals (for use with headsets HMN9021 & HMN9022)
5080371E66	Replacement Ear Pad (for use with headset BDN6647)
3580371E59	Replacement Wind Screen (for use with headset BDN6647)

6.7 Remote Speaker Microphones

HMN9030	Remote Speaker Microphone with Coil Cord and Clip Back
HKN9094	Replacement Cord (for use with remote speaker microphone HMN9030)

6.8 Ear Microphone Systems

BDN6646	Standard Ear Mic with PTT Only Interface
BDN6706	Standard Ear Mic with PTT and VOX Interface
0180358B38	Ring Push-to-Talk Switch (for use with ear microphone systems BDN6646 & BDN6706)
0180300E83	Body Push-to-Talk (for use with ear microphone systems BDN6646 & BDN6706)
0180300E25	Ear Guard with Adjustable Loop
0180358B32	Ear Holder, Black, Small
0180358B33	Ear Holder, Black, Medium
0180358B34	Ear Holder, Black, Large
0180358B35	Ear Holder, Clear, Small
0180358B36	Ear Holder, Clear, Medium
0180358B37	Ear Holder, Clear, Large

6.9 Miscellaneous

RLN5500	Accessory Retainer Kit (for use with any audio accessory that needs to be secured to the radio due to demandung customer environments)
TDN9327	Portable Radio Hanger for door panels up to 2.75 inch (slides over and hangs from the door panel in vehicle, radio belt clip required)
TDN9373	Portable Radio Hanger for door panels up to 2.75 to 3.25 inch (slides over and hangs from the door panel in vehicle, radio belt clip required)

6.10 Manuals

6880309N60	CP150/CP200 User Guide, English/French
6880309N62	CP150/CP200 Detailed Service Manual, English
HKLN4220	CP150/CP200 User Guide CDROM, English/French

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Section 7

MODEL CHARTS AND TEST SPECIFICATIONS

7.1 VHF 136-162 MHz

CP200, VHF, 136-162 MHz			
Model			**Description**
AAH50JDC9AA1AN			CP200, 136-162 MHz, 5 W, 4 Ch.
	AAH50JDC9AA2AN		CP200, 136-162 MHz, 5 W, 16 Ch.
		Item	**Description**
X		PMUD1981_	CP200, 136-162 MHz, 5 W, 4 Ch.
	X	PMUD1982_	CP200, 136-162 MHz, 5 W, 16 Ch.
X		PMLD4239_	CP200, Back Cover Kit. 136-162 MHz, 4 Ch.
	X	PMLD4240_	CP200, Back Cover Kit, 136-162 MHz, 16 Ch.
X		PMLN4552_	Plain, Front Housing Kit, 4 Ch.
	X	PMLN4553_	Plain, Front Housing Kit, 16 Ch.
X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	NNTN4497_R	Li-Ion Battery, 1800 mAH
X	X	NNTN4851_R	NiMH Battery, 1400 mAH
X	X	NNTN4970_R	Slim Li-Ion Battery, 1600 mAH
X	X	WPLN4138_R	Rapid 90-Min. Desktop Charger w/US Plug
X	X	HLN8255	3” Belt Clip
X	X	NAD6502_R	Antenna, 146-174 MHz, 14cm
X	X	6880309N60	CP200 User Guide, English/French
X	X	HKLN4220	CP200 User Guide CDROM, English/French

X = Indicates compatibility with model(s)

7.2 VHF 146-174 MHz

CP200/CP150, VHF, 146-174 MHz					
Model					**Description**
AAH50KCC9AA1AN					CP150, 146-174 MHz, 2W, 4 Ch.
	AAH50KCC9AA2AN				CP150, 146-174 MHz, 2W, 16 Ch.
		AAH50KDC9AA1AN			CP200, 146-174 MHz, 5W, 4 Ch.
			AA50KDC9AA2AN		CP200, 146-174 MHz, 5W, 16 Ch.
				Item	**Description**
X				PMUD1824_A	CP150, 146-174 MHz, 2W, 4 Ch.
	X			PMUD1826_A	CP150, 146-174 MHz, 2W, 16 Ch.
		X		PMUD1820_A	CP200, 146-174 MHz, 5W, 4 Ch.
			X	PMUD1822_A	CP200, 146-174 MHz, 5W, 16 Ch.
		X		PMLD4204_	CP200, Back Cover Kit. 146-174 MHz, 4 Ch.
			X	PMLD4205_	CP200, Back Cover Kit, 146-174 MHz, 16 Ch.
X				PMLD4206_	CP150, Back Cover Kit, 146-174 MHz, 4 Ch.
	X			PMLD4207_	CP150, Back Cover Kit, 146-174 MHz, 16 Ch.
X		X		PMLN4552_	Plain, Front Housing Kit, 4 Ch.
	X		X	PMLN4553_	Plain, Front Housing Kit, 16 Ch.
X	X	X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	X	X	NNTN4497_R	Li-Ion Battery, 1800 mAH
X	X	X	X	NNTN4851_R	NiMH Battery, 1400 mAH
X	X	X	X	NNTN4970_R	Slim Li-Ion Battery, 1600 mAH
X	X	X	X	WPLN4138_R	Rapid 90-Min. Desktop Charger w/US Plug
X	X	X	X	HLN8255	3” Belt Clip
X	X	X	X	NAD6502_R	Antenna, 146-174 MHz, 14cm
X	X	X	X	6880309N60	CP150/CP200, User Guide
X	X	X	X	HKLN4220	CP150/CP200 User Guide CDROM, English/French

X = Indicates compatibility with model(s)

7.3 VHF Specifications

General

	VHF		
Frequency:	136-162 MHz 146-174 MHz		
Channel Capacity:	4 or 16 Channels		
Power Supply:	7.5 Volts ±20%		
Battery Dimensions: with High Capacity NiCd and High Capacity Li-Ion:	127.5mm H x 61.5mm W x 45mm D (5.0" H x 2.4" W x 1.75" D)		
Battery Dimensions: with NiMH: Slim Li-Ion:	130mm H x 62mm W x 43mm D (5.11" H x 2.44" W x 1.69" D) 130mm H x 62mm W x 42mm D (5.11" H x 2.44" W x 1.65" D)		
Battery Weight: with High Capacity NiCd: High Capacity Li-Ion: NiMH: Slim Li-Ion:	425g (14.98 oz.) 370g (13.04 oz.) 444g (15.7 oz.) 374g (13.2 oz.)		
Average Battery Life @ (5-5-90 Duty Cycle): High Capacity NiCd: High Capacity Li-Ion: NiMH: Slim Li-Ion:	1 W 10 Hrs. 19 Hrs. 13 Hrs. 17 Hrs.	2 W 9 Hrs. 17 Hrs. 11 Hrs. 14 Hrs.	5 W 8 Hrs. 14 Hrs. 10 Hrs. 12 Hrs.
Battery Capacity (mAH): High Capacity NiCd: High Capcity Li-Ion: NiMH: Slim Li-Ion:	1100 mAH 1800 mAH 1400 mAH 1600 mAH		

Transmitter

	VHF	
RF Output NiMH @ 7.5V:	Low 1 W	High 5 W
Frequency:	136-162 MHz 146-174 MHz	
Channel Spacing:	12.5/20/25 kHz	
Freq. Stability: (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-emphasis, 300 to 3000 Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<3%	
FM Noise:	-40 dB (12.5 kHz) -45 dB (25 kHz)	

Receiver

	VHF 12.5 kHz	VHF 20/ 25kHz
Frequency:	136-162 MHz 146-174 MHz	
Sensitivity 12dB EIA SINAD:	0.25 μV (typical)	
Adjacent Channel Selectivity:	-65 dB	-70 dB
Intermodulation:	- 70 dB	
Freq. Stability (-30°C to +60°C):	0.00025%	
Spur Rejection:	-75 dB	
Image and 1/2 I-F Rejection:	-70 dB	
Audio Output @ <5% Distortion:	500 mW	

All specifications are subject to change without notice.

7.4 UHF 403-440 MHz

CP200, UHF, 403-440 MHz			
Model			**Description**
AAH50QDC9AA1AN			CP200, 403-440 MHz, 4 W, 4 Ch.
	AAH50QDC9AA2AN		CP200, 403-440 MHz, 4 W, 16 Ch.
		Item	**Description**
X		PMUE1984_	CP200, 403-440 MHz, 4 W, 4 Ch.
	X	PMUE1985_	CP200, 403-440 MHz, 4 W, 16 Ch.
X		PMLE4297_	CP200, Back Cover Kit,. 403-440 MHz, 4 Ch.
	X	PMLE4298_	CP200, Back Cover Kit, 403-440 MHz, 16 Ch.
X		PMLN4552_	Plain, Front Housing Kit, 4 Ch.
	X	PMLN4553_	Plain, Front Housing Kit, 16 Ch.
X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	NNTN4497_R	Li-Ion Battery, 1800 mAH
X	X	NNTN4851_R	NiMH Battery, 1400 mAH
X	X	NNTN4970_R	Slim Li-Ion Battery, 1600 mAH
X	X	WPLN4138_R	Rapid 90-Min. Desktop Charger w/US Plug
X	X	HLN8255	3” Belt Clip
X	X	NAE6483_R	Antenna, Flexible Whip, 403-520 MHz
X	X	6880309N60	CP200 User Guide, English/French
X	X	HKLN4220	CP200 User Guide CDROM, English/French

X = Indicates compatibility with model(s)

7.5 UHF 438-470 MHz

CP150/CP200, UHF, 438-470 MHz					
Model					**Description**
AAH50RCC9AA1AN					CP150, 438-470 MHz, 2W, 4 Ch.
	AAH50RCC9AA2AN				CP150, 438-470 MHz, 2W, 16 Ch.
		AAH50RDC9AA1AN			CP200, 438-470 MHz, 4W, 4 Ch.
			AA50RDC9AA2AN		CP200, 438-470 MHz, 4W, 16 Ch.
				Item	**Description**
X				PMUE1953_A	CP150, 438-470 MHz, 2W, 4 Ch.
	X			PMUE1955_A	CP150, 438-470 MHz, 2W, 16 Ch.
		X		PMUE1949_A	CP200, 438-470 MHz, 4W, 4 Ch.
			X	PMUE1951_A	CP200, 438-470 MHz, 4W, 16 Ch.
		X		PMLE4255_	CP200, Back Cover Kit,. 438-470, 4 Ch.
			X	PMLE4254_	CP200, Back Cover Kit, 438-470 MHz, 16 Ch.
X				PMLE4256_	CP150, Back Cover Kit, 438-470 MHz, 4 Ch.
	X			PMLE4257_	CP150, Back Cover Kit, 438-470 MHz, 4 Ch.
X		X		PMLN4552_	Plain, Front Housing Kit, 4 Ch.
	X		X	PMLN4553_	Plain, Front Housing Kit, 16 Ch.
X	X	X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	X	X	NNTN4497_R	Li-Ion Battery, 1800 mAH
X	X	X	X	NNTN4851_R	NiMH Battery, 1400 mAH
X	X	X	X	NNTN4970_R	Slim Li-Ion Battery, 1600 mAH
X	X	X	X	WPLN4138_R	Rapid 90-Min. Desktop Charger w/US Plug
X	X	X	X	HLN8255	3” Belt Clip
X	X	X	X	NAE6483_R	Antenna, Flexible Whip, 403-520 MHz
X	X	X	X	6880309N60	CP150/CP200 User Guide, English/French
X	X	X	X	HKLN4220	CP150/CP200 User Guide CDROM, English/French

X = Indicates compatibility with model(s)

7.6 UHF 465-495 MHz

CP200, UHF, 465-495 MHz			
Model			**Description**
AAH50SDC9AA1AN			CP200, 465-495 MHz, 4 W, 4 Ch.
	AAH50SDC9AA2AN		CP200, 465-495 MHz, 4 W, 16 Ch.
		Item	**Description**
X		PMUE1986_	CP200, 465-495 MHz, 4 W, 4 Ch.
	X	PMUE1987_	CP200, 465-495 MHz, 4 W, 16 Ch.
X		PMLE4299_	CP200, Back Cover Kit,. 465-495 MHz, 4 Ch.
	X	PMLE4300_	CP200, Back Cover Kit, 465-495 MHz, 16 Ch.
X		PMLN4552_	Plain, Front Housing Kit, 4 Ch.
	X	PMLN4553_	Plain, Front Housing Kit, 16 Ch.
X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	NNTN4497_R	Li-Ion Battery, 1800 mAH
X	X	NNTN4851_R	NiMH Battery, 1400 mAH
X	X	NNTN4970_R	Slim Li-Ion Battery, 1600 mAH
X	X	WPLN4138_R	Rapid 90-Min. Desktop Charger w/US Plug
X	X	HLN8255	3” Belt Clip
X	X	NAE6483_R	Antenna, Flexible Whip, 403-520 MHz
X	X	6880309N60	CP200 User Guide, English/French
X	X	HKLN4220	CP200 User Guide CDROM, English/French

X = Indicates compatibility with model(s)

7.7 UHF Specifications

General

	UHF		
Frequency:	403-440 MHz 438-470 MHz 465-495 MHz		
Channel Capacity:	4 or 16 Channels		
Power Supply:	7.5 Volts ±20%		
Battery Dimensions: with High Capacity NiCd and High Capacity Li-Ion:	127.5mm H x 61.5mm W x 45mm D (5.0” H x 2.4” W x 1.75” D)		
Battery Dimensions: with NiMH: Slim Li-Ion:	130mm H x 62mm W x 43mm D (5.11” H x 2.44” W x 1.69” D) 130mm H x 62mm W x 42mm D (5.11” H x 2.44” W x 1.65” D)		
Battery Weight: with High Capacity NiCd: High Capacity Li-Ion: NiMH: Slim Li-Ion:	 425g (14.98 oz.) 370g (13.04 oz.) 444g (15.7 oz.) 374g (13.2 oz.)		
Average Battery Life @ (5-5-90 Duty Cycle): High Capacity NiCd: High Capacity Li-Ion: NiMH: Slim Li-Ion:	1 W 10 Hrs. 19 Hrs. 13 Hrs. 17 Hrs.	2 W 9 Hrs. 17 Hrs. 11 Hrs. 14 Hrs.	5 W 8 Hrs. 14 Hrs. 10 Hrs. 12 Hrs.
Battery Capacity (mAH): High Capacity NiCd: High Capcity Li-Ion: NiMH: Slim Li-Ion:	 1100 mAH 1800 mAH 1400 mAH 1600 mAH		

Transmitter

	UHF	
RF Output NiMH @ 7.5V:	Low 1 W	High 4 W
Frequency:	403-440 MHz 438-470 MHz 465-495 MHz	
Channel Spacing:	12.5/20/25 kHz	
Freq. Stability: (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<3%	
FM Noise:	-40 dB (12.5 kHz) -45 dB (25 kHz)	

Receiver

	UHF 12.5 kHz	UHF 20/25kHz
Frequency:	403-440 MHz 438-470 MHz 465-495 MHz	
Sensitivity 12dB EIA SINAD:	0.25 μV (typical)	
Adjacent Channel Selectivity:	-60 dB	-70 dB
Intermodulation:	-70 dB	
Freq. Stability (-30°C to +60°C):	0.00025%	
Spur Rejection:	-75 dB	
Image and 1/2 I-F Rejection:	-70 dB	
Audio Output @ <5% Distortion:	500 mW	

All specifications are subject to change without notice.

7.8 MIL Standards

Table 7-1 MIL STDS 810 C, D, E, and F: Applicable to UHF and VHF Specifications (8.2 and 8.4)

Military Standards 810 C, D, E, & F: Parameters/Methods/Procedures								
	810C		810D		810E		810F	
Applicable MIL-STD	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures
Low Pressure	500.1	1	500.2	2	500.3	2	500.4	1
High Temperature	501.1	1,2	501.2	1,2	501.3	1,2	501.4	1,2
Low Temperature	502.1	1	502.2	1,2	502.3	1,2	501.4	1,2
Temperature Shock	503.1	1	503.2	1	503.3	1	503.4	1
Solar Radiation	505.1	1	505.2	1	505.3	1	505.4	1
Rain	506.1	1,2	506.2	1,2	506.3	1,2	506.4	1
Humidity	507.1	2	507.2	2,3	507.3	2,3	507.4	3
Salt Fog	509.1	1	509.2	1	509.3	1	509.4	1
Dust	510.1	1	510.2	1	510.3	1	510.4	1
Vibration	514.2	8,10	514.3	1	514.4	1	514.5	1
Shock	516.2	1,2,5	516.3	1,4	516.4	1,4	516.5	1

GLOSSARY OF TERMS

Term	Definition
ALC	Automatic Level Control: a circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR (voltage standing wave ratio).
ASFIC	Audio Signalling Filter Integrated Circuit
BKC	Bad Key Chirp
CD	Compact Disk
CMP	Compression
CPS	Customer Programming Software
CSQ	Carrier Squelch
DTMF	Dual-Tone Multifrequency
DPL	Digital Private-Line™
EEPROM	Electronically Erasable/Programmable Read-Only Memory: used by the radio to store its personality
Firmware	Software, or a software/hardware combination of computer programs and data, with a fixed logic configuration stores in a read-only memory. Information cannot be altered or reprogrammed.
FGU	Frequency Generation Unit
GaAs	Gallium Arsenide: a type of crystalline material used in some semiconductors.
GKC	Good Key Chirp
ISW	Inbound Signalling Word: data transmitted on the control channel from a subscriber unit to the central control unit.
LH DATA	Longhorn Data: a bidirectional 0-5V, RS-232 line protocol 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.
MCU	Micro Controller Unit
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.
OMPAC	Over-Molded Pad-Array Carrier: a Motorola custom package, distinguished by the presence of solder balls on the bottom pads.
PC Board	Printed Circuit Board

Term	Definition
PL	Private-Line® tone squelch: a continuous sub-audible tone that is transmitted along with the carrier.
PLL	Phase-Locked Loop: a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PTT	Push-To-Talk: the switch located on the left side of the radio; 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.
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	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
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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