MOTOROLA
intelligence everywhere™

Commercial Series
CP140/CP160/CP180 Portable Radios

Basic Service Manual

6866550D17-O

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SAFETY INFORMATION

Read this information before using the radio.

PRODUCT SAFETY AND RF EXPOSURE FOR PORTABLE TWO-WAY RADIOS.

This document provides information and instructions for the safe and efficient operation of Motorola Portable Two-Way Radios. The information provided in this document supersedes information contained in user guides published prior to **February 2002.**

COMPLIANCE WITH RF ENERGY EXPOSURE STANDARDS

Note: This Radio is intended for use in occupational/controlled applications, where users have been made aware of the potential for exposure and can exercise control over their exposure. This radio device is NOT authorized for general population, consumer or similar use.

This document includes useful information about RF exposure and helpful instructions on how to control RF exposures.

Motorola radios are designed and tested to comply with a number of national and international standards and guidelines regarding human exposure to radio frequency electromagnetic energy. **This radio complies with IEEE and ICNIRP exposure limits for occupational/controlled RF** exposure environments at usage factors of up to 50% talk–50% listen. In terms of measuring RF energy for compliance with the IEEE/ICNIRP exposure guidelines, the radio radiates measurable RF energy only while it is transmitting (during talking), not when it is receiving (listening) or in standby mode.

NOTE: The approved batteries, supplied with this radio, are rated for a 5-5-90 duty cycle (5% talk–5% listen–90% standby), even though this radio complies with IEEE/ICNIRP occupational exposure limits at usage factors of up to 50% talk.

PORTABLE RADIO OPERATION AND EME EXPOSURE

Your Motorola two-way radio complies with the following RF energy exposure standards and guidelines:

- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- United States Federal Communications Commission, Code of Federal Regulations; 47 CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 2001
- ANATEL, Brasil Regulatory Authority, Resolution 256 (April 11, 2001) “additional requirements for SMR, cellular and PCS product certification.”

COMPLIANCE AND CONTROL GUIDELINES AND OPERATING INSTRUCTIONS FOR PORTABLE TWO-WAY RADIOS

To control your exposure and ensure compliance with the occupational/controlled environment exposure limits, always adhere to the following procedures:

- Transmit no more than 50% of the time. To transmit (talk), push the Push-To-Talk (PTT) button. To receive calls, release the PTT button. Transmitting 50% of the time or less is important since the radio generates measurable RF energy exposure only when transmitting (in terms of measuring standards compliance).
- Hold the radio in a vertical position in front of the face with the microphone (and other parts of the radio including the antenna) at least 2.5 to 5 centimeters (one to two inches) away from the lips. Keeping the radio at a proper distance is important since RF exposures decrease with distance from the antenna.
- For body-worn operation, always place the radio in a Motorola approved clip, holder, holster, case, or body harness for this product. Using Motorola non-approved accessories may result in exposure levels which exceed the IEEE/ICNIRP occupational /controlled environment RF exposure limits.
- If you are not using a body-worn accessory and are not using the radio in the intended use position in front of the face, then ensure the antenna and the radio are kept 2.5 cm (one inch) from the body when transmitting. Keeping the radio at a proper distance is important because of RF exposures decrease with distance from the antenna.

Use only Motorola-approved supplied or replacement antennas, batteries, and accessories. Use of non-Motorola approved antennas, batteries and accessories may exceed IEEE/ICNIRP RF exposure guidelines.
For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories:

http://moleurope.comm.mot.com/member/commerce

For additional information on exposure requirements or other training information, visit http://www.motorola.com/rfhealth.

ELECTROMAGNETIC INTERFERENCE/COMPATIBILITY

NOTE: Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately shielded, designed or otherwise configured for electromagnetic compatibility.

Facilities

To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospitals or health care facilities may be using equipment that is sensitive to external RF energy.

Aircraft

When instructed to do so, turn off your radio when on board an aircraft. Any use of a radio must be in accordance with applicable regulations per airline crew instructions.

Medical Devices

Pacemakers

The Advanced Medical Technology Association (AdvaMed) recommends that a minimum separation of 15 cms (6 inches) be maintained between a handheld wireless radio and a pacemaker.These recommendations are consistent with those of the U.S. Food and Drug Administration.

Persons with pacemakers should:

- ALWAYS keep the radio more than 15 cms from their pacemaker when the radio is turned ON.
- Not carry the radio in the breast pocket.
- Use the ear opposite the pacemaker to minimize the potential for interference.
- Turn the radio OFF immediately if you have any reason to suspect that interference is taking place.

Hearing Aids

Some digital wireless radios may interfere with some hearing aids. In the event of such interference, you may want to consult your hearing aid manufacturer to discuss alternatives.

Other Medical Devices

If you use any other personal medical device, consult the manufacturer of your device to determine if it is adequately shielded from RF energy. Your physician may be able to assist you in obtaining this information.

Driver Safety

Check the laws and regulations on the use of radios in the area where you drive. Always obey them.
When using your radio while driving, please:

- Give full attention to driving and to the road.
- Use hands-free operation, if available.
- Pull off the road and park before making or answering a call if driving conditions so require.

OPERATIONAL WARNINGS

Vehicles with an air bag



WARNING: Do not place a portable radio in the area over an air bag or in the air bag deployment area. Air bags inflate with great force. If a portable radio is placed in the air bag deployment area and the air bag inflates, the radio may be propelled with great force and cause serious injury to occupants of the vehicle.

Potentially explosive atmospheres



WARNING: Turn off your radio prior to entering any area with a potentially explosive atmosphere, unless it is a radio type especially qualified for use in such areas as "Intrinsically Safe" (for example, Factory Mutual, CSA, UL or CENELEC Approved). Do not remove, install, or charge batteries in such areas. Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

NOTE The areas with potentially explosive atmospheres referred to above include fuelling areas such as below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles, such as grain, dust or metal powders. Areas with potentially explosive atmospheres are often but not always posted.

Blasting caps and areas



WARNING: To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: "Turn off two-way radio". Obey all signs and instructions.

OPERATIONAL CAUTIONS

Damaged antennas



CAUTION: Do not use any portable radio that has a damaged antenna. If a damaged antenna comes into contact with your skin, a minor burn can result.

Batteries



CAUTION: All batteries can cause property damage and/or bodily injury such as burns if a conductive material such as jewellery, keys, or beaded chains touch exposed terminals. The conductive material may complete an electrical circuit (short circuit) and become quite hot. Exercise care in handling any charged battery, particularly when placing it inside a pocket, purse, or other container with metal objects.

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Chapter 1 Model Charts and Test Specifications

1.1 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: MDH65KDC9AA2AN)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level	Model Revision	Model Package
MD ↑ **MD** = Motorola Internal Use	**H** ↑ **H** = Portable	**65**	**K** VHF (146-174 MHz) **Q** UHF1 (403-440 MHz) **R** UHF2 (438-470 MHz) **S** UHF3 (465-495 MHz)	**D** 4 W or 5 W	**C** Non Display **F** Limited Keypad **H** Full Keypad	**9** Program-mable	**AA** Conven-tional	**2** 16 Chan **3** 32 Chan **4** 64 Chan	**A**	**N**

1.2 Model Chart for VHF 146-174 MHz

CP100 Series, VHF, 146-174 MHz				
Model				**Description**
MDH65KDC9AA2AN				CP140, 146-174 MHz, 5 W, 16 Ch. Non-Display Model
	MDH65KDF9AA3AN			CP160, 146-174 MHz, 5 W, 32 Ch. Limited Keypad Model
		MDH65KDH9AA4AN		CP180, 146-174 MHz, 5 W, 64 Ch. Full Keypad Model
			Item	**Description**
X			PMUD1857_	CP140, 146-174 MHz, Tanapa
	X		PMUD1858_	CP160, 146-174 MHz, Tanapa
		X	PMUD1859_	CP180, 146-174 MHz, Tanapa
X			PMLD4222_	CP140, Back Cover Kit. 146-174 MHz
	X		PMLD4223_	CP160, Back Cover Kit. 146-174 MHz
		X	PMLD4224_	CP180, Back Cover Kit. 146-174 MHz
X			PMLN4601_	CP140, Front Housing Kit, 16 Ch.
	X		PMLN4602_	CP160, Front Housing Kit, 32 Ch.
		X	PMLN4603_	CP180, Front Housing Kit, 64 Ch.
X	X	X	NNTN4497_R	Li-Ion Battery, High Capacity 1800 mAH
X	X	X	NNTN4851_	NiMh Battery, 1400 mAH
X	X	X	NNTN4852_	NiMh Battery, 1300 mAH FM
X	X	X	NNTN4970	Slim Li-Ion Battery 1600 mAH
X	X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	X	WPLN4138_R	Rapid Desktop Charger w/US Plug
X	X	X	WPLN4139_R	Rapid Desktop Charger w/Euro Plug
X	X	X	WPLN4140_R	Rapid Desktop Charger w/UK Plug
X	X	X	HLN8255	3” Belt Clip
X	X	X	NAD6502_R	Antenna, 146-174 MHz, 14cm
X			6866550D01	CP140/CP160/CP180 User Guide
	X		6881096C29	FM Product Listing Manual
		X	6864117B25_	Safety and General Information Leaflet

X = Indicates compatibility with model(s)

1.3 VHF Specifications

General

	VHF
Frequency:	146-174 MHz
Channel Capacity:	16, 32, or 64 Channels
Power Supply:	7.5 Volts ±20%
Dimensions with: High Capacity Li-Ion, NiMH FM NiCd Std NiMH Std Slim Li-Ion Batteries:	 130.5mm H x 62mm W x 45mm D 130.5mm H x 62mm W x 45mm D 130.5mm H x 62mm W x 45mm D 130.5mm H x 62mm W x 43mm D 130.5mm H x 62mm W x 42mm D
Weight: for 16 Channel Model Batteries: High Capacity Li-Ion NiMH FM NiCd Std NiMH Std Slim Li-Ion	 376g (13.26 oz.) 449g (15.83 oz.) 430g (15.17 oz.) 446g (15.73 oz.) 337g (13.30 oz.)
Weight: for 32 & 64 Channel Model Batteries: High Capacity Li-Ion NiMH FM NiCd Std NiMH Std Slim Li-Ion	 396g (13.97 oz.) 469g (16.54 oz.) 451g (15.91 oz.) 467g (16.47 oz.) 377g (14.0 oz.)

Average Battery Life @ (5-5-90 Duty Cycle):	Capacity (mAh)	5 W	1 W
High Capacity Li-Ion	1800	14 Hrs.	19 Hrs.
NiMH FM	1300	9 Hrs.	11 Hrs.
NiCd Std	1100	8 Hrs.	10 Hrs.
NiMH Std	1400	10 Hrs.	13 Hrs.
Slim Li-Ion	1600	12 Hrs.	17 Hrs.

Self-Quieter Frequencies

VHF	
151.19375	167.99375
151.200	168.000
151.20625	168.00625

Transmitter

	VHF	
RF Output NiMH @ 7.5 V:	Low 1 W	High 5 W
Frequency:	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:	146-174 MHz	
Sensitivity 12 dB 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.

1.4 Model Chart for UHF1 403-440 MHz

CP100 Series, UHF1, 403-440 MHz				
Model				**Description**
MDH65QDC9AA2AN				CP140, 403-440 MHz, 4 W, 16 Ch. Non-Display Model
	MDH65QDF9AA3AN			CP160, 403-440 MHz, 4 W, 32 Ch. Limited Keypad Model
		MDH65QDH9AA4AN		CP180, 403-440 MHz, 4 W, 64 Ch. Full Keypad Model
			Item	**Description**
X			PMUE1972_	CP140, 403-440 MHz, Tanapa
	X		PMUE1973_	CP160, 403-440 MHz, Tanapa
		X	PMUE1974_	CP180, 403-440 MHz, Tanapa
X			PMLE4282_	CP140, Back Cover Kit. 403-440 MHz
	X		PMLE4285_	CP160, Back Cover Kit. 403-440 MHz
		X	PMLE4286_	CP180, Back Cover Kit. 403-440 MHz
X			PMLN4601_	CP140, Front Housing Kit, 16 Ch.
	X		PMLN4602_	CP160, Front Housing Kit, 32 Ch.
		X	PMLN4603_	CP180, Front Housing Kit, 64 Ch.
X	X	X	NNTN4497_R	Li-Ion Battery, High Capacity 1800 mAH
X	X	X	NNTN4851_	NiMh Battery, 1400 mAH
X	X	X	NNTN4852_	NiMh Battery, 1300 mAH FM
X	X	X	NNTN4970	Slim Li-Ion Battery 1600 mAH
X	X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	X	WPLN4138_R	Rapid Desktop Charger w/US Plug
X	X	X	WPLN4139_R	Rapid Desktop Charger w/Euro Plug
X	X	X	WPLN4140_R	Rapid Desktop Charger w/UK Plug
X	X	X	HLN8255	3” Belt Clip
X	X	X	NAE6483_	Antenna, 403-520 MHz, 14cm
X			6866550D01	CP140/CP160/CP180 User Guide
	X		6881096C29	FM Product Listing Manual
		X	6864117B25_	Safety and General Information Leaflet

X = Indicates compatibility with model(s)

1.5 Model Chart for UHF2 438-470 MHz

CP100 Series, UHF2, 438-470 MHz				
Model				**Description**
MDH65RDC9AA2AN				CP140, 438-470 MHz, 4 W, 16 Ch. Non-Display Model
	MDH65RDF9AA3AN			CP160, 438-470 MHz, 4 W, 32 Ch. Limited Keypad Model
		MDH65RDH9AA4AN		CP180, 438-470 MHz, 4 W, 64 Ch. Full Keypad Model
			Item	**Description**
X			PMUE1966_	CP140, 438-470 MHz, Tanapa
	X		PMUE1967_	CP160, 438-470 MHz, Tanapa
		X	PMUE1968_	CP180, 438-470 MHz, Tanapa
X			PMLE4283_	CP140, Back Cover Kit. 438-470 MHz
	X		PMLE4290_	CP160, Back Cover Kit. 438-470 MHz
		X	PMLE4291_	CP180, Back Cover Kit. 438-470 MHz
X			PMLN4601_	CP140, Front Housing Kit, 16 Ch.
	X		PMLN4602_	CP160, Front Housing Kit, 32 Ch.
		X	PMLN4603_	CP180, Front Housing Kit, 64 Ch.
X	X	X	NNTN4497_R	Li-Ion Battery, High Capacity 1800 mAH
X	X	X	NNTN4851_	NiMh Battery, 1400 mAH
X	X	X	NNTN4852_	NiMh Battery, 1300 mAH FM
X	X	X	NNTN4970	Slim Li-Ion Battery 1600 mAH
X	X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	X	WPLN4138_R	Rapid Desktop Charger w/US Plug
X	X	X	WPLN4139_R	Rapid Desktop Charger w/Euro Plug
X	X	X	WPLN4140_R	Rapid Desktop Charger w/UK Plug
X	X	X	HLN8255	3” Belt Clip
X	X	X	NAE6483_	Antenna, 403-520 MHz, 14cm
X			6866550D01	CP140/CP160/CP180 User Guide
	X		6881096C29	FM Product Listing Manual
		X	6864117B25_	Safety and General Information Leaflet

X = Indicates compatibility with model(s)

1.6 Model Chart for UHF3 465-495 MHz

CP100 Series, UHF3, 465-495 MHz				
Model				**Description**
MDH65SDC9AA2AN				CP140, 465-495 MHz, 4 W, 16 Ch. Non-Display Model
	MDH65SDF9AA3AN			CP160, 465-495 MHz, 4 W, 32 Ch. Limited Keypad Model
		MDH65SDH9AA4AN		CP180, 465-495 MHz, 4W, 64 Ch. Full Keypad Model
			Item	**Description**
X			PMUE1978_	CP140, 465-495 MHz, Tanapa
	X		PMUE1979_	CP160, 465-495 MHz, Tanapa
		X	PMUE1980_	CP180, 465-495 MHz, Tanapa
X			PMLE4294_	CP140, Back Cover Kit. 465-495 MHz
	X		PMLE4295_	CP160, Back Cover Kit. 465-495 MHz
		X	PMLE4296_	CP180, Back Cover Kit. 465-495 MHz
X			PMLN4601_	CP140, Front Housing Kit, 16 Ch.
	X		PMLN4602_	CP160, Front Housing Kit, 32 Ch.
		X	PMLN4603_	CP180, Front Housing Kit, 64 Ch.
X	X	X	NNTN4497_R	Li-Ion Battery, High Capacity 1800 mAH
X	X	X	NNTN4851_	NiMh Battery, 1400 mAH
X	X	X	NNTN4852_	NiMh Battery, 1300 mAH FM
X	X	X	NNTN4970	Slim Li-Ion Battery 1600 mAH
X	X	X	NNTN4496_R	NiCd Battery, 1100 mAH
X	X	X	WPLN4138_R	Rapid Desktop Charger w/US Plug
X	X	X	WPLN4139_R	Rapid Desktop Charger w/Euro Plug
X	X	X	WPLN4140_R	Rapid Desktop Charger w/UK Plug
X	X	X	HLN8255	3” Belt Clip
X	X	X	NAE6483_	Antenna, 403-520 MHz, 14cm
X			6866550D01	CP140/CP160/CP180 User Guide
	X		6881096C29	FM Product Listing Manual
		X	6864117B25_	Safety and General Information Leaflet

X = Indicates compatibility with model(s)

1.7 UHF Specifications

General

	UHF		
Frequency:	403-440 MHz 438-470 MHz 465-495 MHz		
Channel Capacity:	16, 32, or 64 Channels		
Power Supply:	7.5 Volts ±20%		
Dimensions with: High Capacity Li-Ion, NiMH FM/NiCd Std NiMH Std Slim Li-Ion Batteries:	 130.5mm H x 62mm W x 45mm D 130.5mm H x 62mm W x 45mm D 130.5mm H x 62mm W x 43mm D 130.5mm H x 62mm W x 42mm D		
Weight: for 16 Channel Model Batteries: High Capacity Li-Ion NiMH FM NiCd Std NiMH Std Slim Li-Ion	 376g (13.26 oz.) 449g (15.83 oz.) 430g (15.17 oz.) 446g (15.73 oz.) 337g (13.30 oz.)		
Weight: for 32 & 64 Channel Model Batteries: High Capacity Li-Ion NiMH FM NiCd Std NiMH Std Slim Li-Ion	 396g (13.97 oz.) 469g (16.54 oz.) 451g (15.91 oz.) 467g (16.47 oz.) 377g (14.0 oz.)		
Average Battery Life @ (5-5-90 Duty Cycle): High Capacity Li-Ion NiMH FM NiCd Std NiMH Std Slim Li-Ion	Capacity (mAh) 1800 1300 1100 1400 1600	4 W 14 Hrs. 9 Hrs. 8 Hrs. 10 Hrs. 12 Hrs.	1 W 19 Hrs. 11 Hrs. 10 Hrs. 13 Hrs. 17 Hrs.

Self-Quieter Frequencies

UHF1	UHF2	UHF3
419.993750	443.93125	488.326250
420.000000	443.9375	488.332500
420.006250	443.94375	488.338750
(420+/-6.25kHz)	443.950	488.345000
	443.95625	488.351250
	443.9625	488.357500
	443.96875	488.363750
		488.345+/-18.75kHz

Transmitter

	UHF	
RF Output NiMH @ 7.5 V:	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 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

	UHF 12.5 kHz	UHF 20/25kHz
Frequency:	403-440 MHz 438-470 MHz 465-495 MHz	
Sensitivity 12 dB 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.

1.8 MIL Standards

Table 1-2. 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

Chapter 2 Theory Of Operation

2.1 Introduction

This chapter provides a basic theory of operation for the radio components.

2.2 Major Assemblies

- Transceiver Board – contains all transmit, receive, and audio circuitry.
- Display (Limited and Full Keypad models only) – 8 characters (14 segments star burst) and 10 icons with backlighting, liquid-crystal display (LCD).

Keypad Board (Limited and Full Keypad models only) –
Limited Keypad: a 2-button menu keypad with 2-way navigation button,
Full Keypad: a 2-button menu keypad with 2-way navigation button, and a 3 x 4 alphanumeric keypad.Transceiver Board (Figure 2-1).

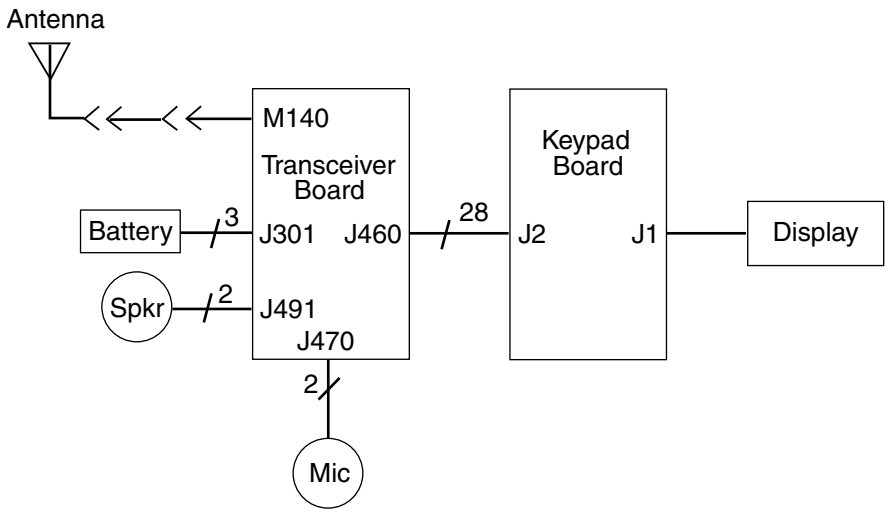


Figure 2-1. Major Assemblies Block Diagram

2.2.1 Receiver

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, interstage filter, and a double-balanced first mixer (Figure 2-2).

The mixer output is applied to a diplexer network which matches the 44.85 MHz IF signal to the crystal filter, and terminates the mixer into 50 ohms at all other frequencies.

The receiver back-end is a dual conversion design. High IF selectivity is provided by a 4-pole fundamental mode 44.85 MHz crystal filter. The output is matched to an IF amplifier stage. The output of the IF amplifier is applied to the input of the receiver IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio, and RSSI Op Amps. The second LO frequency, 44.395 MHz, is determined by a crystal oscillator. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters. The first ceramic filter is a 4-pole filter used between the second mixer and IF amp. The second ceramic filter is a 6-pole filter and is used between the IF amp and the limiter input. For the second ceramic filter, a wider filter is used for 20/25 kHz channel spacing, and a narrower filter is used for 12.5 kHz channels.

A ceramic resonator provides phases vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. The output of the IFIC is the recovered audio signal which is fed to the audio IC for amplification and signal conditioning. The output of the audio IC is injecting into the audio PA which drives the 24 Ohm speaker.

2.2.2 Transmitter

When the radio is transmitting, microphone audio is passed through the audio IC, where pre-emphasis and low-pass (splatter) filtering are done. The output of the audio IC is used to modulate the TX VCO, which creates the modulated carrier. The modulated carrier is then amplified by the pre-driver and power amplifier circuit, which transmits the signal under dynamic power control

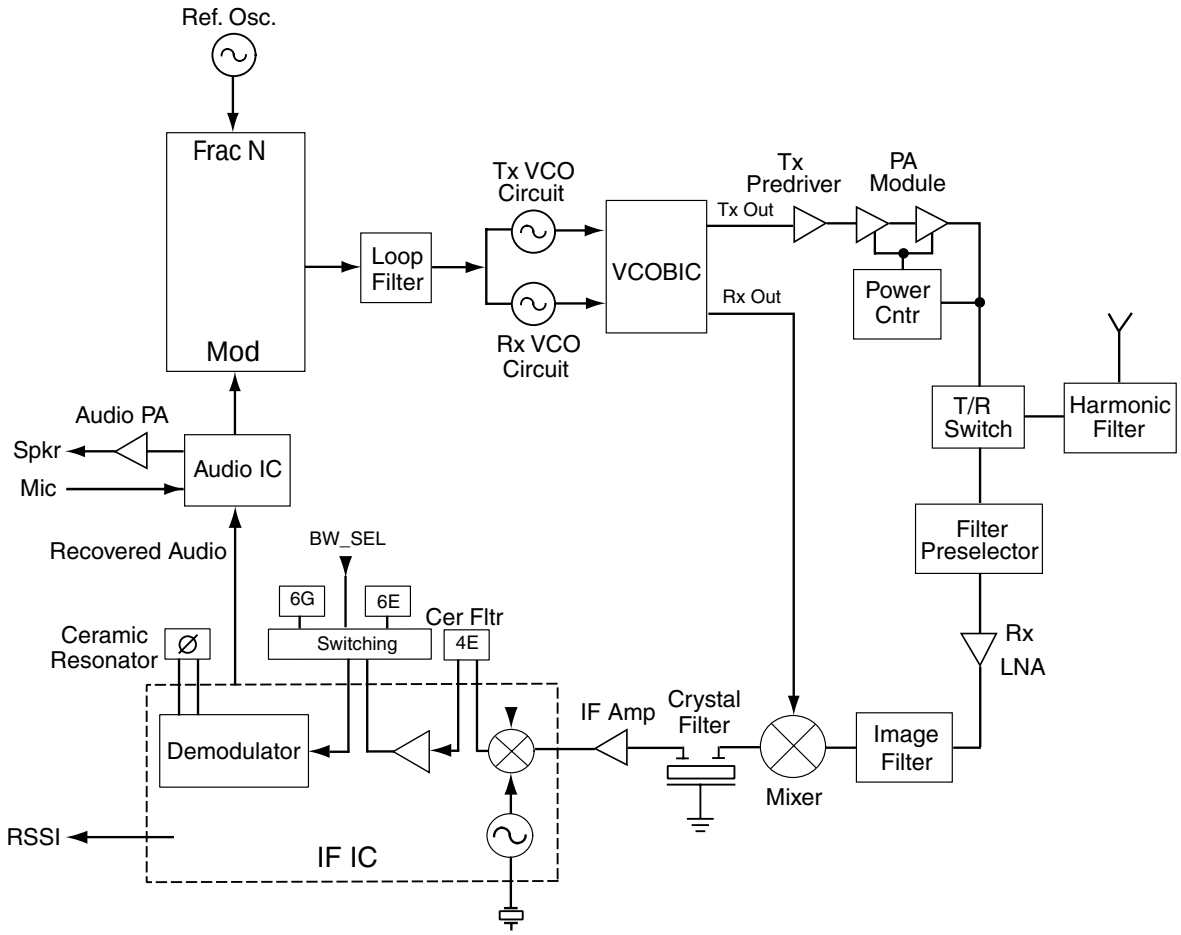


Figure 2-2. Transceiver Block Diagram

Chapter 3 Test Equipment, Service Aids, and Service Tools

3.1 Test Equipment

Table 3-1 lists test equipment required to service the CP100 Series Portable Radios.

Table 3-1. Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2600 series	Comms System analyzer (non MPT)	This item will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1074_	Fluke 87 digital multi-meter	True RMS metering, 200 kHz frequency counter, 32-segment bargraph with backlit display	Digital voltmeter is recommended for AC/DC voltage and current measurements
*R1377_	AC voltmeter	1mV to 300mV, 10 mega-ohm input impedance	Audio voltage measurements
R1611_	Dual channel 100 MHz oscilloscope (Agillent)	Two-channel, 100 MHz bandwidth, 200M sample rate/sec, 2MB memory/ channel	Waveform measurements
S1339_	RF millivolt meter	100µV to 3V RF, 10 kHz to 1 GHz frequency range	RF level measurements
*R1013_ or *R1370_	SINAD meter or SINAD meter with RMS	Without RMS audio voltmeter or With RMS audio voltmeter	Receiver sensitivity measurements
S1348D	Programmable DC power supply	0-20V DC, 0-5 amps, current limited	Bench supply for 7.5 V DC
R1440A 0180305F14 0180305F30 0180305F39 RLN4610A T1013	Wattmeter, Plug-in Element Plug-in Element Plug-in Element Carry case RF Dummy Load	Thruline 50-Ohm, ±5% accuracy 10W, 25 - 60 MHz 10W, 100 - 250 MHz 10W, 200 - 500 MHz Wattmeter and 6 elements	Transmitter power output measurements

3.2 Service Aids

Table 3-2 lists service aids recommended for working on the CP100 Series Portable Radios. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 3-2. 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.
PMKN4004	Programming Test Cable	Connects radio to RIB (RLN4008).
PMKN4003	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 BNC Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
0180305K08	Shop Battery Eliminator	Interconnects radio to power supply.
EPN4040_	Wall-Mounted Power Supply (UK)	Used to supply power to the RIB
EPN4041_	Wall-Mounted Power Supply (220VAC)	Used to supply power to the RIB
HSN9412	Wall-Mounted Power Supply (120VAC)	Used to supply power to the RIB
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 (RLN4008).
HKN9216	IBM Computer Interface Cable	Connection from computer to RIB.
6680702Z01	Knob Remover/Chassis Opener	Used to remove the front cover assembly.
RSX4043A	TORX screwdriver	Tighten and remove chassis screws
6680387A70	T6 TORX bit	Removable TORX screwdriver bit
WADN4055A	Portable Soldering Station	Digitally controlled soldering iron
6604008K01	0.4mm replacement tip	For WADN4055A Soldering iron
6604008K02	0.8mm replacement tip	For WADN4055A Soldering iron
0180386A82	Anti-static Grounding Kit	Used for all radio assembly/disassembly procedures
6684253C72	Straight Prober	
6680384A98	Brush	
1010041A86	Solder (RMA type)	63/37, 0.5mm diameter, 2.2kg (1lb) spool.

Programming/Test Cable

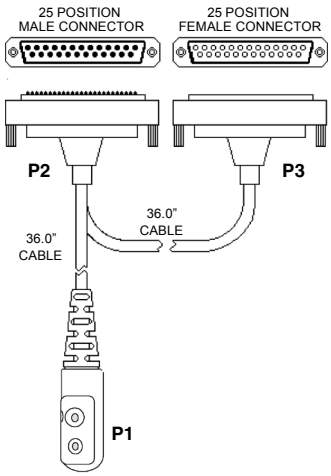


Figure 3-1. Programming/Test Cable

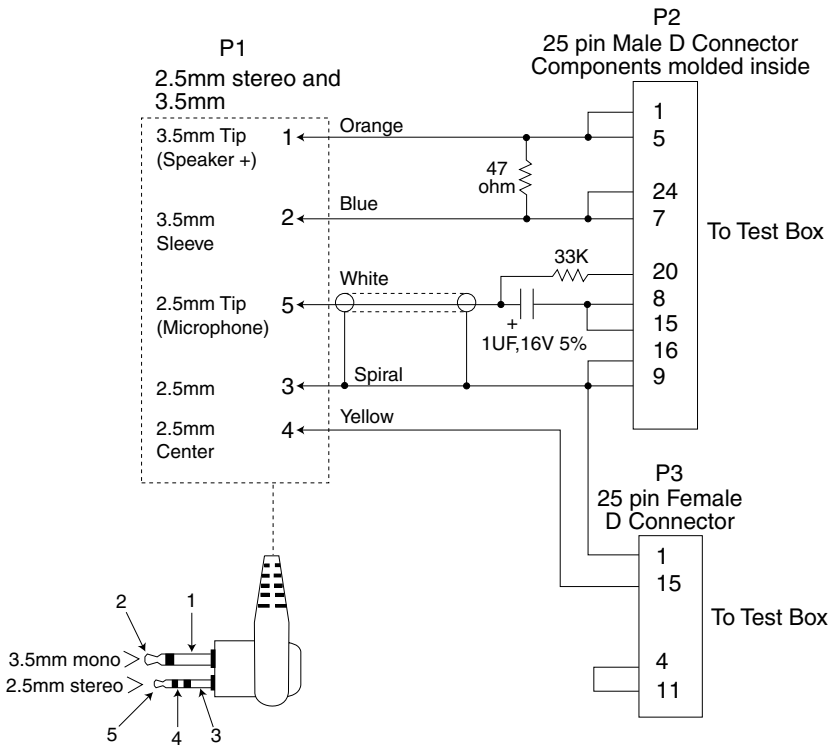


Figure 3-2. Wiring of the Connectors

Chapter 4 Performance Checks

4.1 General

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

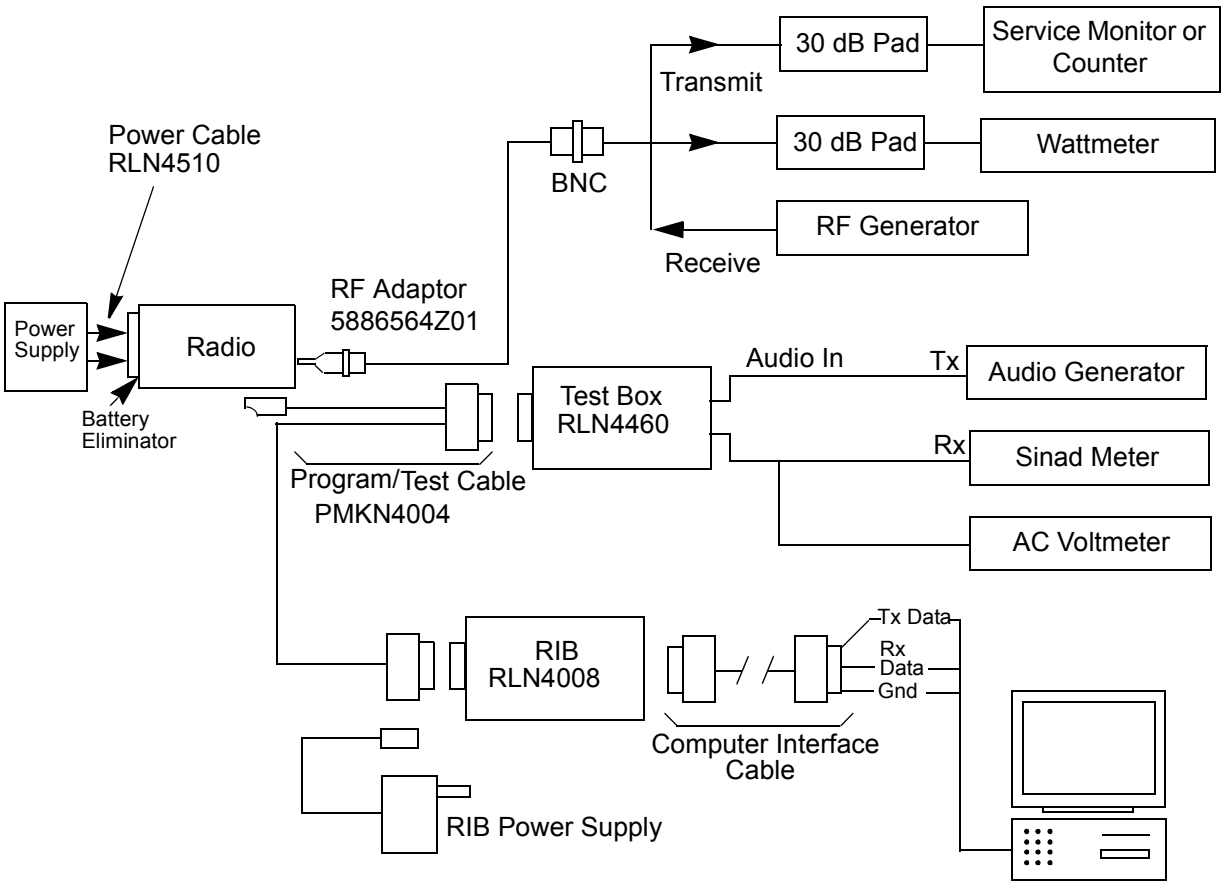


Figure 4-1. Radio Tuning Setup

4.2 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 4-1).

Initial equipment control settings should be as indicated in Table 4-1 and should be the same for all performance checks and tuner alignment procedures.

Table 4-1. Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Spkr set: A	Voltage: 7.5 Vdc
RF Attenuation: -70	Spkr/load: Speaker	DC on/standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 10 V
Oscilloscope Source: Mod Oscilloscope Horiz: 1 0 mSec/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: 2.5 A

4.3 RF Test Mode

When the PR400 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. 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.

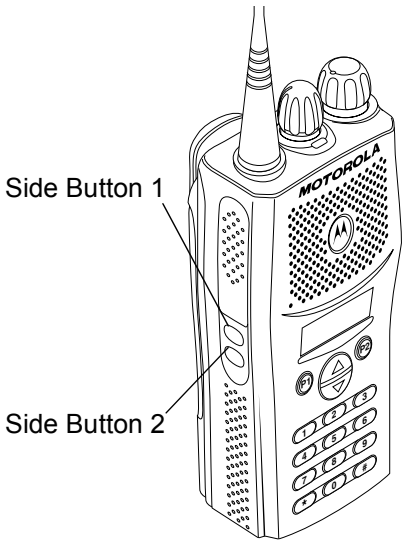


Figure 4-2. Side Button Locations

To enter test mode:

1. Turn the radio on.

Within ten seconds after the self test is complete (self test tone is heard), press SB2 (Side Button 2 in Figure 4-2) five times in succession. If the self test complete tone is not heard, see Error Codes information in Chapter 9. Entry into the test mode is indicated by a positive indicator tone followed by a good key chirp (GKC)Upon entering test mode, the radio is in the carrier squelch mode.

2. Press SB1 (Side Button 1) and scroll through and access test environments as shown in Table 4-2.
3. Press SB2 and scroll through the channel spacing available as shown in Table 4-3.
4. Turn the channel selector knob to change the test channel for that environment as shown in Table 4-4.
5. Press the PTT on a test channel to cause the radio to transmit at the test frequency for the channel.

Table 4-2. 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 (192.8 Hz) detected TX: mic audio + tone (192.8 Hz)
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
5 BKC	Unsquelch Open	RX: constant unsquelch TX: mic audio
9 BKC	High-Speed Signal-ing	RX: unsquelch if carrrier detected TX: 1500 Hz tone

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

Table 4-3. Test Channel Spacing

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

Table 4-4. Test Frequencies

Channel Selector Switch Position	Test Channel	VHF (146-174 MHz)	UHF1 (403-440 MHz)	UHF 2 (438-470 MHz)	UHF3 (465-495 MHz)
1 Low Power 8 High Power	TX#1 or #8 RX#1 or #8	146.625	403.625	438.625	465.625
2 Low Power 9 High Power	TX#2 or #9 RX#2 or #9	150.775	409.775	443.775	470.775
3 Low Power 10 High Power	TX#3 or #10 RX#3 or #10	155.275	415.275	448.275	475.275
4 Low Power 11 High Power	TX#4 or #11 RX#4 or #11	160.125	420.125	454.125	480.125
5 Low Power 12 High Power	TX#5 or #12 RX#5 or #12	164.475	426.475	459.475	485.475
6 Low Power 13 High Power	TX#6 or #13 RX#6 or #13	169.475	432.475	464.475	490.475
7 Low Power 14 High Power	TX#7 or #14 RX#7 or #14	173.875	437.875	469.875	494.875

Table 4-5. Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	PTT to continuous (during the performance check)	Frequency error to be ±200 Hz VHF ±500 Hz UHF
Rated Audio	Mode: GEN Output level: 1.0m V RF 4th channel test frequency* Mod: 1 kHz tone at 3 kHz 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 3.46 Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <3.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12 dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.30 μV (0.25 μV typical).
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1 mV RF	As above	PTT to OFF (center), meter selection to Audio PA, spkr/load to speaker	Set volume control to 3.46 Vrms
	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 μV. Preferred SINAD = 6-9 dB

*. See Table 4-4

Table 4-6. Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch Output at antenna	PTT to continuous (during the performance check)	Frequency error to be ±200 Hz VHF ±500 Hz UHF
Power RF	As above	As above	As above	Refer to Maintenance Specifications
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out Monitor: DVM, AC Volts Set 1 kHz Mod Out level for 0.025 Vrms at test set, 80m Vrms 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)
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 ≤ 1000 Hz (25 kHz Ch Sp).

*. See Table 4-4

Notes:

Chapter 5 Radio Tuning and Programming

5.1 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).

A CPS/Tuner Installation Manual (6866550D14) is included in the Product Manual.

5.2 CPS Programming Setup

Refer to online help files for the CPS Programming procedures. (See Figure 5-1 for CPS Programming Setup).

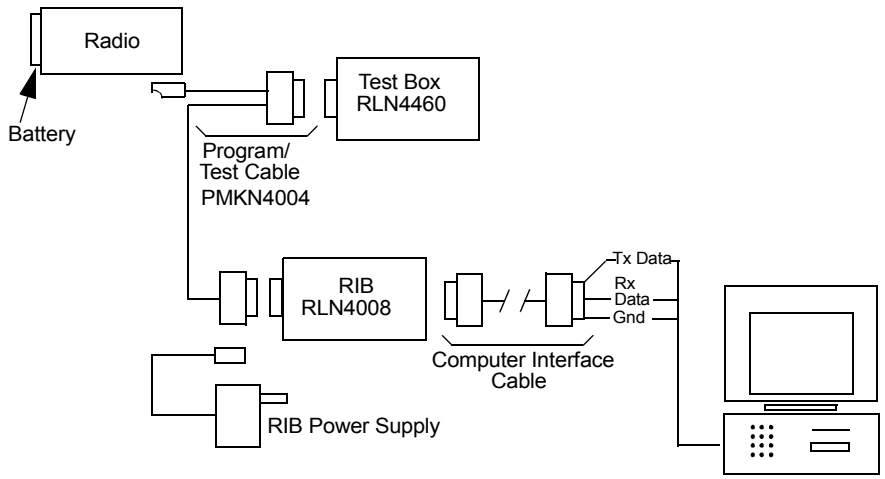


Figure 5-1. CPS Programming Setup

5.3 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 5-2 below. Refer to online help files for the tuning procedures.

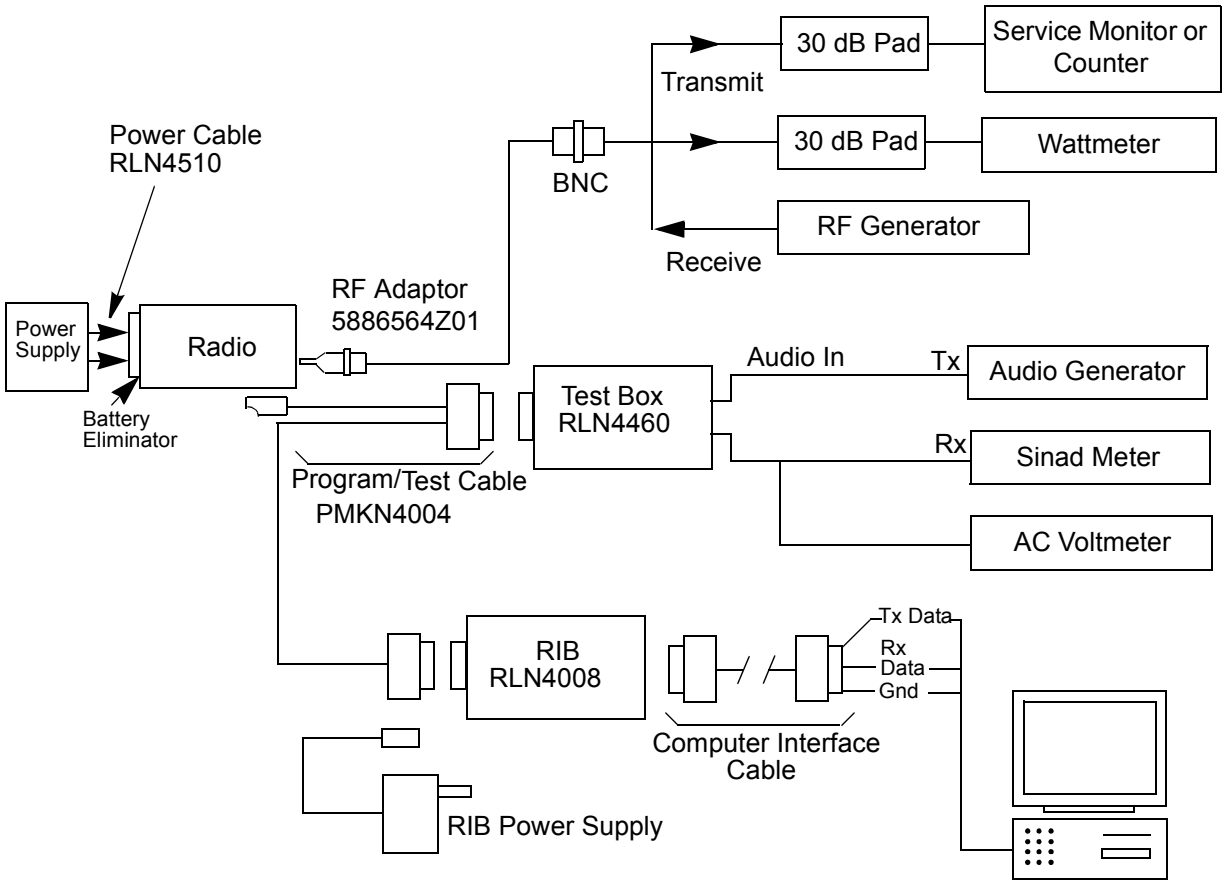


Figure 5-2. Radio Tuning Setup

5.3.1 Initial Test Equipment Control Settings

The initial test equipment control settings are listed in Table 5-1.

Table 5-1. 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

5.4 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 (PMKN4003) 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 5-3). 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.

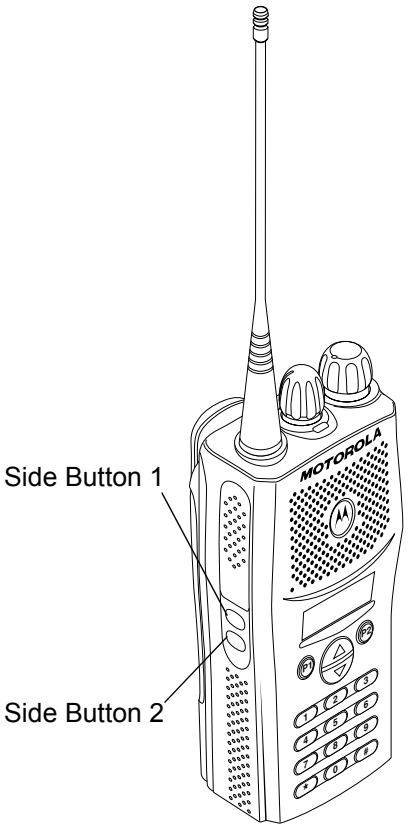


Figure 5-3. Side Button Locations

Chapter 6 Full Keypad Model Disassembly and Re-assembly

6.1 Introduction

This section provides details about the following:

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

6.2 Preventive Maintenance

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

6.2.1 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.

6.2.2 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).

6.3 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.

6.4 Disassembling and Re-assembling the Radio — General

Since these radios may be disassembled and re-assembled 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 Chapter 3 for a list of service aids):

- Knob remover/chassis opener
- Penknife-size screwdriver
- TORX™ T6 screwdriver
- Scribe

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 Appendix B for a list of authorized service centers.

The following disassembly procedures should be performed only if necessary:

- Chassis Disassembly
- Speaker Disassembly
- PTT Disassembly

6.4.1 Radio Disassembly — Detailed

6.4.1.1 Front Cover From Chassis Disassembly

1. Turn off the radio.
2. Remove the battery (Figure 6-1):
   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.

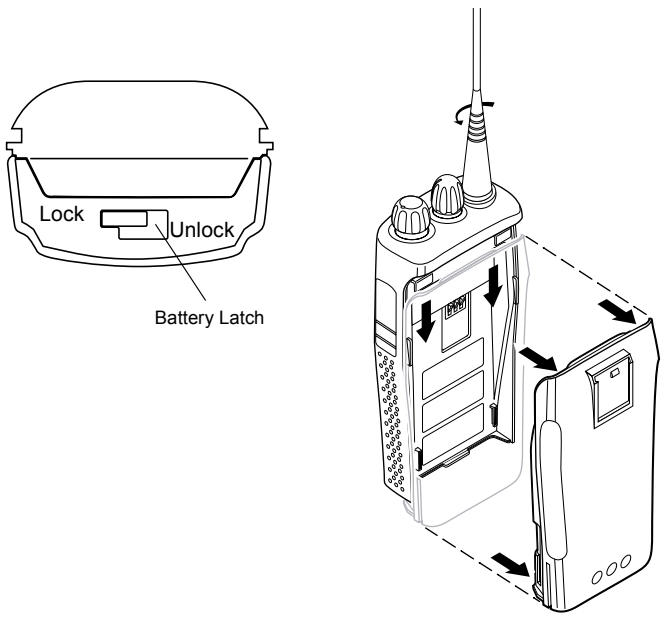


Figure 6-1. Battery Removal

3. Remove the antenna.
4. Pry off the volume and channel selector knobs from their shafts using the knob removal/chassis opener tool (Motorola part # 6686533Z01). (Figure 6-2).

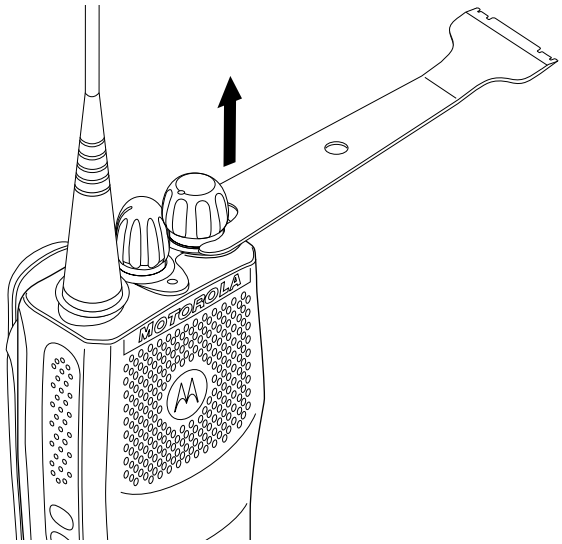


Figure 6-2. Antenna and Knob Removal

Note: Both knobs slide on and off. However the knobs are designed to fit very tightly on the shaft.

5. Separate the chassis from the front housing assembly by using the knob remover/chassis opener too. Place the broad side of the opener into the slots located at the base of the radio (Figure 6-3). Press the handle on the opener downwards. This pressing action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

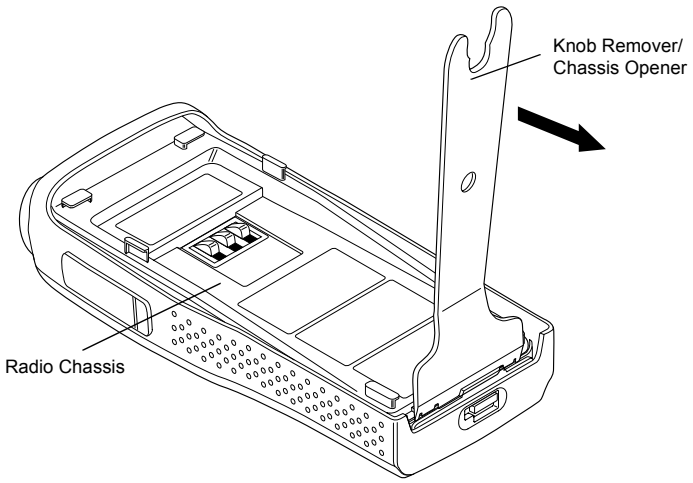


Figure 6-3. Chassis Removal

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.

6. Pull the chassis assembly out of the front cover only until the volume and channel selectors shaft just clear the top of the case. (Figure 6-4).

Note: The speaker wire assembly microphone wire assembly and keypad flex cable connector connecting the front housing assembly and the chassis prevent the two units from being completely separated

7. Rotate the bottom of the chassis up about 20° to disconnect the keyboard flex cable connector. Push down 2 end tabs to release flex connector at the bottom of the chassis.

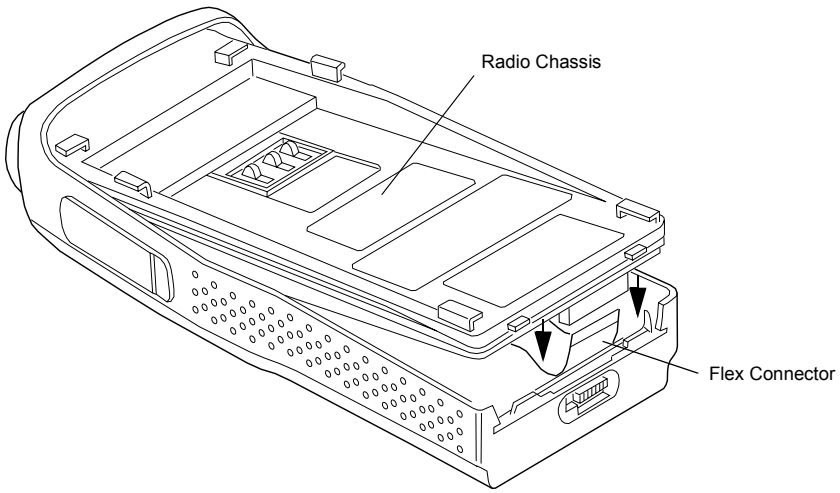


Figure 6-4. Keyboard Flex Connection

8. Rotate the chassis counterclockwise out of the housing and position next to the housing. Take care not to damage the speaker and microphone wires that are still connected to the chassis (Figure 6-5).

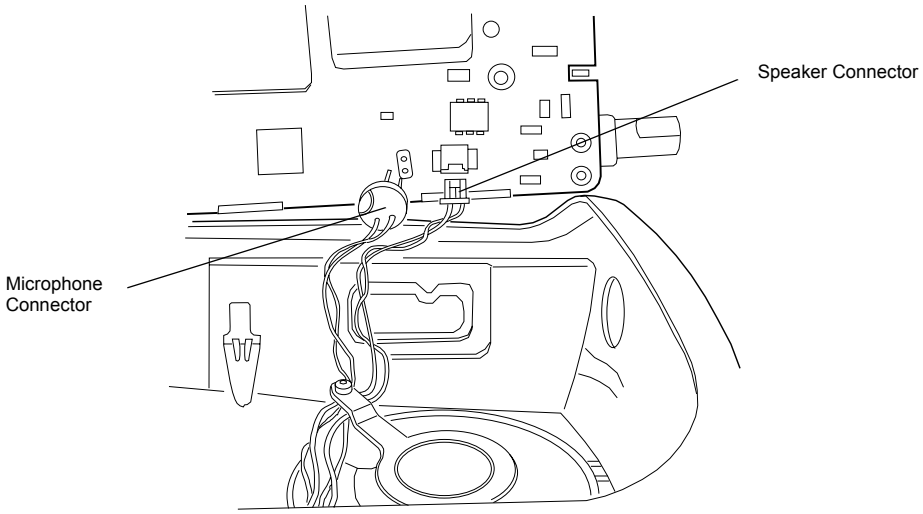


Figure 6-5. Microphone and Speaker Connections

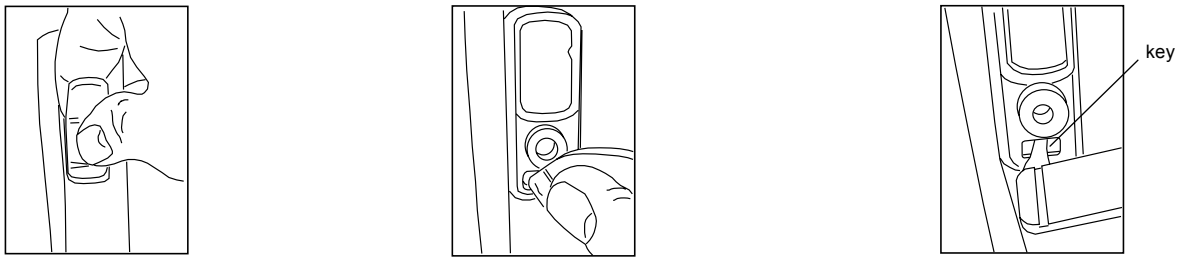
9. Unplug the speaker wire assembly from the 2-pin connector on the chassis.

10. Unplug the microphone wire assembly from the socket on the chassis.

11. Move the chassis away from the housing and place on a clean work surface.

6.4.1.2 Dust Cover Disassembly

1. Gently pry the top of the dust cover away from the body of the radio. (See Figure 6-6).
2. Rotate the dust cover 90° in a counterclockwise direction to allow the key to be removed.
3. 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 6-6. Dust Cover Disassembly

6.4.1.3 Speaker and Microphone 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 screw from the speaker retainer using a T6 Torx screwdriver (Figure 6-7).
2. Lift the retainer off the speaker, sliding end of retainer out of corner slot on the housing.
3. Lift the speaker out from the front housing.
4. Carefully lift microphone assembly out of housing.

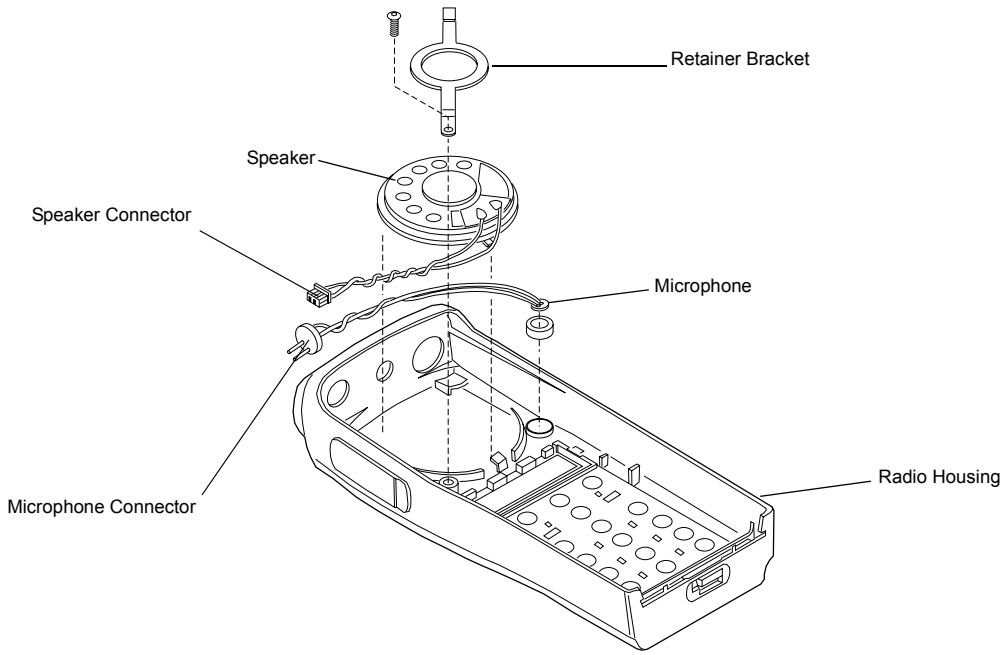


Figure 6-7. Removal Speaker-Microphone Assembly

6.4.1.4 Keyboard Removal

1. Carefully pry the four keypad retainer locking tabs free from the housing use a scribe.

Note: Use care when removing the keypad retainer to prevent damage to the keyboard flex cable.

2. Lift the keypad retainer up from the bottom and slide the top tabs out.
3. Slide keypad retainer out of chassis carefully to prevent damage to flex cable.

CAUTION: Refer to the CMOS CAUTION paragraph (6.3) before removing the main board. Be sure to use Electrostatic Discharge protection when handling circuit boards.

4. Lift LCD keypad board out of housing (Figure 6-8).
5. Lift keypad out of housing.

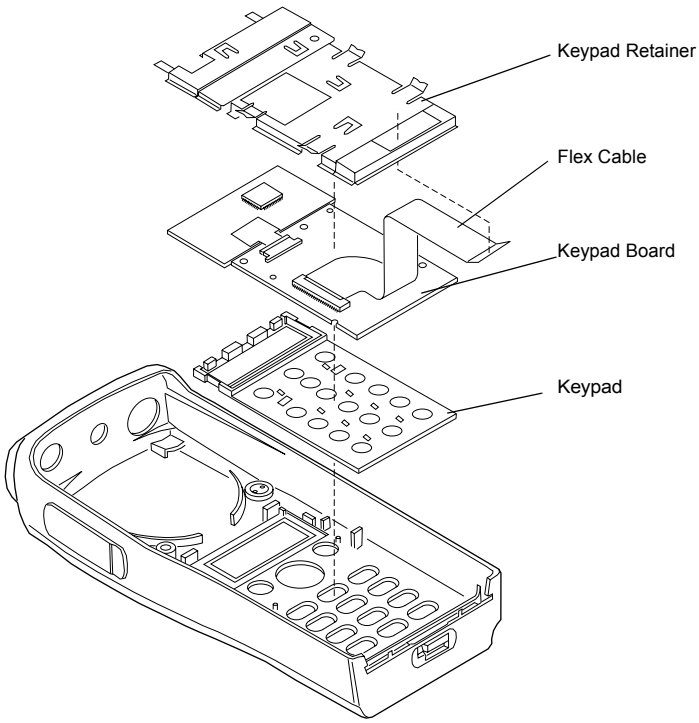


Figure 6-8. Keypad Removal

6.4.1.5 PTT Disassembly

1. If required, the PTT (Figure 6-9 can be disassembly 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.

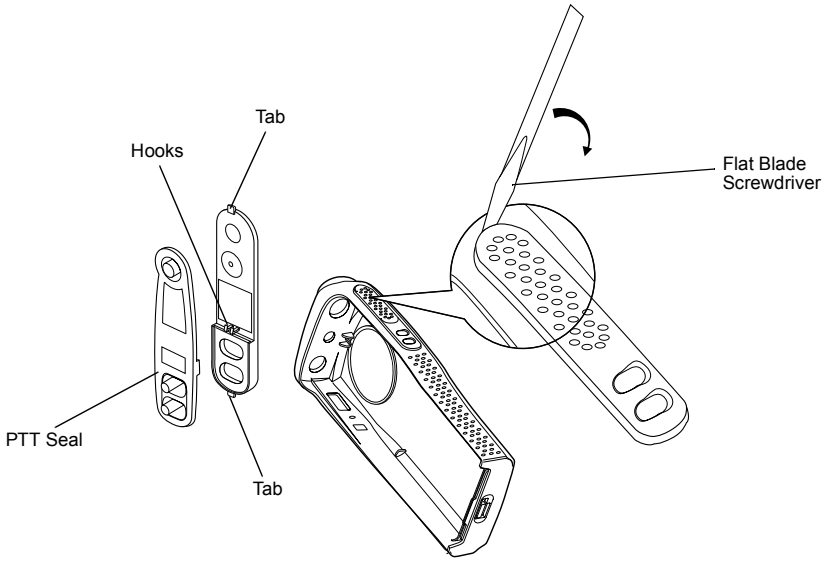


Figure 6-9. PTT Removal

6.4.1.6 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 6-10) holding the main board to the chassis.

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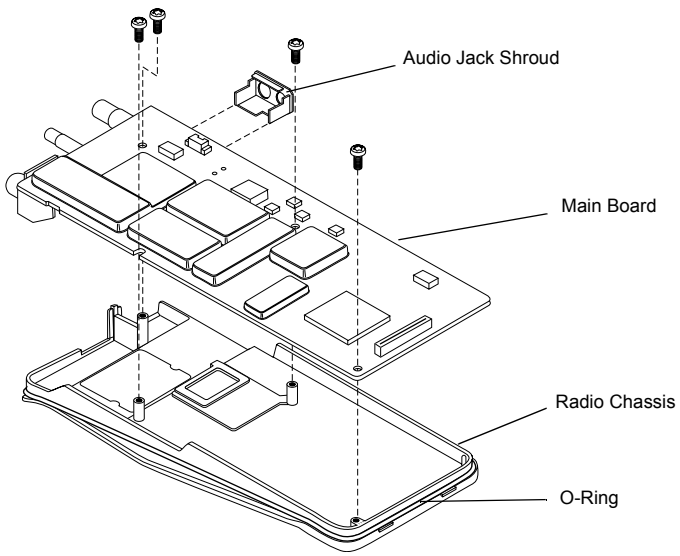


Figure 6-10. Removal of Main Board from Chassis

3. The audio jack shroud can be removed from the main board.
4. Lift the main board from the chassis (Figure 6-10).
5. Remove the battery contact seal.

6.4.2 Radio Re-assembly - Detailed

6.4.2.1 Dust Cover Re-assembly

1. Insert the tail of the dust cap into the bottom hole of the audio jacks housing opening (Figure 6-11).
2. Press the dust cap until the tail is fully into the hole.

Note: Make sure the dust cap is placed between the keypad retainer mounting post and the side wall of the radio.

3. Twist the dust cap counter-clockwise until the cap is seated properly onto the recess.
4. Press the cap again to ensure it fully covers the opening for the audio jack.

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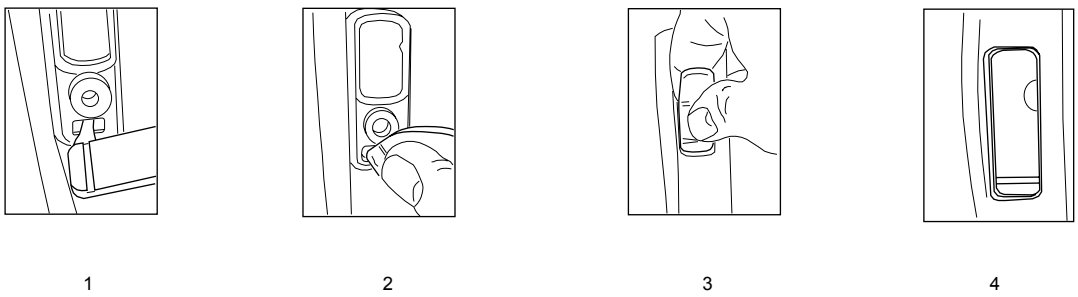


Figure 6-11. Dust Cap Re-assembly

6.4.2.2 Microphone and Speaker Re-assembly

1. Check that the mic and speaker felts are in position and not damaged. If damaged replace felts.
2. Insert the microphone sub-assembly into the microphone boot.
3. 3. Insert the Boot and microphone sub-assembly into the microphone recess in the housing and route wires as shown in Figure 6-12.

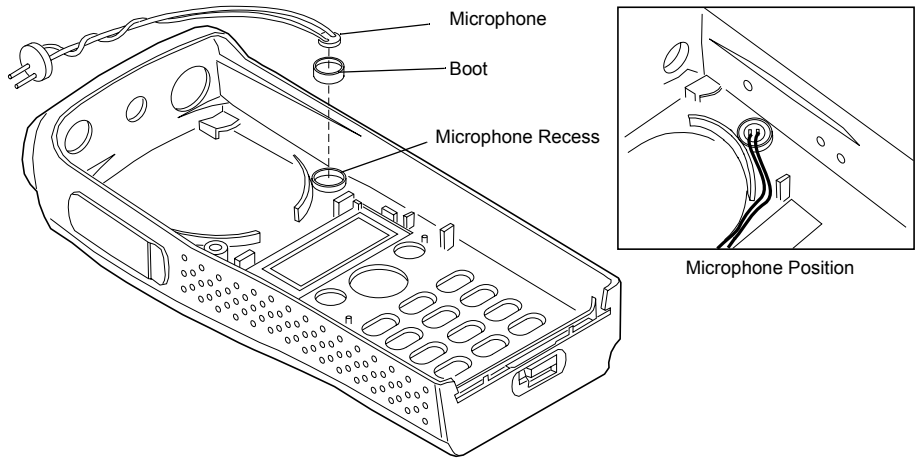


Figure 6-12. Microphone Re-assembly

4. Locate the speaker tab and align it with the tab opening in the front housing (Figure 6-13).
5. Insert the speaker tab into the speaker recess in the housing. Ensure the speaker is seated flush in the housing.

Note: Make sure the speaker and microphone wires are routed tightly between the speaker basket and the housing post.

6. Insert one end of the speaker retainer into the slot in the front housing (See Figure 6-13).

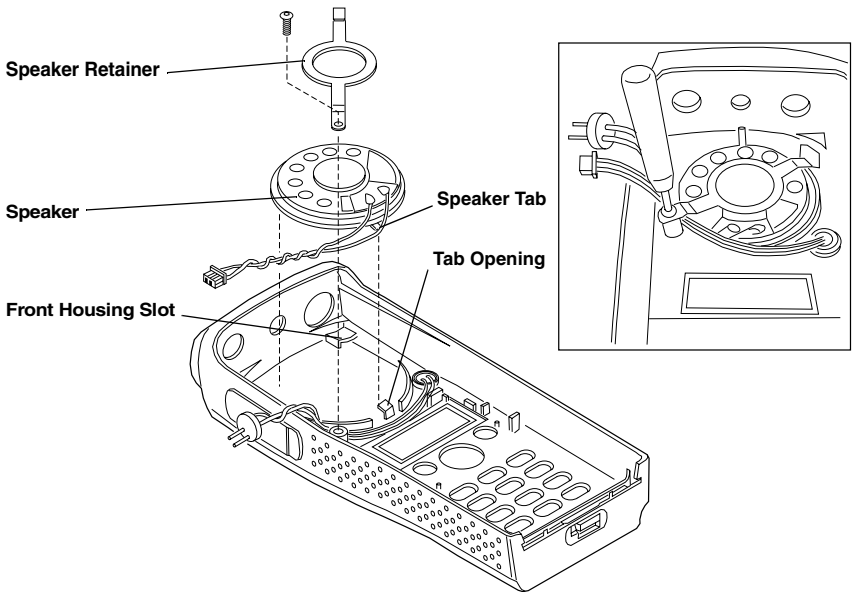


Figure 6-13. Speaker Re-assembly

Note: When fastening the speaker retainer screw, make sure the wires are out of the way to prevent pinching by the retainer.

7. Install the retainer screw using a T6 Torx screwdriver. Torque to 0.26 - 0.28Nm (2.3 - 2.5 lb/in).

6.4.2.3 Keypad and LCD/Keyboard Re-assembly

1. Attach the flex cable from the LCD module to the keyboard, if not already attached (Figure 6-15).
2. Remove protective mylar from window and from keypad, if present.
3. Install the new keypad into the housing. Use the two housing posts for keypad alignment (Figure 6-14).

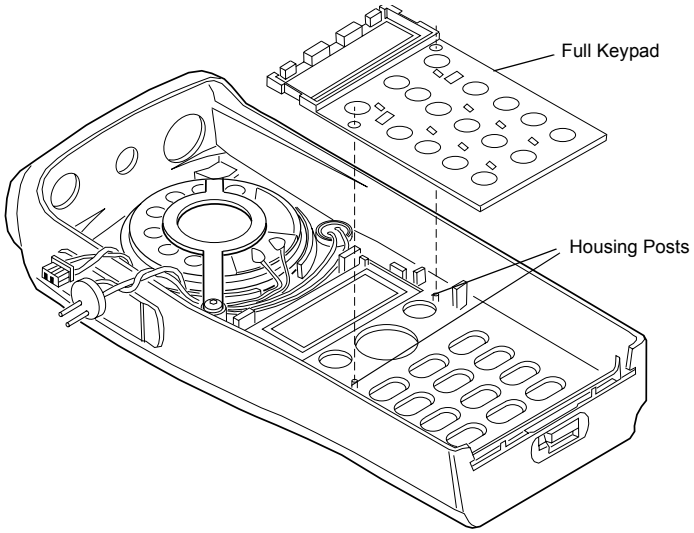


Figure 6-14. Keypad Re-assembly

4. Remove mylar from LCD if present.

CAUTION: Make sure the microphone and speaker wires are not trapped under the LCD module.

5. Install the LCD/Keypad sub-assembly into the housing (Figure 6-15).

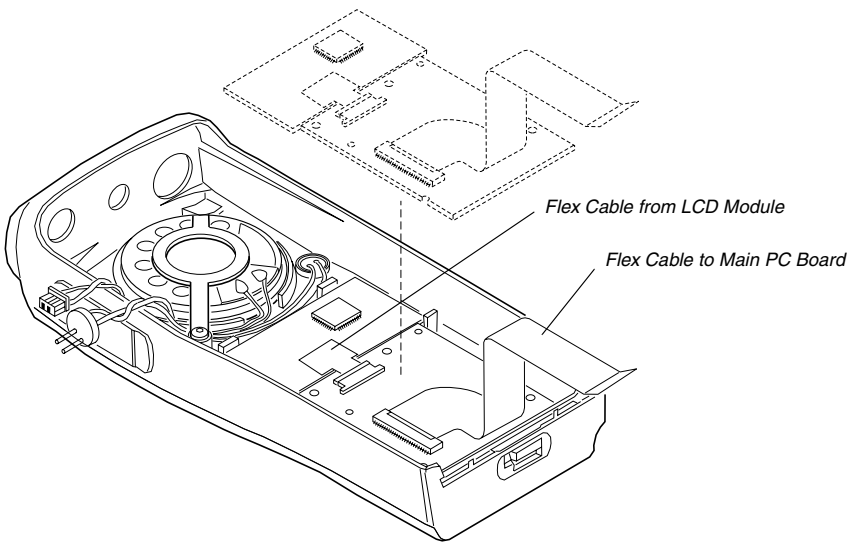


Figure 6-15. LCD/Keypad Board Re-assembly

6. Attach the flex cable into the connector on the keypad board, if not already connected.
7. Bend the flex cable as shown (Figure 6-15)

6.4.2.4 Keyboard Retainer Re-assembly

1. Insert the flex cable through the slot at the bottom of the keyboard retainer (Figure 6-16).

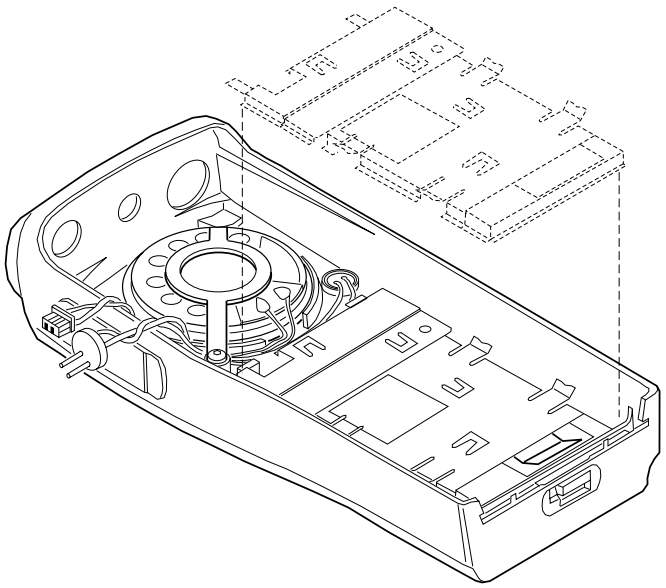


Figure 6-16. Keyboard Retainer Re-assembly

2. Insert the two top tabs of the keyboard retainer into the two tab retainers located on each side of the speaker in the front housing (Figure 6-16).
3. Press the four keypad retainer locking tabs into the housing.
4. Push the speaker and microphone wires into the top left hand corner of the housing.

6.4.2.5 Chassis Assembly/Re-assembly

1. Replace the battery contact seal (if necessary) surrounding the battery contact (Figure 6-17).
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 with the frequency and volume switches facing down (Figure 6-17).

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 0.42 - 0.44Nm (3.7 - 3.9 in/lb).
5. Replace the O-ring by positioning it 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.
6. Check that the O-ring is not twisted and being held by the top and bottom chassis groves.

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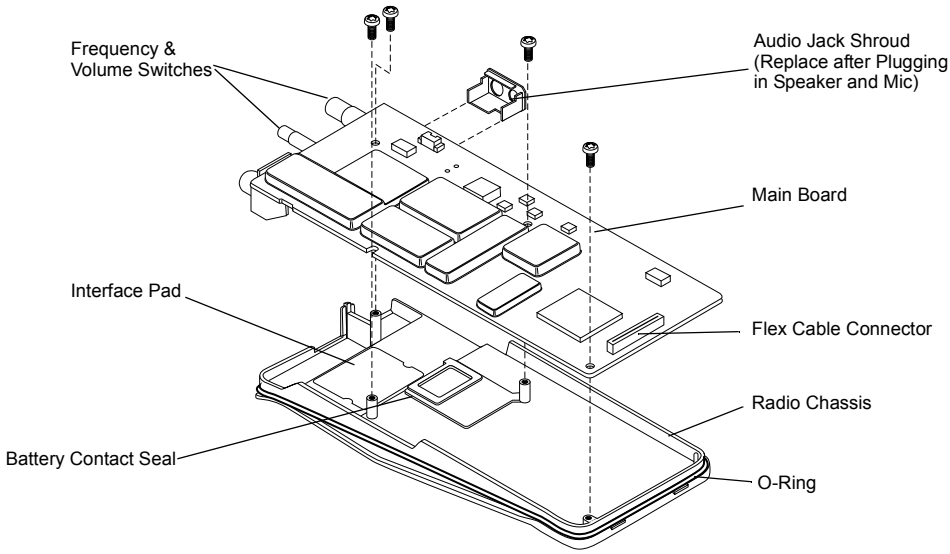


Figure 6-17. Main Board onto Chassis Re-assembly

6.4.2.6 Chassis and Front Cover Re-assembly

1. Dress and connect the speaker wires.

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

Note: Ensure that the plug orientation is correct with the exposed pins in the wire casing facing upward and fully plugged in.

a. 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 6-18).

b. Connect the microphone wire assembly into the two hole socket on the main board and bend the wires at the board connector so the wires are positioned toward the top of the radio (Figure 6-18).

c. Slide the audio jack shroud onto accessory connector (Figure 6-17).

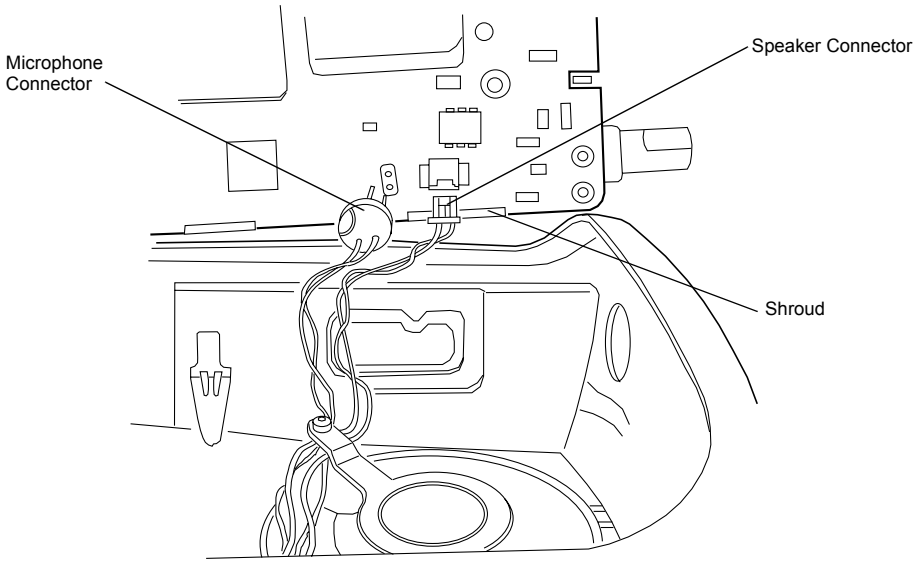


Figure 6-18. Microphone and Speaker Wires Re-assembly

2. Position the radio (Figure 6-19), and reconnect the flex connector from the keyboard into the connector located on the bottom of the main board, pushing up the 2 end tabs.

3. 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, between shroud and housing.

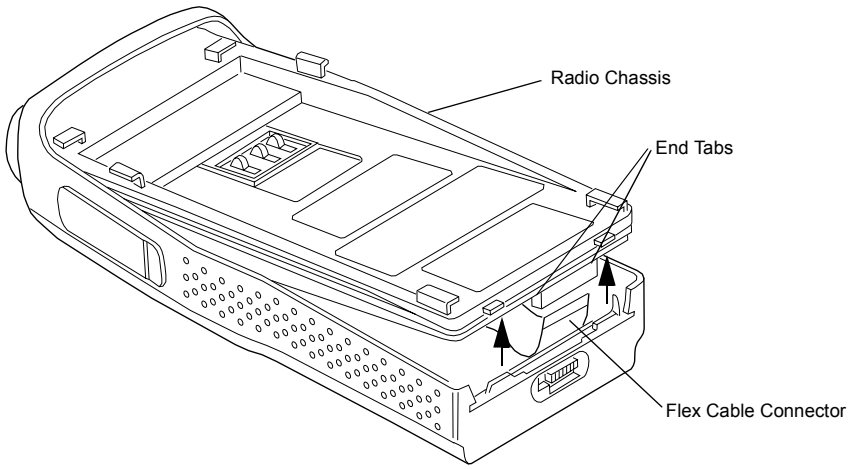


Figure 6-19. Keyboard Flex Cable Connection

4. Push the topside of the board chassis upward until it touches the housing end. Before snapping the board into the housing, perform the following checks:

a. Open the dust cap and ensure the wires are not pinched between the shroud and housing.

b. Ensure the O-ring is seated in the groove.

c. Ensure that the bottom side of the dust cap is fully pressed into the housing before the snapping the board into place.

5. Snap chassis assembly completely into the top of the front cover (Figure 6-20) until it settles in place.

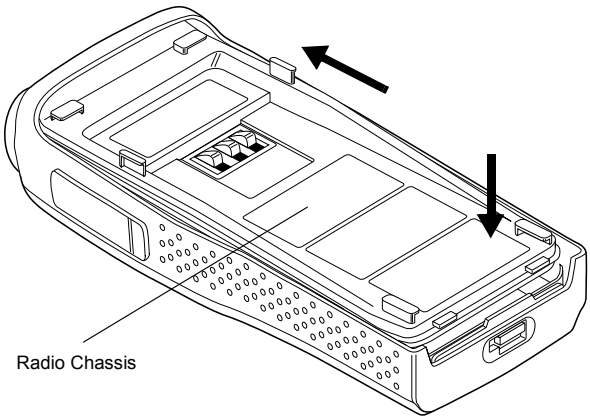
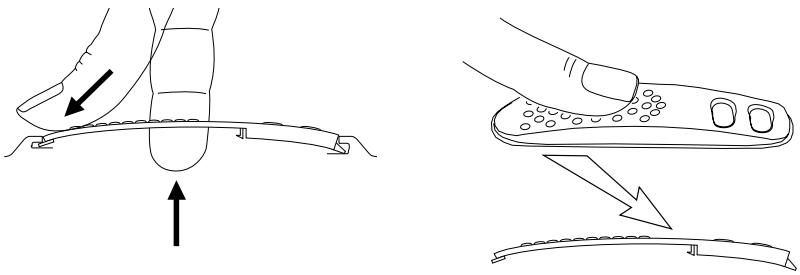


Figure 6-20. Fastening the Chassis

6. Make sure the 0-ring is properly seated. If the O-ring seal is pinched, separate the chassis from the housing using the knob removal/chassis opener and dress O-ring properly.
7. Snap the bottom of the chassis into the front cover.
8. Check that O-ring is visible at the corners.
9. Re-assemble the knobs, antenna, and battery.

6.4.2.7 PTT Re-assembly

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 6-21a).
3. Press the PTT assembly against the front cover opening (Figure 6-21b).



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

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

Figure 6-21. PTT Re-assembly

6.5 Mechanical View and Parts List

6.5.1 CP180 Full-Keypad Exploded View and Parts List

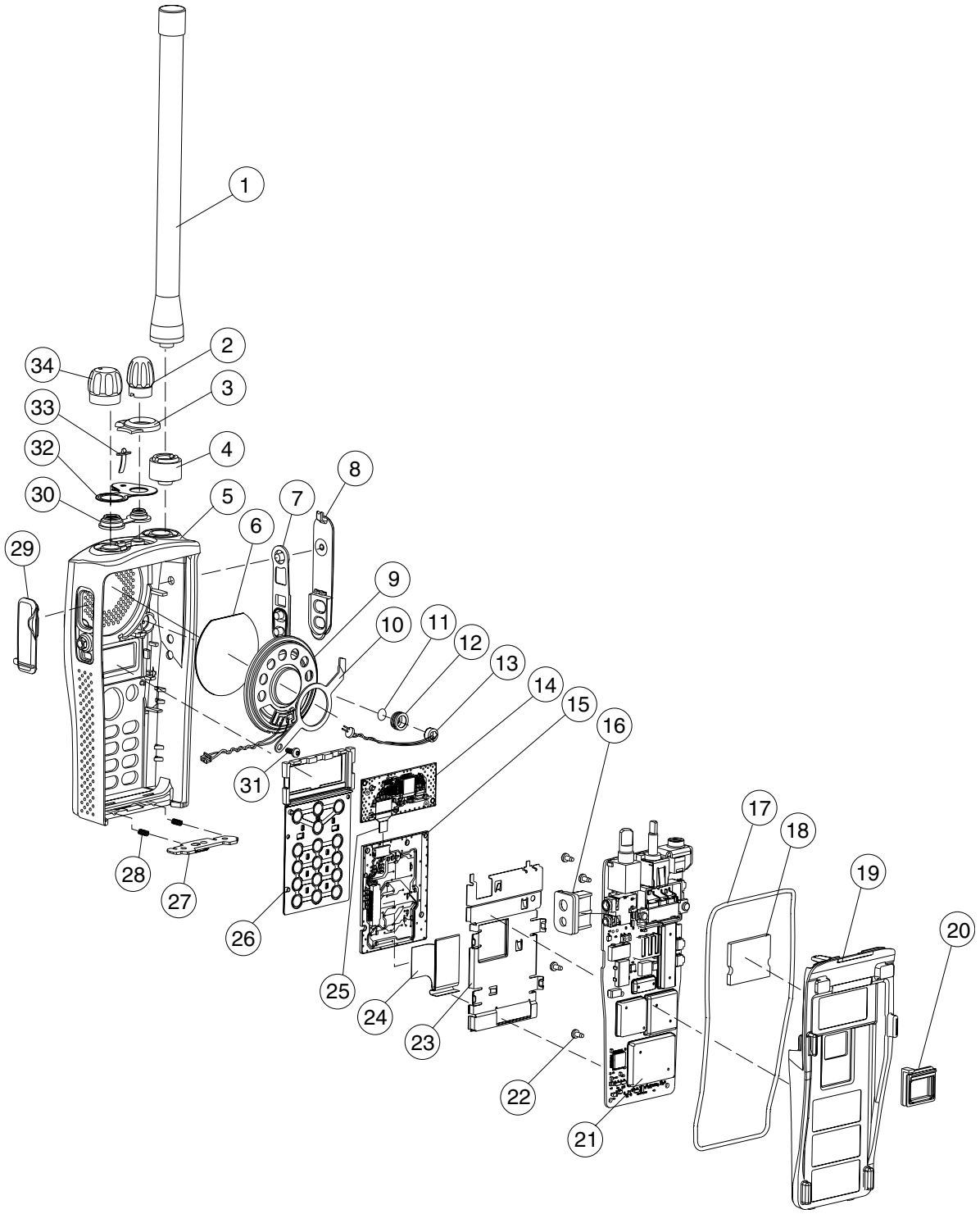


Figure 6-22. CP180 Full Keypad Radio Exploded View

Item	Motorola Part Number	Description
1	See Section 6	Antenna
2	3680530Z02	Knob, Frequency
3	1386440Z01 1386440Z02	Escutcheon, Top; 4 Ch. Escutcheon, Top; 16 Ch.
4	Not Field Repairable	Antenna Adaptor/Seal (Optional)
5	1586391Z03	Housing, Full, with Lens
6	3586621Z01	Speaker, Felt
7	3886489Z01	PTT, Rubber
8	4586439Z01	PTT, Plastic
9	5085738Z08	Speaker
10	4286620Z01	Retainer Speaker
11	3586621Z02	Felt, Microphone
12	0780608V01	Boot, Microphone
13	5085880L01	Microphone
14	5104949J16	Display, LCD Module
15	0104017J18	Keypad Board Assy
16	1586437Z01	Shroud, Audio Jack
17	3286431Z02	Seal, Main O-ring
18	7586436Z01	Pad, PA Interface
19	2786389Z01	Chassis
20	3286435Z01	Seal, Battery Contact Block
21	Refer to Chap 1 Model Charts	Back Cover Kit (Main Board + chassis)
22	0304726J05	Screws, Chassis; 4 Used
23	4286648Z01	Plate, Retainer
24	0909059E19	Connector, 28-pin
25	0986632Z02	9 Pin Connector
26	7586654Z03	Keypad, Full
27	5586445Z02	Latch Assembly
28	4105944K01	Spring, Latch; 2 Used
29	3886441Z01	Cap, Dust
30	3286432Z01	Seal, Control Shaft
31	0386434Z01	Screw, Speaker Retainer
32	3386443Z01	Label, Escutcheon Seal
33	6186446Z02	Lightpipe
34	3680529Z01	Knob, Volume

Item	Motorola Part Number	Description
NON-REFERENCED ITEMS		
	3386625Z01	Nameplate, Motorola
	3386623Z07	Nameplate, CP180

Notes:

Chapter 7 Limited Keypad Model Disassembly and Re-assembly

7.1 Introduction

This section provides details about the following:

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

7.2 Preventive Maintenance

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

7.2.1 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.

7.2.2 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).

7.3 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.

7.4 Disassembling and Re-assembling the Radio — General

Since these radios may be disassembled and Re-assembled 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 Chapter 3 for a list of service aids):

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

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 Appendix B for a list of authorized service centers.

The following disassembly procedures should be performed only if necessary:

- Chassis Disassembly
- Speaker Disassembly
- PTT Disassembly

7.4.1 Radio Disassembly — Detailed

7.4.1.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery (Figure 7-1):
    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 1cm (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.

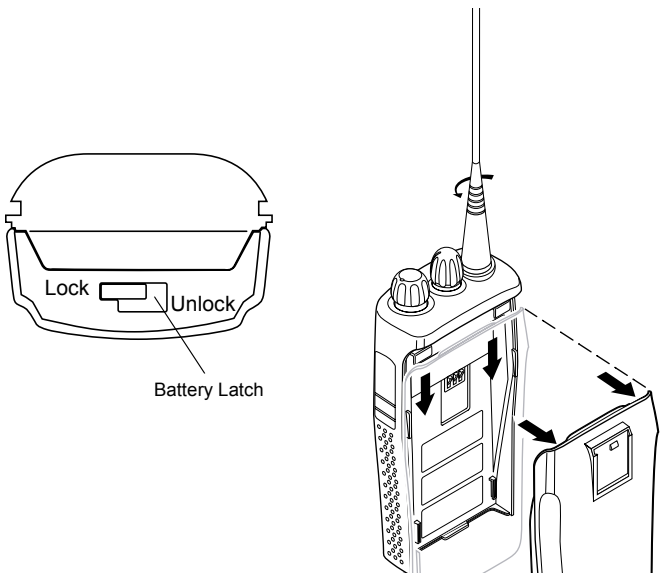


Figure 7-1. Battery Removal

4. Pry off the volume and channel selector knobs from their shafts using the knob remover/chassis opener tool (Motorola part # 6686533Z01) (Figure 7-2).

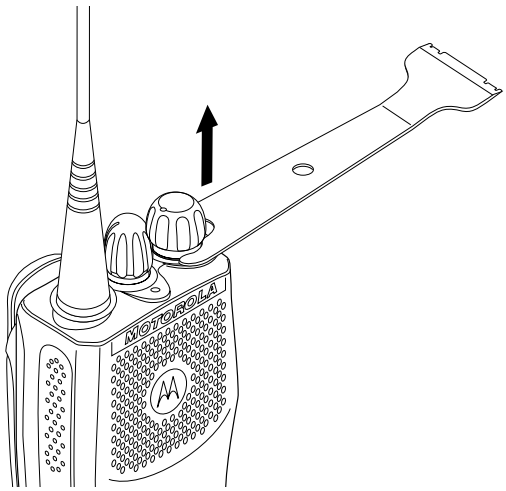


Figure 7-2. Antenna and Knob Removal

Note: Both knobs slide on and off. However, the knobs are designed to fit very tightly on the shaft.

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 7-3). 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

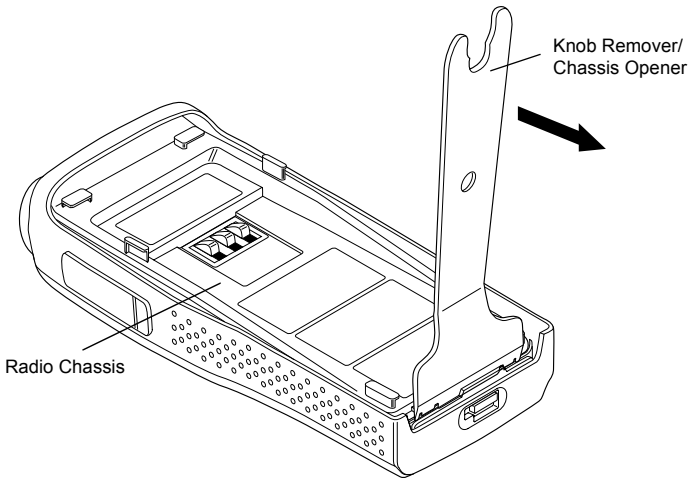


Figure 7-3. Chassis Removal

.

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 microphone wire assembly and keypad flex cable connecting the front housing assembly and the chassis prevent the two units from being completely separated.

6. Pull the chassis assembly out of the front cover only until the volume and channel selectors shaft just clear the top of the case. (Figure 7-4).
7. Rotate the bottom of the chassis up about 20° to access the keyboard flex connector. Push down 2 end tabs to release flex connector at the bottom of the chassis.

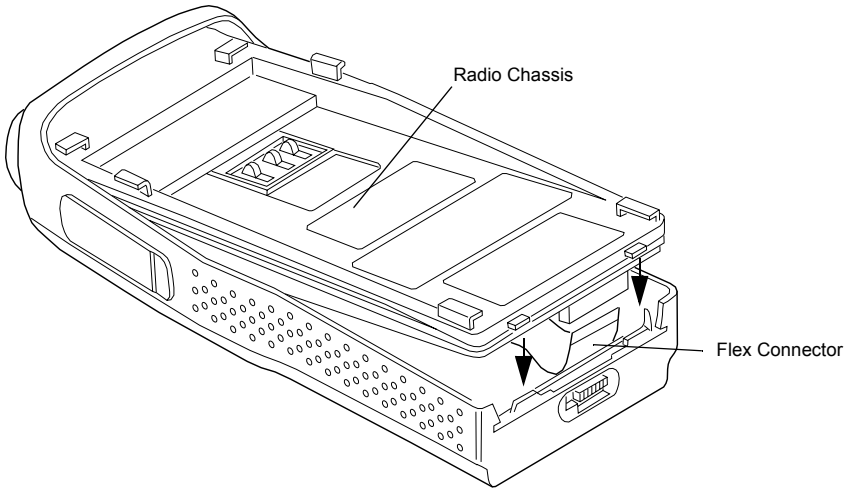


Figure 7-4. Keyboard Flex Connector

8. Rotate the chassis counterclockwise out of the housing and position next to the housing. Take care not to damage the speaker and microphone wires that are still connected to the chassis (Figure 7-5).

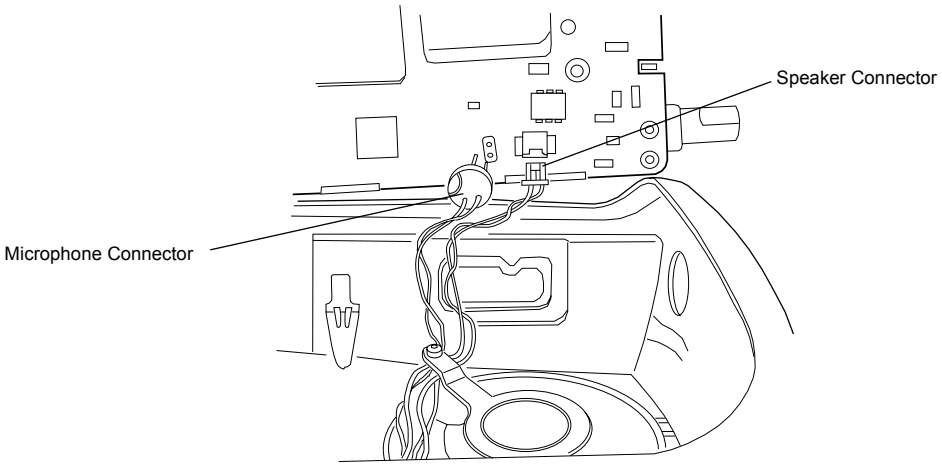
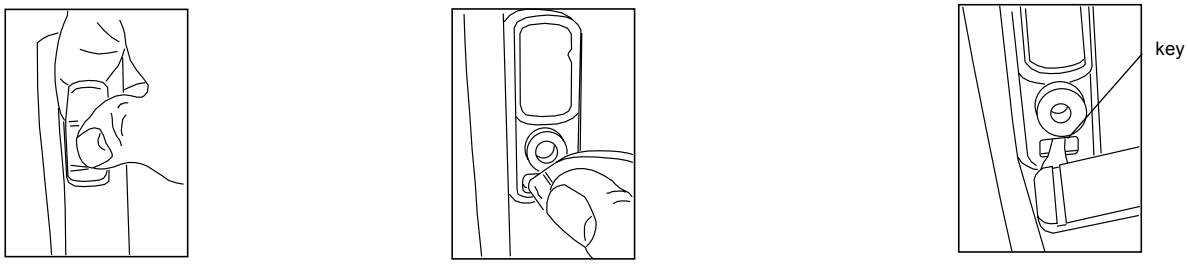


Figure 7-5. Microphone and Speaker Connections

9. Unplug the speaker wire assembly from the 2-pin connector on the chassis.
10. Unplug the microphone wire assembly from the socket on the chassis.
11. Move the chassis away from the housing and place on a clean work surface.

7.4.1.2 Dust Cover Disassembly

1. Gently pry the top of the dust cover away from the body of the radio. (See Figure 7-6).
2. Rotate the dust cover 90° in a counterclockwise direction to allow the key to be removed.
3. 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 7-6. Dust Cover Disassembly

7.4.1.3 Speaker and Microphone 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 screw from the speaker retainer using a T6 Torx screwdriver (Figure 7-7).
2. Lift the retainer off the speaker, sliding end of retainer out of corner slot on the housing.
3. Lift the speaker out from the front housing.
4. Carefully lift microphone assembly out of housing.

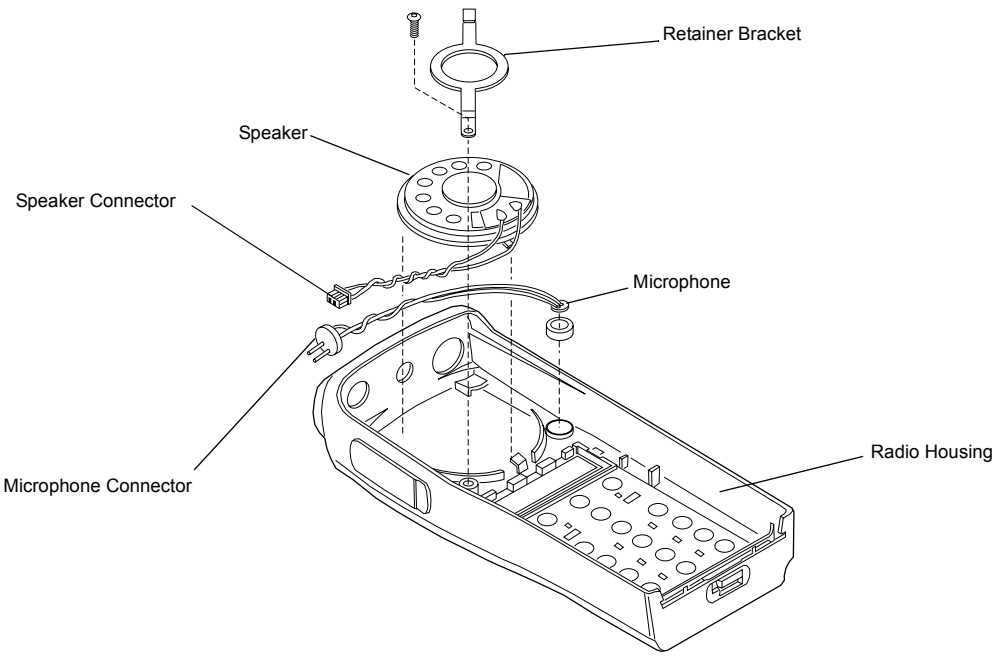


Figure 7-7. Removal Speaker-Microphone Assembly

7.4.1.4 Keyboard Removal

1. Carefully pry the four keypad retainer locking tabs free from the housing use a scribe.

Note: Use care when removing the keypad retainer to prevent damage to the keyboard flex cable.

2. Lift the keypad retainer up from the bottom and slide the top tabs out.
3. Slide keypad retainer out of chassis carefully to prevent damage to flex cable.

CAUTION: Refer to the CMOS CAUTION paragraph (7.3) before removing the main board. Be sure to use Electrostatic Discharge protection when handling circuit boards.

4. Lift LCD keypad board out of housing (Figure 7-8).
5. Lift keypad out of housing

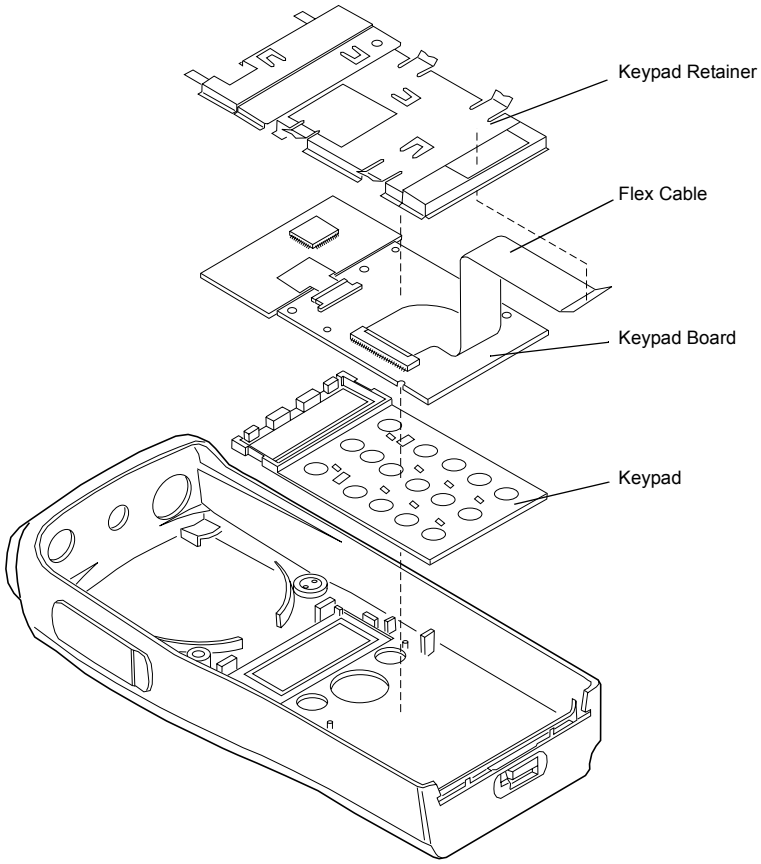


Figure 7-8. Keypad Removal

7.4.1.5 PTT Disassembly

1. If required, the PTT (Figure 7-9) can be disassembly 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.

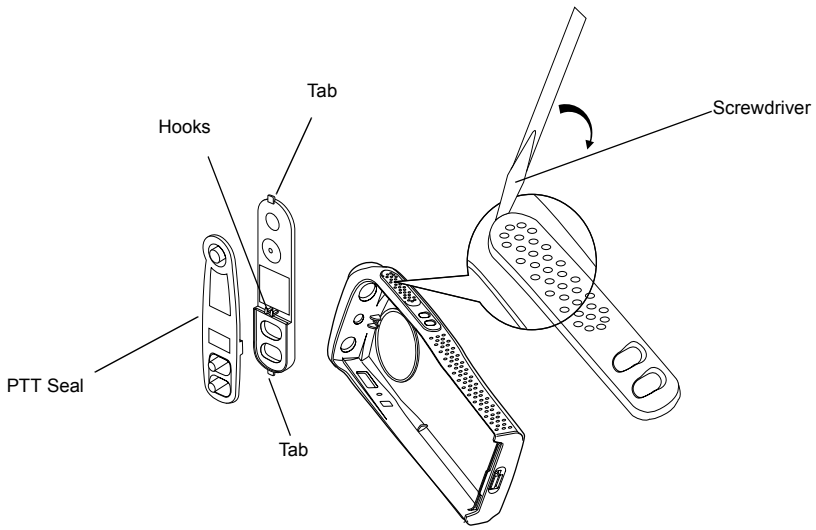


Figure 7-9. PTT Removal

7.4.2 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 7-10) holding the main board to the chassis.
3. The audio jack shroud can be removed from the main board.
4. Lift the main board from the chassis (Figure 7-10).
5. Remove the battery contact seal.

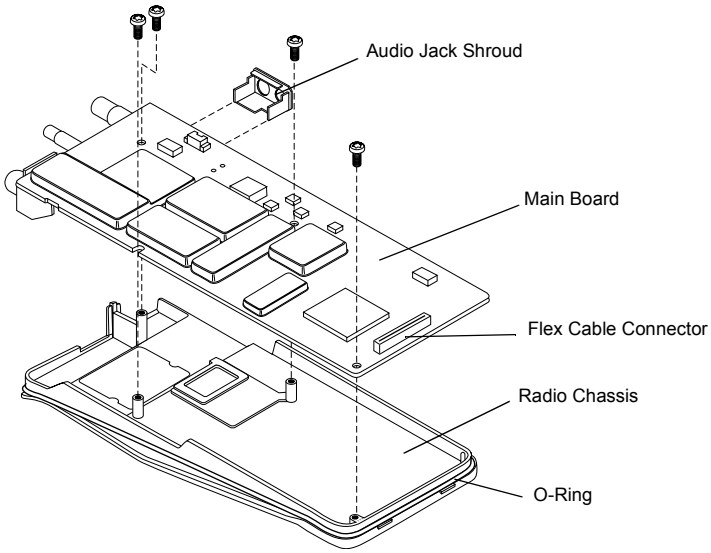


Figure 7-10. Removal of Main Board from Chassis

7.4.3 Radio Re-assembly - Detailed

7.4.3.1 Dust Cover Re-assembly

1. Insert the tail of the dust cap into the bottom hole of the audio jacks housing opening (Figure 7-11).
2. Press the dust cap until the tail is fully into the hole.

Note: Make sure the dust cap is placed between the keypad retainer mounting post and the side wall of the radio.

3. Twist the dust cap counter-clockwise until the cap is seated properly onto the recess.
4. Press the cap again to ensure it fully covers the opening for the audio jack.

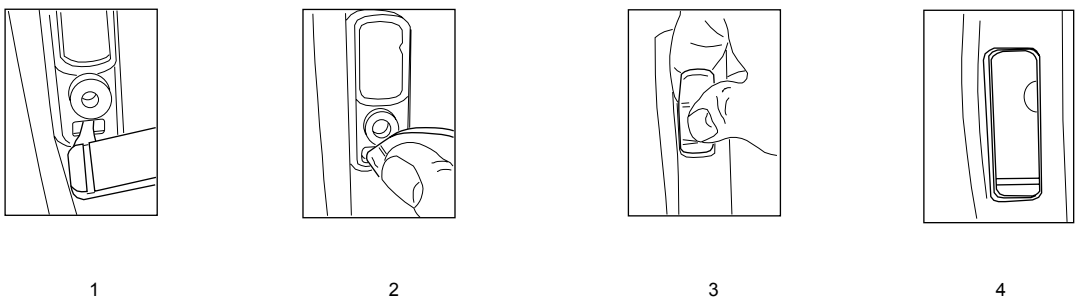


Figure 7-11. Dust Cap Re-assembly

7.4.3.2 Microphone and Speaker Re-assembly

1. Check that the mic and speaker felts are in position and not damaged. If damaged replace felts.
2. Insert the microphone sub-assembly into the microphone boot.

3. Insert the Boot and microphone sub-assembly into the microphone recess in the housing and route wires as shown in Figure 7-12.

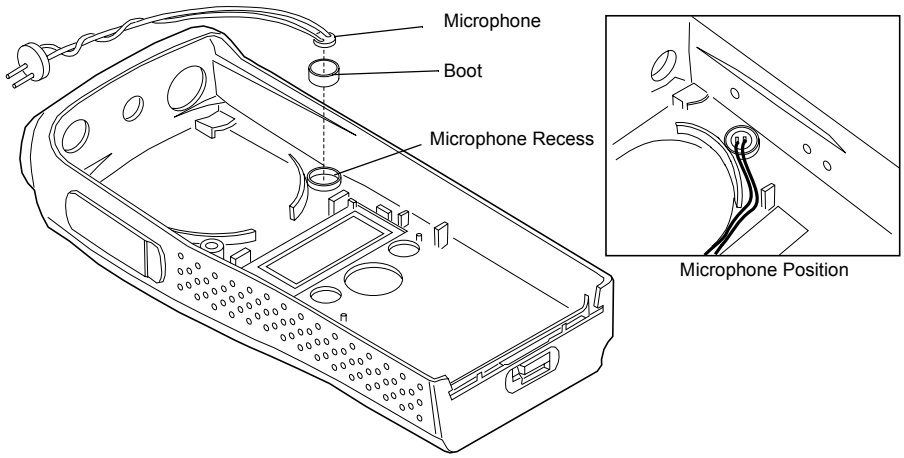


Figure 7-12. Microphone Re-assembly

4. Locate the speaker tab and align it with the tab opening in the front housing (Figure 7-13).

5. Insert the speaker tab into the speaker recess in the housing. Ensure the speaker is seated flush in the housing.

Note: Make sure the speaker and microphone wires are routed tightly between the speaker basket and the housing post

6. Insert one end of the speaker retainer into the slot in the front housing (See Figure 7-13).

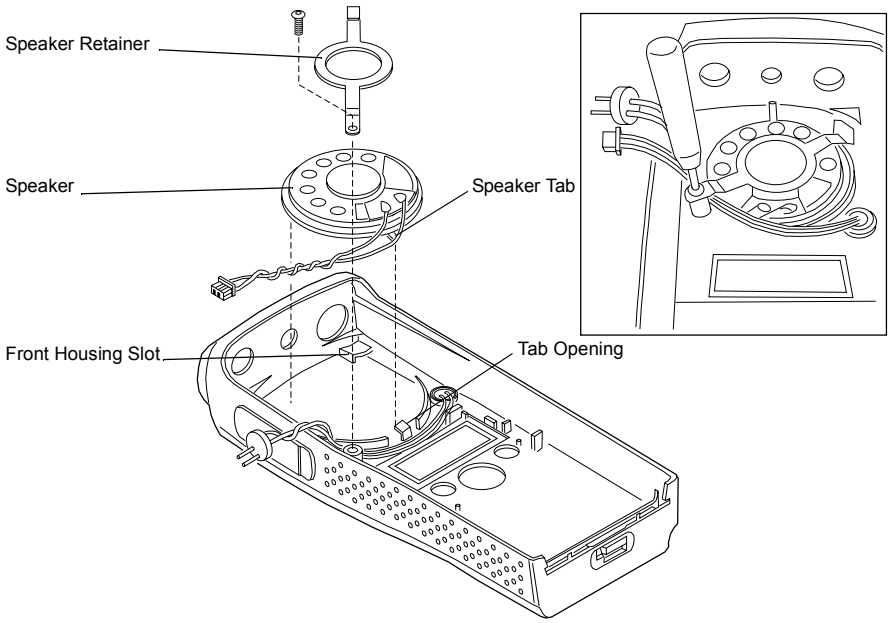


Figure 7-13. Speaker Re-assembly

Note: When fastening the speaker retainer screw, make sure the wires are out of the way to prevent pinching by the retainer.

7. Install the retainer screw using a T6 Torx screwdriver. Torque to 0.26 - 0.28Nm (2.3 - 2.5 lb/in).

7.4.3.3 Keypad and LCD/Keyboard Re-assembly

1. Attach the flex cable connector from the LCD module to the keyboard, if not already attached (Figure 7-15).
2. Remove protective mylar from window and from keypad, if present.
3. Install the new keypad into the housing. Use the two housing posts for keypad alignment (Figure 7-14)

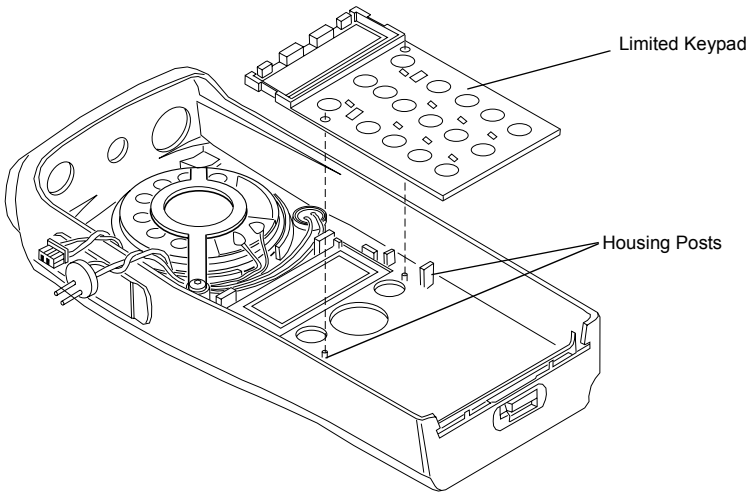


Figure 7-14. Keypad Re-assembly

4. Remove mylar from LCD if present.
5. Install the LCD/Keypad sub-assembly into the housing (Figure 7-15).

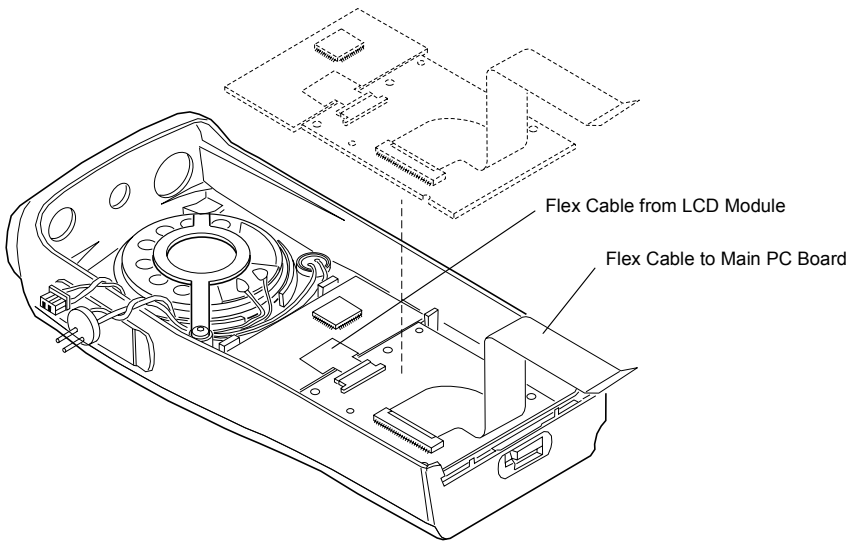


Figure 7-15. LCD/Keypad Board Re-assembly

6. Attach the flex cable connector into the connector on the keypad board, if not already connected.

CAUTION: Make sure the microphone and speaker wires are not trapped under the LCD module.

7. Bend the flex cable connector as shown (Figure 7-15).

7.4.3.4 Keyboard Retainer Re-assembly

1. Insert the flex cable connector through the slot at the bottom of the keyboard retainer (Figure 7-16).

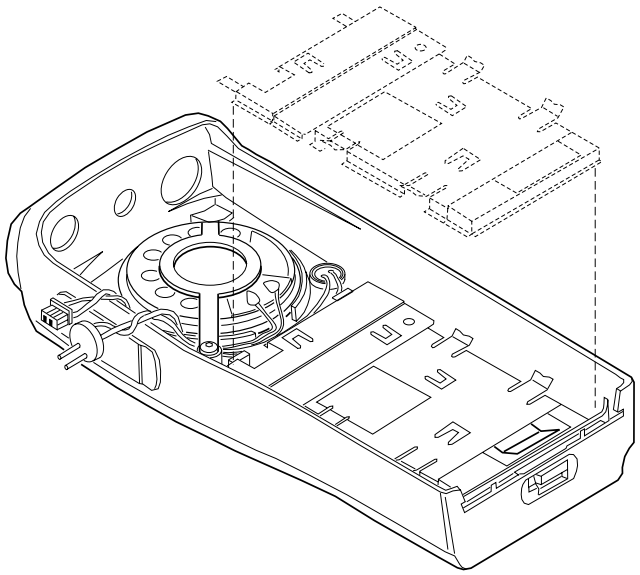


Figure 7-16. Keyboard Retainer Re-assembly

2. Insert the two top tabs of the keyboard retainer into the two tab retainers located on each side of the speaker in the front housing (Figure 7-16).
3. Press the four keypad retainer locking tabs into the housing.
4. Push the speaker and microphone wires into the top left hand corner of the housing.

7.4.3.5 Chassis Assembly/Re-assembly

1. Replace the battery contact seal (if necessary) surrounding the battery contact (Figure 7-17).
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 with the frequency and volume switches facing down (Figure 7-17).

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 0.42 - 0.44Nm (3.7 - 3.9 in/lb).
5. Replace the O-ring by positioning it 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.
6. Check the top corner of the chassis by flipping the O-ring, if the O-ring comes out easily, twist the O-ring and re-try until the O-ring is held properly by the chassis

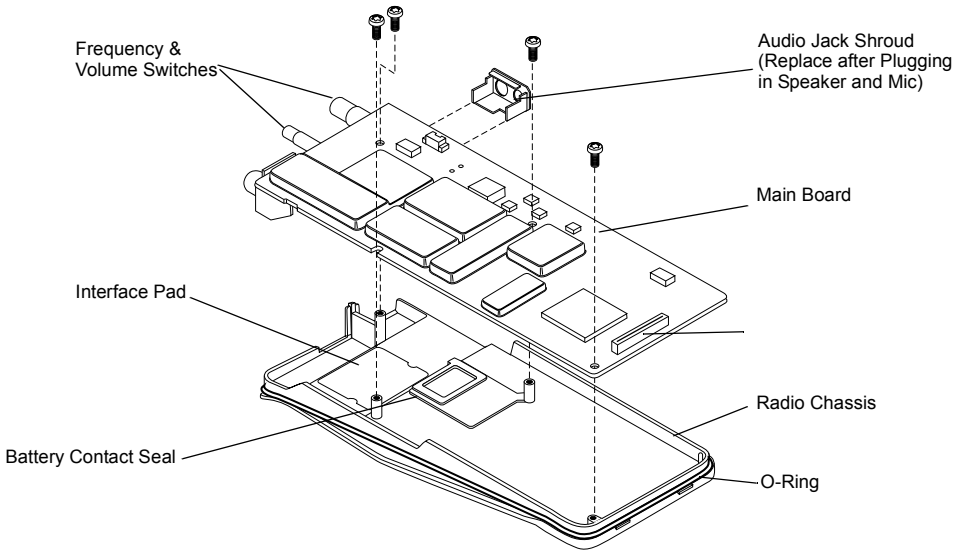


Figure 7-17. Installation of Main Board onto Chassis

7.4.3.6 Chassis and Front Cover Re-assembly

1. Dress and connect the speaker wires.

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

Note: Ensure that the plug orientation is correct with the exposed pins in the wire casing facing upward and fully plugged in.

a. 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 7-18).

b. Connect the microphone wire assembly into the two hole socket on the main board and bend the wires at the board connector so the wires are positioned toward the top of the radio (Figure 7-18).

c. Slide the audio jack shroud onto accessory connector (Figure 7-17).

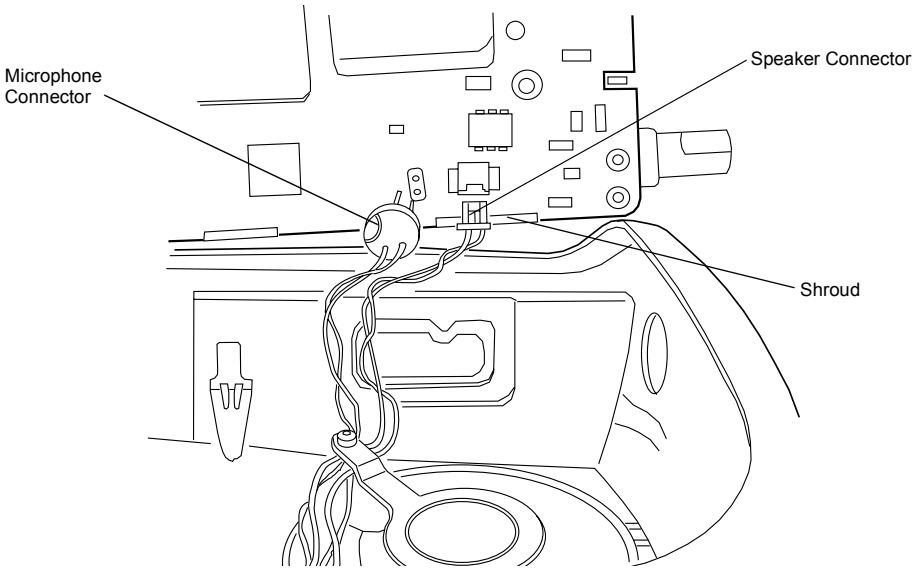


Figure 7-18. Microphone and Speaker Wires

2. Position the radio (Figure 7-19) and reconnect the flex cable connector from the keyboard into the connector located on the bottom of the main board, pushing up the 2 end tabs.

3. 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, between the shroud and housing.

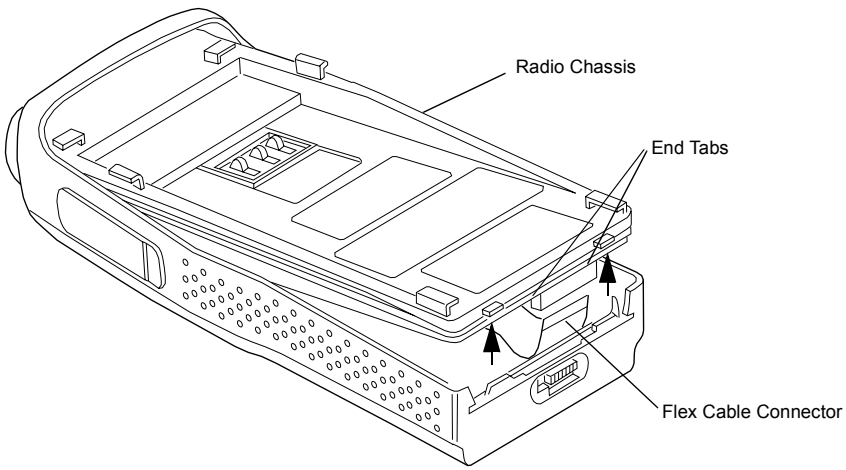


Figure 7-19. Keyboard Flex Cable Connection

4. Push the topside of the board chassis upward until it touches the housing end. Before snapping the board into the housing, perform the following checks:

a. Open the dust cap and ensure the wires are not pinched between the shroud and housing.

b. Ensure the O-ring is seated in the groove.

c. Ensure that the bottom side of the dust cap is fully pressed into the housing before the snapping the board into place.

5. Snap chassis assembly completely into the top of the front cover (Figure 7-20) until it settles in place.

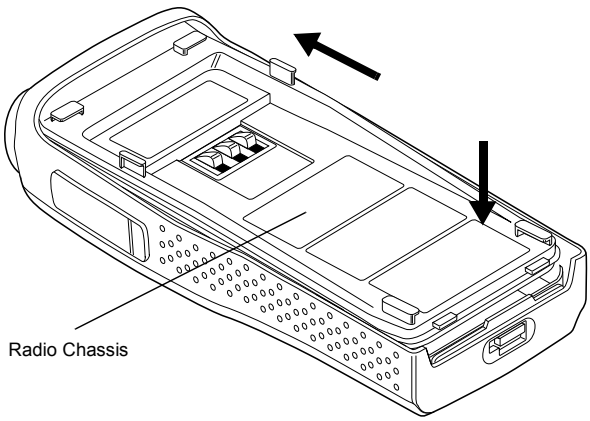
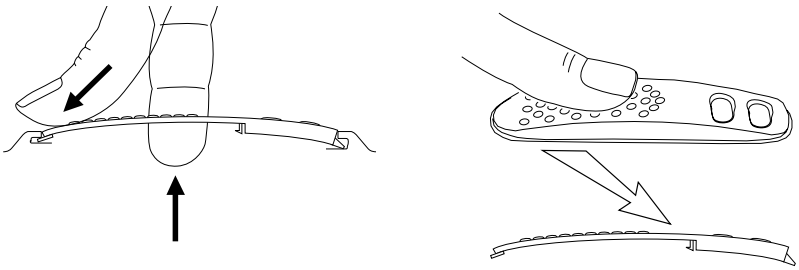


Figure 7-20. Fastening the Chassis

6. Make sure the 0-ring is properly seated. If the O-ring seal is pinched, separate the chassis from the housing using the knob removal/chassis opener and dress O-ring properly.
7. Snap the bottom of the chassis into the front cover.
8. Check that O-ring is visible at the corners.
9. Re-assemble the knobs, antenna, and battery.

7.4.3.7 PTT Re-assembly

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 7-21a).
3. Press the PTT assembly against the front cover opening (Figure 7-21b).



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

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

Figure 7-21. PTT Re-assembly

7.5 Mechanical View and Parts List

7.5.1 CP160 Limited-Keypad Exploded View and Parts List

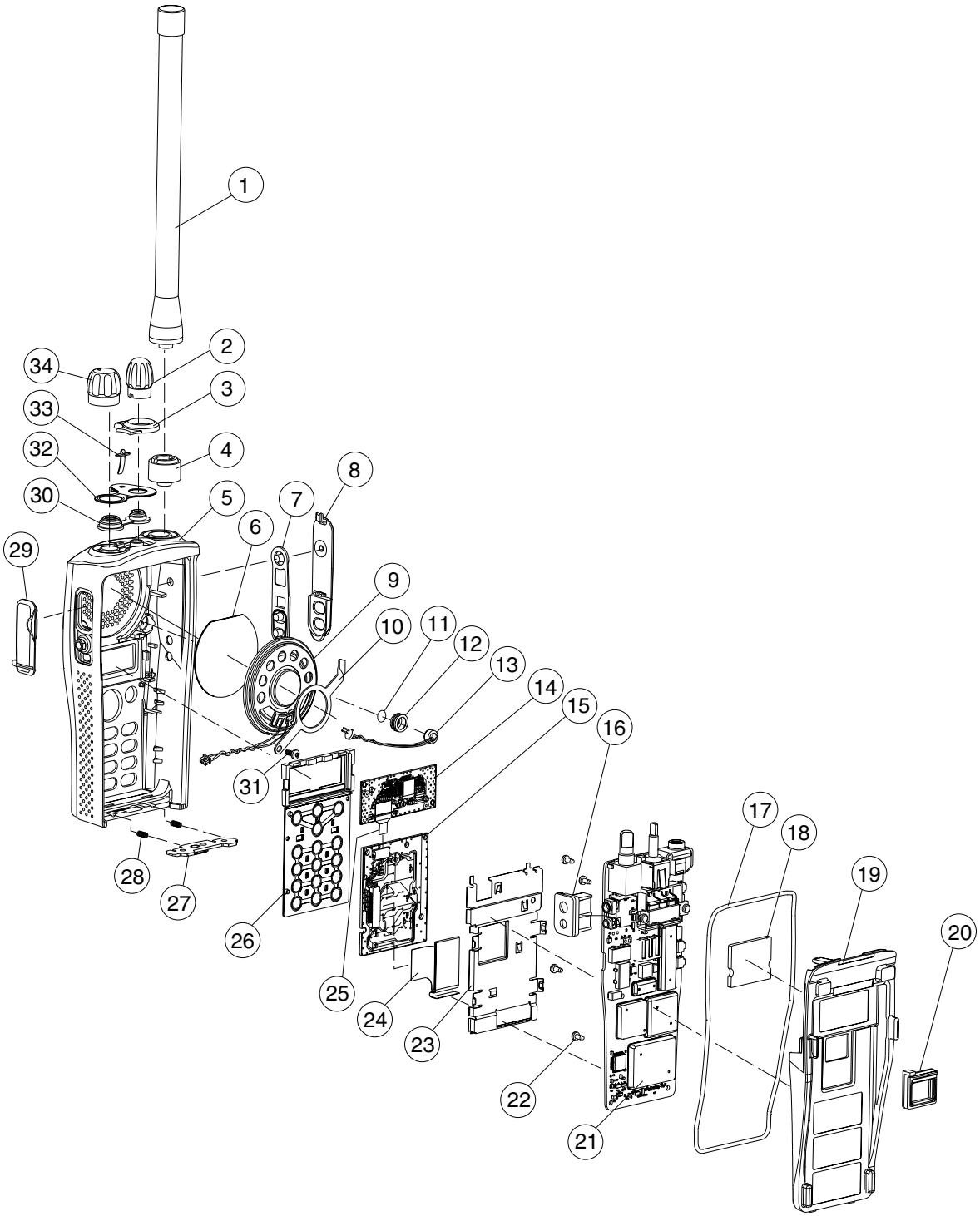


Figure 7-22. CP160 Limited Keypad Radio Exploded View

Item	Motorola Part Number	Description
1	See Section 6	Antenna
2	3680530Z02	Knob, Frequency
3	1386440Z03 1386440Z02	Escutcheon, Top; 4 Ch. Escutcheon, Top; 16 Ch.
4	Not Field Repairable	Antenna Adaptor/Seal (Optional)
5	1586391Z02	Housing, Limited, with Lens
6	3586621Z01	Speaker, Felt
7	3886489Z01	PTT, Rubber
8	4586439Z01	PTT, Plastic
9	5085738Z08	Speaker
10	4286620Z01	Retainer Speaker
11	3586621Z02	Felt, Microphone
12	0780608V01	Boot, Microphone
13	5085880L01	Microphone
14	5104949J16	Display, LCD Module
15	0104017J19	Keypad Board Assy
16	1586437Z01	Shroud, Audio Jack
17	3286431Z02	Seal, Main O-ring
18	7586436Z01	Pad, PA Interface
19	2786389Z01	Chassis
20	3286435Z01	Seal, Battery Contact Block
21	Ref. Chap 1 Model Charts	Back Cover Kit (Main Board + chassis)
22	0304726J05	Screws, Chassis; 4 Used
23	4286648Z01	Plate, Retainer
24	0986615Z02	Connector, 28-pin
25	0986632Z02	Connector, 9-pin
26	7586654Z02	Keypad, Limited
27	5586445Z02	Latch Assembly
28	4105944K01	Spring, Latch; 2 Used
29	3886441Z01	Cap, Dust
30	3286432Z01	Seal, Control Shaft
31	0386434Z01	Screw, Speaker Retainer
32	3386443Z01	Label, Escutcheon Seal
33	6186446Z02	Lightpipe
34	3680529Z01	Knob, Volume

Item	Motorola Part Number	Description
NON-REFERENCED ITEMS		
	3386625Z01	Nameplate, Motorola
	3386623Z06	Nameplate, CP160

Notes:

Chapter 8 Non-Keypad Model Disassembly and Re-assembly

8.1 Introduction

This section provides details about the following:

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

8.2 Preventive Maintenance

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

8.2.1 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.

8.2.2 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).

8.3 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.

8.4 Disassembling and Re-assembling the Radio — General

Since these radios may be disassembled and re-assembled 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 Chapter 3 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 Appendix B for a list of authorized service centers.

The following disassembly procedures should be performed only if necessary:

- Chassis Disassembly
- Speaker Disassembly
- PTT Disassembly

8.4.1 Radio Disassembly — Detailed

8.4.1.1 Front Cover From Chassis Disassembly

1. Turn off the radio
2. Remove the battery (Figure 8-1):
   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 1cm (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.

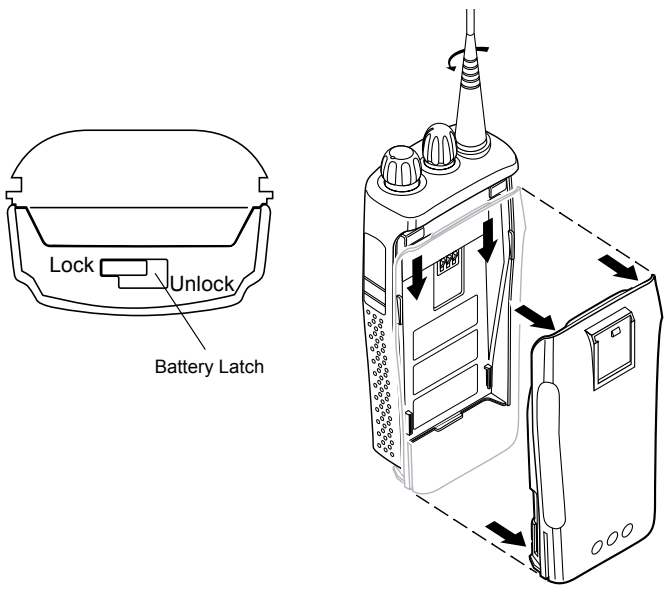


Figure 8-1. Battery Removal

3. Remove the antenna.
4. Pry off the volume and channel selector knobs from their shafts using the knob removal/chassis opener tool (Motorola part # 6686533Z01). (Figure 8-2)

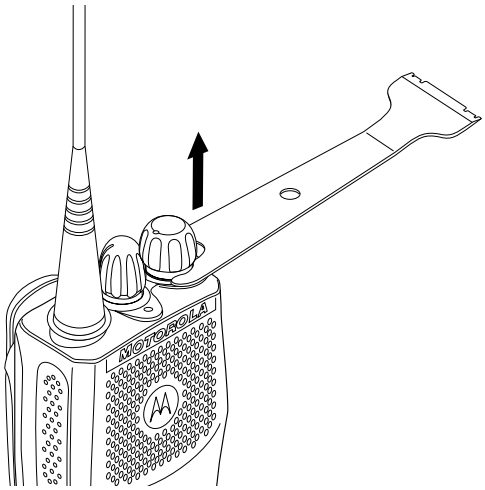


Figure 8-2. Antenna and Knob Removal

Note: Both knobs slide on and off. However the knobs are designed to fit very tightly on the shaft.

5. Separate the chassis from the front housing assembly by using the knob remover/chassis opener too. Place the broad side of the opener into the slots located at the base of the radio (Figure 8-3). Press the handle on the opener downwards. This pressing action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs..

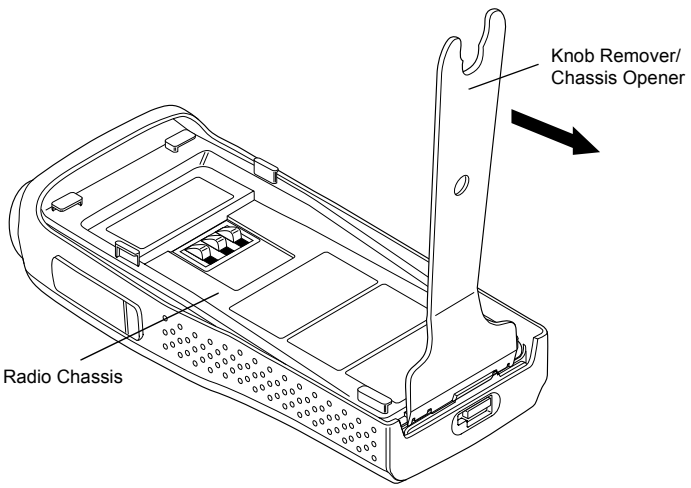


Figure 8-3. Chassis Removal

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 microphone wire assembly and keypad ribbon connector connecting the front housing assembly and the chassis prevent the two units from being completely separated

6. Pull the chassis assembly out of the front cover only until the volume and channel selectors shaft just clear the top of the case. (Figure 8-4).

Rotate the chassis counterclockwise out of the housing and position next to the housing. Take care not to damage the speaker and microphone wires that are still connected to the chassis (Figure 8-4).

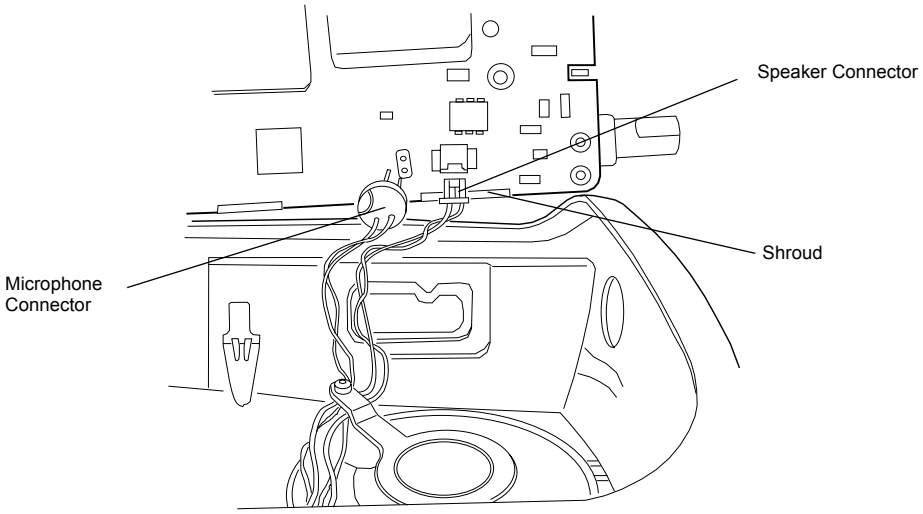


Figure 8-4. Microphone and Speaker Connections

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

8. Unplug the microphone wire assembly from the socket on the chassis.

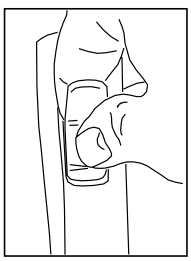
9. Move the chassis away from the housing and place on a clean work surface.

8.4.1.2 Dust Cover Disassembly

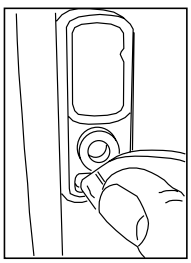
1. Gently pry the top of the dust cover away from the body of the radio. (See Figure 8-5).

2. Rotate the dust cover 90° in a counterclockwise direction to allow the key to be removed.

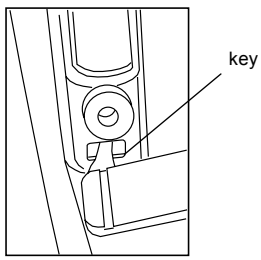
3. Separate the dust cover away from the body of the radio. The dust cover key is fragile; apply only light pressure to the key while removing the dust cover.



a. Pry dust cover from body.



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



c. Separate dust cover from body.

Figure 8-5. Dust Cover Disassembly

8.4.1.3 Speaker and Microphone 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 screw from the speaker retainer using a T6 Torx screwdriver (Figure 8-6).
2. Lift the retainer off the speaker, sliding end of retainer out of corner slot on the housing.
3. Lift the speaker out from the front housing.
4. Carefully lift microphone assembly out of housing.

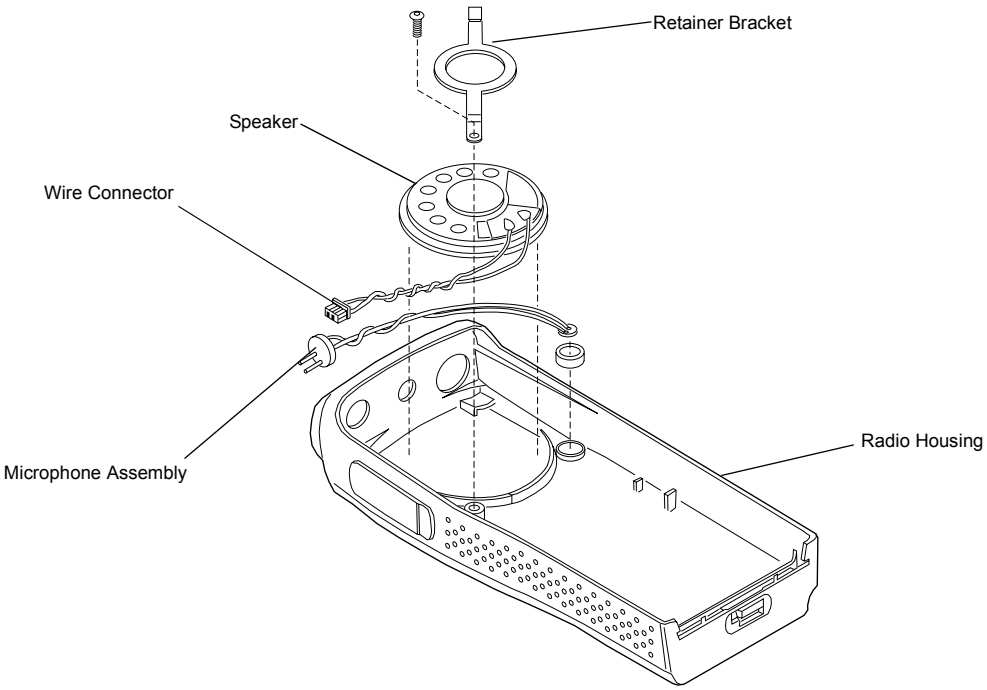


Figure 8-6. Removal Speaker-Microphone Assembly

8.4.1.4 PTT Disassembly

1. If required, the PTT (Figure 8-7) can be disassembly 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.

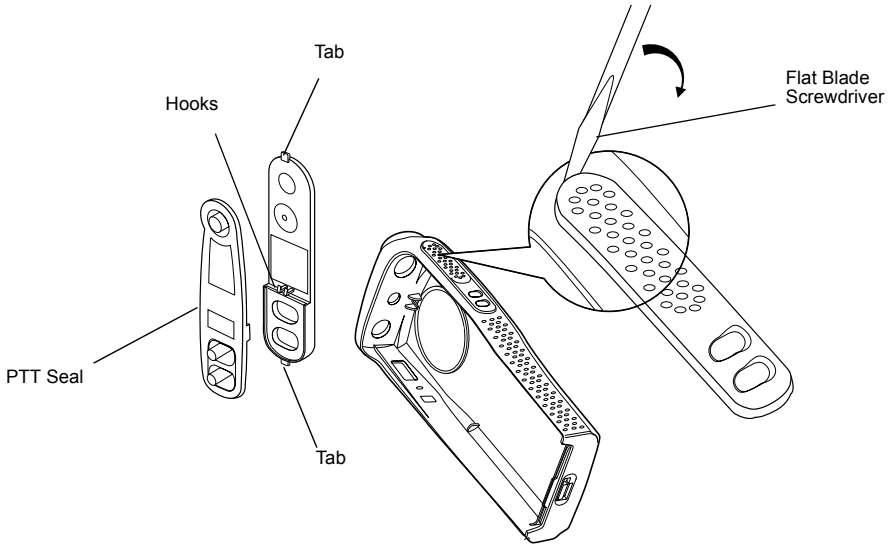


Figure 8-7. PTT Removal

8.4.2 Chassis Disassembly

CAUTION: Refer to the CMOS CAUTION paragraph (8.3) 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 8-8) holding the main board to the chassis.

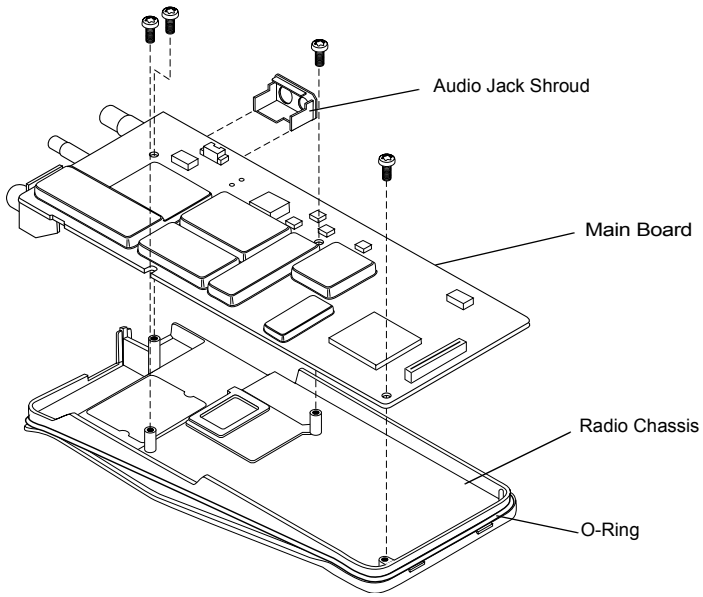


Figure 8-8. Removal of Main Board from Chassis

3. The audio jack shroud can be removed from the main board.
4. Lift the main board from the chassis.
5. Remove the battery contact seal.

8.4.3 Radio Re-assembly - Detailed

8.4.3.1 Dust Cover Re-assembly

1. Insert the tail of the dust cap into the bottom hole of the audio jacks housing opening (Figure 8-9).
2. Press the dust cap until the tail is fully into the hole.
3. Twist the dust cap counter-clockwise until the cap is seated properly onto the recess.
4. Press the cap again to ensure it fully covers the opening for the audio jack.

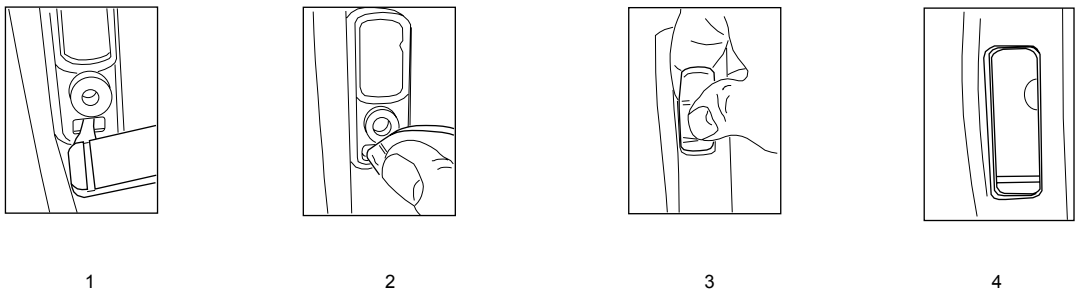


Figure 8-9. Dust Cap Re-assembly

8.4.3.2 Microphone and Speaker Re-assembly

1. Check that the speaker felt is in position and is not damaged. If damaged replace felt.
2. Insert the microphone sub-assembly into the microphone boot.
3. Insert the Boot and microphone sub-assembly into the microphone recess in the housing and route the wires as shown in Figure 8-10.

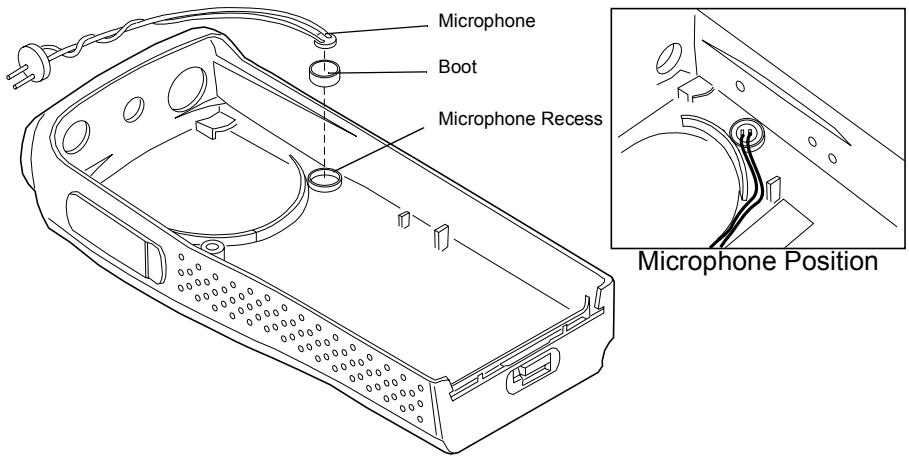


Figure 8-10. Microphone Re-assembly

4. Locate the speaker tab and align it with the tab opening in the front housing (Figure 8-11).
5. Insert the speaker tab into the speaker recess in the housing. Ensure the speaker is seated flush in the housing

Note: Make sure the speaker and microphone wires are routed tightly between the speaker basket and the housing post

6. Insert one end of the speaker retainer into the slot in the front housing (See Figure 8-11).

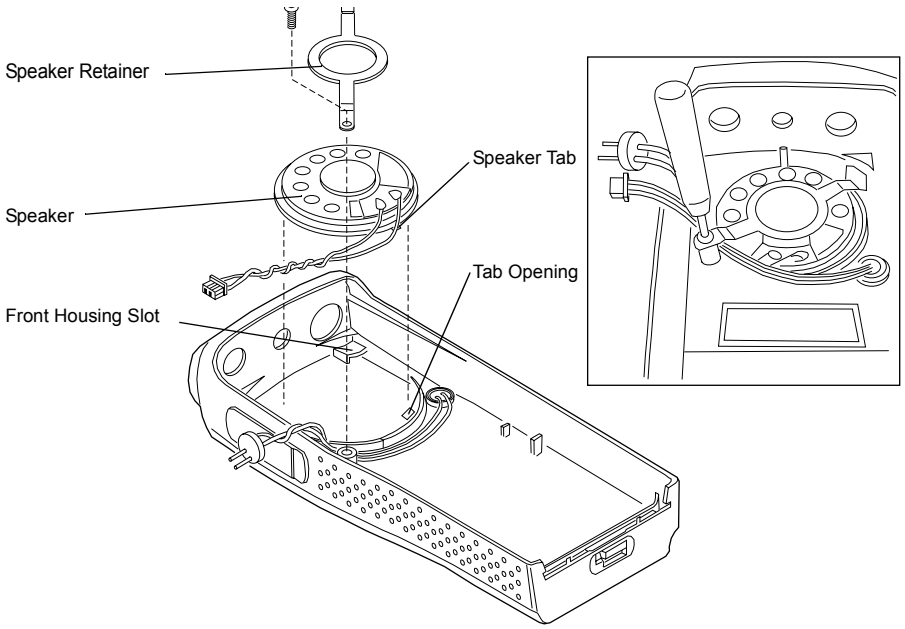


Figure 8-11. Speaker Re-assembly

Note: When fastening the speaker retainer screw, make sure the wires are out of the way to prevent pinching by the retainer.

7. Install the retainer screw using a T6 Torx screwdriver. Torque to 0.26 - 0.28Nm (2.3 - 2.5 lb/in).

8.4.3.3 Chassis Assembly/Re-assembly

1. Replace the battery contact seal (if necessary) surrounding the battery contact (Figure 8-12).
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 with the frequency and volume switches facing down (Figure 8-15.

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 0.42 - 0.44Nm (3.7 - 3.9 in/lb).
5. Replace the O-ring by positioning it 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.
6. Check that the O-ring is not twisted and is being held by the top and bottom chassis groves.
7. Replace the audio jack shroud.

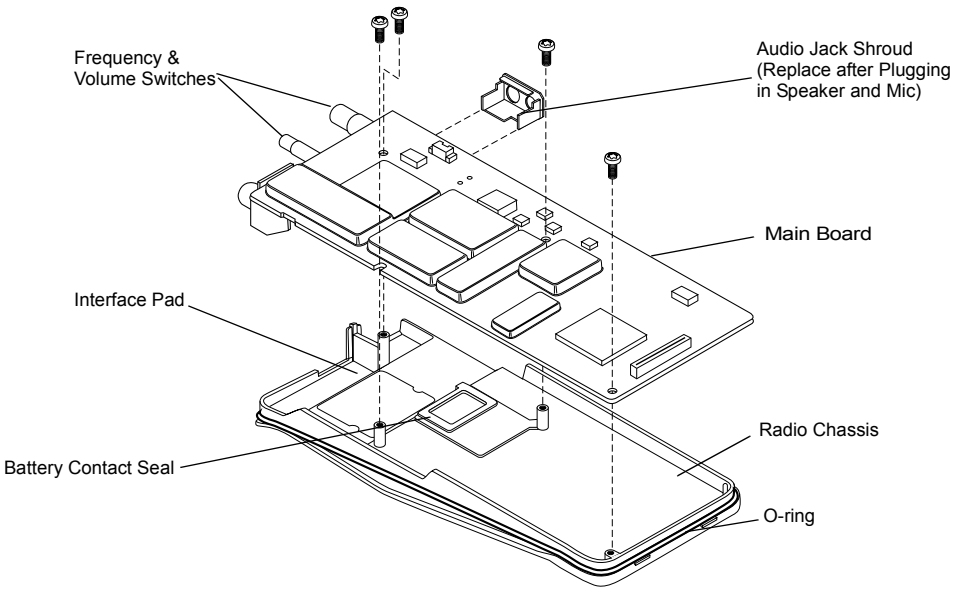


Figure 8-12. Installation of Main Board onto Chassis

8.4.3.4 Chassis and Front Cover Re-assembly

1. Dress and connect the speaker wires.

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

Note: Ensure that the plug orientation is correct with the exposed pins in the wire casing facing upward and fully plugged in.

a. Connect the speaker wire assembly into the 10-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 8-13).

b. Connect the microphone wire assembly into the two hole socket on the main board and bend the wires at the board connector so the wires are positioned toward the top of the radio (Figure 8-13).

c. Slide the audio jack shroud onto accessory connector (Figure 8-12).

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 topside of the board chassis upward until it touches the housing end. Before snapping the board into the housing, perform the following checks.:

a. Open the dust cap and ensure the wires are not pinched between the shroud and housing.

b. Ensure the O-ring is seated in the groove.

c. Ensure that the bottom side of the dust cap is fully pressed into the housing before the snapping the board into place.

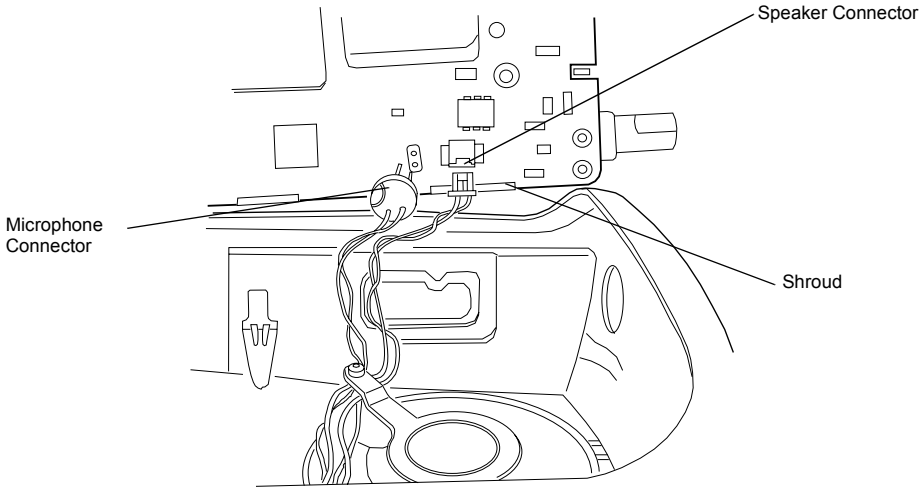


Figure 8-13. Microphone and Speaker Wires Re-assembly

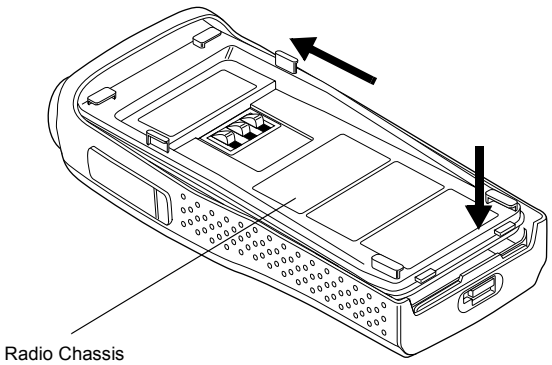
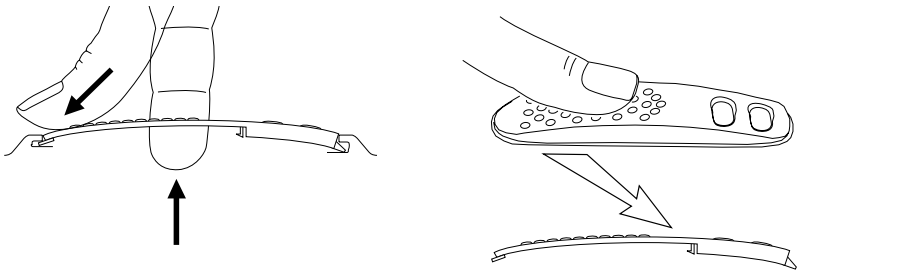


Figure 8-14. Fastening the Chassis

4. Snap chassis assembly completely into the top of the front cover (Figure 8-14) until it settles in place.
5. Make sure the O-ring is properly seated. If the O-ring seal is pinched, separate the chassis from the housing using the knob removal/chassis opener and dress O-ring properly.
6. Snap the bottom of the chassis into the front cover.
7. Check that O-ring is visible at the corners.
8. Re-assemble the knobs, antenna, and battery.

8.4.3.5 PTT Re-assembly

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 8-15a).
3. Press the PTT assembly against the front cover opening (Figure 8-15b).



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

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

Figure 8-15. PTT Re-assembly

8.5 Mechanical View and Parts List

8.5.1 CP140 Non-Keypad Exploded View and Parts List

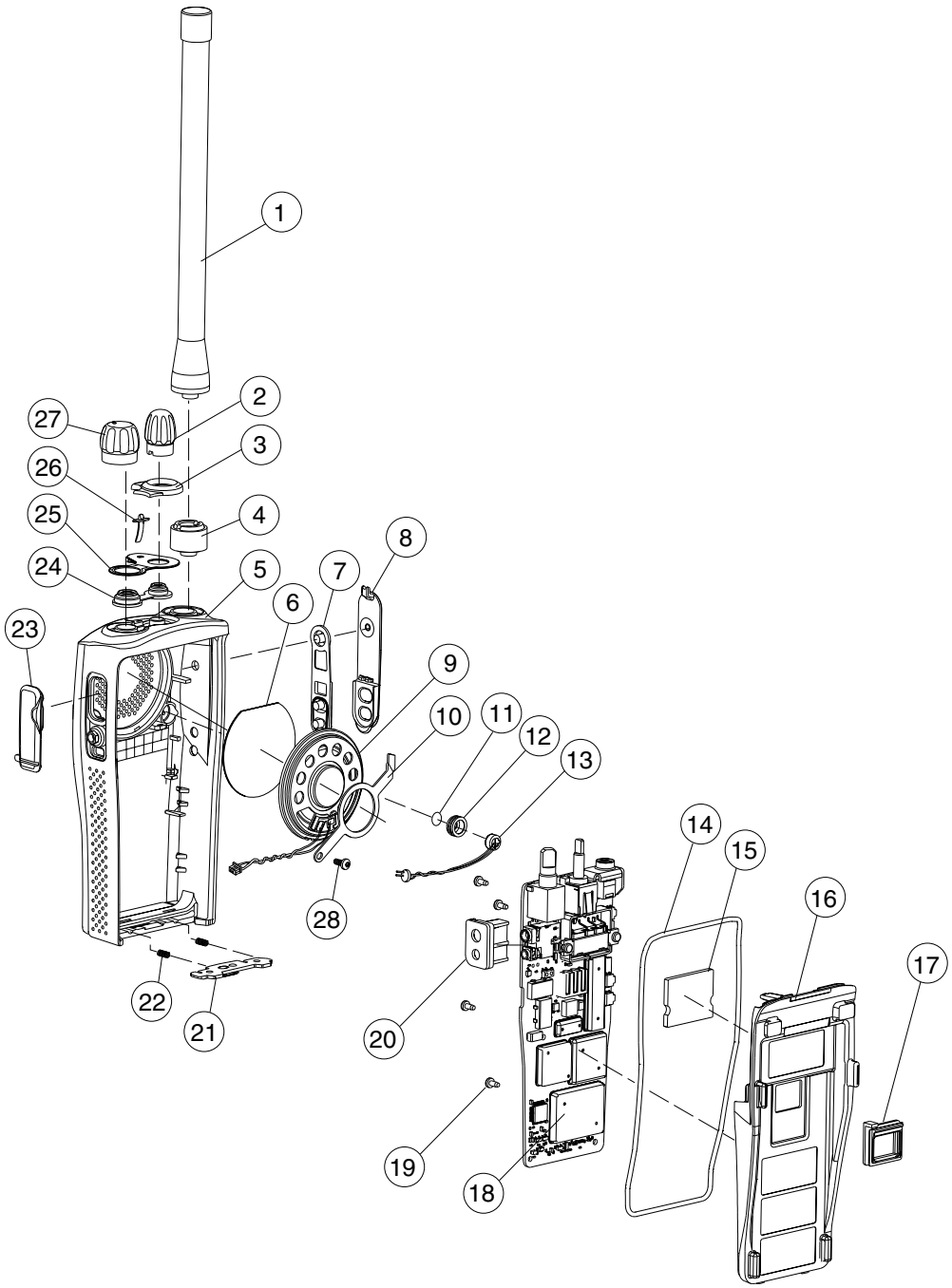


Figure 8-16. CP140 Non-Keypad Radio Exploded View

Item	Motorola Part Number	Description
1	See Section 6	Antenna
2	3680530Z02	Knob, Frequency
3	1386440Z02	Escutcheon, Top; 16 Ch.
4	Not Field Repairable	Antenna Adaptor / Seal
5	1586391Z01	Housing, ELP+, Plain
6	3586621Z01	Felt, Speaker
7	3886489Z01	PTT, Rubber
8	4586439Z01	PTT, Plastic
9	5085738Z08	Speaker
10	4286620Z01	Retainer, Speaker
11	3586621Z02	Felt, Microphone
12	0780608V01	Boot, Microphone
13	5085880L01	Microphone
14	3286431Z02	Seal, Main O-ring
15	7586436Z01	Pad, PA Interface
16	2786389Z01	Chassis
17	3286435Z01	Seal, Battery Contact Block
18	Ref. Chap 1 Model Charts	Back Cover Kit (Main Board + chassis)
19	0304726J05	Screws, Chassis; 4 Used
20	1586437Z01	Shroud, Audio Jack
21	5586445Z02	Latch Assembly
22	4105944K01	Spring, Latch; 2 Used
23	3886441Z01	Cap, Dust
24	3286432Z01	Seal, Control Shaft
25	3386443Z01	Label, Escutcheon Seal
26	6186446Z02	Lightpipe
27	3680529Z01	Knob, Volume
28	0386434Z01	Screw, Speaker Retainer
NON-REFERENCED ITEMS		
	3386625Z01	Nameplate, Motorola
	3386623Z05	Nameplate, CP140

Chapter 9 Troubleshooting Tables

9.1 Power-Up Error Codes

During radio power-up, the radio performs dynamic tests to determine if the radio is working properly. Problems detected during these tests are presented as an error code on the radio's display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Use Table 9-1 to aid in understanding particular operational error codes.

Table 9-1. Power-Up Error Code Display

Error Code	Possible Causes	Corrective Action
RAM ERR	RAM Test Failure	Retest radio by turning if off and tuning it on again. If message reoccurs, replace main board or send radio to depot.
ROM ERR	ROM checksum is wrong	Reprogram FLASH memory and retest. If message reoccurs, replace main board or send radio to depot.
EPRM ERR	EEPROM Hardware Error – Codeplug structure mismatch or non-existence of codeplug or, EEPROM Checksum Error – Codeplug checksum is wrong	Reprogram codeplug with correct codeplug and retest. If message reoccurs, replace main board or send radio to depot.

9.2 Operational Error Codes

During radio operation, the radio performs dynamic tests to determine if the radio is working properly. Problems detected during these tests are presented as an error code on the radio's display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Use Table 9-2 to aid in understanding particular operational error codes.

Table 9-2. Operational Error Code Display

Error Code	Possible Causes	Corrective Action
SYN UNLK	Synthesizer Out-of-Lock	Verify codeplug and reprogram if necessary. If message reoccurs, replace main board or send radio to depot.

9.3 Troubleshooting Table for Receiver

Table 9-3 lists the possible causes of, and corrections for, receiver problems.

Table 9-3. Receiver Troubleshooting Table

Symptom	Possible Causes	Corrective or Test (Measurements at Room Temperature)
Radio Dead; Display Does Not Turn On	1. Dead Battery.	Replace with charged battery.
	2. Blown Fuse	Send radio to depot.
	3. On/Off Switch	
	4. Regulators	
	5. Regulator fault	
Radio Dead; Display Turns On	Transceiver Board	Send radio to depot.
No Receive Audio, or Receiver Does Not Unmute	Programming	1. Does the transmitted signal match the receiver configuration (PL, DPL, etc.)? 2. With the monitor function enabled, can the radio be unmuted?
Audio Distorted or Not Loud Enough	Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; realign it off by more than ±150 Hz (VHF), ±500 Hz (UHF)
RF Sensitivity Poor	1. Synthesizer Not on Frequency	Check synthesizer frequency by measuring the transmitter frequency; realign it off by more than ±150 Hz (VHF), ±500 Hz (UHF)
	2. Antenna Switch/Connector	Send radio to depot.
	3. Receiver Front End Tuning	Check RF front-end tuning for optimum sensitivity using the tuner.
Radio Will Not Turn Off	Transceiver Board	Send radio to depot.

9.4 Troubleshooting Table for Transmitter

Table 9-4 lists the possible causes of, and corrections for, transmitter problems.

Table 9-4. Transmitter Troubleshooting Table

Symptom	Possible Causes	Corrective or Test (Measurements at Room Temperature)
No RF Power Out	1. Tx Power Level or Frequency	Check Tx power level and frequency programming (from tuner).
	2. No Injection To Power Amplifier	Send radio to depot.
	Antenna Switch/Connector	
No Modulation; Distortion Modulation	1. Programming	Check deviation and compensation settings using the tuner.
	2. Transceiver Board	Send radio to depot.
Bad Microphone Sensitivity	1. Check Deviation and Compensation	Realign if necessary.
	2. Microphone	Send radio to depot.
No/Low Signaling (PL, DPL, MDC)	1. Programming	Check programming.
	2. Transceiver Board	Send radio to depot.
Cannot Set Deviation Balance	RF Board	Send radio to depot.

Notes:

Appendix A Accessories

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)
NAE6483_R	Flexible Whip Antenna (403-520 MHz)
8505816K24	UHF Heliflex Stubby (400-440 MHz)
8505816K26	UHF Heliflex Stubby (470-520 MHz)
5886627Z01	Antenna Adapter

Carrying Accessories

RLN5383	Hard Leather Case with Belt Loop and D rings
RLN5384	Hard Leather Case with 2-1/2 inch swivel Belt Loop
RLN5385	Hard Leather Case with 3 inch swivel Belt Loop
RLN5498	Hard Leather Case with Belt Loop
RLN5496	Hard Leather Case, Full DTMF with 2-1/2 inch Swivel Belt Loop
RLN5497	Hard Leather Case, Full DTMF with 3 inch Swivel Belt Loop
RLN5640	Hard Leather Case, Full DTMF with Belt Loop
RLN5641	Hard Leather Case, Full DTMF with 2-1/2 inch Swivel Belt Loop
RLN5642	Hard Leather Case, Full DTMF with 3 inch Swivel Belt Loop
HLN9701B	Nylon Case with Belt Loop and D ring
HLN9985B	Waterproof Bag
HLN8255	3 inch Spring Action Belt Clip
NTN5243	Shoulder Strap for Hard Leather Cases attaches to D-Shaped Rings on case)
RLN4815A	Universal RadioPak
RLN4570A	Break-away Chest Pack

Miscellaneous Accessoires

RLN5500	Accessory Retainer Kit

Chargers

WPLN4138_R	Desktop Rapid Charger w/US Plug
WPLN4139_R	Desktop Rapid Charger w/Euro Plug
WPLN4140_R	Desktop Rapid Charger w/UK Plug
WPLN4161	Multi-Unit Rapid Charger w/US Plug
WPLN4162	Multi-Unit Rapid Charger w/Euro Plug
WPLN4163	Multi-Unit Rapid Charger w/UK Plug

Batteries

NNTN4496_R	NiCd, 1100 mAh
NNTN4497_R	Li-Ion, High Cap, 1800 mAh
NNTN4851_R	NiMH, 1400 mAh
NNTN4852_R	NiMH FM, 1300 mAh
NNTN4970_R	Slim Li-Ion, 1600 mAh

Audio 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_P	Earpiece with Microphone & PTT Combined (Black) including Low Noise Kit, 2-Wire Surveillance Kit w/Clear Comfortable Acoustic Tube (includes NTN8371)
BDN6720	Flexible Ear Receiver (RX only)
PLMN4443	Flexible Ear Receiver with Microphone & PTT Combined
PLMN4444	Earset w/Flexible Boom Microphone
HMN9036	Earbud with Microphone & PTT Combined, 2-Wire (Black)
PMLN4294	Earbud with Microphone & PTT Combined
PMLN4442	Earbud with Microphone & PTT Combined
HLN9132	Earbud Single Wire Receive Only (Black)
NTN8370	Extreme Noise Kit
5080384T72	Replacement Noise Attenuating Plug for NTN8370
NTN8371	Low Noise Kit
RLN4760	Small Custom Clear Earpiece, Right Ear
RLN4763	Small Custom Clear Earpiece, Left Ear
RLN4761	Medium Custom Clear Earpiece, Right Ear
RLN4764	Medium Custom Clear Earpiece, Left Ear
RLN4762	Large Custom Clear Earpiece, Right Ear
RLN4765	Large Custom Clear Earpiece, Left Ear
RLN5317	2-wire Comfort Earpiece with Microphone & PTT Combined, Beige
RLN5318	2-wire Comfort Earpiece with Microphone & PTT Combined, Black
BDN6646	Standard 95 dB Ear Microphone with PTT Interface Module
BDN6706	Standard 95 dB Ear Microphone with VOX & PTT Interface Module
0180358B38	Ring PTT Switch for Ear Microphone System
0180300E83	Body PTT Switch for Ear Microphone System

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
5080371E66	Replacement Ear Pad for BDN6647
RMN5015	Heavy Duty Dual Muff Racing Headset (requires RKN4090 Headset Adapter Cable)
REX4648	Ear Pad and Windscreen Kit
RKN4090	Adapter Cable for use with RMN5015 Racing Headset
RMN4051	2-Way Hard Hat Mount, Black, Noise Reduction Rating (22db) (requires RKN4094 Adapter Cable)
RMN4052	Tactical Headband Style Headset, Grey
RMN4053	Tactical Hard Hat Mount Headset, Grey
RMN4054	Receive-Only Hard Hat Mount Headset with 3.5mm Right Angle Plug
RMN4055	Receive-Only Headband Style Headset with 3.5mm Right Angle Plug
HLN9133	VOX Adapter Kit (for use with Headsets only)
RKN4094	In-Line PTT Adapter for use with headsets RMN4051, RMN4052, and RMN4053 only)
PMLN4425	Earset Boom Microphone w/Remote Ring PTT
MDPMLN4445	Ultra-Light Headset with Boom Microphone

Remote Speaker Microphones

HMN9030	Remote Speaker Microphone
RLN4904	Mic Jacket for HMN9030 Remote Speaker Microphone
HKN9094	Replacement Cord for HMN9030
PMMN4008	Remote Speaker Microphone

Manuals

6866550D01_	CP140/CP160/CP180 Basic User Guide - Multi-Language
GMLN1091A	CP140/CP160/CP180 Basic User Guide - Multi-Language CDROM
GMLN1092A	CP100 Series Product Manual - English
GMLN1093A	CP100 Series Product Manual - French
GMLN1094A	CP100 Series Product Manual - Russian
GMLN1098A	CP100 Series Product Manual - English/French/Russian CDROM
6881096C29_	FM Listing Booklet
6864117B25_	Product Safety and RF Exposure Booklet
6866550D20_	CP100 Series Detailed Service Manual, English

Appendix B Warranty, Service Support, and Replacement Parts

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 Authorised 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 Aftermarket and Accessory Division (AAD) offers a repair service to both end users and dealers at competitive prices.
2. AAD supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

2.3 European Radio Support Centre (ERSC)

The ERSC Customer Information Desk is available through the following service numbers:

Austria:	08 00 29 75 41	Italy:	80 08 77 387
Belgium:	08 00 72 471	Luxemburg:	08 00 23 27
Denmark:	80 88 05 72	Netherlands:	08 00 22 45 13
Finland:	08 00 11 49 910	Norway:	80 01 11 15
France:	08 00 90 30 90	Portugal:	08 00 84 95 70
Germany:	08 00 18 75 240	Spain:	90 09 84 902
Greece:	00 80 04 91 29 020	Sweden:	02 07 94 307
UK :	08 00 96 90 95	Switzerland:	08 00 55 30 82
Ireland:	18 00 55 50 21	Iceland:	80 08 147

Or dial the European Repair and Service Centre:

Tel: +49 30 6686 1555

Please use these numbers for repair enquiries only.

2.4 Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola part number is assigned to the part, it is available from Motorola Radio Aftermarket and Accessory Division (AAD). If no part number is assigned, the part is not normally available from Motorola. If the part number is appended with an asterisk, the part is serviceable by Motorola Depot only. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

All part orders should be directed to :

Motorola GmbH
Customer Care
Am Borsigturm 130
13507 Berlin
Germany.

2.5 Technical Support

Motorola Product Services is available to assist the dealer/distributors in resolving any malfunctions which may be encountered.

UK/Ireland - Richard Russell
Telephone: +44 (0) 1256 488 082
Fax: +44 01256 488 080
Email: BRR001@email.mot.com

Central/East Europe - Siggy Punzenberger
Telephone: +49 (0) 6128 70 2342
Fax: +49 (0) 6128 95 1096
Email: TFG003@email.mot.com

Scandinavia
Telephone: +46 8 735 9282
Fax: +46 8 735 9280
Email: C14749@email.mot.com

Germany -Customer Connect Team
Telephone: +49 (0) 30 6686 1539
Fax: +49 (0) 30 6686 1916
Email: cgiss.emea@europe.mot.com

France - Lionel Lhermitte
Telephone: +33 1 6929 5722
Fax: +33 1 6929 5904
Email: TXE037@email.mot.com

Italy - Ugo Gentile
Telephone: +39 0 2822 0325
Fax: +39 0 2822 0334
Email: C13864@email.mot.com

Africa & Middle East - Armand Roy
Telephone: +33 1 6929 5715
Fax: +33 1 6929 5778
Email: armand.roy@Motorola.com

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
PL	Private-Line® tone squelch: a continuous sub-audible tone that is transmitted along with the carrier.

Term	Definition
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