MOTOTRBO™ PORTABLE

PROFESSIONAL DIGITAL TWO-WAY RADIO

MOTOTRBO[™] PORTABLE CP100d BASIC SERVICE MANUAL

JUNE 2020



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Contents

List of Figures	5
List of Tables	6
Foreword	7
Product Safety and RF Exposure Compliance	7
Computer Software Copyrights	7
Document Copyrights	7
Disclaimer	7
Trademarks	7
Document History	8
Related Publication	9
Notations Used in This Manual	10
Chapter 1: Introduction	11
1.1 Radio Description	11
1.1.1 Non-Keypad Model	11
1.2 Portable Radio Model Numbering Scheme	12
1.3 Model Chart	13
1.3.1 UHF Model Chart	13
1.3.2 VHF Model Chart	14
1.4 Specifications	14
1.4.1 General	14
1.4.2 Receiver	15
1.4.3 Transmitter	15
1.4.4 Self-Quieter	17
1.4.5 Military Standards	17
1.4.6 Environmental	18
Chapter 2: Test Equipment and Service Aids	20
2.1 Recommended Test Equipment	20
2.2 Service Aids	21
2.3 Programming, Testing, and Alignment Cable	21
Chapter 3: Transceiver Performance Testing	24
3.1 Setup	24
3.2 Non-Display Model Test Mode	24
3.2.1 Entering Non-Display Radio Test Mode	24
3.2.2 RF Test Mode	25
3.2.3 LED Test Mode	29

3.2.4 Speaker Tone Test Mode	29
3.2.5 Earpiece Tone Test Mode	30
3.2.6 Audio Loopback Earpiece Test Mode	30
3.2.7 Battery Check Test Mode	30
3.2.8 Button/Knob/PTT Test Mode	30
Chapter 4: Radio Programming and Tuning	32
4.1 Customer Programming Software Setup	32
4.2 AirTracer Application Tool	32
4.3 Radio Tuning Setup	33
4.3.1 RF Adaptor Holder Assembly	33
Chapter 5: Disassembly and Reassembly Procedures	40
5.1 Preventive Maintenance	
5.2 Safe Handling of CMOS and LDMOS Devices	41
5.3 General Repair Procedures and Techniques	42
5.4 Disassembling and Reassembling the Radio	43
5.5 Detailed Radio Disassembly	43
5.5.1 Chassis and Front Housing Disassembly	43
5.5.2 Chassis Disassembly	48
5.5.3 Speaker and Microphone Disassembly	49
5.5.4 Dust Cover Disassembly	50
5.5.5 Micro USB Dust Cover Disassembly	50
5.5.6 PTT Disassembly	51
5.6 Detailed Radio Reassembly	52
5.6.1 PTT Reassembly	52
5.6.2 Micro USB Dust Cover Reassembly	54
5.6.3 Audio Jack Dust Cover Reassembly	55
5.6.4 Speaker and Microphone Reassembly	56
5.6.5 Chassis Reassembly	57
5.6.6 Chassis and Front Housing Reassembly	61
5.7 Radio Exploded Mechanical View and Parts List	
5.7.1 Non-Keypad Exploded View	63
5.7.2 Back Cover Kit Part Numbers	
5.7.3 Torque Chart	65
Chapter 6: Basic Troubleshooting	66
6.1 Replacement Back Cover Kit Procedures	66
Chapter 7: Authorized Accessories List	67
Appendix A: Replacement Parts Ordering	69
Appendix B: Motorola Solutions Service Centers	71

MN006550A01-AA
Contents

Glossary......72

List of Figures

Figure 1: Non-Keypad Model	11
Figure 2: Portable Programming Cable with TTR (PMKN4128_)	22
Figure 3: Portable Test Cable (PMKN4156_)	23
Figure 4: CPS Programming Setup	32
Figure 5: Radio Tuning Equipment Setup	33
Figure 6: Nameplate disassembly	34
Figure 7: Aligning RF Adaptor	35
Figure 8: Inserting the RF Adaptor	36
Figure 9: Inserting the RF connector	37
Figure 10: Affixing the backer	38
Figure 11: Complete RF adaptor assembly	39
Figure 12: Battery Removal	44
Figure 13: Channel Selector and Volume Knob Removal	45
Figure 14: Chassis Screw Removal	46
Figure 15: Chassis Removal from Front Housing	47
Figure 16: Speaker and Microphone Wires Removal	47
Figure 17: Speaker and Microphone Disassembly	49
Figure 18: Dust Cover Disassembly	50
Figure 19: Micro USB Dust Cover Removal	51
Figure 20: PTT Disassembly	52
Figure 21: PTT Assembly	53
Figure 22: PTT Bezel Orientation	53
Figure 23: PTT Reassembly	54
Figure 24: Micro USB Dust Cover Reassembly	55
Figure 25: Audio Jack Dust Cover Reassembly	56
Figure 26: Speaker and Microphone Reassembly	57
Figure 27: Battery Contact Seal Assembly	58
Figure 28: Thermal Pad Assembly	59
Figure 29: PCB and Top Control Seal Assembly	60
Figure 30: Chassis and Front Housing Reassembly	61
Figure 31: Inserting Chassis Assembly into Housing	62

List of Tables

Table 1: Radio Frequency Ranges and Power Levels	11
Table 2: Portable Radio Model Numbering Scheme	12
Table 3: Sales Models – Description of Symbols	12
Table 4: CP100d, UHF, 403–480 MHz Model Chart	13
Table 5: CP100d, VHF, 136–174 MHz Model Chart	14
Table 6: General Specifications	14
Table 7: Receiver Specifications	15
Table 8: Transmitter Specifications	15
Table 9: Self-Quieter Specification	17
Table 10: Military Standards (810C–810E)	17
Table 11: Military Standards (810F–810H)	18
Table 12: Environmental Specifications	18
Table 13: Test Equipment	20
Table 14: Service Aids	21
Table 15: Pin Configuration of Portable Programming Cable with TTR	22
Table 16: Pin Configuration of Portable Test Cable	23
Table 17: Initial Equipment Control Settings	24
Table 18: Test Environments	25
Table 19: Test Frequencies	25
Table 20: Transmitter Performance Checks	26
Table 21: Receiver Performance Checks	28
Table 22: Button/Knob/PTT Checks	30
Table 23: Software Installation Kits Radio Tuning Setup	32
Table 24: Lead Free Solder Wire Part Number List	42
Table 25: Lead Free Solder Paste Part Number List	42
Table 26: Non-Keypad Exploded View Part List	63
Table 27: Back Cover Kit Part Numbers	65
Table 28: Torque Specifications for Screws	65
Table 29: Motorola Solutions Service Centers	71

Foreword

This manual includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures.



CAUTION: These servicing instructions are for the use of qualified personnel only. To reduce the risk of electric shock, do not service parts other than those contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Product Safety and RF Exposure Compliance



CAUTION: Before using this product, read the Product Safety and RF Exposure booklet enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.

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Document History

The following major changes have been implemented in this manual since the previous edition:

Version	Description	Date
MN006550A01-AA	Initial Release	June 2020

Related Publication

The following list contains part numbers and titles of related publications.

- 6881095C98, Product Safety and RF Energy Exposure Booklet for Portable Two-Way Radios
- MN006548A01, CP100d Quick Reference Guide

Notations Used in This Manual

Throughout the text in this publication, you will notice the use of warning, caution, and notice notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.



WARNING: WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury.



CAUTION: CAUTION indicates a potentially hazardous situation which, if not avoided, might result in equipment damage.



NOTICE: NOTICE indicates an operational procedure, practice, or condition that is essential to emphasize.

Chapter 1

Introduction

1.1

Radio Description

The radios are available in the following frequency ranges and power levels.

Table 1: Radio Frequency Ranges and Power Levels

Frequency Band	Bandwidth	Power Level
UHF	403–480 MHz	1 W or 4 W
VHF	136–174 MHz	1 W or 5 W

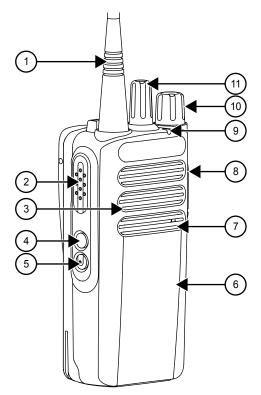
These digital radios are among the most sophisticated two-way radios available. They have a robust design for radio users who need high performance, quality, and reliability in their daily communications. This architecture provides the capability of supporting a multitude of legacy and advanced features resulting in a more cost-effective two-way radio communication solution.

1.1.1

Non-Keypad Model

This section explains the name and description of your radio buttons.

Figure 1: Non-Keypad Model



Label	Item	Description
1	Antenna	Provides the needed RF amplification when transmitting or receiving.
2	Push-To-Talk (PTT)	Press to execute voice operations (for example, Group call and Private Call).
3	Speaker	Plays all tones and audio that are generated by the radio.
4, 5	Side Buttons	These two buttons are field programmable using the Customer Programming Software (CPS).
6	USB with Dust Cover	Dust cover to prevent dust from clogging the USB port.
7	Microphone	Voice is sent when PTT or voice operations are activated.
8	Accessory Connector with Dust Cover	Interface point for all accessories to connect to the radio.
9	LED Indicator	Red, green, and orange light-emitting diodes indicate operating status.
10	On/Off/Volume Knob	Rotate clockwise until click is heard to turn on radio; rotate counterclockwise until click is heard to turn off radio. Rotate clockwise to increase volume level; rotate counterclockwise to decrease volume level.
11	Channel Selector Knob	Rotate clockwise to increase the channel; rotate counterclockwise to decrease the channel.

1.2

Portable Radio Model Numbering Scheme

Table 2: Portable Radio Model Numbering Scheme

Position	1	2	3	4	5	6	7	8	9	10	11	12	13
Typical Model Number	AA	Н	8	7	Y	D	О	9	J	Α	2	Α	N

Table 3: Sales Models – Description of Symbols

Position	Description	Value			
1	Region	AA = North America			
2	Type of Unit	H = Portable			
3	Model Series	87 = MOTOTRBO CP100d			
4					
5	Band	J = 136–174 MHz			
		Y = 403–480 MHz			
6	Power Level	C = 1.0, 2.0, 2.5, or 3.5 W			

Position	Description	Value
		D = 4.0–5.0 W
7	Physical Packages	C = Plain Model
8	Channel Information	8 = Variable/Programmable Channel Spacing with unique number of channels
		9 = Variable/Programmable Channel Spacing
9	Primary Operation	J = Basic (No GPS, no Bluetooth, no embedded GOB)
		K = GPS and Bluetooth
		L = GPS only
		M = Bluetooth only
		N = Bluetooth with embedded GOB
10	Primary System Type	A = Conventional
		B = Trunking
		C = Analog only
11	Feature Level	1 = Standard with FM
		2 = Non-FM
		3 = CSA IE CEx ATEX
		4 = CQST
12	Version Letter	N/A
13	Unique Variation	N = Standard Package

1.3

Model Chart



NOTICE:

"X" = Part is compatible with checked model.

"_" = The latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

1.3.1

UHF Model Chart

Table 4: CP100d, UHF, 403-480 MHz Model Chart

Model/Item	Description
AAH87YDC9JA2_N	CP100d, 403–480 MHz, Non-Keypad Portable
PMLE5235_S	Back Cover Kit, 403–480 MHz, Non-Keypad Portable
PMLN6835_	Front Cover Kit, Non-Keypad Portable
PMAE4002_	UHF Stubby Antenna, 403–433 MHz, 9 cm
PMAE4003_	UHF Stubby Antenna, 430–470 MHz, 9 cm

¹ This is applicable to PMUE4526B.

Model/Item	Description		
AAH87YDC9JA2_N	CP100d, 403–480 MHz, Non-Keypad Portable		
PMAE4006_	UHF Stubby Antenna, 465–495 MHz, 9 cm		
PMAE4016_	UHF Whip Antenna, 403–520 MHz, 17 cm		

1.3.2

VHF Model Chart

Table 5: CP100d, VHF, 136-174 MHz Model Chart

Model/Item	Description
AAH87JDC9JA2_N	CP100d, 136–174 MHz, Non-Keypad Portable
PMLD4898_S	Back Cover Kit, 136–174 MHz, Non-Keypad Portable
PMLN6835_	Front Cover Kit, Non-Keypad Portable
HAD9742_	VHF Stubby Antenna, 146–162 MHz, 9 cm
HAD9743_	VHF Stubby Antenna, 162–174 MHz, 9 cm
NAD6502_R	VHF Heliflex Antenna, 146–174 MHz, 15 cm
PMAD4012_	VHF Stubby Antenna, 136–146 MHz, 9 cm
PMAD4014_	VHF Antenna, 136–155 MHz, 14 cm
PMAD4042_	VHF Heliflex Antenna, 136–150.8 MHz

1.4

Specifications

1.4.1

General

Table 6: General Specifications

General Specification	Value for Non-Keypad	
Channel Capacity	16	
F	UHF: 403-480 MHz	
Frequency		VHF: 136–174MHz
Dimensions H x W x L (mm)	Li-lon battery	120.0 x 55.0 x 34.7
	High Capacity Li-Ion battery	120.0 x 55.0 x 39.9
	Li-lon battery	276
Weight (g): ²	High Capacity Li-Ion battery	281
	Power Supply	7.5 V (nominal)
Average battery life at 5/5/90 duty cycle with battery saver		Analog: 10.7 hours

² Weight can have 5% margin of error.

General Specification	Value for Non-Keypad	
enabled in carrier squelch and transmitter in high pow- er.		Digital: 14.4 hours
	High Capacity Li-Ion battery	Analog: 15.0 hours
	Trigit Capacity Li-ton battery	Digital: 20.0 hours

1.4.2

Receiver

Table 7: Receiver Specifications

Receiver Specification	Value for Non-Keypad
Frequencies	UHF: 403-480 MHz
	VHF: 136–174 MHz
Channel Spacing	12.5/25 kHz
Frequency Stability (-30 °C, +60 °C, +25 °C Ref)	+/- 0.5 ppm
Analog Sensitivity (12 dB SINAD)	0.3 μV
	0.22 μV (typical)
Digital Sensitivity (5% BER)	0.25 μV
	0.19 μV (typical)
Intermodulation (TIA603D)	70 dB
Adjacent Channel Selectivity TIA603D	45 dB (12.5 kHz)
	70 dB (25 kHz)
Spurious Rejection (TIA603D)	-70 dB
Rated Audio	0.5 W (internal)
Audio Distortion @ Rated Audio	5% (3% typical)
Hum and Noise	-40 dB (12.5 kHz)
	-45 dB (25 kHz)
Audio Response	TIA603D
Conducted Spurious Emission (TIA603D)	-57 dBm

1.4.3

Transmitter

Table 8: Transmitter Specifications

Transmitter Specification	Value for Non-Keypad		
Frequencies	UHF: 403–480 MHz		
	VHF: 136–174 MHz		

Transmitter Specification	Value for Non-Keypad
Channel Spacing	12.5/25 kHz
Frequency Stability (-30 °C to +60 °C, +25 °C Ref)	+/-0.5 ppm
Power Output (Low Power)	1 W
Power Output (High Power)	UHF: 4 W
	VHF: 5 W
Modulation Limiting	+/-2.5 kHz (12.5 kHz)
	+/-5.0 kHz (25 kHz)
FM Hum and Noise	-40 dB (12.5 kHz)
	-45 dB (25 kHz)
Conducted/Radiated Emission	-36 dBm < 1 GHz
	-30 dBm > 1 GHz
Adjacent Channel Power	60 dB (12.5 kHz)
	70 dB (25 kHz)
Audio Response	TIA603D
Audio Distortion	3% (typical)
FM Modulation	12.5 kHz: 11K0F3E
	25 kHz: 16K0F3E
4FSK Digital Modulation	12.5 kHz Data: 7K60F1D and 7K60FXD
	12.5 kHz Voice: 7K60F1E and 7K60FXE
	Combination of 12.5 kHz Data and Voice: 7K60F1W
Digital Vocoder Type	AMBE+2™
Digital Protocol	ETSI-TS102361-1
	ETSI-TS102361-2
	ETSI-TS102361-3

Conforms to:

- ETSI TS 102 361 (Parts 1, 2, and 3) ETSI DMR Standard
- ETSI EN 300 086 ETSI RF Specifications (Analog)
- ETSI EN 300 113 ETSI RF Specifications (Digital)
- 2014/53/EU (RED Radio Equipment Directive)
- 2011/65/EU (RoHS 2 Banned Substances)
- 2012/19/EU (WEEE Waste Electrical and Electronic Equipment)
- 94/62/EC (Packaging and Packaging Waste)
- Radio meets applicable regulatory requirements.

MN006550A01-AA Chapter 1: Introduction

1.4.4 **Self-Quieter**

Table 9: Self-Quieter Specification

UHF Self-Quieter Frequencies
441.6 MHz
444 MHz
460.8 MHz
480 MHz

VHF Self-Quieter Frequencies
144.0 MHz
153.6 MHz
160.0 MHz

1.4.5

Military Standards

Table 10: Military Standards (810C–810E)

Applica- ble MIL- STD	810C		810D	810D		810E	
	Methods	Proce- dures	Methods	Proce- dures	Methods	Proce- dures	
Low Pres- sure	500.1	I	500.2	II	500.3	II	
High Tem- perature	501.1	I, II	501.2	I/A1, II/A1	501.3	I-A1, II/A1	
Low Tem- perature	502.1	I	502.2	I/C3, II/C1	502.3	I-C3, II/C1	
Tempera- ture Shock	503.1	I	503.2	I/A1C3	503.3	I/A1C3	
Solar Ra- diation	505.1	II	505.2	I	505.3	I/A1	
Rain	506.1	I, II	506.2	I, II	506.3	1,11	
Humidity	507.1	II	507.2	II	507.3	II	
Salt fog	509.1	1	509.2	I	509.3	_	
Blowing Dust	510.1	I	510.2	I	510.3	I	
Blowing Sand	_	-	510.2	II	510.3	II	
Vibration	514.2	VIII/F, XI	514.3	I/10, II/3	514.4	I/10, II/3	
Shock	516.2	I, II, V	516.3	I, IV, VI	516.4	I, IV, VI	

Applica- ble MIL- STD	810C		810D		810E	
	Methods	Proce- dures	Methods	Proce- dures	Methods	Proce- dures
Shock (Drop)	516.2	II	516.3	IV	516.4	IV

Table 11: Military Standards (810F–810H)

Applica- ble MIL- STD	810F		810G	810G		810H	
	Methods	Proce- dures	Methods	Proce- dures	Methods	Proce- dures	
Low Pres- sure	500.4	II	500.6	II	500.6	II	
High Tem- perature	501.4	I/Hot, II/Hot	501.6	I/A1, II/A1	501.7	I/A1, II/A1	
Low Tem- perature	502.4	I/C3, II/C1	502.6	I/C3, II/C1	502.7	I/C3, II/C1	
Tempera- ture Shock	503.4	I	503.6	I-C	503.7	I-C	
Solar Ra- diation	506.4	I/A1	505.6	I/A1	505.7	I/A1	
Rain	506.4	I, III	506.6	I, III	506.6	1, 111	
Humidity	507.4	_	507.6	II- Aggra- vated	507.6	II- Aggra- vated	
Salt fog	509.4	_	509.6	_	509.7	_	
Blowing Dust	510.4	I	510.6	I	510.7	I	
Blowing Sand	510.4	II	510.6	II	510.7	II	
Vibration	514.5	I/24, II/5	514.7	I/24, II/5	514.8	I/24, II/5	
Shock	516.5	I, IV, VI	516.7	I, IV, VI	516.8	I, IV, VI	
Shock (Drop)	516.5	IV	516.7	IV	516.8	IV	

1.4.6

Environmental

Table 12: Environmental Specifications

Environmental Specifications		
Operating Temperature ³	-30 °C to +60 °C	
Storage Temperature	-40 °C to +85 °C	

³ Operating temperature specification with Li-lon battery is -10 °C to +60 °C.

Environmental Specifications			
Thermal Shock	Per MIL-STD		
Humidity	Per MIL-STD		
ESD	IEC 61000-4-2 Level 3		
Dust and Water Intrusion	IEC 60529 -IP54		
Packaging Test	As per MIL-STD		

Chapter 2

Test Equipment and Service Aids

This section lists the recommended test equipment and service aids, as well as information on field programming equipment that can be used in servicing and programming Motorola Solutions radios.

2.1

Recommended Test Equipment

The list of equipment contained in the following table includes most of the standard test equipment required.

Table 13: Test Equipment

Equipment	Characteristics	Example	Application	
Service Monitor	Can be used as a substitute.	Aeroflex 3920 (www.aero- flex.com) or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment.	
Digital RMS	100 μV to 300 V	Fluke 179 (www.fluke.com) or	AC/DC voltage and current	
Multimeter ⁴	5 Hz to 1 MHz	equivalent	measurements. Audio voltage measurements.	
	10 MΩ Impedance			
RF Signal	100 MHz to 1 GHz	Agilent N5181A (www.agi-	Receiver measurements	
Generator ⁴	-130 dBm to +10 dBm	lent.com), Ramsey RSG1000B (www.ramseye-		
	FM Modulation: 0 kHz to 10 kHz	lectronics.com), or equivalent		
	Audio Frequency: 100 Hz to 10 kHz			
Oscillo-	2 Channel	Tektronix TDS1001b	Waveform measurements	
scope ⁴	50 MHz Bandwidth	(www.tektronix.com) or equivalent		
	5 mV/div to 20 V/div			
Power Meter	5% Accuracy	Bird 43 Thruline Watt Meter	Transmitter power output	
and Sensor ⁴	100 MHz to 500 MHz	(www.bird-electronic.com) or equivalent	measurements	
	50 W			
RF Millivolt-	100 mV to 3 V RF	Boonton 92EA (www.boon-	RF level measurements	
meter	10 kHz to 1 GHz	ton.com) or equivalent		
Power Sup-	0 V to 32 V	B&K Precision 1790	Voltage supply	
ply	0 A to 20 A	(www.bkprecision.com) or equivalent		

⁴ Can use Service Monitor as substitute.

2.2

Service Aids

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

Table 14: Service Aids

Motorola Solutions Part No.	Description	Application
RLN4460_	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
PMVN4130_	Customer Programming Software (CPS) and AirTracer on CD-ROM	CPS allows Dealers/Distributors to program radio parameters. AirTracer allows the capturing of radio traffic into logs for analysis by Motorola Solutions.
PMVN4131_	Tuner on CD-ROM	Radio Tuning.
		NOTICE: Only Motorola Solutions Service Centers or Authorized Motorola Solutions Service Dealers can perform this function.
PMKN4128_	Portable Programming Cable with TTR	This cable connects the radio to a USB port for radio programming and data applications.
PMKN4156_	Portable Test Cable	This cable connects the radio to RLN4460 Portable Test Set for test and measurement.
PMDN4080_R	7.5 V Universal Battery Eliminator	Connects to radio battery eliminator cable.
PMLN6154_	RF Adaptor	Application adapts radio antenna port to BC cabling of test equipment.
PMLN7119_	RF Adaptor Holder	Holds RF Adaptor
1185937A01	Grease	Acts to lubricate parts.
N/A	Flat Square Tip Plastic Tweezer	Remove components during disassembly.

2.3

Programming, Testing, and Alignment Cable

Programming, Testing, and Alignment Cable and Side Connector are required in servicing and programming radios.

Portable Programming Cable and Portable Test Cable

Figure 2: Portable Programming Cable with TTR (PMKN4128_)

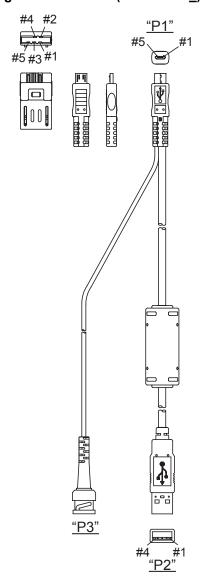
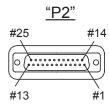


Table 15: Pin Configuration of Portable Programming Cable with TTR

CONNECTION			
P1	P2	Р3	Function
1	1	-	VCC(5 V)
2	2	-	Data-
3	3	-	Data+
4	-	BNC Center Pin	TTR
5	4	BNC Shell	Ground

Figure 3: Portable Test Cable (PMKN4156_)



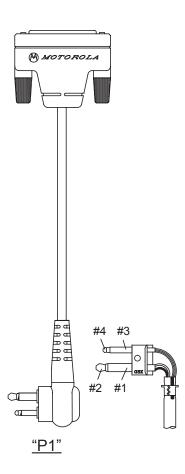


Table 16: Pin Configuration of Portable Test Cable

CONNECTION			
P1	P2	Function	
1	1, 5	Ground	
2	7, 24	External Mic	
3	16	External Speaker -	
4	17	External Speaker +	

Chapter 3

Transceiver Performance Testing

These radios meet published specifications through their manufacturing process by utilizing high-accuracy laboratory-quality test equipment.

The recommended field service equipment approaches the accuracy of the manufacturing equipment with few exceptions. This accuracy must be maintained in compliance with the calibration schedule recommended by the manufacturer.

Although these radios function in digital and analog modes, all testing is done in analog mode.

3.1

Setup

Supply voltage is provided using a 7.5 VDC power supply. The equipment required for alignment procedures is connected as shown in the Radio Tuning Setup chapter.



WARNING: Do NOT use any form of connector, for example wires, crocodile clips, and probes, to supply voltage to the radio, other than the Motorola Solutions approved battery eliminator.

Initial equipment control settings must be as indicated in the following table:

Table 17: Initial Equipment Control Settings

Service Monitor	Power Supply	Test Set
Monitor Mode: Power Monitor	Voltage: 7.5 Vdc	Speaker set: A
RF Attn: -70	DC on/standby: Standby	Speaker/load: Speaker
AM, CW, FM: FM	Volt Range: 10 V	PTT: OFF
Oscilloscope Source: Mod	Current: 2.5 A	
Oscilloscope Horizontal: 10 ms/Div		
Oscilloscope Vertical: 2.5 kHz/Div		
Oscilloscope Trigger: Auto		
Monitor Image: Hi		
Monitor Bandwidth: Narrow		
Monitor Squelch: Middle setting		
Monitor Vol: 1/4 setting		

3.2

Non-Display Model Test Mode

3.2.1

Entering Non-Display Radio Test Mode

Procedure:

1 Turn the radio on.

2 Within 10 seconds after Self-Test is complete, press **Side Button 2** five times in succession.

The radio beeps.

3.2.2

RF Test Mode

When the radio is operating in its normal environment, the radio microcontroller controls the RF channel selection, transmitter key-up, and receiver muting, according to the customer codeplug configuration.

When and where to use: However, when the unit is on the bench for testing, alignment, or repair, it must be removed from its normal environment by using a special routine, called Test Mode or "air test".

Procedure:

1 Short press **Side Button 2** to change the test environment (CSQ->TPL->DIG->USQ ->CSQ).

In the following table, DIG is digital mode and other test environments are analog mode.

Table 18: Test Environments

No. of Beeps	Description	Function
1	Carrier Squelch (CSQ)	RX: if carrier detected TX: mic audio
2	Tone Private-Line (TPL)	RX: unsquelch if carrier and tone detected TX: mic audio + tone
3	Digital Mode (DIG)	RX: if carrier detected TX: mic audio
4	Unsquelch (USQ)	RX: constant unsquelch TX: mic audio

The radio beeps once when radio toggles to CSQ, beeps twice for TPL, beeps three times for DIG, and beeps four times for USQ.

DIG is digital mode and other test environments are analog mode as described in Test Environments table.

- 2 Short press **Side Button 1** to toggle the channel spacing between 25 kHz and 12.5 kHz. The radio beeps once when radio toggles to 25 kHz and beep twice for 12.5 kHz.
- 3 Turn the **Channel Knob** to change the test channel from 1 to 16.

Table 19: Test Frequencies

Channel Selector Switch Position	Test Channel	UHF	VHF
1 Low Power	TX#1 or #9	403.150	136.075

Channel Selector Switch Position	Test Channel	UHF	VHF
9 High Power	RX#1 or #9	403.150	136.075
2 Low Power	TX#2 or #10	414.150	142.575
10 High Power	RX#2 or #10	414.150	142.575
3 Low Power	TX#3 or #11	425.150	146.575
11 High Power	RX#3 or #11	425.150	146.575
4 Low Power	TX#4 or #12	436.450	155.575
12 High Power	RX#4 or #12	436.450	155.575
5 Low Power	TX#5 or #13	447.150	161.575
13 High Power	RX#5 or #13	447.150	161.575
6 Low Power	TX#6 or #14	458.150	167.575
14 High Power	RX#6 or #14	458.150	167.575
7 Low Power	TX#7 or #15	469.850	173.975
15 High Power	RX#7 or #15	469.850	173.975
8 Low Power	TX#8 or #16	479.850	174.000
16 High Power	RX#8 or #16	479.850	174.000

The radio beeps at each position.

Refer to "Test Frequencies" for the test channel descriptions.

Table 20: Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Refer- ence Fre- quency	Mode: PWR MON Fourth channel test frequency Monitor: Frequency er- ror Input at RF In/Out	Test Mode, Test Channel 4 carrier squelch	PTT to continu- ously transmit.	Frequency error to be: ±68 Hz (VHF) ±201 Hz (UHF)
Power RF	As above	As above	As above	Low Power 0.9–1.5 W (VHF/UHF) High Power 4.0–4.8 W (UHF) 5.0–5.8 W (VHF)
Voice Modula- tion	Mode: PWR MON Fourth channel test frequency	As above	As above, meter se- lector to mic	Deviation: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp).

Test	Communications An-	Radio	Test Set	Comments
Name	alyzer	itaaio	1031 061	Comments
	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, 80 mVrms at AC/DC test set jack			
Internal	Mode: PWR MON	Test	Remove	Press PTT switch on
Voice Modula-	Fourth channel test frequency	Mode, Test Channel	modula- tion input	radio. Say "four" loudly into the radio mic.
tion	Atten to -70, input to RF In/Out	4 carrier squelch output at antenna		Measure deviation: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp)
TPL Modula-	As above	Test Mode,	As above	Deviation: ≥500 Hz but ≤1000Hz
tion	Fourth channel test frequency	Test		(25 kHz Ch Sp).
	BW to narrow	Channel 4 TPL		
RF Power	DMR Mode. Slot 1 Power and Slot 2 Pow- er	Test Mode, Digital Mode, transmit without modula- tion	Key up radio without modula-tion using Tuner	TTR Enable is needed and IFR to be set to trigger mode with signal level ~1.5 V
FSK Error	DMR Mode. FSK Error	Test Mode, Digital Mode, transmit with 0.153 test pat- tern	Key up radio with O.513 test pattern modulation using Tuner	Not Exceed 5%
Magni- tude Error	DMR Mode. Magnitude error	As above	As above	Not Exceed 1%
Symbol Deviation	DMR Mode. Symbol Deviation	As above	As above	Symbol Deviation should be within 648 Hz± 10% and 1944 Hz ± 10%
Transmit- ter BER	DMR Mode	As above	As above	Transmitter BER should be 0%

Table 21: Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Refer- ence Fre- quency	Mode: PWR MON Fourth channel test frequency Monitor: Frequency er- ror Input at RF In/Out	Test Mode, Test Channel 4 carrier squelch output at antenna.	PTT to continu-ously transmit. (during the performance check).	Frequency error to be: ±68 Hz for VHF ±201 Hz for UHF
Rated Audio	Mode: GEN Output level: 1.0 mV RF Sixth channel test frequency Mod: 1 kHz tone at 3 kHz deviation Monitor: DVM: AC Volts	Test Mode , Test Channel 6 carrier squelch	PTT to OFF (center), meter se- lector to Audio PA	Set volume control to 2.83 Vrms
Distortion	As above, except distortion	As above	As above	Distortion <3.0%
Sensitivi- ty (SI- NAD)	As above, except SI- NAD, lower the RF lev- el for 12 dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.35 μV
Noise Squelch Threshold (only ra- dios with conven- tional system need to be tes- ted.)	RF level set to 1 mV RF	As above	Meter se- lection to Audio PA, speaker/ load to speaker	Set volume control to 2.83 Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	Out of Test Mode; se- lect a conven- tional system.	As above	Unsquelch to occur at <0.25 µV. Preferred SINAD = 9–10 dB
Receiver BER	IFR DMR mode. Signal generator with O.153 test pattern	Test Mode, Digital Mode, transmit with O.153 test pat- tern	Read BER us- ing Tu- ner. Ad- just RF level to get 5% BER	RF level to be <0.35 μV for 5% BER

Test Name	Communications Analyzer	Radio	Test Set	Comments
Receiver Rated Audio	IFR DMR mode. Signal generator with 1031 test pattern	Test Mode, Digital Mode, re- ceive 1031 test pattern	RF level = -47 dBm. Set audio an- alyzer to read Vrms. Ad- just vol- ume to get rated audio	Adjust volume until Vrms = 2.83 V
Receiver Audio Distortion	IFR DMR Mode. Signal generator with 1031 test pattern.	As above	As above. Then set audio an- alyzer to measure distortion.	Not exceed 5%

3.2.3

LED Test Mode

Procedure:

1 Press and hold **Side Button 1** after RF Test Mode.

The radio beeps once.

2 Press any button/key.

The red LED lights up.

3 Press any button/key.

The red LED turns off and the radio lights up the green LED.

4 Press any button/key.

The green LED turns off and the radio turns on both LEDs.

3.2.4

Speaker Tone Test Mode

Procedure:

Press and hold **Side Button 1** after LED Test Mode.

The radio beeps once.

The radio generates a 1 kHz tone with the internal speaker.

3.2.5

Earpiece Tone Test Mode

Procedure:

Press and hold **Side Button 1** after Speaker Tone Test Mode.

The radio beeps once.

The radio generates a 1 kHz tone with the earpiece.

3 2 6

Audio Loopback Earpiece Test Mode

Procedure:

Press and hold **Side Button 1** after Earpiece Tone Test Mode.

The radio beeps once.

The radio routes any audio on the external mic to the earpiece.

3.2.7

Battery Check Test Mode

Procedure:

Press and hold **Side Button 1** after Audio Loopback Earpiece Test Mode.

The radio beeps once.

The radio LED lights up as follows:

- · Green LED for High Battery Level
- · Orange LED for Mid Battery Level
- · Blinking red LED for Low Battery Level

3.2.8

Button/Knob/PTT Test Mode

Any key press causes the test to advance from one step to the next.

Table 22: Button/Knob/PTT Checks

Action	Result
Press and hold Side Button 1 .	The radio beeps once.
Rotate the Volume Knob.	The radio beeps at each position.
Rotate the Channel Knob.	The radio beeps at each position.
Press Side Button 1.	The radio beeps.
Release the button.	The radio beeps.
Press Side Button 2.	The radio beeps.

Action	Result
Release the button.	The radio beeps.
Press the PTT button.	The radio beeps.
Release the button.	The radio beeps.

Chapter 4

Radio Programming and Tuning

This chapter provides an overview of the MOTOTRBO Customer Programming Software (CPS), Tuner, and AirTracer applications, which are all designed for use in a Windows 2000 onwards environment.



NOTICE: Refer to the online help files of the appropriate program for the programming procedures.

These programs are available in one kit as listed in the following table. An Installation Guide is also included with the kit.

Table 23: Software Installation Kits Radio Tuning Setup

Description	Part Number
MOTOTRBO CPS, Tuner, and AirTracer Applications CD	RVN5115_

4.1

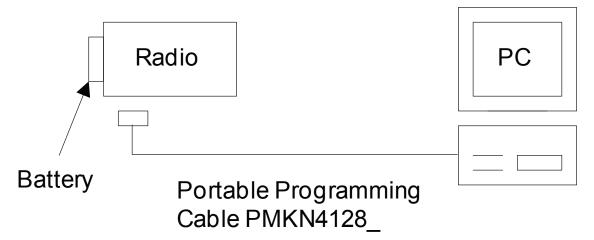
Customer Programming Software Setup

Program the radio using the following setup.



CAUTION: Computer USB ports can be sensitive to Electrostatic Discharge. Do not touch exposed contacts on a cable when connected to a computer.

Figure 4: CPS Programming Setup



4.2

AirTracer Application Tool

The MOTOTRBO AirTracer application tool has the ability to capture over-the-air digital radio traffic and save the captured data into a file.

The AirTracer application tool can also retrieve and save internal error logs from MOTOTRBO radios. The saved files can be analyzed by trained Motorola Solutions personnel to suggest improvements in system configurations or to help isolate problems.

4.3

Radio Tuning Setup

Retuning is not required if service kit has been replaced and factory tuned. However, check service kit for performance before use.

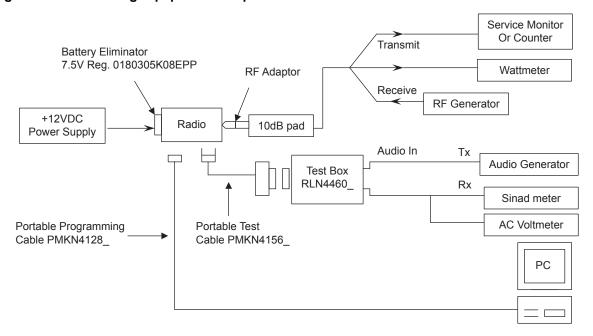
Before keying up the radio, set the Bias DAC for the appropriate final device bias current. If the bias is not properly set, it may cause damage to the transmitter.



CAUTION: Only Motorola Solutions Service Centers or Authorized Motorola Solutions Service Dealers can perform this function.

A personal computer (PC) with Windows 2000 onwards and a tuner program are required to tune the radio. See "Radio Tuning Equipment Setup" to perform tuning procedures.

Figure 5: Radio Tuning Equipment Setup



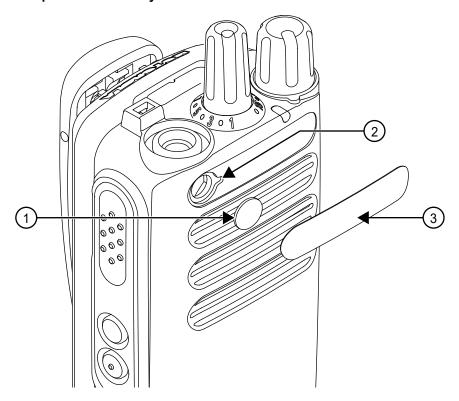
4.3.1

RF Adaptor Holder Assembly

Procedure:

1 Use a tweezer to lift up one end of the nameplate then pull it out.

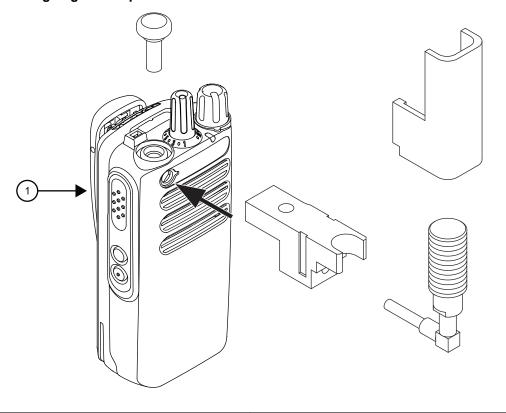
Figure 6: Nameplate disassembly



Label	Description
1	RF Seal
2	Tweezer access area
3	Nameplate

- 2 Use a tweezer to remove the RF Seal from the tweezer access area.
- 3 Align the RF adaptor holder to the opening on the housing.

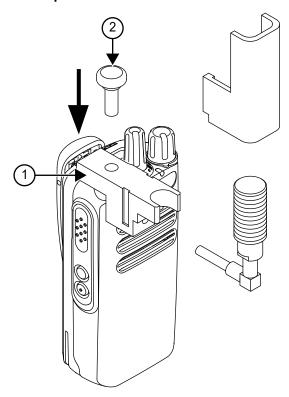
Figure 7: Aligning RF Adaptor



Label	Description
1	RF Slot

4 Insert the RF Adaptor Holder into the RF slot on the front housing. Fasten the screw provided to hold the RF adapter.

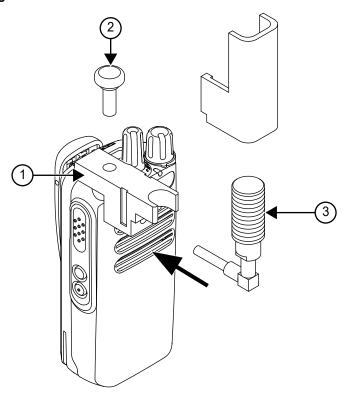
Figure 8: Inserting the RF Adaptor



Label	Description
1	RF Adaptor
2	Screw

5 Slot in the RF connector into the RF adaptor holder slot.

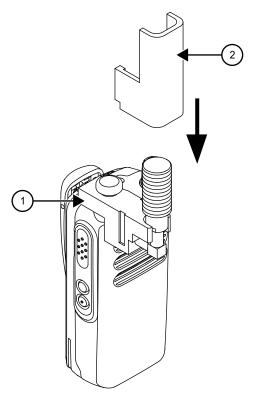
Figure 9: Inserting the RF connector



Label	Description
1	RF Adaptor
2	Screw
3	RF Connector

6 Slide down the RF adaptor holder backer to hold the RF adaptor in place.

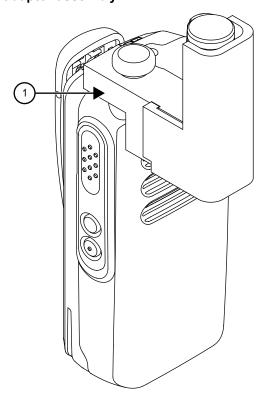
Figure 10: Affixing the backer



Label	Description
1	RF Adaptor
2	Backer

7 Attached the RF adaptor correctly.

Figure 11: Complete RF adaptor assembly



Label	Description
1	RF Adaptor

Chapter 5

Disassembly and Reassembly Procedures

This chapter provides details about the following:

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

5.1

Preventive Maintenance

Periodic visual inspection and cleaning are recommended.

Inspection

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

Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to clean the external and internal surfaces of your radio.

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



CAUTION: Use all chemicals as prescribed by the manufacturer. Follow all safety precautions as defined on the label or material safety data sheet.

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



NOTICE:

Only clean internal surfaces when your radio is disassembled for service or repair.

Cleaning External Plastic Surfaces



IMPORTANT: The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dish-washing detergent in water.

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

Cleaning Internal Circuit Boards and Components



IMPORTANT:

The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume).

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

Apply Isopropyl alcohol (100%) 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 your 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 it can cause the liquid to collect in unwanted places. After completing of the cleaning process, use a soft, absorbent, lint-less cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

5.2

Safe Handling of CMOS and LDMOS Devices

Complementary Metal Oxide Semiconductor (CMOS) and Laterally Diffused Metal Oxide Semiconductor (LDMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high-voltage charges.

Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS/LDMOS circuits and are especially important in low humidity conditions. Do not attempt to disassemble your radio without referring to the following caution statement.



CAUTION:

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

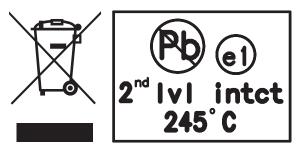
- Store and transport all CMOS/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS devices into conventional plastic "snow" trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS/LDMOS device. It is recommended that you use a wrist strap, two ground cords, a table mat, a floor mat, electrostatic discharge (ESD) shoes, and an ESD chair.
- 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 Solutions part number 4280385A59.
- Do not wear nylon clothing while handling CMOS/LDMOS devices.
- Do not insert or remove CMOS/LDMOS devices with power applied. Check all power supplies used for testing CMOS/LDMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS/LDMOS pins, provide ground straps for the apparatus used.
- · When soldering, use a grounded soldering iron.
- Handle CMOS/LDMOS devices by the package and not by the leads. Before 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.

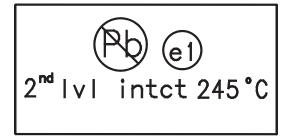
5.3

General Repair Procedures and Techniques

Environmentally Preferred Products (EPP) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's Restriction of Hazardous Substances (ROHS 2) Directive 2011/65/EU and Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU. To maintain product compliance and reliability, use only the Motorola Solutions specified parts in this manual.

For the identification of lead (Pb) free assemblies, all EPP products carry the EPP Marking, shown in the following examples, on the Printed Circuit Board (PCB). This marking provides information to those performing assembly, servicing, and recycling operation on this product, adhering to the JEDEC Standard No. 97. The EPP Marking takes the form of a label or marking on the PCB.





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

Table 24: Lead Free Solder Wire Part Number List

Motorola Solutions Part Number	Alloy	• •	Flux Content by Weight	Point		Diame- ter	Weight
1088929Y01	95.5Sn/3.8Ag/ 0.7Cu	RMA Version	2.7–3.2%	217 °C		0.015 in.	1 lb spool

Table 25: Lead Free Solder Paste Part Number List

Manufactur- er Part Num- ber	Viscosity			Liquid Tem- perature
NC-SMQ230	900–1000KCPs Brookfield (5 rpm)	Type 3 (-325/+500)	(95.5%Sn-3.8%Ag-0. 7%Cu) 89.3%	217 °C

Parts Replacement and Substitution

When damaged parts are replaced, identical parts must be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola Solutions part number and order the part.

Rigid Circuit Boards

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

When soldering near a connector:

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

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

5.4

Disassembling and Reassembling the Radio

When disassembling and reassembling the radio, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.



CAUTION: To assure the safety and regulatory compliance of your radio, repair your radio only at Motorola Solutions service facilities. Please contact your local dealer or Point of Sale for further instructions.

The following tools are required for disassembling the radio:

- TORX[™] T6 screwdriver
- Flat Square tip plastic tweezers

The following tools are required for reassembling the radio:

- Grease (1185937A01)
- TORX T6 Screwdriver
- Flat Square tip plastic tweezers



NOTICE: If a unit requires further testing or service than is customarily performed at the basic level, send radio to Motorola Solutions Service Center.

5.5

Detailed Radio Disassembly

The section describes the detailed disassembly procedure of your radio.

5.5.1

Chassis and Front Housing Disassembly

Procedure:

- 1 Turn off the radio.
- 2 Remove the battery:
 - **a** Slide the battery latch into the unlock position. Disengage by pressing the latch upward fully and holding the latch towards the back of the radio.



NOTICE: Ensure metal latch is not protruding out from the slot on the battery housing.

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

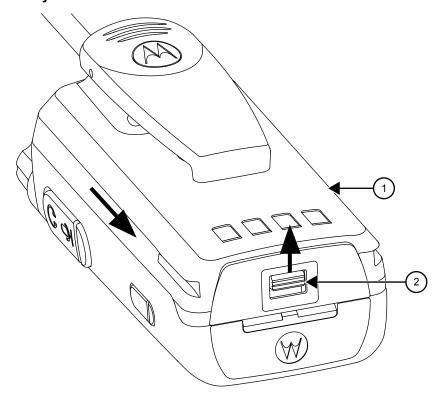


NOTICE: Do not put too much pressure on the battery while sliding it out from top of the radio.

c Remove the battery from the radio.

3 Remove the antenna by turning it counterclockwise.

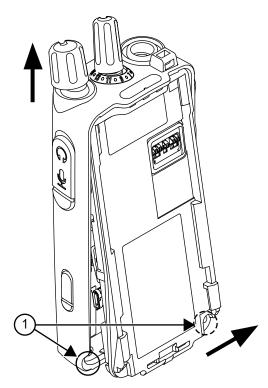
Figure 12: Battery Removal



Label	Description
1	Battery
2	Latch

4 Unscrew two chassis screw at bottom of the chassis with a T6 TORX .

Figure 13: Channel Selector and Volume Knob Removal

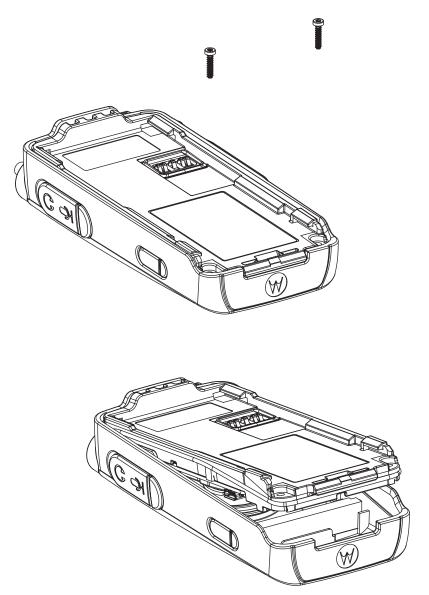


Label	Description
1	Bottom Corner

- **5** Hold down plastic housing beside screw and slowly pull the chassis bottom top upward.
- **6** The knob will self alight from the shaft.
 - 1

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

Figure 14: Chassis Screw Removal



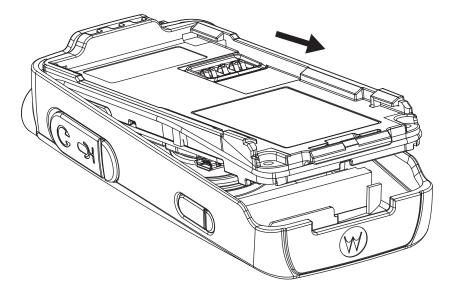


CAUTION: Marring the front housing O-ring, sealing area will prevent the radio from sealing properly. If the O-ring is damaged, replace it with a new one.



NOTICE: The speaker wire and microphone wire connecting the front housing assembly and the chassis assembly prevent the two units from being completely separated.

Figure 15: Chassis Removal from Front Housing

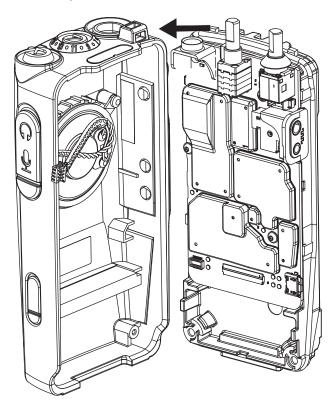


7 Slowly slide out the chassis assembly from the front housing until the volume and channel selector shafts are free from the top of the housing.



CAUTION: Do not pull out the chassis forcefully. This will cause damage to the speaker and microphone wires that are still connected to the chassis assembly.

Figure 16: Speaker and Microphone Wires Removal

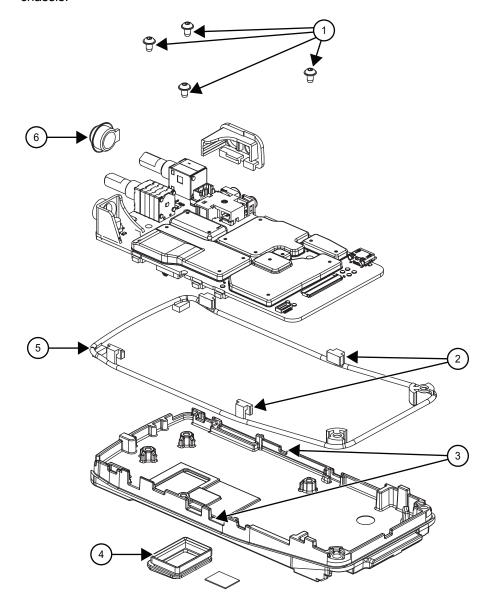


5.5.2

Chassis Disassembly

Procedure:

1 Use a TORX screwdriver with a T6 bit to remove the four screws holding the main board to the chassis.



Label	Description
1	Main Board Screws
2	Tabs
3	Grooves
4	Battery Contact Seal
5	O-ring
6	Top Control Seal

- 2 Lift the main board from the chassis.
- 3 Remove the O-ring by releasing the four tabs from the grooves on the chassis.
- 4 Remove the top control seal and battery contact seal.

5.5.3

Speaker and Microphone Disassembly

Procedure:

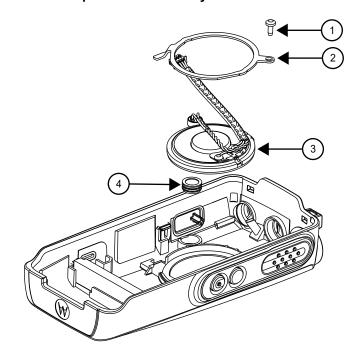
1 Carefully lift the microphone out of the housing, then remove the rubber boot.



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

- **2** Use a TORX screwdriver with a T6 bit to remove the screw holding the speaker retainer to the front housing.
- 3 Lift the retainer off the speaker by sliding the end of the retainer out of the corner slot on the housing.
- 4 Lift the speaker microphone assembly out of the housing.

Figure 17: Speaker and Microphone Disassembly



Label	Description
1	Screw
2	Speaker Retainer
3	Speaker
4	Microphone

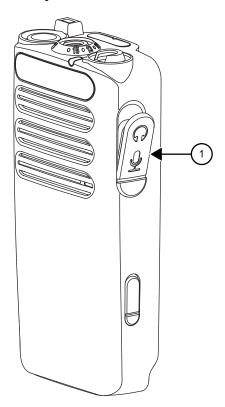
5.5.4

Dust Cover Disassembly

Procedure:

1 Gently pry the top of the dust cover away from the body of the housing.

Figure 18: Dust Cover Disassembly



Label	Description
1	Dust Cover

- **2** Face the audio jack side and rotate the dust cover 90° in clockwise direction. Flip open the dust cover 90° in clockwise direction to allow the key to be removed.
- 3 Separate the dust cover from the front housing.



NOTICE: The dust cover key is fragile; apply only light pressure to the key while removing the dust cover. If the key is damaged, replace with a new dust cover.

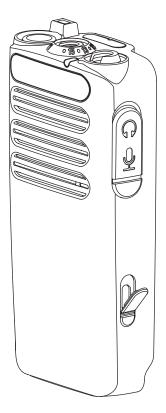
5.5.5

Micro USB Dust Cover Disassembly

Procedure:

1 If required, the micro USB dust cover can be disassembled using a flat square tip plastic tweezer.

Figure 19: Micro USB Dust Cover Removal



- 2 Cut off the head from inside of the housing with a cutter.
- 3 Separate the dust cover from the front housing.
 - 1

NOTICE: Micro USB dust cover is non-serviceable. Replace with a new one during reassembly.

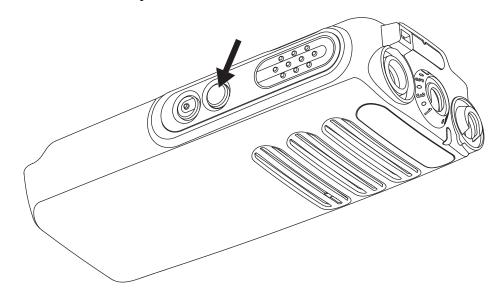
5.5.6

PTT Disassembly

Procedure:

1 Insert tweezer into the gap between PTT keypad and PTT bezel. Pop out the PTT bezel by lifting the tweezer. Remove the PTT bezel and PTT keypad.

Figure 20: PTT Disassembly





CAUTION: PTT bezel and PTT keypad are not reusable once removed.

5.6

Detailed Radio Reassembly

The section describes the detailed reassembly procedure of your radio.



NOTICE: Motorola Solutions recommends using a low rotation speed setting when using an electric screwdriver with a selectable rotation speed. The bit must be inline with the direction of the screw when assembling the screws.

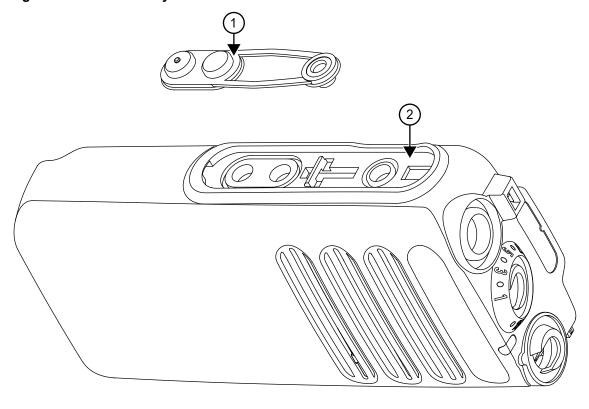
5.6.1

PTT Reassembly

Procedure:

1 Assemble the PTT keypad and ensure that sealing ribs are inserted all around and well into the sealing groove of the front housing.

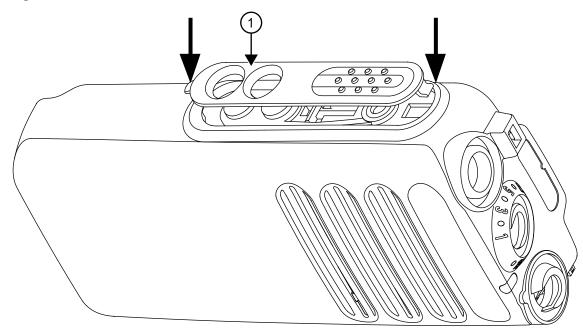
Figure 21: PTT Assembly



Label	Description
1	PTT rubber
2	Sealing groove

2 Orient and slot the bottom end and top end of PTT bezel to front housing.

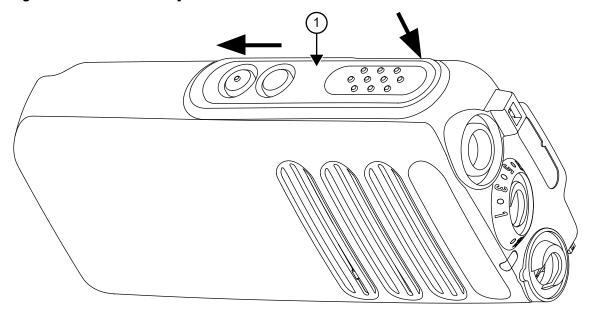
Figure 22: PTT Bezel Orientation



Label	Description
1	PTT bezel

3 Push down on the PTT bezel and drag towards the programming button until the PTT bezel snaps in.

Figure 23: PTT Reassembly



Label	Description
1	PTT bezel

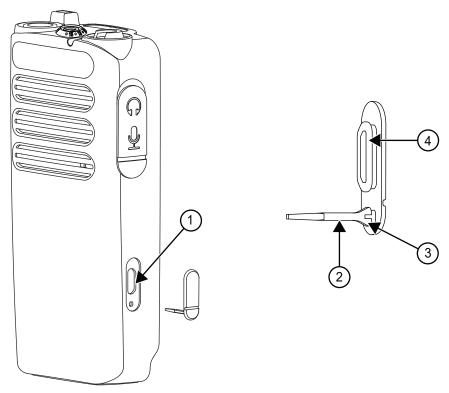
5.6.2

Micro USB Dust Cover Reassembly

Procedure:

- 1 Insert the tail of the dust cover into the bottom hole on the front housing micro USB opening.
- **2** By using a long nose plier, pull the tail inward from the inside of the housing until the head is fully inserted.
- **3** Cut off the tail with a cutter.
- 4 Insert the top tab into the slot on the housing.

Figure 24: Micro USB Dust Cover Reassembly



Label	Description
1	Insertion Point
2	Tail
3	Head
4	Tab

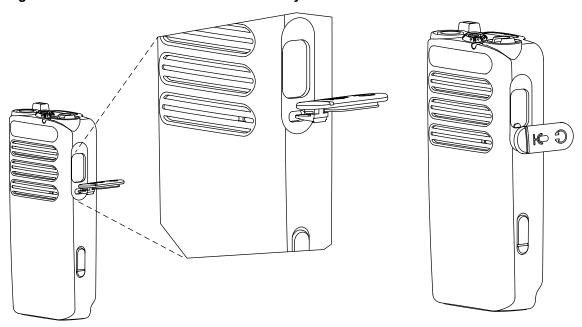
5.6.3

Audio Jack Dust Cover Reassembly

Procedure:

- 1 Insert the dust cover key into the slot on the housing at a 90° angle.
- **2** Flip the dust cover 90° in counterclockwise direction to allow the key to be fully inserted into the housing.

Figure 25: Audio Jack Dust Cover Reassembly



- **3** With one hand pressing on the bottom of the dust cover, rotate the dust cover 90° in counterclockwise direction.
- 4 Press the dust cover to ensure it fully covers the audio jack opening.

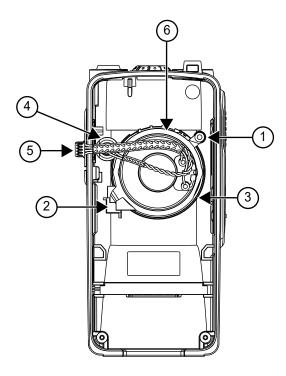
5.6.4

Speaker and Microphone Reassembly

Procedure:

- 1 Check if the microphone and speaker felts are in position and not damaged. If damaged, replace front cover kit as the felts are not serviceable.
- 2 Insert the microphone into the microphone rubber boot.
- 3 Place the microphone wire and connector through retainer hole.
- **4** Align the groove on the speaker to the tab on the housing and place the speaker into the speaker recess. Ensure the speaker is seated flush to the housing.

Figure 26: Speaker and Microphone Reassembly



Label	Description
1	Speaker screw boss
2	Retainer slot
3	Speaker recess
4	Microphone recess
5	Speaker Microphone Assembly wire routing
6	Speaker tab

- **5** Insert one end of the speaker retainer into the corner slot on the housing. Align the other end to the screw boss.
- **6** With one hand holding the retainer to the housing, fasten the screw using a T6 TORX screwdriver. Tighten torque should be between 2.7 to 2.9 lb/in.

NOTICE: When fastening the speaker retainer screw, make sure the speaker wire is routed under the retainer to prevent pinching by the retainer.

7 Place the microphone assembly into the microphone recess on the housing.

5.6.5

Chassis Reassembly

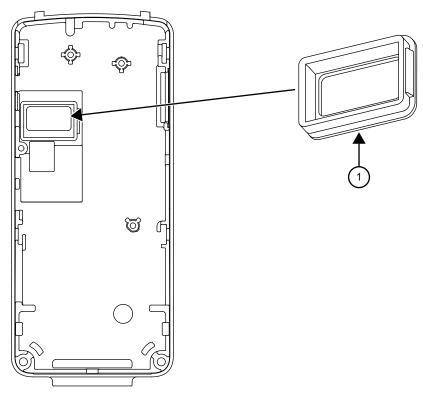
Procedure:

1 Assemble the battery contact seal onto the opening of the chassis in the correct orientation.



NOTICE: Make sure the battery contact seal protrudes through the chassis, following the recess shape.

Figure 27: Battery Contact Seal Assembly



Label	Description
1	Battery Contact Seal

2 Assemble the main O-ring onto the chassis by pushing the two tabs all the way into the chassis main O-ring groove. Stretch the O-ring to fit it around the sides of the chassis.



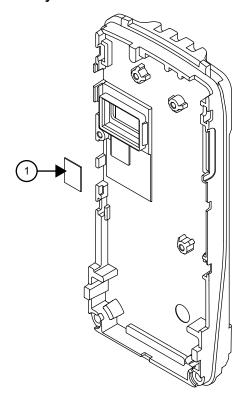
NOTICE: Make sure the main O-ring is not twisted.

3 Remove both the thermal pads and place the new ones onto their respective recess on the chassis by using a pair of clean plastic tweezers. Thin thermal pad (gray color) is to be placed on the recess to the bottom of the battery contact seal.



NOTICE: Replace with new thermal pads each time when the board is disassembled from chassis and ensure that both the thermal pads are placed correctly in their respective position and orientation.

Figure 28: Thermal Pad Assembly



Label	Description
1	Thermal pad

4 Insert the top control seal into the volume and channel selector shafts until it is seated on the switches.



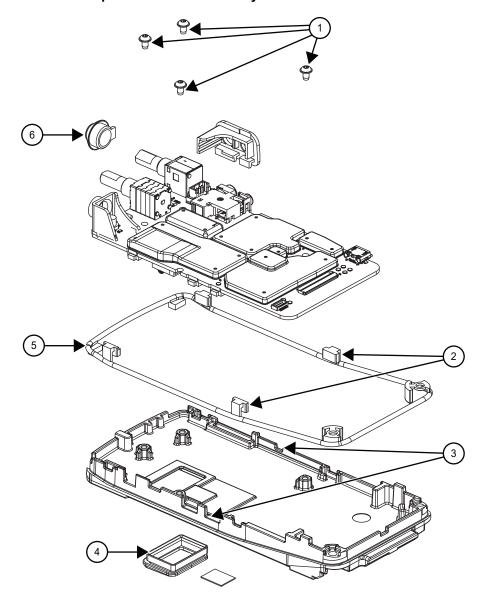
NOTICE: Replace the battery contact seal, main O-ring and top control seal with a new one if marred.

5 Assemble the main board to the chassis by aligning the board to the PCB guide protruded from the chassis, with the volume and frequency switches facing downward.



NOTICE: Make sure the battery contact seal is not pinched under the chassis.

Figure 29: PCB and Top Control Seal Assembly



Label	Description
1	Main Board Screws
2	Tabs
3	Grooves
4	Battery Contact Seal
5	O-ring
6	Top Control Seal

- 6 Align the four screw holes to the screw bosses on the chassis.
- 7 Use a T6 TORX screwdriver to fasten the screws holding the main board to the chassis.
- 8 Tighten torque should be between 3.1 to 3.3 lb/in.

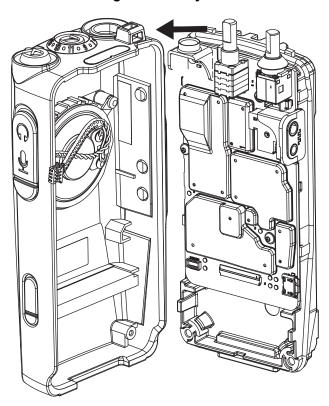
5.6.6

Chassis and Front Housing Reassembly

Procedure:

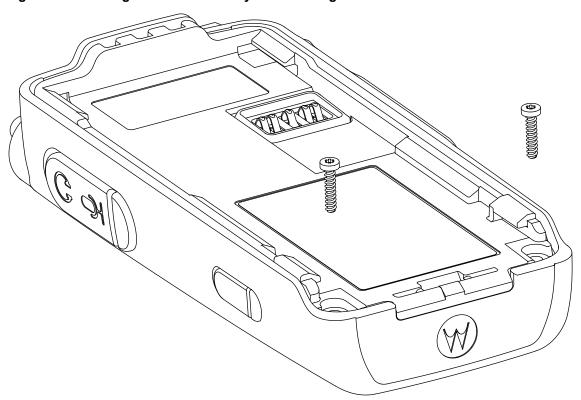
- **1** Apply a thin layer of grease on both the sides and the bottom (except the top) of the main O-ring.
- 2 Connect the speaker microphone assembly wires from the housing to the 4-pin connector on the main board.

Figure 30: Chassis and Front Housing Reassembly



3 Slide the chassis assembly into the front housing with the volume and channel selector shafts to the respective opening on the housing. Snap the bottom side of the chassis assembly into the housing.

Figure 31: Inserting Chassis Assembly into Housing



CAUTION:

Make sure the speaker and microphone wires are not pinched in between the audio jack shroud and housing.

Make sure the main O-ring is not pinched in between the chassis and housing.

- **4** Use a T6 TORX screwdriver to fasten the screw holding back kit to the housing. Tightening torque should be between 2.1 to 2.3 lb/in.
- **5** Attach the volume and channel selector knobs into their respective shafts.
- 6 Attach the antenna and battery.

5.7

Radio Exploded Mechanical View and Parts List

5.7.1

Non-Keypad Exploded View

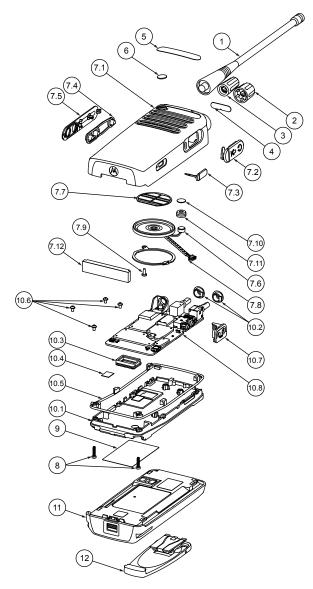


Table 26: Non-Keypad Exploded View Part List

Item	Description	Part Number
1	Antenna	See Authorized Accessories List on page 67
2	Knob, Volume	HW000158A01
3	Knob, Frequency	HW000159A01
4	Product Number Label	LB000196A05
5	Nameplate	LB000305A01

Item		Description	Part Number
6		RF Label	SL000083A01
7		Front Cover Kit	PMLN6835_
	7.1	Front Housing Assembly	Part of Front Cover Kit
	7.2	Dust Cover, Audio Jack	SL000061A01
	7.3	Dust Cover, Micro USB	SL000062A01
	7.4	PTT Keypad	KP000022A01
	7.5	PTT Bezel	HN000241A01
	7.6	Speaker Mic Assembly	0104062J18
	7.7	Speaker Felt	Part of Front Cover Kit
	7.8	Speaker Retainer	BR000065A01
	7.9	Speaker Retainer Screw	0386434Z02
	7.10	Mic Felt	Part of Front Cover Kit
	7.11	Mic Boot	0780608V01
	7.12	Acoustic Poron	Part of Front Cover Kit
8		Screw	0316281H01
9		Chassis Label	Not Field Replaceable
10		Back Cover Kit	PMLD4898_S
			PMLE5235_S
	10.1	Chassis	CH000206A01
	10.2	Top Control Seal	SL000060A01
	10.3	Battery Contact Seal	SL000063A01
	10.4	Thermal Pad	7515526H01
	10.5	Main O-Ring	SL000058A01
	10.6	Screw	03012034001
	10.7	Audio Jack Shroud	HN000239A01
	10.8	PCB Assembly	Part of Back Cover Kit
11		Battery	See Authorized Accessories List on page 67
12		Belt Clip	See Authorized Accessories List on page 67

5.7.2

Back Cover Kit Part Numbers

Table 27: Back Cover Kit Part Numbers

Motorola Solutions Part Number	Super Tanapa ⁵	Description
PMLD4898_S	PMUD3486_	136–174 MHz, 5 W, Non-Keypad Portable
PMLE5235_S	PMUE4526_	403–480 MHz, 4 W, Non-Keypad Portable

5.7.3

Torque Chart

The following table lists the various screws by part number and description, followed by the torque values in different units of measure. Torque all screws to the recommended value when assembling the radio.

Table 28: Torque Specifications for Screws

Part Number	Description	Driver/ Socket	Torque (lbs/in)
0386434Z02	Screw, Speaker	T6 TORX	2.7 to 2.9
03012034001	Screw, Main Board	T6 TORX	3.1 to 3.3
0316281H01	Screw, Chassis	T6 TORX	2.1 to 2.3

⁵ Super Tanapas are not customer orderable.

Chapter 6

Basic Troubleshooting

This chapter contains error codes and board replacement procedures.

If the board does not pass all the performance checks in Transceiver Performance Testing on page 24 or exhibits an error code listed below, then the circuit board must be replaced. If repair requires knowledge on details of component level troubleshooting, please send the radio to a Motorola Solutions Service Center.

To access the various connector pins, use the housing eliminator or test fixture along with the diagrams found in this section of the manual. See "Service Aids" for the appropriate Motorola Solutions service aid and tool part numbers.

6.1

Replacement Back Cover Kit Procedures

Once a problem has been isolated to a specific board, install the appropriate back cover kit (Refer to "Model Charts"), which is orderable from Motorola Solutions Radio Products and Solutions Organization.

If a board is replaced, it does not necessarily need to be retuned if it has been factory tuned. It must however be checked for performance before being placed into service. Of particular concern is the Bias DAC, that must be set for the appropriate final device bias current prior to keying up the radio. If the bias is not properly set, it may cause damage to the transmitter.



CAUTION:

The Tuner Tool only allows the serial number of the blank board to be entered once. Be very attentive during this procedure.

Chapter 7

Authorized Accessories List

Antennas

- UHF, 403–433 MHz, 9 cm Stubby Antenna (PMAE4002)
- UHF, 430–470 MHz, 9 cm Stubby Antenna (PMAE4003_)
- UHF, 465–495 MHz, 9 cm Stubby Antenna (PMAE4006)
- UHF, 403–520 MHz, Antenna Whip (PMAE4016_)
- VHF, 146–162 MHz, 9 cm Stubby Antenna (HAD9742_)
- VHF, 162–174 MHz, 9 cm Stubby Antenna (HAD9743)
- VHF, 146–174 MHz, 15 cm Heliflex Antenna (NAD6502 R)
- VHF, 136–155 MHz, 9 cm Stubby Antenna (PMAD4012)
- VHF, 136–155 MHz, 14 cm Antenna (PMAD4014_)
- VHF, 136–150.8 MHz, Heliflex Antenna (PMAD4042_)

Batteries

- High Capacity Li-Ion, 2150 mAh Battery (PMNN4080_)
- Li-lon, 1500 mAH Battery (PMNN4081_)
- NiMH, 1300 mAH Battery (PMNN4092)
- Li-lon, 1750 mAh IP54 Battery (PMNN4476_)

Cables

Programming Cable USB (PMKN4128_)

Carry Devices

- Universal Chest Pack (HLN6602)
- Spring Belt Clip (For 1.5 in. Belt Width)(HLN9844_)
- Waterproof Bag, Includes Large Carry Strap (HLN9985_)
- Adjustable Black Nylon Carrying Strap (Attaches to D-Ring on Carry Case)(NTN5243_)
- Nylon Carry Case (PMLN7075_)
- Break-A-Way Chest Pack (RLN4570_)
- Universal Radio Pack and Utility Case (Fanny Pack)(RLN4815)

Chargers

- Desktop Single-Unit Charger, US/NA Plug (PMPN4172)
- Standard Multi-Unit Charger, US/NA Plug (PMLN6597)

Earbuds and Earpieces

- Receive-Only Earbud (AARLN4885)
- D-Shell Receive Only Earpiece (One Size) for Remote Speaker Microphone (PMLN4620)

- Ear Receiver with In-Line Microphone/PTT/VOX Switch (Mag One)(PMLN6531)
- Swivel Earpiece with In-Line Microphone and PTT (PMLN6532)
- Earset with Combined Microphone and PTT (PMLN6533_)
- Earbud with In-Line Microphone/PTT/VOX Switch (Mag One)(PMLN6534_)
- D-Style Earpiece with Microphone/PTT (PMLN6535)
- Earset with Boom Microphone and In-Line PTT/VOX Switch (Mag One) (PMLN6537_)
- Receive-Only Earpiece with Translucent Tube for Remote Speaker Microphone (RLN4941_)
- Over-the-Ear Receiver for Remote Speaker Microphone (WADN4190)

Headsets and Headset Accessories

- Lightweight Headset with Swivel Boom Microphone (PMLN6538_)
- Lightweight Temple Transducer Headset (PMLN6541_)
- MagOne Ultra-Lite Headset, behind-the-head, adjustable with boom microphone and In-Line PTT (PMLN6542)
- Heavy Duty Headset, Noise Cancelling Boom Mic Headset (PMLN6854_)
- Medium Weight Over-the-Head Dual Muff Headset (PMLN7468)

Remote Speaker Microphones

- Remote Speaker Microphone with 3.5 mm Audio Jack (PMMN4013_)
- Remote Speaker Microphone IP57 (PMMN4029)
- Remote Speaker Microphone (Mag One) (PMMN4092_)

Surveillance Accessories

- 2-Wire Surveillance Kit with Clear Acoustic Earpiece, Beige (Palm Garden) (PMLN6445)
- 2-Wire Surveillance Kit, with Clear Acoustic Earpiece, Black (Palm Garden) (PMLN6530_)
- 2-Wire Surveillance Kit with Quick Disconnect Acoustic Tube, Black (OTTO) (PMLN6536_)



NOTICE: Consult your authorized Motorola Solutions dealer on the availability of these accessories.

Appendix A

Replacement Parts Ordering

Some replacement parts, spare parts, and/or product information can be ordered directly from the Motorola Solutions local distribution organization or through Motorola Online.

Basic Ordering Information

While parts may be assigned with a Motorola Solutions part number, they may not be available from the Motorola Solutions Radio Products and Solutions Organization (RPSO). Some parts may have become obsolete and are no longer available in the market due to cancellations by the supplier. If no Motorola Solutions part number is assigned, the part is normally not available from Motorola Solutions, or is not a user-serviceable part. Part numbers appended with an asterisk are serviceable by Motorola Solutions Depot only.

Place orders for replacement parts, kits, and assemblies directly on Motorola Solutions local distribution organization or through Motorola Online. When ordering replacement parts or equipment information, include the complete identification number. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part of, and sufficient description of the desired component to identify it.

To identify non-referenced spare parts, request for help from the Customer Care organization of a Motorola Solutions local area representative.

Motorola Online

The product catalog is available on the Motorola Online website. To register for login access:

For U.S. and Canada Service Centers only, call 1-800-422-4210.

Types of Orders	Contact Information
Mail Orders	Motorola Solutions
Mail orders are only accepted by the U.S. Federal Government Markets Division (USFGMD).	7031 Columbia Gateway Drive
eral Government Markets Division (GSI GMD).	3rd Floor – Order Processing
	Columbia, MD 21046
	U.S.A.
Telephone Orders and Parts Identification	Radio Products and Solutions Organization (RPSO) (United States and Canada)
	7:00 AM to 7:00 PM (Central Standard Time)
	Monday through Friday (Chicago, U.S.A.)
	1-800-422-4210
	1-847-538-8023 (United States and Canada)
	U.S. Federal Government Markets Division (USFGMD)

Radio Products and Solutions Organization (RPSO) was formerly known as the Radio Products Services Division (RPSD) and/or the Accessories and Aftermarket Division (AAD).

Types of Orders	Contact Information	
	1-800-826-1913 Federal Government Parts (Credit Cards Only)	
	8:30 AM to 5:00 PM (Eastern Standard Time)	
Fax Orders	Radio Products and Solutions Organization (RPSO) (United States and Canada)	
	1-800-622-6210	
	1-847-576-3023 (United States and Canada)	
	U.S. Federal Government Markets Division (USFGMD)	
	1-800-526-8641	

Product Customer Service

Radio Products and Solutions Organization (RPSO) (United States and Canada) 1-800-927-2744

Appendix B

Motorola Solutions Service Centers

If a unit requires further testing, knowledge and/or details of component level troubleshooting or service than is customarily performed at the basic level, send the radio to a Motorola Solutions Service Center.

Table 29: Motorola Solutions Service Centers

Types of Center	Address	Telephone Number
Motorola Solutions Service Center	1220 Don Haskins Drive, Suite A El Paso, TX 79936	915-872-8200
Motorola Solutions Federal Technical Center	10105 Senate Drive Lanham, MD 20706	1800-969-6680
		Fax: 1800-784-4113
Motorola Solutions Canadian Technical Logistics Center	181 Whitehall Drive Markham, Ontario L3R 9T1	1-800-543-3222

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to portable and mobile subscriber radio products. All terms do not necessarily apply to all radios, and some terms are merely generic in nature.

Analog Refers to a continuously variable signal or a circuit or device designed to handle such signals.

Band Frequencies allowed for a specific purpose.

Customer Programming Software (CPS) Software with a graphical user interface containing the feature set of a radio.

Default A pre-defined set of parameters.

Digital Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals.

Digital Private-Line (DPL) A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.

Federal Communications Commission (FCC) Regulates interstate and international communications by radio, television, wire, satellite and cable in all 50 states, the District of Columbia, and U.S. territories. It was established by the Communications Act of 1934 and operates as an independent U.S. government agency overseen by Congress. The commission is committed to being a responsive, efficient and effective agency capable of facing the technological and economic opportunities of the new millennium.

Frequency Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).

General-Purpose Input/Output (GPIO) Pins whose function is programmable.

Integrated Circuit (IC) An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.

kilohertz (kHz) One thousand cycles per second. Used especially as a radio-frequency unit.

Liquid-Crystal Display (LCD) An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.

Light Emitting Diode (LED) An electronic device that lights up when electricity is passed through it.

Motorola Digital Communications (MDC) A Motorola Solutions proprietary signaling scheme permitting the transfer of data communications at the rate of 1200 bits per second. Designed specifically for high reliability in the land-mobile radio environment. Digital encoding allows a much greater amount of information to pass over the channel with each message than with alternative tone encoding methods. Some features include: PTT ID, Emergency, Call Alert, Emergency Alarm, Voice Selection Call (SelCall), Radio Check, and Monitor.

Megahertz (MHz) One million cycles per second. Used especially as aradio-frequency unit.

Paging One-way communication that alerts the receiver to retrieve a message.

Printed Circuit Board (PC Board) A circuit manufactured so that many or all of the components are attached to a non-conductive circuit board with copper strips on one or both sides to replace wires.

Private-Line Tone Squelch (PL) A continuous sub-audible tone that is transmitted along with the carrier.

Programming Cable A cable that allows the computer to communicate directly with certain radios using USB.

Receiver Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.

Repeater Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).

Radio Frequency (RF) The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).

Signal An electrically transmitted electromagnetic wave.

Spectrum Frequency range within which radiation has specific characteristics.

Squelch Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.

Time-out Timer (TOT) A timer that limits the length of a transmission.

Tone Private Line (TPL) A continuous tone-coded squelch, which contains 29 codes. It is not compatible with DPL, and is common among all radio manufacturers.

Transceiver Transmitter-receiver: A device that both transmits and receives analog or digital signals.

Abbreviation: XCVR

Transmitter Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.

MN006550A01-AA Glossary

Ultra-High Frequency (UHF) The term for the International Telecommunication Union (ITU) Radio Band with a frequency range of 300 to 3000 MHz.

Universal Serial Bus (USB) An external bus standard that supports data transfer rates of 12 Mbps.