

MOTOTRBO™ MOBILE
PROFESSIONAL DIGITAL TWO-WAY RADIO



MOTOTRBO™ MOBILE
XPR 5350e/XPR
5550e/XPR 5380e/XPR
5580e BASIC SERVICE
MANUAL

SEPTEMBER 2018

© 2018 Motorola Solutions, Inc. All rights reserved



MN002201A01-AC

Contents

| | |
|--|-----------|
| List of Figures | 5 |
| List of Tables | 8 |
| Foreword | 9 |
| Product Safety and RF Exposure Compliance..... | 9 |
| Computer Software Copyrights..... | 9 |
| Document Copyrights..... | 9 |
| Disclaimer..... | 9 |
| Trademarks..... | 10 |
| Document History | 11 |
| Notations Used in This Manual | 12 |
| Commercial Warranty | 13 |
| I. What This Warranty Covers And For How Long..... | 13 |
| II. General Provisions..... | 13 |
| III. State Law Rights (Applicable Only in U.S.A.)..... | 14 |
| IV. How To Get Warranty Service..... | 14 |
| V. What This Warranty Does Not Cover..... | 14 |
| VI. Patent And Software Provisions..... | 14 |
| VII. Governing Law..... | 15 |
| Chapter 1: Introduction | 16 |
| 1.1 Radio Description..... | 16 |
| 1.2 Control Head Description..... | 17 |
| 1.2.1 Control Head Controls (Color Display Model)..... | 17 |
| 1.2.2 Control Head Controls (Numeric Display Model)..... | 18 |
| 1.3 Mobile Radio Model Numbering Scheme..... | 18 |
| 1.4 Model Charts..... | 20 |
| 1.4.1 VHF (136–174 MHz) Model Chart | 20 |
| 1.4.2 UHF1 Model Chart..... | 21 |
| 1.4.3 UHF2 Model Chart..... | 22 |
| 1.4.4 800/900 Band (806–870 MHz, 896–941 MHz) Model Chart..... | 23 |
| 1.5 Specifications..... | 23 |
| 1.5.1 General..... | 23 |
| 1.5.2 Receiver..... | 24 |
| 1.5.3 Transmitter..... | 25 |
| 1.5.4 Self-Quieter..... | 27 |
| 1.5.5 GNSS..... | 27 |

| | |
|--|-----------|
| 1.5.6 Bluetooth..... | 27 |
| 1.5.7 Wi-Fi..... | 28 |
| 1.5.8 MIL Standard..... | 28 |
| 1.5.9 Environmental Specifications..... | 29 |
| Chapter 2: Test Equipment and Service Aids..... | 30 |
| 2.1 Recommended Test Equipment..... | 30 |
| 2.2 Service Aids..... | 31 |
| 2.3 Programming Cables..... | 31 |
| Chapter 3: Transceiver Performance Testing..... | 33 |
| 3.1 Setup..... | 33 |
| 3.2 Color Display Model Test Mode..... | 34 |
| 3.2.1 Entering Display Radio Test Mode..... | 34 |
| 3.2.2 RF Test Mode..... | 34 |
| 3.2.2.1 RF Testing..... | 35 |
| 3.2.3 Color Display Test Mode..... | 39 |
| 3.2.4 LED Test Mode..... | 39 |
| 3.2.5 Backlight Test Mode..... | 40 |
| 3.2.6 Speaker Tone Test Mode..... | 40 |
| 3.2.7 Earpiece Tone Test Mode..... | 40 |
| 3.2.8 Audio Loopback Test Mode..... | 40 |
| 3.2.9 Audio Loopback Earpiece Test Mode..... | 40 |
| 3.2.10 Button/Knob/PTT Test Mode..... | 41 |
| 3.3 Numeric Display Model Test Mode..... | 41 |
| 3.3.1 Entering Display Radio Test Mode..... | 41 |
| 3.3.2 RF Test Mode..... | 41 |
| 3.3.3 Display Test Mode..... | 42 |
| 3.3.4 LED Test Mode..... | 42 |
| 3.3.5 Speaker Tone Test Mode..... | 42 |
| 3.3.6 Earpiece Tone Test Mode..... | 43 |
| 3.3.7 Audio Loopback Test Mode..... | 43 |
| 3.3.8 Audio Loopback Earpiece Test Mode..... | 43 |
| 3.3.9 Button/Knob/PTT Test Mode..... | 43 |
| Chapter 4: Radio Programming and Tuning..... | 44 |
| 4.1 Customer Programming Software Setup..... | 44 |
| 4.2 AirTracer Application Tool..... | 45 |
| 4.3 Radio Tuning Setup..... | 45 |
| Chapter 5: Disassembly/Reassembly Procedures..... | 47 |
| 5.1 Preventive Maintenance..... | 47 |
| 5.1.1 Inspection..... | 47 |

| | |
|--|------------|
| 5.1.2 Cleaning Procedures..... | 47 |
| 5.2 Safe Handling of CMOS and LDMOS Devices..... | 48 |
| 5.3 General Repair Procedures and Techniques..... | 49 |
| 5.4 Disassembling and Reassembling the Radio..... | 50 |
| 5.5 Detailed Radio Disassembly..... | 50 |
| 5.5.1 Control Head Removal..... | 50 |
| 5.5.2 Top Cover Removal..... | 52 |
| 5.5.3 Transceiver Board Removal..... | 54 |
| 5.5.4 Disassembly of Color Display Control Head..... | 63 |
| 5.5.5 Disassembly of Numeric Display Control Head..... | 70 |
| 5.6 Detailed Radio Reassembly..... | 76 |
| 5.6.1 Color Display Control Head | 76 |
| 5.6.2 Numeric Display Control Head..... | 83 |
| 5.6.3 Radio Assembly..... | 89 |
| 5.6.4 Thermal Pad Replacement Procedure..... | 91 |
| 5.6.5 Transceiver Board Reassembly..... | 92 |
| 5.6.6 Assemble Control Head to Radio Assembly..... | 106 |
| 5.7 Exploded Mechanical Views and Parts Lists..... | 110 |
| 5.7.1 Radio Assembly Exploded View and Parts List..... | 111 |
| 5.7.2 Control Head Exploded Views and Parts Lists..... | 113 |
| 5.8 Torque Chart..... | 115 |
| Chapter 6: Basic Troubleshooting..... | 116 |
| 6.1 High Power RF Precaution..... | 116 |
| 6.2 Replacement Service Kit Procedures..... | 116 |
| 6.3 Power-Up Error Codes..... | 116 |
| Chapter 7: Authorized Accessories List..... | 118 |
| Appendix A: Replacement Parts Ordering..... | 122 |
| Appendix B: Motorola Solutions Service Centers..... | 124 |
| Appendix C: Limited Level 3 Servicing..... | 125 |
| C.1 Component Location and Parts List..... | 125 |
| Glossary..... | 127 |

List of Figures

| | |
|--|----|
| Figure 1: Radio Control Head (Color Display Model)..... | 17 |
| Figure 2: Radio Control Head (Numeric Display Model)..... | 18 |
| Figure 3: Mobile Front Programming Cable HKN6184_..... | 31 |
| Figure 4: Mobile & Repeater Rear Programming Cable PMKN4010_..... | 32 |
| Figure 5: Mobile & Repeater Rear Accessory Programming and Test Cable PMKN4016_..... | 32 |
| Figure 6: Customer Programming Software Setup from Front Connector..... | 44 |
| Figure 7: Customer Programming Software Setup from Rear Accessory Connector..... | 45 |
| Figure 8: Customer Programming Software Setup with Test Box Connection..... | 45 |
| Figure 9: Radio Tuning Equipment Setup..... | 46 |
| Figure 10: Typical Control Head Removal..... | 51 |
| Figure 11: Flexible Connection Removal..... | 51 |
| Figure 12: Flex Cable Removal..... | 52 |
| Figure 13: Dismantling Top Cover (Image May Not Match Exact Product)..... | 53 |
| Figure 14: Top Cover Removal..... | 53 |
| Figure 15: Expansion Board Removal (Image May Not Match Exact Product)..... | 54 |
| Figure 16: Expansion Board Flex Removal (Image May Not Match Exact Product)..... | 55 |
| Figure 17: GNSS Nameplate Removal..... | 55 |
| Figure 18: GNSS Connector Nut Removal..... | 56 |
| Figure 19: GNSS Cable Removal..... | 57 |
| Figure 20: Option Board Removal (Image May Not Match Exact Product)..... | 57 |
| Figure 21: Option Board Flex Removal (Image May Not Match Exact Product)..... | 58 |
| Figure 22: Acoustic Plug Removal..... | 58 |
| Figure 23: Main Shield and PCB Screw Removal..... | 59 |
| Figure 24: Die Cast Main Shield Removal..... | 59 |
| Figure 25: PA Screw Removal..... | 60 |
| Figure 26: Accessory Connector Removal..... | 60 |
| Figure 27: DC Connector Retention Clip Removal..... | 61 |
| Figure 28: RF Connector Nut Removal..... | 62 |
| Figure 29: Transceiver Board Removal..... | 63 |
| Figure 30: Removing Gaskets and Replacing Final Driver Thermal Pad..... | 63 |
| Figure 31: Speaker Plug Removal..... | 64 |
| Figure 32: Control Head Flex Removal..... | 64 |
| Figure 33: Volume/Channel Knob Removal..... | 65 |
| Figure 34: Control Head Screws and Speaker Removal..... | 65 |
| Figure 35: PCB Retainer Removal..... | 66 |
| Figure 36: Control Head Board Removal..... | 66 |

| | |
|--|----|
| Figure 37: Power Button Removal..... | 67 |
| Figure 38: Light Barrier Removal..... | 67 |
| Figure 39: Separating Keypad from Keypad Frame..... | 68 |
| Figure 40: Keypad Removal..... | 68 |
| Figure 41: Volume Encoder Seal and Mic Jack Seal Removal..... | 69 |
| Figure 42: Display Pad Gasket Removal..... | 69 |
| Figure 43: Display Flex Removal..... | 70 |
| Figure 44: Color Display Removal from PCB..... | 70 |
| Figure 45: Speaker Plug Removal..... | 71 |
| Figure 46: Control Head Flex Removal..... | 71 |
| Figure 47: Volume/Channel Knob Removal..... | 72 |
| Figure 48: Control Head Board Screw Removal..... | 72 |
| Figure 49: Control Head Board Removal..... | 73 |
| Figure 50: Power Button Removal..... | 73 |
| Figure 51: Light Barrier Removal..... | 74 |
| Figure 52: Power Button and Keypad Removal..... | 74 |
| Figure 53: Speaker Removal (Optional)..... | 75 |
| Figure 54: Volume Encoder Seal and Mic Jack Seal Removal..... | 76 |
| Figure 55: Power Button Placement..... | 77 |
| Figure 56: Keypad Assembly..... | 77 |
| Figure 57: Assembly to Control Head Housing..... | 78 |
| Figure 58: Assembling Color Display to PCB..... | 78 |
| Figure 59: Pressing Along Outer Perimeter of Display and Closing Flex..... | 79 |
| Figure 60: Assembling Mic Jack Seal..... | 79 |
| Figure 61: Assembling Display Pad Gasket and Control Head Flex..... | 80 |
| Figure 62: Assembling Control Head Board to Control Head Assembly..... | 80 |
| Figure 63: Assembling PCB Retainer..... | 81 |
| Figure 64: Assembling Speaker Retainer..... | 81 |
| Figure 65: Assembling Speaker..... | 82 |
| Figure 66: Assembling Speaker Plug..... | 82 |
| Figure 67: Volume/Channel Knob Assembly..... | 83 |
| Figure 68: Power Button Placement..... | 84 |
| Figure 69: Keypad Assembly..... | 84 |
| Figure 70: Assembly to Control Head Housing..... | 85 |
| Figure 71: Assembling Mic Jack Seal..... | 85 |
| Figure 72: Assembling Speaker..... | 86 |
| Figure 73: Speaker Retainer Assembly..... | 87 |
| Figure 74: Assembling Control Head Board to Control Head Assembly..... | 87 |
| Figure 75: Screw Sequence..... | 88 |

| | |
|---|-----|
| Figure 76: Assembling Speaker Plug..... | 88 |
| Figure 77: Volume/Channel Knob Assembly..... | 89 |
| Figure 78: Thermal Pads and Shield Gasketing on Chassis and Die Cast Main Shield..... | 90 |
| Figure 79: Chassis with Thermal Pads..... | 91 |
| Figure 80: Applying Thermal Grease..... | 92 |
| Figure 81: Placing the Transceiver Board in the Chassis..... | 93 |
| Figure 82: Inserting DC Retention Clip..... | 93 |
| Figure 83: Inserting RF Lock Washer and Nut..... | 94 |
| Figure 84: Screw Sequence to Compress PCB..... | 95 |
| Figure 85: Installing PA Screws..... | 95 |
| Figure 86: Inserting Accessory Connector..... | 96 |
| Figure 87: Assembling Die Cast Main Shield onto Chassis..... | 96 |
| Figure 88: Screw Sequence to Tighten Die Cast Main Shield..... | 97 |
| Figure 89: RF Connector Nut Final Torque..... | 97 |
| Figure 90: Acoustic Plug Installation..... | 98 |
| Figure 91: Inspection of Cover Assembly with Seal..... | 98 |
| Figure 92: Assembling Cover onto Chassis..... | 99 |
| Figure 93: GNSS Cable Installation..... | 100 |
| Figure 94: Installing GNSS Cable Strain Relief..... | 100 |
| Figure 95: GNSS Cable Installation..... | 101 |
| Figure 96: Flex Connection Connectors..... | 102 |
| Figure 97: Expansion Board Assembly..... | 102 |
| Figure 98: GNSS Nameplate Assembly..... | 103 |
| Figure 99: GNSS Antenna Connector Assembly..... | 104 |
| Figure 100: Orientation of Option Board Flex to Option Board..... | 104 |
| Figure 101: Assemble Option Board to Radio Chassis (Image may not match exact product)..... | 105 |
| Figure 102: Securing Option Board to Chassis..... | 106 |
| Figure 103: Assemble O-ring to Chassis (Image May Not Match Exact Product)..... | 107 |
| Figure 104: Flex Cable Connected..... | 107 |
| Figure 105: Assembling Flex Cable..... | 108 |
| Figure 106: Assemble Control Head to Radio Chassis..... | 108 |
| Figure 107: Radio Assembly Exploded View..... | 111 |
| Figure 108: Color Display Control Head Exploded View..... | 113 |
| Figure 109: Numeric Display Control Head Exploded View..... | 114 |
| Figure 110: PCB Top Side View..... | 125 |
| Figure 111: PCB Bottom Side View..... | 126 |

List of Tables

| | |
|--|-----|
| Table 1: Radio Frequency Ranges and Power Levels..... | 16 |
| Table 2: Mobile Radio Model Numbering Scheme..... | 18 |
| Table 3: Sales Models – Description of Symbols..... | 19 |
| Table 4: VHF High Power 25–45 W, Mini-U Model Chart..... | 20 |
| Table 5: VHF Low Power 1–25 W, Mini-U Model Chart..... | 21 |
| Table 6: UHF1 High Power 403–470 MHz, 25–40 W, Mini-U Model Chart..... | 21 |
| Table 7: UHF1 Low Power 403–470 MHz, 1–25 W, Mini-U Model Chart..... | 21 |
| Table 8: UHF2 450–512 MHz, 1–40 W, Mini-U Model Chart..... | 22 |
| Table 9: 800/900 Band 10–35/30 W, Mini-U Model Chart..... | 23 |
| Table 10: General Specifications..... | 23 |
| Table 11: Receiver Specifications..... | 24 |
| Table 12: Transmitter Specifications..... | 25 |
| Table 13: Self-Quieter Specifications..... | 27 |
| Table 14: GNSS Specifications..... | 27 |
| Table 15: Bluetooth Specifications..... | 27 |
| Table 16: Wi-Fi Specifications..... | 28 |
| Table 17: Environmental Specifications..... | 29 |
| Table 18: Test Equipments..... | 30 |
| Table 19: Service Aids..... | 31 |
| Table 20: Initial Equipment Control Settings..... | 33 |
| Table 21: Front Panel Access Test Mode Displays..... | 34 |
| Table 22: Test Environments..... | 35 |
| Table 23: Test Frequencies..... | 35 |
| Table 24: Transmitter Performance Checks..... | 36 |
| Table 25: Receiver Performance Checks..... | 38 |
| Table 26: Software Installation Kits Radio Tuning Setup..... | 44 |
| Table 27: Lead Free Solder Wire Part Number List..... | 49 |
| Table 28: Lead Free Solder Paste Part Number List..... | 49 |
| Table 29: Radio Exploded View Parts List..... | 111 |
| Table 30: Color Display Control Head (PMLN7501_) Exploded View Parts List..... | 113 |
| Table 31: Numeric Display Control Head (PMLN7500_) Exploded View Parts List..... | 114 |
| Table 32: Torque Specifications for Nuts and Screws..... | 115 |
| Table 33: Power-Up Error Codes..... | 117 |
| Table 34: Component Parts List..... | 126 |

Foreword

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

This level of service goes down to the board replacement level and is typical of some local service centers, Motorola Solutions authorized dealers, self-maintained customers, and distributors.



CAUTION: These servicing instructions are for the use of qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that 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.

For a list of Motorola Solutions-approved antennas, batteries, and other accessories, visit the following web site: <http://www.motorolasolutions.com>

Computer Software Copyrights

The Motorola Solutions products described in this manual may include copyrighted Motorola Solutions computer programs stored in semiconductor memories or other media. Laws in the United States and other countries preserve for Motorola Solutions certain exclusive rights for copyrighted computer programs, including, but not limited to, the exclusive right to copy or reproduce in any form the copyrighted computer program. Accordingly, any copyrighted Motorola Solutions computer programs contained in the Motorola Solutions products described in this manual may not be copied, reproduced, modified, reverse-engineered, or distributed in any manner without the express written permission of Motorola Solutions. Furthermore, the purchase of Motorola Solutions products shall not be deemed to grant either directly or by implication, estoppel, or otherwise, any license under the copyrights, patents or patent applications of Motorola Solutions, except for the normal non-exclusive license to use that arises by operation of law in the sale of a product.

Document Copyrights

No duplication or distribution of this document or any portion thereof shall take place without the express written permission of Motorola Solutions. No part of this manual may be reproduced, distributed, or transmitted in any form or by any means, electronic or mechanical, for any purpose without the express written permission of Motorola Solutions.

Disclaimer

The information in this document is carefully examined, and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. Furthermore, Motorola Solutions reserves the right to make changes to any products herein to improve readability, function, or design. Motorola Solutions does not assume any liability arising out of the applications or use of any product or circuit described herein; nor does it cover any license under its patent rights nor the rights of others.

Trademarks

MOTOROLA, MOTO, MOTOROLA SOLUTIONS and the Stylized M logo are trademarks or registered trademarks of Motorola Trademark Holdings, LLC and are used under license. All other trademarks are the property of their respective owners.

© 2018 Motorola Solutions, Inc. All rights reserved.

Document History

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

| Edition | Description | Date |
|----------------|--|----------------|
| MN002201A01-AA | Initial Release. | November 2015 |
| MN002201A01-AB | Compliance with the new Motorola Solutions design standard. | December 2017 |
| MN002201A01-AC | Updated Control Head Flex Cable part number from 30012045002 to PF001884A01. | September 2018 |

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.

Commercial Warranty

Limited Warranty

For information on warranty terms, see the Support page at <https://www.motorolasolutions.com>.

I. What This Warranty Covers And For How Long

Motorola Solutions Inc. ("Motorola Solutions") warrants the Motorola Solutions manufactured Communication Products listed below ("Product") against defects in material and workmanship under normal use and service for a period of time from the date of purchase as scheduled below:

| | |
|---------------------|-----------|
| Mobile Radios | Two Years |
| Product Accessories | One Year |

The radios additionally ship with a standard 1-year Repair Service Advantage (RSA) (for U.S. customers) or 1-year Extended Warranty (for Canada customers). However, at the time of order, you may choose to omit these warranties. For more RSA or Extended Warranty information, please refer to the price pages or Motorola Online (<https://businessonline.motorolasolutions.com>) > Resource Center > Services > Service Product Offerings > Repair Service Advantage or Extended Warranty.

Motorola Solutions, at its option, will at no charge either repair the Product (with new or reconditioned parts), replace it (with a new or reconditioned Product), or refund the purchase price of the Product during the warranty period provided it is returned in accordance with the terms of this warranty. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts of Product shall become the property of Motorola Solutions.

This express limited warranty is extended by Motorola Solutions to the original end user purchaser only and is not assignable or transferable to any other party. This is the complete warranty for the Product manufactured by Motorola Solutions. Motorola Solutions assumes no obligations or liability for additions or modifications to this warranty unless made in writing and signed by an officer of Motorola Solutions. Unless made in a separate agreement between Motorola Solutions and the original end user purchaser, Motorola Solutions does not warrant the installation, maintenance or service of the Product.

Motorola Solutions cannot be responsible in any way for any ancillary equipment not furnished by Motorola Solutions which is attached to or used in connection with the Product, or for operation of the Product with any ancillary equipment, and all such equipment is expressly excluded from this warranty. Because each system which may use the Product is unique, Motorola Solutions disclaims liability for range, coverage, or operation of the system as a whole under this warranty.

II. General Provisions

This warranty sets forth the full extent of Motorola Solutions responsibilities regarding the Product. Repair, replacement or refund of the purchase price, at Motorola Solutions option, is the exclusive remedy.

This warranty is given in lieu of all other express warranties, implied warranties, including without limitation, implied warranties of merchantability and fitness for a particular purpose, are limited to the duration of this limited warranty. In no event shall Motorola Solutions be liable for damages in excess of the purchase price of the product, for any loss of use, loss of time, inconvenience, commercial loss, lost profits or savings or other incidental, special or consequential damages arising out of the use or inability to use such product, to the full extent such may be disclaimed by law.

III. State Law Rights (Applicable Only in U.S.A.)

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitation on how long an implied warranty lasts, so the above limitation or exclusions may not apply.

This warranty gives specific legal rights, and there may be other rights which may vary from state to state.

IV. How To Get Warranty Service

You must provide proof of purchase (bearing the date of purchase and Product item serial number) in order to receive warranty service and, also, deliver or send the Product item, transportation, and insurance prepaid, to an authorized warranty service location.

Warranty service will be provided by Motorola Solutions through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service.

You can also call Motorola Solutions at 1-800-927-2744 US/Canada.

V. What This Warranty Does Not Cover

This warranty does not cover the following conditions:

- Defects or damage resulting from use of the Product in other than its normal and customary manner.
- Defects or damage from misuse, accident, water, or neglect.
- Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- Breakage or damage to antennas unless caused directly by defects in material workmanship.
- A Product subjected to unauthorized Product modifications, disassemblies or repairs (including, without limitation, the addition to the Product of non-Motorola Solutions supplied equipment) which adversely affect performance of the Product or interfere with Motorola Solutions normal warranty inspection and testing of the Product to verify any warranty claim.
- Product which has had the serial number removed or made illegible.
- Rechargeable batteries if:
 - Any of the seals on the battery enclosure or cells are broken or show evidence of tampering.
 - The damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.
- Freight costs to the repair depot.
- A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with Motorola Solutions published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from Motorola Solutions.
- Scratches or other cosmetic damage to Product surfaces that does not affect the operation of the Product.
- Normal and customary wear and tear.

VI. Patent And Software Provisions

Motorola Solutions will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and

Motorola Solutions will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim.

But such defense and payments are conditioned on the following:

- Motorola Solutions will be notified promptly in writing by such purchaser of any notice of such claim.
- Motorola Solutions will have sole control of the defense of such suit and all negotiations for its settlement or compromise.
- Product or parts become, or in Motorola Solutions opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit Motorola Solutions, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes noninfringing or to grant such purchaser a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by Motorola Solutions.

Motorola Solutions will have no liability with respect to any claim of patent infringement which is based upon the combination of the Product or parts furnished hereunder with software, apparatus or devices not furnished by Motorola Solutions, nor will Motorola Solutions have any liability for the use of ancillary equipment or software not furnished by Motorola Solutions which is attached to or used in connection with the Product. The foregoing states the entire liability of Motorola Solutions with respect to infringement of patents by the Product or any parts thereof.

Laws in the United States and other countries preserve for Motorola Solutions certain exclusive rights for copyrighted Motorola Solutions software such as the exclusive rights to reproduce in copies and distribute copies of such Motorola Solutions software. Motorola Solutions software may be used in only the Product in which the software was originally embodied and such software in such Product may not be replaced, copied, distributed, modified in any way, or used to produce any derivative thereof. No other use including, without limitation, alteration, modification, reproduction, distribution, or reverse engineering of such Motorola Solutions software or exercise of rights in such Motorola Solutions software is permitted. No license is granted by implication, estoppel or otherwise under Motorola Solutions patent rights or copyrights.

VII. Governing Law

This Warranty is governed by the laws of the State of Illinois, USA.

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 |
|----------------|----------------------------|--------------------|
| VHF | 136-174 MHz | 1-25 W 25-45 W |
| UHF1 | 403-470 MHz | 1-25 W 25-40 W |
| UHF2 | 450-512 MHz | 1-40 W |
| 800/900 Band | 806-870 MHz 896-941 MHz | 10-35 W 10-30 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 communications solution.

1.2

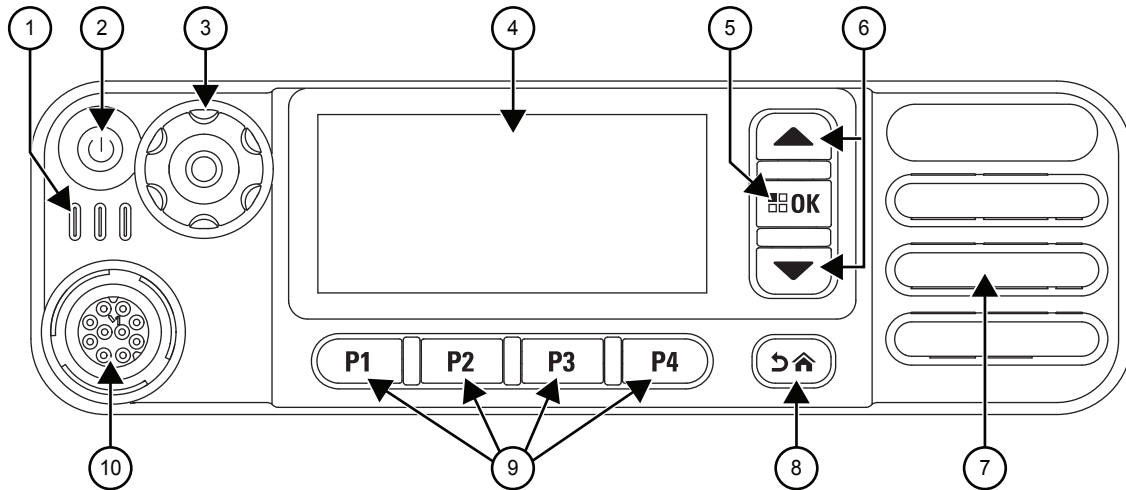
Control Head Description

The control head used with the radio has logic circuitry that operates the standard and optional features built into the system.

1.2.1

Control Head Controls (Color Display Model)

Figure 1: Radio Control Head (Color Display Model)

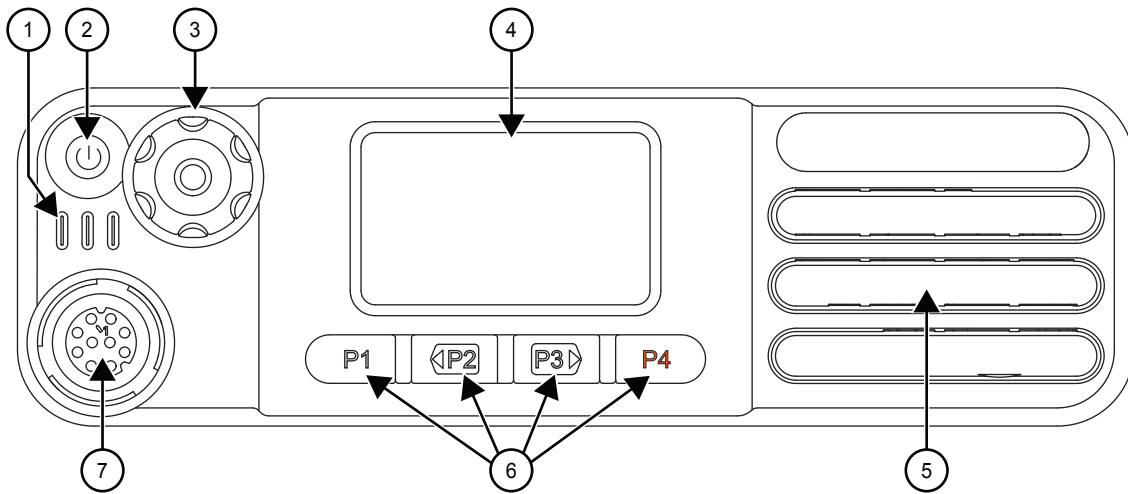


| Label | Feature | Description |
|-------|------------------------------|---|
| 1 | LED Indicator | Red, yellow, and green light-emitting diodes indicate operating status. |
| 2 | Power Button | Turns the radio on and off. |
| 3 | Volume/Channel Knob | Rotate clockwise to increase volume level; rotate counterclockwise to decrease volume level. Push knob to activate channel function; rotate clockwise and counterclockwise to select channel. |
| 4 | LCD (Liquid Crystal Display) | 160 x 72 display provides visual information about many radio features. |
| 5 | OK/Menu Button | One button to provide menu navigation and selection interface. |
| 6 | Scroll Up/Down Buttons | Press buttons to scroll. |
| 7 | Speaker | Outputs all tones and audio generated by the radio. |
| 8 | Return/Home Button | One button which quickly brings you to the home page. |
| 9 | Programmable Buttons | Four buttons are field programmable using the CPS. |
| 10 | Mic Connector | Interface point for mic to be used with the radio. |

1.2.2

Control Head Controls (Numeric Display Model)

Figure 2: Radio Control Head (Numeric Display Model)



| Label | Feature | Description |
|-------|----------------------|---|
| 1 | LED Indicator | Red, yellow, and green light-emitting diodes indicate operating status. |
| 2 | Power Button | Turns the radio on and off. |
| 3 | Volume/Channel Knob | Rotate clockwise to increase volume level; rotate counterclockwise to decrease volume level. Push knob to activate channel function; rotate clockwise and counterclockwise to select channel. |
| 4 | LED Numeric Display | Two-digit numeric display |
| 5 | Speaker | Outputs all tones and audio generated by the radio. |
| 6 | Programmable Buttons | Four buttons are field programmable using the CPS. |
| 7 | Mic Connector | Interface point for mic to be used with the radio. |

1.3

Mobile Radio Model Numbering Scheme

Table 2: Mobile Radio Model Numbering Scheme

| | | | | | | | | | | | | | |
|----------------------|----|---|---|---|---|---|---|---|---|----|----|----|----|
| Position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Typical Model Number | AA | M | 2 | 8 | J | N | C | 9 | R | A | 1 | A | N |

Table 3: Sales Models – Description of Symbols

| Position | Description | Value |
|---------------|---------------------|---|
| 1 | Region | AA = North America |
| | | AZ = Asia |
| | | LA = Latin America |
| | | MD = Europe/Middle East/Africa |
| 2 | Type of Unit | M = Mobile |
| 3 | Model Series | 28 = MOTOTRBO Mobile |
| 4 | | |
| 5 | Band | J = 136–174 MHz |
| | | M = 217–222 MHz |
| | | K = 300–360 MHz |
| | | P = 350–400 MHz |
| | | Q = 403–470 MHz |
| | | T = 450–527 MHz |
| | | X = 450–520 MHz |
| | | U = 806–941 MHz |
| 6 | Power Level | N = 1–25W |
| | | P = 25–40W |
| | | Q = 25–45W |
| | | R = 1–40W |
| | | M = 10–35W |
| 7 | Physical Packages | C = Numeric Display |
| | | H = Monochrome Display |
| | | N = Color Display |
| | | X = No Control Head |
| 8 | Channel Information | 9 = Variable/Programmable Channel Spacing |
| 9 | Primary Operation | J = Basic (No GNSS, No Bluetooth) |
| | | K = GNSS (GPS or GLONASS) and Bluetooth |
| | | L = GPS only |
| | | M = Bluetooth only |
| | | R = GNSS, WiFi, and Bluetooth |
| | | S = WiFi and Bluetooth only |
| | | V = Basic (No WiFi, No GNSS, No Bluetooth, No embedded GOB) |
| W = GNSS only | | |

| Position | Description | Value |
|----------|---------------------|---------------------------|
| 10 | Primary System Type | A = Conventional |
| | | B = Trunking |
| | | C = Analog Only |
| | | D = Limited System |
| | | E = Modified Conventional |
| 11 | Feature Level | 1 = Mini-U (Mobile) |
| | | 2 = BNC (Mobile) |
| 12 | Version Letter | N/A |
| 13 | Unique Variation | N = Standard Package |

1.4

Model Charts



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.

1.4.1

VHF (136–174 MHz) Model Chart

Table 4: VHF High Power 25–45 W, Mini-U Model Chart

| Model/Item | | | | Description |
|----------------|----------------|---|-------------|---|
| AAM28JQN9WA1_N | | | | 136–174 MHz, 25–45 W, MOTOTRBO XPR 5550e Color Display Mobile with GNSS, CFS, Bluetooth/Wi-Fi |
| | AAM28JQC9RA1_N | | | 136–174 MHz, 25–45 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS |
| | AAM28JQN9RA1_N | | | 136–174 MHz, 25–45 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS |
| X | X | X | PMUD3402_S | Service Kit, VHF, 25–45 W ¹ |
| X | X | X | PMLN7252_S | Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board |
| X | X | X | PMLN7324_S | Service Kit, Generic Option Board |
| | X | | PMLN7500_ | Numeric Display Model Control Head |
| X | | X | PMLN7501_ | Color Display Model Control Head |
| X | X | X | MN002330A01 | Mobile Quick Reference Guide and Safety Booklet |

Table 5: VHF Low Power 1–25 W, Mini-U Model Chart

| Model/Item | | | Description |
|----------------|---|-------------|--|
| AAM28JNC9RA1_N | | | 136–174 MHz, 1–25 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS |
| AAM28JNN9RA1_N | | | 136–174 MHz, 1–25 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS |
| X | X | PMUD3401_S | Service Kit , VHF, 1–25 W ¹ |
| X | X | PMLN7252_S | Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board |
| X | X | PMLN7324_S | Service Kit, Generic Option Board |
| X | | PMLN7500_ | Numeric Display Model Control Head |
| | X | PMLN7501_ | Color Display Model Control Head |
| X | X | MN002330A01 | Mobile Quick Reference Guide and Safety Booklet |

1.4.2

UHF1 Model Chart

Table 6: UHF1 High Power 403–470 MHz, 25–40 W, Mini-U Model Chart

| Model/Item | | | Description | |
|----------------|---|---|---|---|
| AAM28QPN9WA1_N | | | 403–470 MHz, 25–40 W, MOTOTRBO XPR 5550e Color Display Mobile with GNSS, CFS, Bluetooth/Wi-Fi | |
| AAM28QPC9RA1_N | | | 403–470 MHz, 25–40 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS | |
| AAM28QPN9RA1_N | | | 403–470 MHz, 25–40 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS | |
| X | X | X | PMUE4997_S | Service Kit, UHF1, 25–40 W ² |
| X | X | X | PMLN7252_S | Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board |
| X | X | X | PMLN7324_S | Service Kit, Generic Option Board |
| | X | | PMLN7500_ | Numeric Display Model Control Head |
| X | | X | PMLN7501_ | Color Display Model Control Head |
| X | X | X | MN002330A01 | Mobile Quick Reference Guide and Safety Booklet |

Table 7: UHF1 Low Power 403–470 MHz, 1–25 W, Mini-U Model Chart

| Model/Item | | | Description |
|----------------|---|------------|--|
| AAM28QNC9RA1_N | | | 403–470 MHz, 1–25 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS |
| AAM28QNN9RA1_N | | | 403–470 MHz, 1–25 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS |
| X | X | PMUE4994_S | Service Kit, UHF1, 1–25 W ² |

¹ Service Kit is the main board only.

| Model/Item | | | Description |
|-----------------------|---|-------------|---|
| AAM28QNC9RA1_N | | | 403–470 MHz, 1–25 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS |
| AAM28QNN9RA1_N | | | 403–470 MHz, 1–25 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS |
| X | X | PMLN7252_S | Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board |
| X | X | PMLN7324_S | Service Kit, Generic Option Board |
| X | | PMLN7500_ | Numeric Display Model Control Head |
| | X | PMLN7501_ | Color Display Model Control Head |
| X | X | MN002330A01 | Mobile Quick Reference Guide and Safety Booklet |

1.4.3

UHF2 Model Chart

Table 8: UHF2 450–512 MHz, 1–40 W, Mini-U Model Chart

| Model/Item | | | Description | |
|-----------------------|---|---|---|---|
| AAM28TRN9WA1_N | | | 450–512 MHz, 1–40 W, MOTOTRBO XPR 5550e Color Display Mobile with GNSS, CFS, Bluetooth/Wi-Fi | |
| AAM28TRC9RA1_N | | | 450–512 MHz, 1–40 W, MOTOTRBO XPR 5350e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS | |
| AAM28TRN9RA1_N | | | 450–512 MHz, 1–40 W, MOTOTRBO XPR 5550e Color Display Mobile with Bluetooth/Wi-Fi and GNSS | |
| X | X | X | PMUE4999_S | Service Kit, UHF B2, 1–40 W ³ |
| X | X | X | PMLN7252_S | Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board |
| X | X | X | PMLN7324_S | Service Kit, Generic Option Board |
| | X | | PMLN7500_ | Numeric Display Model Control Head |
| X | | X | PMLN7501_ | Color Display Model Control Head |
| X | X | X | MN002330A01 | Mobile Quick Reference Guide and Safety Booklet |

² Service Kit is the main board only.

³ Service Kit is the main board only.

1.4.4

800/900 Band (806–870 MHz, 896–941 MHz) Model Chart

Table 9: 800/900 Band 10–35/30 W, Mini-U Model Chart

| Model/Item | Description |
|-----------------------|---|
| AAM28UMN9WA1_N | 800/900 MHz, 10–35/30 W, MOTOTRBO XPR 5580e Color Display Mobile with GNSS, CFS, Bluetooth/Wi-Fi |
| AAM28UMC9RA1_N | 800/900 MHz, 10–35/30 W, MOTOTRBO XPR 5380e Numeric Display Mobile with Bluetooth/Wi-Fi and GNSS |
| AAM28UMN9RA1_N | 800/900 MHz, 10–35/30 W, MOTOTRBO XPR 5580e Color Display Mobile with Bluetooth/Wi-Fi and GNSS |
| X X X PMUF1891_S | Service Kit , 800/900 MHz, 10–35/30 W ⁴ |
| X X X PMLN7252_S | Service Kit, Bluetooth/Wi-Fi and GNSS Expansion Board |
| X X X PMLN7324_S | Service Kit, Generic Option Board |
| X PMLN7500_ | Numeric Display Model Control Head |
| X X PMLN7501_ | Color Display Model Control Head |
| X X X MN002330A01 | Mobile Quick Reference Guide and Safety Booklet |

1.5

Specifications

1.5.1

General

Table 10: General Specifications

| Band | VHF | | UHF1 | | UHF2 | | 800/900 Band | |
|--------------------------------|------------------------------|-----------------------|------------------------------|-----------------------|------------------------------|---|------------------------------|-----------------------|
| Model | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play |
| Channel Capacity | 32 | 1000 | 32 | 1000 | 32 | 1000 | 32 | 1000 |
| Typical RF Output (Low Power) | 1–25 W | | 1–25 W | | - | | - | |
| Typical RF Output (High Power) | 25–45 W | | 25–40 W | 1–40 W | | 806–870 10–35 W 896–941 10–30 W ⁵ | | |
| Frequency Range | 136–174 MHz | | 403–470 MHz | | 450–512 MHz | | 806–870 MHz | |

⁴ Service Kit is the main board only.

⁵ 901–902 MHz: 7 W, 940–941 MHz: 7 W

| Band | VHF | | UHF1 | | UHF2 | | 800/900 Band | |
|---------------------------|--|-----------------------|---|-----------------------|------------------------------|-----------------------|--|-----------------------|
| Model | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play |
| | | | | | | | 896–941 MHz | |
| Dimensions (H x W x L) | 2.1 x 6.9 x 8.1 in. (53.3 x 175.3 x 205.7 mm) | | | | | | | |
| Weight | 3.9 lbs. (1.8 kg) | | | | | | | |
| Operating Volt- age | Nominal: 13.2 VDC | | | | | | | |
| | Range: 10.8–15.6 VDC | | | | | | | |
| Current Drain: Standby | 0.81 A max | | | | | | | |
| Receive @ rated audio | 2 A max | | | | | | | |
| Transmit | 1–25 W: 11.0 A max 25–40 W: 14.5 A max 25–45 W: 14.5 A max | | | | | | 1–25 W: 11.0 A max 25–40 W: 12 A max 25–45 W: 12 A max | |
| FCC Description | 1–25 W: AZ492FT7082 25–45 W: AZ492FT7081 | | 1–25 W: AZ492FT7080 25–40 W: AZ492FT7079 | | 1–40 W: AZ492FT7076 | | AZ492FT7083 | |
| IC Description | 1–25 W: 109U-92FT7082 25–45 W: 109U-92FT7081 | | 1–25 W: 109U-92FT7080 25–40 W: 109U-92FT7079 | | 1–40 W: 109U-92FT7076 | | 109U-92FT7083 | |

1.5.2

Receiver

Table 11: Receiver Specifications

| Band | VHF | | UHF1 | | UHF2 | | 800/900 Band | |
|-------------|------------------------------|-----------------------|------------------------------|-----------------------|------------------------------|-----------------------|------------------------------|-----------------------|
| Model | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play |
| Frequencies | 136–174 MH | | 403–470 MHz | | 450–512 MHz | | 851–870 MHz 935–941 MHz | |

| Band | VHF | | UHF1 | | UHF2 | | 800/900 Band | |
|--|--------------------------------|-----------------------|------------------------------|-----------------------|------------------------------|-----------------------|------------------------------|-----------------------|
| Model | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play |
| Channel Spacing | 12.5 kHz/20 kHz/25 kHz | | | | | | 12.5 kHz/25 kHz ⁶ | |
| Analog Sensitivity | 0.3 μ V | | | | | | | |
| | 0.22 μ V (Typical) | | | | | | | |
| Digital Sensitivity (5% BER) | 0.25 μ V | | | | | | | |
| | 0.19 μ V (Typical) | | | | | | | |
| Intermodulation (TIA603D) | 78 dB | | 75 dB | | | | | |
| Adjacent Channel Selectivity (TIA603D) | 50 dB @ 12.5 kHz | | 50 dB @ 12.5 kHz | | | | | |
| | 80 dB @ 25 kHz | | 75 dB @ 25 kHz | | | | | |
| Spurious Rejection (TIA603D) | 80 dB | | 75 dB | | | | | |
| Rated Audio | 3 W (Internal) | | | | | | | |
| | 7.5 W (External – 8 Ω) | | | | | | | |
| | 13 W (External – 4 Ω) | | | | | | | |
| Audio Distortion @ Rated Audio | 3% (Typical) | | | | | | | |
| Hum and Noise | -40 dB @ 12.5 kHz | | | | -40 dB @ 12.5 kHz | | | |
| | -45 dB @ 20/25 kHz | | | | -45 dB @ 25 kHz | | | |
| Audio Response | TIA603D | | | | | | | |
| Conducted Spurious Emission | -57 dBm | | | | | | | |

1.5.3

Transmitter

Table 12: Transmitter Specifications

| Band | VHF | | UHF1 | | UHF2 | | 800/900 Band | |
|-------------|------------------------------|-----------------------|------------------------------|-----------------------|------------------------------|-----------------------|------------------------------|-----------------------|
| Model | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play |
| Frequencies | 136–174 MH | | 403–470 MHz | | 450–512 MHz | | 851–870 MHz 935–941 MHz | |

⁶ The frequency bands 851–870 MHz will support 12.5 or 25 kHz channels, and 935–941 MHz will support 12.5 kHz channels only.

| Band | VHF | | UHF1 | | UHF2 | | 800/900 Band | |
|---|--|-----------------------|------------------------------|-----------------------|--|-----------------------|------------------------------------|-----------------------|
| Model | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play |
| | | | | | | | 806–825 MHz 896–902 MHz | |
| Channel Spacing | 12.5 kHz/20 kHz/25 kHz | | | | | | 12.5 kHz/25 kHz ⁷ | |
| Frequency Stability (-30 °C to +60 °C,+25 °C Ref) | ±0.5 ppm | | | | | | | |
| Power Output (Low Power) | 1–25 W | | 1–25 W | | – | | – | |
| Power Output (High Power) | 25–45 W | | 25–40 W | | 1–40 W | | 806–870 10–35 W 896–941 10–30 W | |
| Modulation Limiting | ±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz | | | | ±2.5 kHz @ 12.5 kHz ±5.0 kHz @ 25 kHz | | | |
| FM Hum and Noise | -40 dB @ 12.5 kHz -45 dB @ 20/25 kHz | | | | -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 @ 20/25 kHz | | | | 60 dB @ 12.5 kHz 70 dB @ 25 kHz | | | |
| Audio Response | TIA603D | | | | | | | |
| Audio Distortion | 3% | | | | | | | |
| 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 Voice and Data: 7K60F1W | | | | | | | |
| Digital Vocoder Type | AMBE+2™ | | | | | | | |

⁷ The frequency bands 851–870 MHz will support 12.5 or 25 kHz channels, and 935–941 MHz will support 12.5 kHz channels only.

⁸ 901–902 MHz: 7 W, 940–941 MHz: 7 W

| Band | VHF | | UHF1 | | UHF2 | | 800/900 Band | |
|------------------|---|-----------------------|------------------------------|-----------------------|------------------------------|-----------------------|------------------------------|-----------------------|
| Model | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play | Nu- meric Dis- play | Color Dis- play |
| Digital Protocol | ETSI TS 102 361-1 ETSI TS 102 361-2 ETSI TS 102 361-3 | | | | | | | |

1.5.4

Self-Quieter

Table 13: Self-Quieter Specifications

| VHF | UHF1 | UHF2 | 800/900 Band |
|-------------|------|------|--------------|
| 156.975 MHz | - | - | - |

1.5.5

GNSS

Table 14: GNSS Specifications

| Model | Numeric Display | Color Display |
|--|-----------------|---------------|
| Accuracy specs are for long-term tracking (95th percentile values > 5 satellites visible at a nominal -130 dBm signal strength). | | |
| Time to First Fix (TTFF) Cold Start | < 1 minute | |
| TTFF Hot Start | < 10 seconds | |
| Horizontal Accuracy | < 5 meters | |

1.5.6

Bluetooth

Table 15: Bluetooth Specifications

| Model | Numeric Display | Color Display |
|---------|--|---------------|
| Version | Supports Bluetooth 4.1 + EDR Specification | |
| Range | Class 2, 10 meters | |

1.5.7 Wi-Fi

Table 16: Wi-Fi Specifications

| Model | Numeric Display | Color Display |
|---------|-------------------------------------|---------------|
| Version | Supports 802.11 b/g/n, 2.4 GHz band | |

1.5.8 MIL Standard

| Military Standards | | | | | | | | | | |
|--------------------|---------|--------------------------|---------|--------------------|---------|--------------------|---------|--------------------|---------|--------------------|
| Applicable MIL-STD | 810C | | 810D | | 810E | | 810F | | 810G | |
| | Methods | Procedures | Methods | Procedures | Methods | Procedures | Methods | Procedures | Methods | Procedures |
| Low Pressure | 500.1 | I | 500.2 | II | 500.3 | II | 500.4 | II | 500.5 | II |
| High Temperature | 501.1 | I, II | 501.2 | I/A1, II/A1 | 501.3 | I/A1, II/A1 | 501.4 | I/Hot, II/Hot | 501.5 | I/A1, II/A1 |
| Low Temperature | 502.1 | I | 502.2 | I/C3, II/C1 | 502.3 | I/C3, II/C1 | 502.4 | I/C3, II/C1 | 502.5 | I/C3, II/C1 |
| Temperature Shock | 503.1 | I | 503.2 | A1/C3 | 503.3 | A1/C3 | 503.4 | I | 503.5 | I-C |
| Solar Radiation | 505.1 | II | 505.2 | I/Hot-Dry | 505.3 | I/Hot-Dry | 505.4 | I/Hot-Dry | 505.5 | I/A1 |
| Rain | 506.1 | I, II | 506.2 | I, II | 506.3 | I,II | 506.4 | I, III | 506.5 | I, III |
| Humidity | 507.1 | II | 507.2 | II/Hot-Humid | 507.3 | II / Hot-Humid | 507.4 | – | 507.5 | I/Hot-Humid |
| Salt fog | 509.1 | I | 509.2 | I | 509.3 | I | 509.4 | – | 509.5 | – |
| Dust | 510.1 | I, II | 510.2 | I, II | 510.3 | I, II | 510.4 | I, II | 510.5 | I, II |
| Vibration | 514.2 | VIII/ CatF/ Curve -W, XI | 514.3 | I/ Cat10, II/ Cat3 | 514.4 | I/ Cat10, II/ Cat3 | 514.5 | I/ Cat24, II/ Cat5 | 514.6 | I/ Cat24, II/ Cat5 |
| Shock | 516.2 | I, II | 516.3 | I, IV | 516.4 | I, IV | 516.5 | I, IV | 516.6 | I, V, VI |

1.5.9

Environmental Specifications

Table 17: Environmental Specifications

| Specifications | Value |
|--------------------------|----------------------|
| Operating Temperature | -30 °C to +60 °C |
| Storage Temperature | -40 °C to +85 °C |
| Thermal Shock | Per MIL-STD |
| Humidity | Per MIL-STD |
| ESD | IEC61000-4-2 Level 3 |
| Water and Dust Intrusion | IP54, MIL-STD |



NOTICE: Specifications subject to change without notice. All specifications shown are typical.

Chapter 2

Test Equipment and Service Aids

This chapter 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 18: Test Equipments

| Equipment | Characteristics | Example | Application |
|-------------------------------------|-----------------------------------|--|--|
| Service Monitor | Can be used as a substitute. | Aeroflex 3920 (www.aeroflex.com) or equivalent | Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment. |
| Digital RMS Multimeter ⁹ | 100 μ V to 300 V | Fluke 179 (www.fluke.com) or equivalent | AC/DC voltage and current measurements. Audio voltage measurements. |
| | 5 Hz to 1 MHz | | |
| | 10 $M\Omega$ Impedance | | |
| RF Signal Generator ⁹ | 100 MHz to 1 GHz | Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent | Receiver measurements |
| | -130 dBm to +10 dBm | | |
| | FM Modulation: 0 kHz to 10 kHz | | |
| | Audio Frequency: 100 Hz to 10 kHz | | |
| Oscilloscope ⁹ | 2 Channel | Tektronix TDS1001b (www.tektronix.com) or equivalent | Waveform measurements |
| | 50 MHz Bandwidth | | |
| | 5 mV/div to 20 V/div | | |
| Power Meter and Sensor ⁹ | 5% Accuracy | Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent | Transmitter power output measurements |
| | 100 MHz to 500 MHz | | |
| | 50 W | | |
| RF Millivolt-meter | 100 mV to 3 V RF | Boonton 92EA (www.boonton.com) or equivalent | RF level measurements |
| | 10 kHz to 1 GHz | | |
| Power Supply | 0 V to 32 V | B&K Precision 1790 (www.bkprecision.com) or equivalent | Voltage supply |
| | 0 A to 20 A | | |

⁹ 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 19: Service Aids

| Motorola Solutions Part No. | Description | Application |
|-----------------------------|---|--|
| RLN4460_ | Test Box | Enables connection to audio/accessory jack. Allows switching for radio testing. |
| RVN5115_ | Customer Programming Software on CD-ROM | Allows servicer to program radio parameters, tune and troubleshoot radios. |
| PMKN4010_ | Mobile and Repeater Rear Programming Cable | Connects the radio rear connector to a USB port for radio programming and data applications. |
| PMKN4016_ | Mobile and Repeater Rear Accessory Programming and Test Cable | Connects the radio rear connector to a USB port for radio programming, data applications, testing, and alignment. |
| PMKN4018_ | Mobile and Repeater Rear Accessory Connector Universal Cable | Connects the radio rear connector to accessory devices such as desk sets. Cable contains all 26 wires and is unterminated at the user end. |
| HKN6184_ | Mobile Front Programming Cable | Connects the radio front connector to a USB port for radio programming and data applications. |
| HPN4007_ | Power Supply | Provides the radio with power when bench testing. |
| PMEN4027_ | Housing Eliminator | Test Fixture used to bench test the radio PCB. |
| 6686119B01 | Control Head Dismantling Tool | Assists in the removal of radio control head. |
| 66012025001 | Volume/Channel Knob Removal Tool | Assists in the removal of the Volume/Channel knob. |
| 66012020001 | RFIC (U0000) Repair Stencil | Fixture to screen solder paste onto the IC leads for replacement. |

2.3 Programming Cables

Figure 3: Mobile Front Programming Cable HKN6184_



Figure 4: Mobile & Repeater Rear Programming Cable PMKN4010_

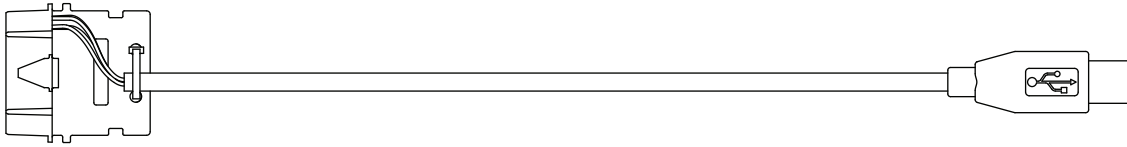
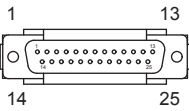
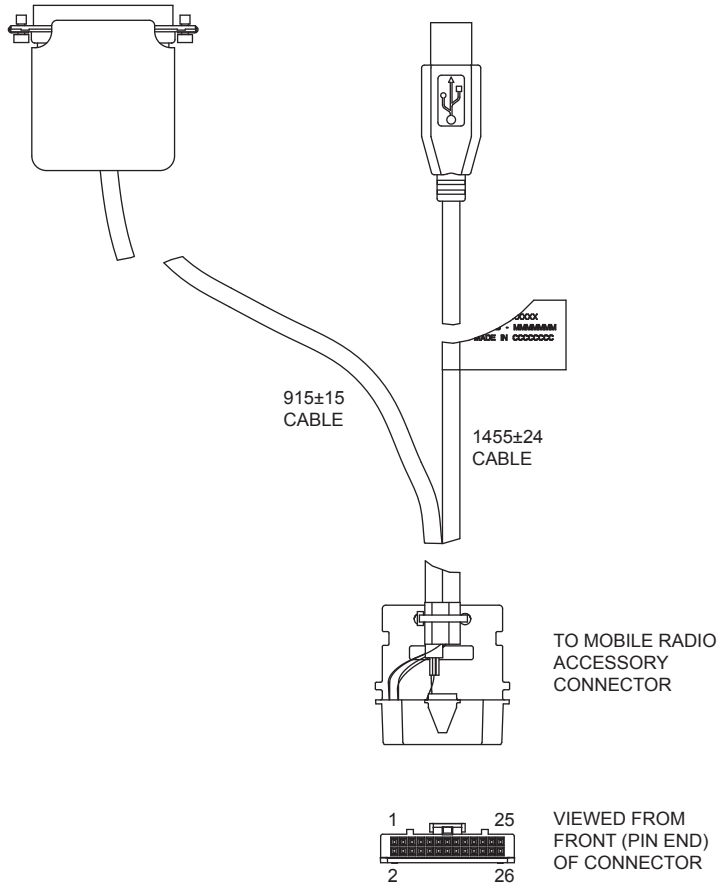
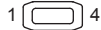


Figure 5: Mobile & Repeater Rear Accessory Programming and Test Cable PMKN4016_

DB 25 CONNECTOR



USB CONNECTOR



| WIRE DIAGRAM | | | |
|---------------------------------|----------------------|-------|-------|
| 26 PIN ACCESSORY PORT CONNECTOR | | USB | DB25P |
| PIN NO. | DESCRIPTION | | |
| 3 | VCC (5v) | 1 | |
| 2 | DATA - | 2 | |
| 1 | DATA + | 3 | |
| 4 | GND | 4 | |
| | DRAIN WIRE AND BRAID | SHELL | |
| 9 | SPEAKER - | | 7 |
| 11 | EXT MIC | | 17 |
| 17 | DIGI IN I (EXT PTT) | | 20 |
| 16 | GND | | 16 |
| 10 | SPEAKER + | | 1 |

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 13.8 VDC power supply. Applying 13.8 VDC at the DC power cable will ensure a minimum of 13.2 VDC at the DC connector of the radio. 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 20: Initial Equipment Control Settings

| Service Monitor | Power Supply | Test Set |
|---|------------------------|-----------------------|
| Monitor Mode: Power Monitor | Voltage: 13.8 VDC | Speaker set: A |
| RF Attn: -70 | DC on/standby: Standby | Speaker/load: Speaker |
| AM, CW, FM: FM | Volt Range: 20 V | PTT: OFF |
| Oscilloscope Source: Mod 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 | Current: 20 A | |

3.2 Color Display Model Test Mode

3.2.1 Entering Display Radio Test Mode

Procedure:

- 1 Turn the radio on.
- 2 Within 10 seconds after Self-Test is completed, press the **P2** button five times in succession.

The radio beeps and shows a series of displays regarding various version numbers and subscriber-specific information. The displays are described in the following table.

Table 21: Front Panel Access Test Mode Displays

| Name of Display | Description | Appears |
|-----------------|---|---------|
| Service Mode | The literal string indicates the radio has entered test mode. | Always |
| Host Version | The version of host firmware. | Always |
| DSP Version | The version of DSP firmware. | Always |
| Model Number | The radio model number as programmed in the codeplug. | Always |
| MSN | The radio serial number as programmed in the codeplug. | Always |
| FLASHCODE | The FLASH codes as programmed in the codeplug. | Always |
| RF Band | The radio band. | Always |



NOTICE: The radio stops at each display for 2 seconds before moving to the next information display. If the information cannot fit into one line, the radio display scrolls automatically character by character after 1 second to view the whole information. If the **Top Navigation** Button is pressed before the last information display, the radio suspends the information display until the user presses **Bottom Navigation** Button to resume the information display. The last display shows `RF Test Mode`.

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.

However, when the unit is on the bench for testing, alignment, or repair, it must be removed from its normal environment with a special routine, called Test Mode or air test.

In RF Test Mode, the first line displays `RF Test`, together with the power level icon at the right end of the first line. The second line displays the test environment, the channel number, and channel spacing. The default test environment is CSQ.

3.2.2.1 RF Testing

Procedure:

- 1 Each short press of the **P2** button changes the test environment (CSQ->TPL->DIG->USQ->CSQ).

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



NOTICE: DIG is digital mode and other test environments are analog mode as described in [Table 22: Test Environments on page 35](#).

Table 22: Test Environments

| No. of Beeps | Description | Function |
|--------------|-------------------------|--|
| 1 | Carrier Squelch (CSQ) | RX: unsquelch if carrier detected TX: mic audio |
| 2 | Tone Private-Line (TPL) | RX: unsquelch if carrier and tone (192.8 Hz) detected TX: mic audio + tone (192.8 Hz) |
| 3 | Digital Mode (DIG) | RX: unsquelch if carrier and digital code detected TX: mic audio |
| 4 | Unsquelch (USQ) | RX: constant unsquelch TX: mic audio |

- 2 Each short press of the **P1** button toggles the channel spacing between 20 kHz, 25 kHz, and 12.5 kHz.

The radio beeps once when radio toggles to 20 kHz, beeps twice for 25 kHz and beeps three times for 12.5 kHz.

- 3 Push and hold in the **Volume/Channel** knob for approximately 2 seconds to enter the Channel mode. Turn the Volume/Channel knob clockwise to increase from channel 1 to channel 14 or counterclockwise to decrease the channel number.

See the following Test Frequencies table for the test channel descriptions.

The radio beeps in each position.



NOTICE: The **Volume/Channel** knob will stay in Channel mode until the **Volume/Channel** knob is pushed in momentarily. This is not the case in normal operation.

Table 23: Test Frequencies

| Test Channel- Low and High Power | VHF | UHF1 | UHF2 | 800/900 Band |
|----------------------------------|---------|---------|---------|--------------|
| TX #1 or #8 | 136.075 | 403.000 | 450.000 | 806.575 |
| RX #1 or #8 | | | | 851.025 |
| TX #2 or #9 | 142.575 | 414.150 | 462.800 | 825.575 |
| RX #2 or #9 | | | | 855.025 |

| Test Channel- Low and High Power | VHF | UHF1 | UHF2 | 800/900 Band |
|----------------------------------|---------|---------|---------|--------------|
| TX #3 or #10 | 146.575 | 425.350 | 475.700 | 862.575 |
| RX #3 or #10 | | | | 860.525 |
| TX #4 or #11 | 155.575 | 436.500 | 488.500 | 897.575 |
| RX #4 or #11 | | | | 869.925 |
| TX #5 or #12 | 161.575 | 447.675 | 501.300 | 900.575 |
| RX #5 or #12 | | | | 935.025 |
| TX #6 or #13 | 167.575 | 458.850 | 514.200 | 936.575 |
| RX #6 or #13 | | | | 938.025 |
| TX #7 or #14 | 174.975 | 470.000 | 527.000 | 940.975 |
| RX #7 or #14 | | | | 940.925 |

Table 24: Transmitter Performance Checks

| Test Name | Communications Analyzer | Radio | Test Set | Comments |
|---------------------|---|---|---|---|
| Reference Frequency | Mode: PWR MON Fourth channel test frequency. ¹⁰ Monitor: Frequency error Input at RF In/Out | TEST MODE Test Channel 4, carrier squelch | PTT to continuously transmit (during the performance check) | Frequency error: ±80 Hz for VHF ±220 Hz (UHF1) ±250 Hz (UHF2) ±450 Hz (800 Band) |
| Power RF | As above | TEST MODE Test Channel 4, carrier squelch TEST MODE Test Channel 11, carrier squelch | As above | Low Power Set 1.0–1.3 W: 1 VHF 1–25 W 2 UHF1 1–25 W 3 UHF2 1–40 W 25–29 W: 1 VHF 25–45 W 2 UHF1 25–40 W) 10 W: 800/900 10–35/30 W High Power Set 25–29 W: 1 VHF 1–25 W |

¹⁰ See "Test Frequencies" Table".

| Test Name | Communications Analyzer | Radio | Test Set | Comments |
|---------------------------|---|--|---------------------------------|--|
| | | | | <p>2 UHF1 1–25 W 40–47 W: 1 UHF1 25–40 W 2 UHF2 1–40 W 45–53 W: VHF 25–45 W 35 W: 806–870 M 10–35 W 30 W: 896–941 M 10–30 W</p> |
| Voice Modulation | <p>Mode: PWR MON Fourth channel test frequency¹⁰ atten to -70, input to RF In/Out Monitor: DVM: AC Volts Set 1 kHz Mod Out level for 800 mVrms at test set, 800 mVrms at AC/DC test set jack</p> | TEST MODE Test Channel 4, carrier squelch | As above, meter selector to mic | <p>Deviation: 2.5 kHz Max. (12.5 kHz Ch. Sp.) 4 kHz Max. (20 kHz Ch. Sp.) 5 kHz Max. (25 kHz Ch. Sp.)</p> |
| Internal Voice Modulation | <p>Mode: PWR MON Fourth channel test frequency¹⁰ atten to -70, input to RF In/Out</p> | TEST MODE Test Channel 4, carrier squelch output at antenna | Remove modulation input | |
| TPL Modulation | <p>As above Fourth channel test frequency¹⁰ BW to narrow</p> | TEST MODE Test Channel 4 TPL | As above | <p>Deviation: 0.25–0.5 kHz (12.5 kHz Ch. Sp.) 0.4–0.8 kHz (20 kHz Ch. Sp.) 0.5–1.0 kHz (25 kHz Ch. Sp.)</p> |
| FSK Error | DMR Mode. FSK Error | TEST MODE | Key up radio with O.153 | Not Exceed 5% |

| Test Name | Communications Analyzer | Radio | Test Set | Comments |
|------------------|----------------------------|--|--------------------------------------|--|
| | | Digital Mode, transmit with O.153 test pattern | test pattern modulation using Tuner. | |
| Magnitude 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 648Hz +/-10% and 1944Hz +/-10% |
| Transmitter BER | DMR Mode | As above | As above | Transmitter BER should be 0% |


 **NOTICE:** Motorola Solutions recommends that the reference oscillator be recalibrated after two years to maintain optimized Dual Capacity Direct Mode performance.

Table 25: Receiver Performance Checks

| Test Name | Communications Analyzer | Radio | Test Set | Comments |
|--|---|--|---|---|
| Rated Audio | Mode: GEN Output level: 1.0 mV RF Fourth channel test frequency ¹⁰ Mod: 1 kHz tone at 3 kHz deviation Monitor: DVM: AC Volts | TEST MODE Test Channel 4, 25 kHz channel spacing, carrier squelch | PTT to OFF (center), meter selector to Audio PA. | Set volume control to 7.75 Vrms |
| Distortion | As above, except to distortion | As above | As above | Distortion <5.0% |
| Sensitivity (SINAD) | As above, except SINAD, lower the RF level for 12 dB SINAD. | As above | PTT to OFF (center) | RF input to be <0.3 μ V |
| 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 7.75 Vrms |
| | As above, except change frequency to a conventional system. Raise RF level from zero until radio un-squelches. | Out of TEST MODE; Select a conventional system | As above | Unsquench to occur at <0.25 μ V. Preferred SINAD = 9–10 dB |

| Test Name | Communications Analyzer | Radio | Test Set | Comments |
|--------------|---|---|--|--|
| Receiver BER | IFR DMR mode. Signal generator with O.153 test pattern | TEST MODE Digital Mode, receive O.153 test pattern | Read BER using Tuner. Adjust RF level to get 5% BER | RF level to be <0.3 μ V for 5% BER |

3.2.3

Color Display Test Mode

Procedure:

- 1 Press and hold the **P1** button in RF Test Mode.
The radio beeps once and momentarily displays `Display Test Mode`.
- 2 Press any button/key.
The negative image of `Display Test Mode` appears.
- 3 Press any button/key.
With each successive press, the display background changes from Red->Green->Blue.
- 4 Press any button/key.
With each successive press, the displays shows a growing horizontal bar with a cyclic color of Red->Green->Blue->Black->Red->Green->Blue->Black->Red (Full Screen).
- 5 Press any button/key.
With each successive press, the displays shows a growing vertical bar with a cyclic color of Red->Green->Blue->Black->Red->Green (Full Screen).
- 6 Press any button/key.
The display clears and 12 icons appear at the top of the display.

3.2.4

LED Test Mode

Procedure:

- 1 Press and hold the **P1** button after Display Test Mode.
The radio beeps once and displays `LED Test Mode`.
- 2 Press any button/key.
The red LED lights up and the radio displays `Red LED On`.
- 3 Press any button/key.
The red LED is turned off. The green LED lights up and the radio displays `Green LED On`.
- 4 Press any button/key.
The green LED is turned off. The yellow LED lights up and the radio displays `Yellow LED On`.

3.2.5

Backlight Test Mode

Procedure:

Press and hold the **P1** button after LED Test Mode.

The radio beeps once and displays `Backlight Test Mode`.

The radio turns on both LCD and keypad backlight.

3.2.6

Speaker Tone Test Mode

Procedure:

Press and hold the **P1** button after Backlight Test Mode.

The radio beeps once and displays `Speaker Tone Test Mode`.

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

3.2.7

Earpiece Tone Test Mode

Procedure:

- 1 Connect the external accessory to the radio.
- 2 Press and hold the **P1** button after Speaker Tone Test Mode.

The radio beeps once and displays `Earpiece Tone Test Mode`.

The radio generates a 1 kHz tone from the earpiece.

3.2.8

Audio Loopback Test Mode

Procedure:

Press and hold the **P1** button after Earpiece Tone Test Mode.

The radio beeps once and displays `Audio Loopback Test Mode`.

The radio routes any audio on the mic to the internal speaker.

3.2.9

Audio Loopback Earpiece Test Mode

Procedure:

Press and hold the **P1** button after the Earpiece Tone Test Mode.

The radio beeps once and displays `Audio Loopback Earpiece Test Mode`.

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

3.2.10

Button/Knob/PTT Test Mode

Procedure:

Press and hold the **P1** button after Audio Loopback Earpiece Test Mode.

The radio beeps once and displays `Button Test` on the first line.

The radio also displays the button/knob/PTT Button Command Opcode (BCO) and state (BCO/state) on the screen (line 2) upon any button state changes.

Postrequisites: The radio must be powered off to end Test Mode.

3.3

Numeric Display Model Test Mode

3.3.1

Entering Display Radio Test Mode

Procedure:

- 1 Turn the radio on.
- 2 Within 10 seconds after Self-Test is complete, press the **P2** button five times in succession.

The radio beeps.

3.3.2

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 the **P2** button to change the test environment (CSQ->TPL->DIG->USQ->CSQ).

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 [Table 22: Test Environments on page 35](#).

- 2 Short press the **P1** button to toggle the channel spacing between 20 kHz, 25 kHz, and 12.5 kHz.
The radio beeps once when radio toggles to 20 kHz, beeps twice for 25 kHz and beeps three times for 12.5 kHz.

- 3 Push and hold in the **Volume/Channel** knob clockwise to increase the channel number from 1 to 14 or counterclockwise to decrease the channel number.

The radio beeps at each position.

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



NOTICE: The **Volume/Channel** knob stays in Channel mode until the **Volume/Channel** knob is pushed momentarily. This is not the case in normal operation.

3.3.3

Display Test Mode

Procedure:

- 1 Press and hold the **P1** button in RF Test Mode.
The radio beeps once and enters Display Test Mode.
- 2 Press any button to turn on the two character seven segment display.

3.3.4

LED Test Mode

Procedure:

- 1 Press and hold the **P1** button after Display 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 lights up the yellow LED.

3.3.5

Speaker Tone Test Mode

Procedure:

Press and hold the **P1** button after LED Test Mode.

The radio beeps once.

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

3.3.6

Earpiece Tone Test Mode

Procedure:

Press and hold the **P1** button after Speaker Tone Test Mode.

The radio beeps once.

The radio generates a 1 kHz tone with the earpiece.

3.3.7

Audio Loopback Test Mode

Procedure:

Press and hold the **P1** button after Earpiece Tone Test Mode.

The radio beeps once.

The radio routes any audio on the mic to the internal speaker.

3.3.8

Audio Loopback Earpiece Test Mode

Procedure:

Press and hold the **P1** button after Earpiece Tone Test Mode.

The radio beeps once.

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

3.3.9

Button/Knob/PTT Test Mode

Procedure:

- 1 Press and hold the **P1** button after Audio Loopback Earpiece Test Mode.

The radio beeps once.

- 2 Rotate the **Volume/Channel** knob.

The radio beeps at each position.

- 3 Press any button.


The radio beeps once.

Postrequisites: The radio must be powered off to end Test Mode.

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 8/7/2000/XP/Vista 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 26: 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 6: Customer Programming Software Setup from Front Connector

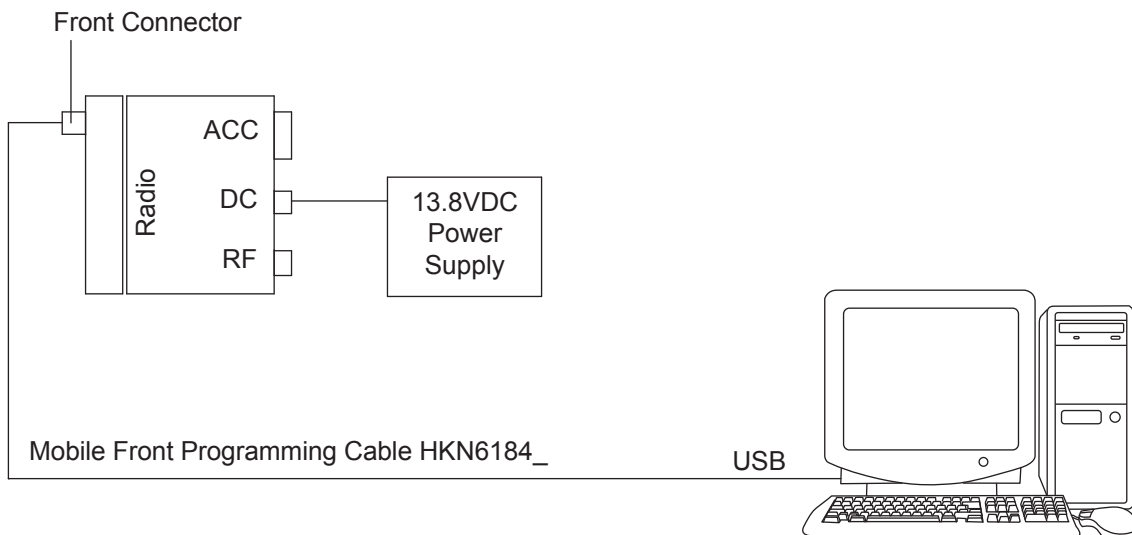


Figure 7: Customer Programming Software Setup from Rear Accessory Connector

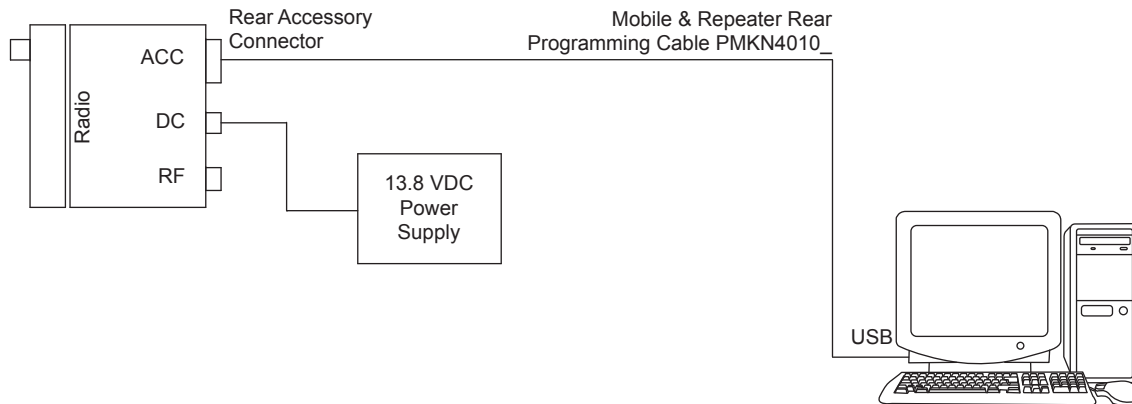
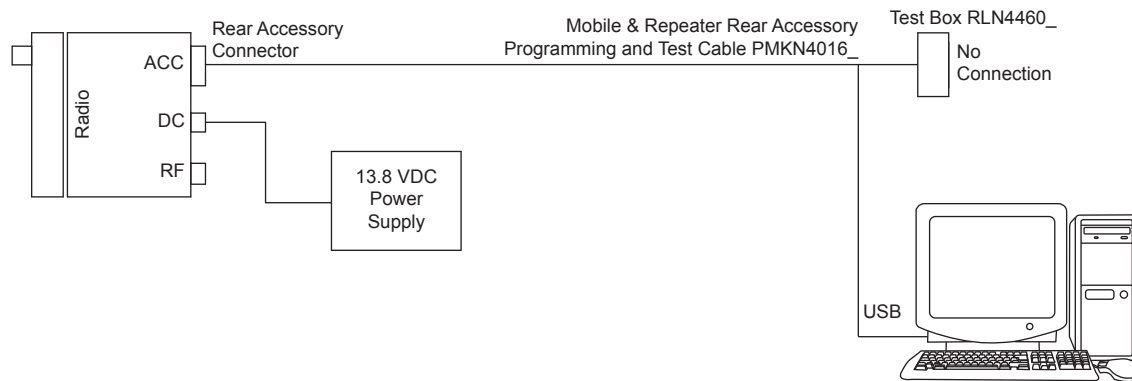


Figure 8: Customer Programming Software Setup with Test Box Connection



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.

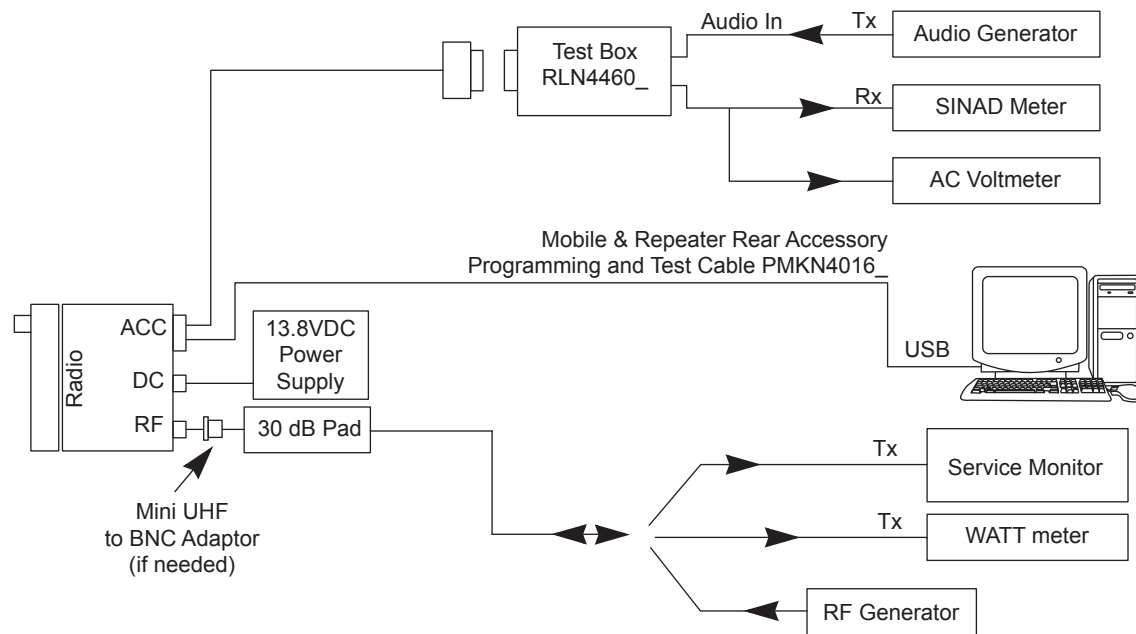
Before keying up the radio, set the Bias DAC for the appropriate final device bias current. If the bias is not properly set, it may cause damage to the transmitter.



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

A personal computer (PC) with Windows, Windows 2000/XP/Vista/Windows 7 and a tuner program are required to tune the radio. See [Figure 9: Radio Tuning Equipment Setup on page 46](#) to perform tuning procedures.

Figure 9: Radio Tuning Equipment Setup



Chapter 5

Disassembly/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 is recommended.

5.1.1

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.

5.1.2

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.



NOTICE:

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

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume).



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

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

Cleaning External Plastic Surfaces

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

Cleaning Internal Circuit Boards and Components

Isopropyl alcohol (100%) may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls 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, control head and housing assembly.



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

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:

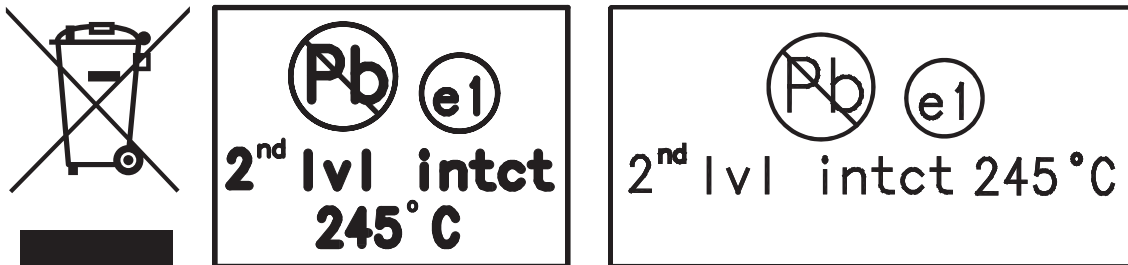
- Store and transport all CMOS/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS devices into conventional plastic "snow" trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench 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 27: Lead Free Solder Wire Part Number List

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

Table 28: Lead Free Solder Paste Part Number List

| Manufacturer Part Number | Viscosity | Type | Composition and Percent Metal | Liquid Temperature |
|--------------------------|---------------------------------|--------------------|-------------------------------|--------------------|
| 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

These radios may be disassembled and reassembled with the use of only ten screws (board to casting). 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 and reassembling the radio:

- Small Flat Blade Screwdriver
- Control Head Dismantling Tool (Motorola Solutions Part No. 6686119B01)
- Volume/Channel Knob Removal Tool (Motorola Solutions Part No. 66012025001)
- Torque Driver (2-36 lbs-in or 0.2-4.0 N-m), (Motorola Solutions Part No. RSX4043A)
- TORX™ T10 Driver Bit (Motorola Solutions Part No. 6680387A74)
- TORX T8 Driver Bit (Motorola Solutions Part No. 6680387A72)
- TORX T6 Driver Bit (Motorola Solutions Part No. 6680387A70) (for radios with expansion board or option board)
- 5/16 in. or 8 mm Socket Driver (for radios with expansion board)
- 9/16 in. Deep Socket Driver (RF Connector Nut)



NOTICE: The following disassembly procedures should be performed only if necessary.



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.

The procedure to remove and replace the control head, top cover, or transceiver board is similar for all models. A typical procedure is therefore provided in this section followed by detailed disassembly procedures for each specific control head model.

5.5.1

Control Head Removal

Procedure:

- 1 Insert the dismantling tool in the groove between the control head and the radio assembly.
- 2 Press the dismantling tool under the control head to release the snap features.

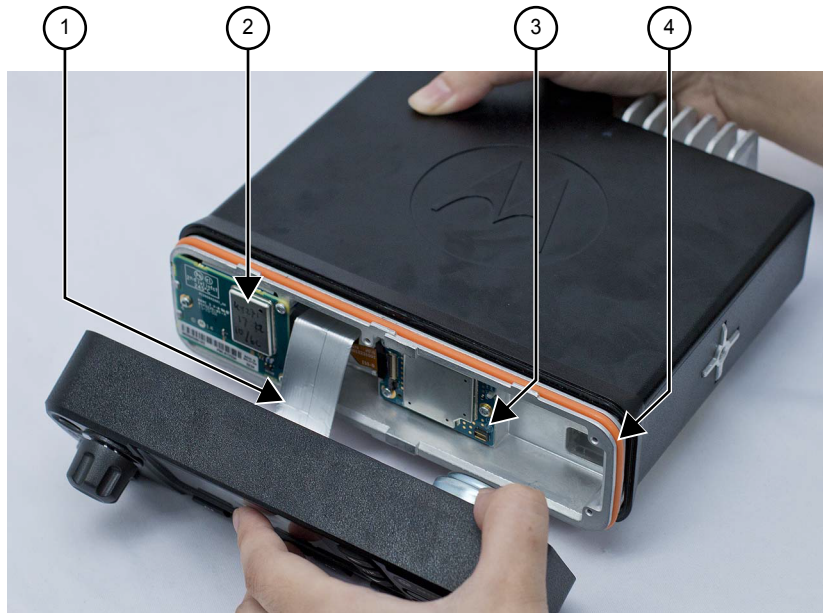
Figure 10: Typical Control Head Removal



| Label | Description |
|-------|------------------|
| 1 | Dismantling Tool |

- 3 Pull the control head away from the radio assembly.

Figure 11: Flexible Connection Removal

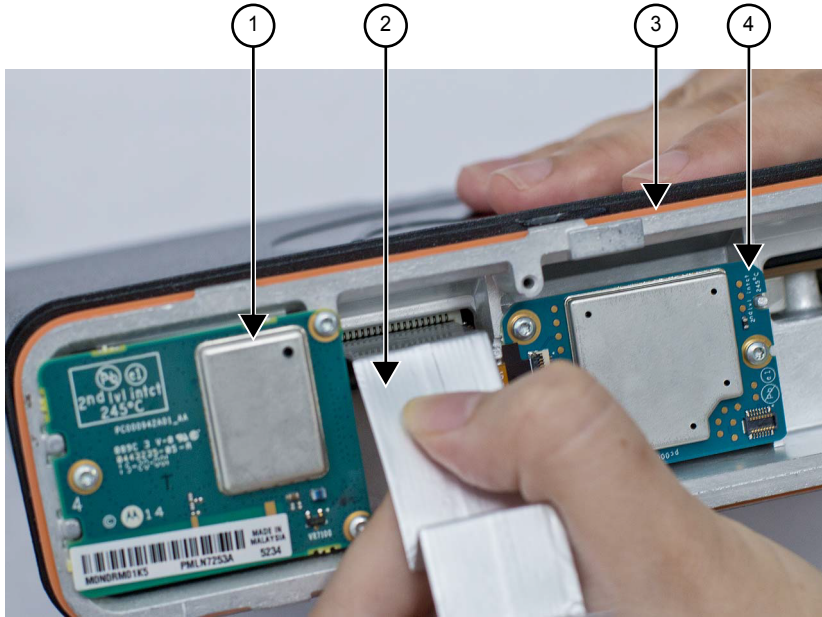


| Label | Description |
|-------|-----------------|
| 1 | Flex Cable |
| 2 | Expansion Board |
| 3 | Option Board |

| Label | Description |
|-------|-------------------|
| 4 | Control Head Seal |

- Remove the flex cable from the socket on the radio assembly.

Figure 12: Flex Cable Removal



| Label | Description |
|-------|-------------------|
| 1 | Expansion Board |
| 2 | Flex Cable |
| 3 | Control Head Seal |
| 4 | Option Board |

- Then remove the control head seal, if required.

5.5.2

Top Cover Removal

Procedure:

- Insert the dismantling tool between the top cover and the chassis.
- Press on the dismantling tool until one side wall of the top cover starts to clear the chassis trunnion mounting features.
- Repeat step 2 for the other side of the top cover.

Figure 13: Dismantling Top Cover (Image May Not Match Exact Product)



| Label | Description |
|-------|---------------------------|
| 1 | Trunnion Mounting Feature |
| 2 | Dismantling Tool |

4 Lift the top cover from the chassis.

Figure 14: Top Cover Removal



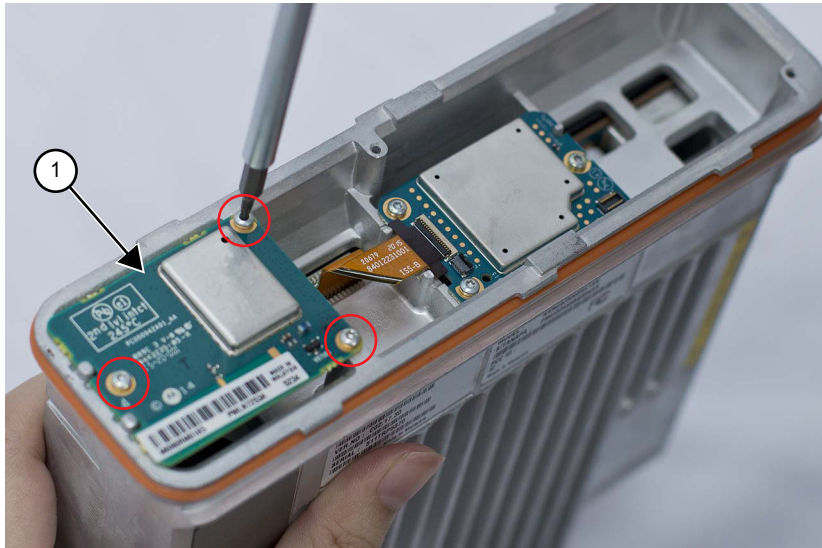
| Label | Description |
|-------|-------------|
| 1 | Top Cover |
| 2 | Chassis |

5.5.3 Transceiver Board Removal

Procedure:

- 1 Using a T6 TORX™ driver, remove the screws securing the expansion board to the chassis.

Figure 15: Expansion Board Removal (Image May Not Match Exact Product)



| Label | Description |
|-------|-----------------|
| 1 | Expansion Board |

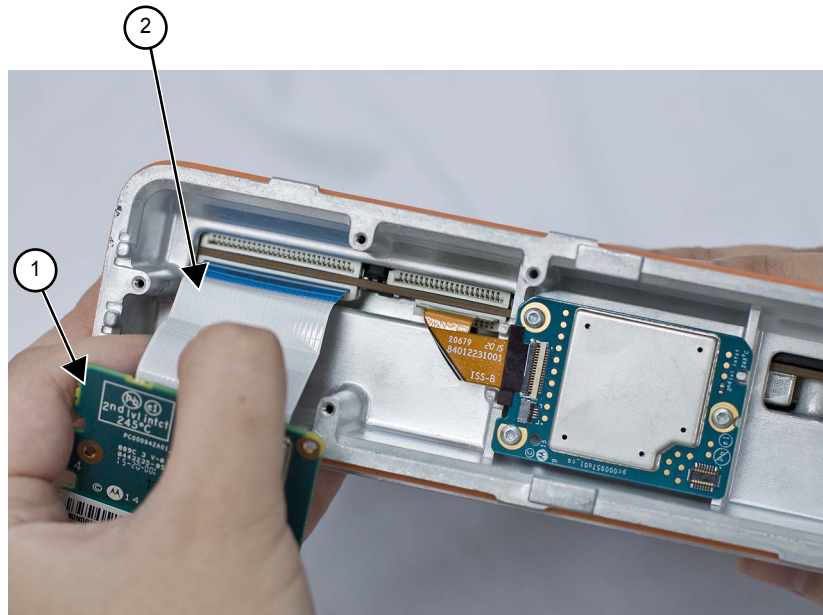
- 2 Unplug the GNSS cable MCX connector from the expansion board.



NOTICE: Disconnect the MCX connector by grabbing and pulling on the MCX connector body and not the GNSS cable itself.

- 3 Unplug the flex from the transceiver board.

Figure 16: Expansion Board Flex Removal (Image May Not Match Exact Product)



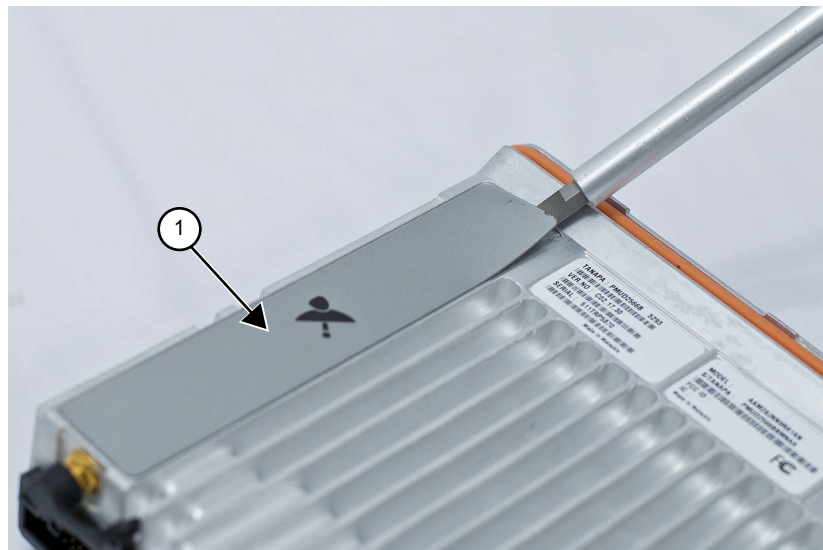
| Label | Description |
|-------|----------------------|
| 1 | Expansion Board |
| 2 | Expansion Board Flex |




NOTICE: Skip steps [step 4](#) through [step 6](#), if GNSS cable and nameplate do not require servicing.

- 4 Use a flat-blade screwdriver to lift the GNSS nameplate from the chassis.

Figure 17: GNSS Nameplate Removal

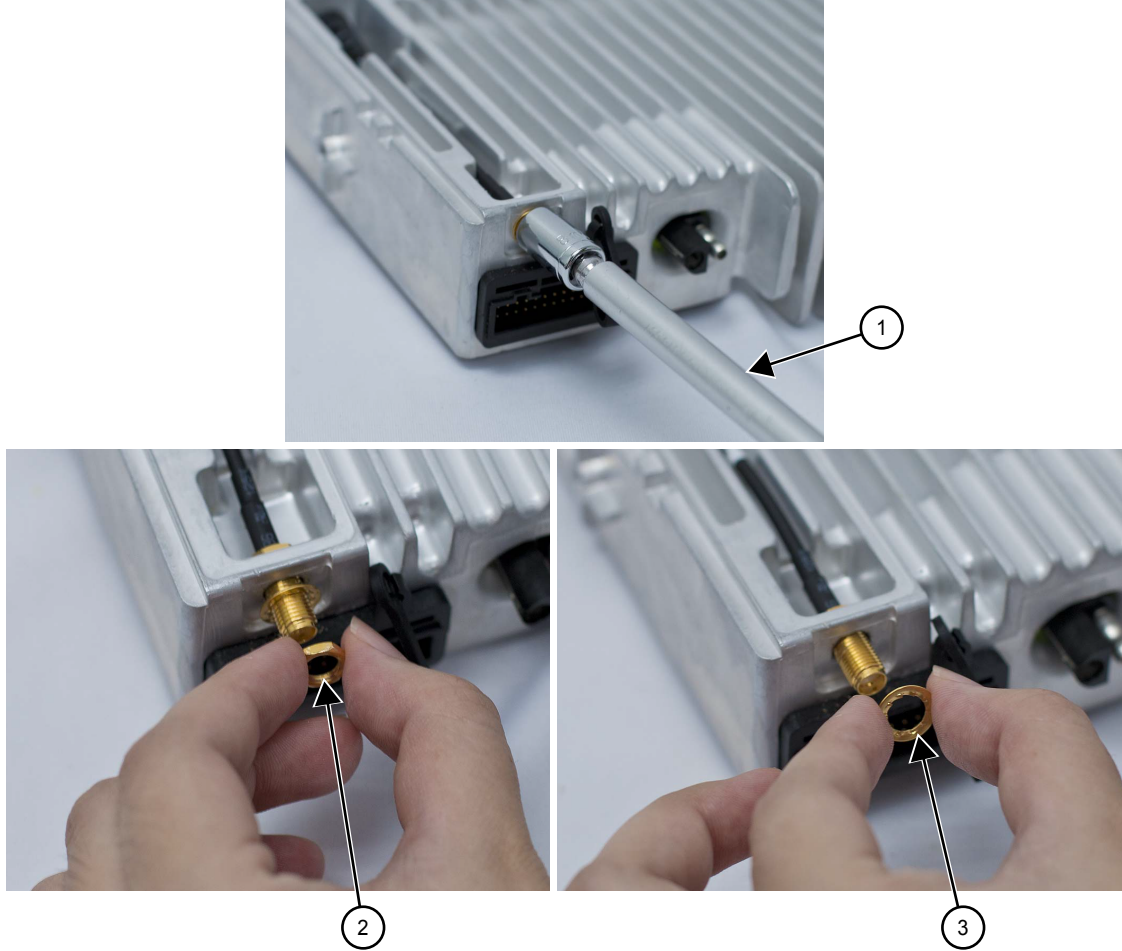


| Label | Description |
|-------|----------------|
| 1 | GNSS Nameplate |

 **NOTICE:** If the GNSS nameplate is removed, it will need to be replaced.

- 5 Using a 5/16 in. or 8 mm socket driver, remove the nut from the GNSS antenna connector and remove the lock washer from the connector.

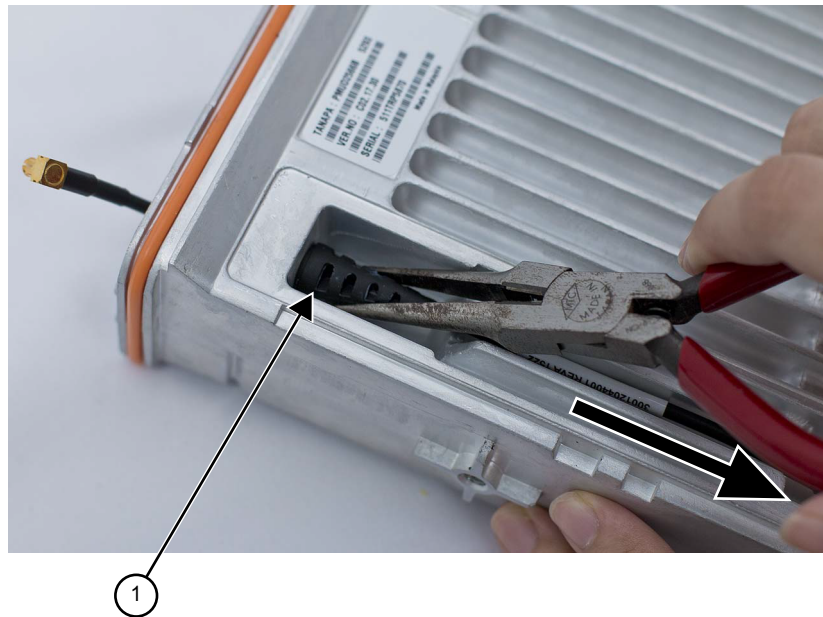
Figure 18: GNSS Connector Nut Removal



| Label | Description |
|-------|---------------|
| 1 | Socket Driver |
| 2 | Nut |
| 3 | Washer |

- 6 Remove the GNSS cable from the chassis by pulling on the GNSS cable strain relief.

Figure 19: GNSS Cable Removal

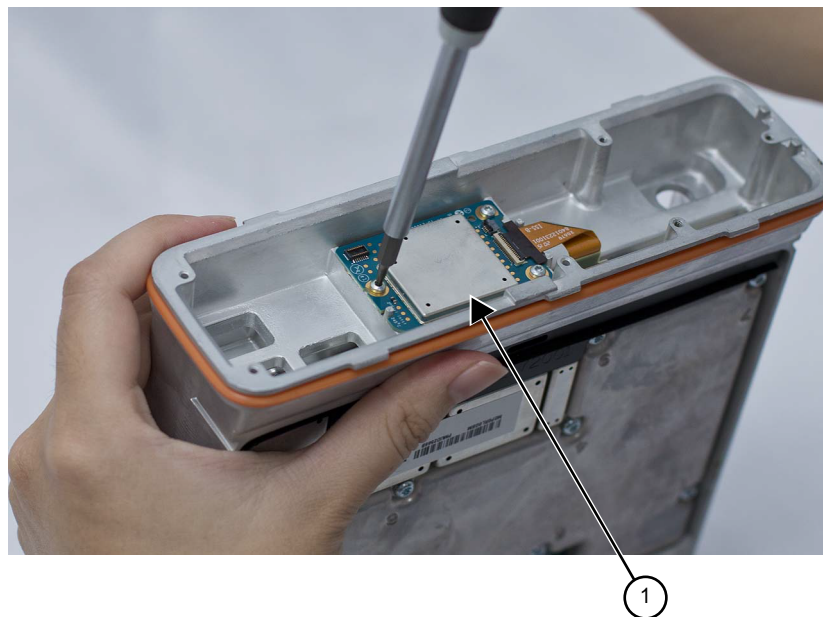


| Label | Description |
|-------|--------------------------|
| 1 | GNSS Cable Strain Relief |

Option Board Removal

- Using a T6 TORX driver, remove the screws securing the option board to the chassis.

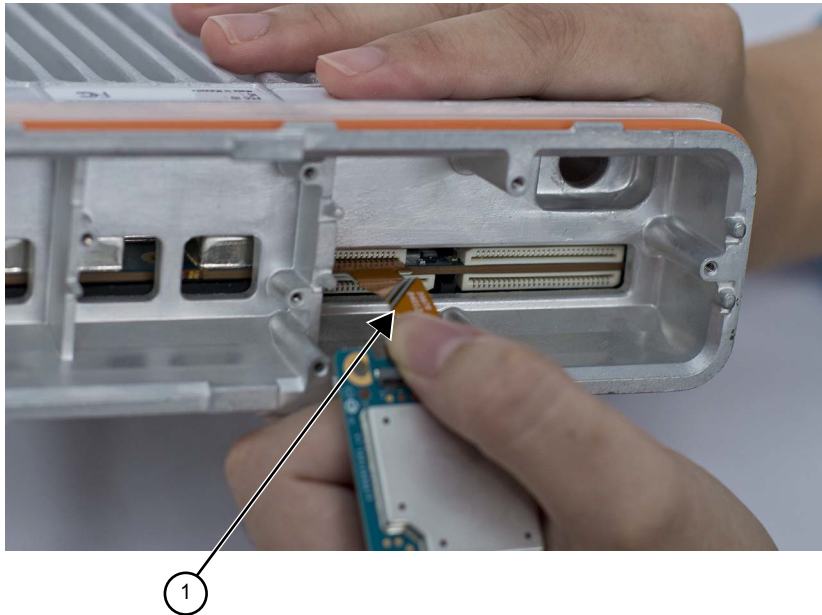
Figure 20: Option Board Removal (Image May Not Match Exact Product)



| Label | Description |
|-------|--------------|
| 1 | Option Board |

- Unplug the flex from the transceiver board.

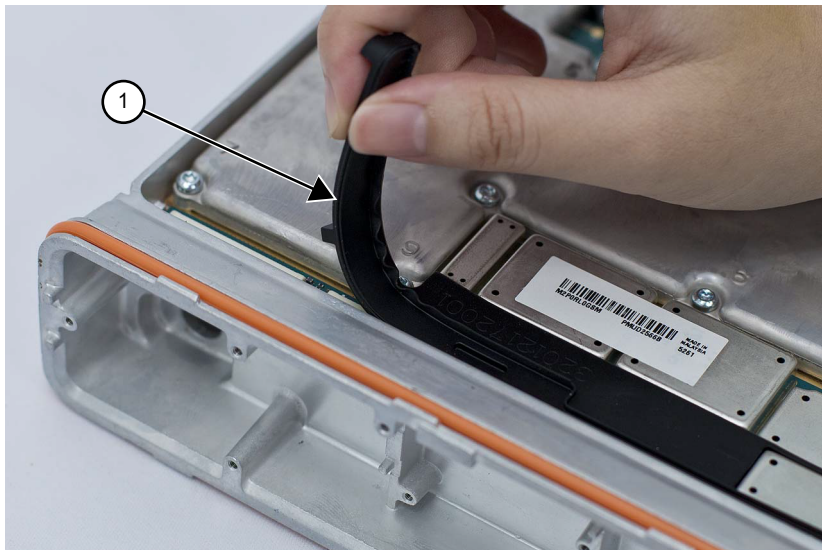
Figure 21: Option Board Flex Removal (Image May Not Match Exact Product)



| Label | Description |
|-------|-------------------|
| 1 | Option Board Flex |

- 9 Remove the acoustic plug by pulling up on it.

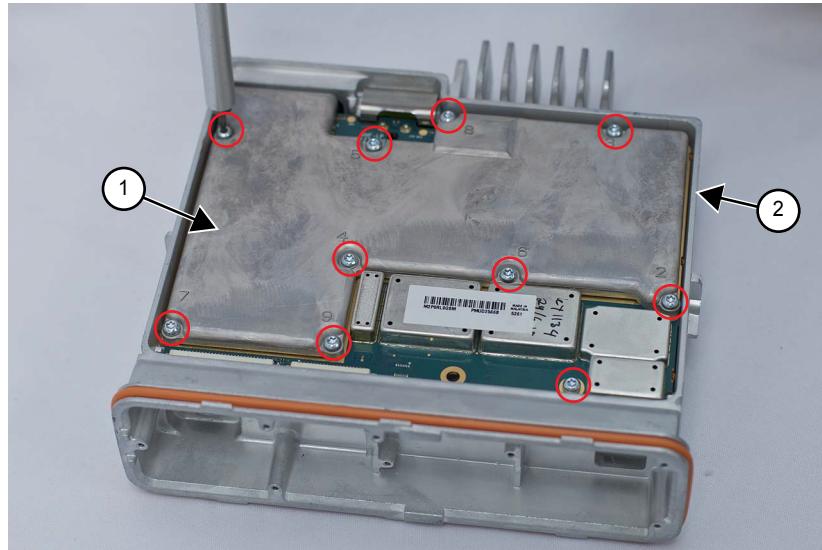
Figure 22: Acoustic Plug Removal



| Label | Description |
|-------|---------------|
| 1 | Acoustic Plug |

- 10 Remove the nine main shield screws from the die cast main shield and the PCB screw directly on the PCB using the T10 TORX™ driver.

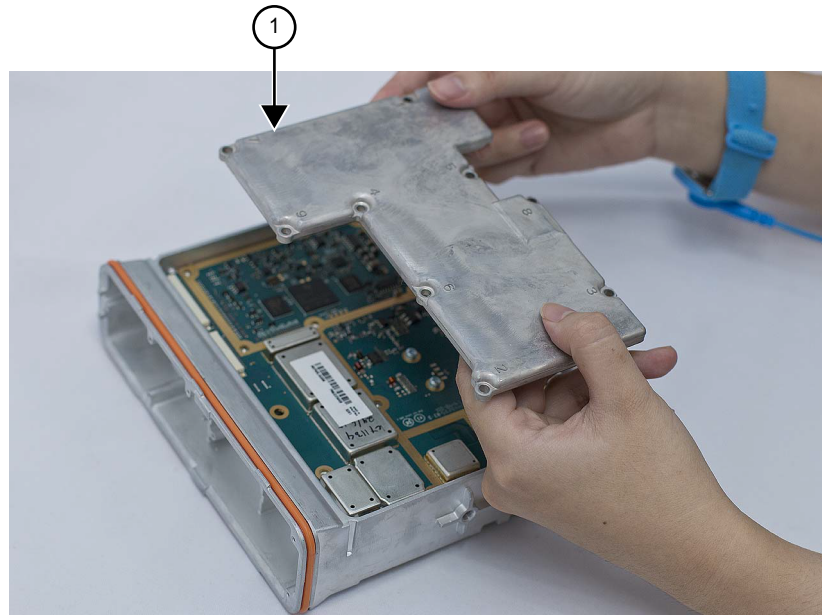
Figure 23: Main Shield and PCB Screw Removal



| Label | Description |
|-------|----------------------|
| 1 | Die Cast Main Shield |
| 2 | Radio Chassis |

11 Lift the die cast main shield from the chassis.

Figure 24: Die Cast Main Shield Removal



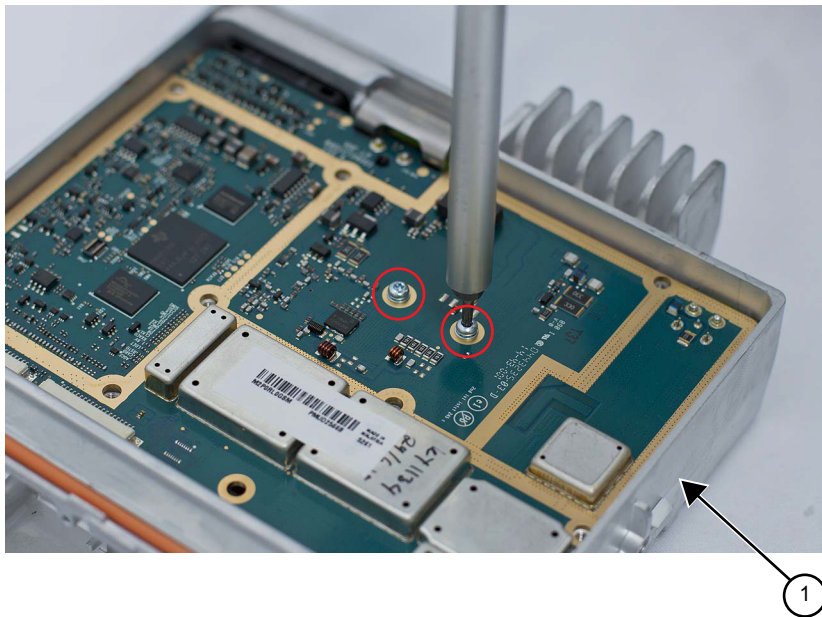
| Label | Description |
|-------|----------------------|
| 1 | Die Cast Main Shield |

12 Remove the two screws from the PCB using the T8 TORX driver.



NOTICE: Do not remove the washers from the screws.

Figure 25: PA Screw Removal

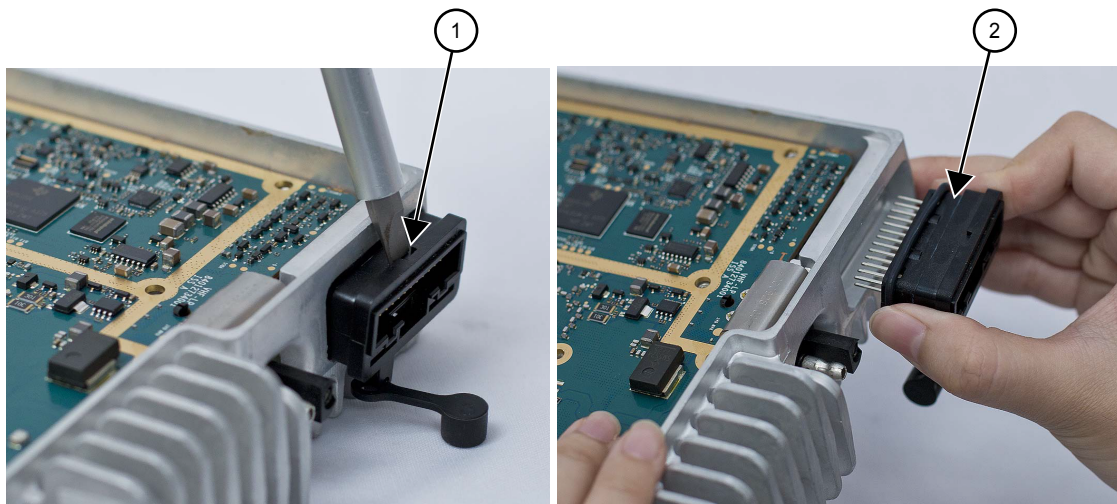


| Label | Description |
|-------|---------------|
| 1 | Radio Chassis |

- 13** Remove the accessory connector from the radio assembly by inserting a flat-blade screwdriver into the slot on the top of the connector.

CAUTION: The accessory connector should never be removed when the die cast main shield is still assembled to the radio.

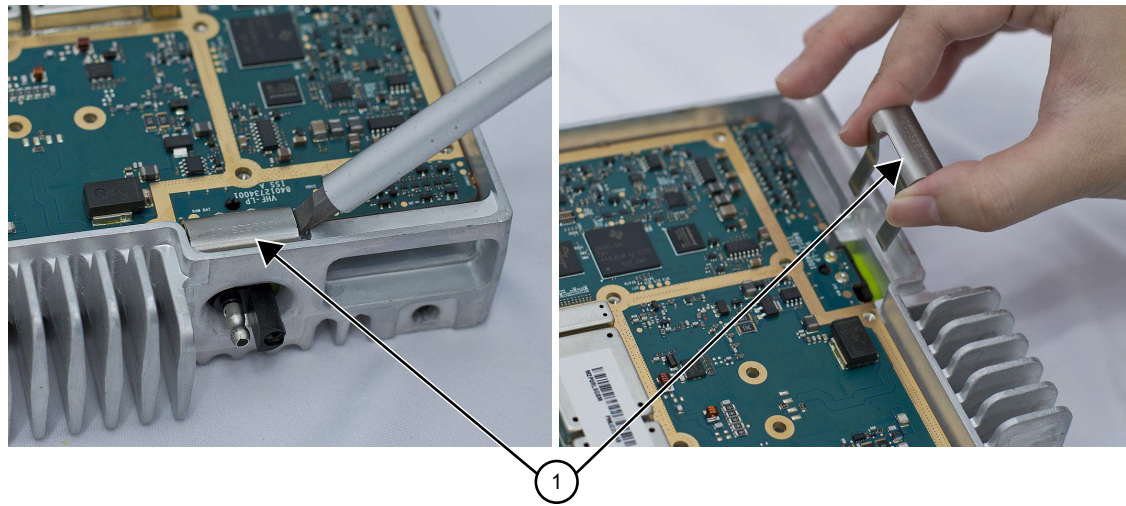
Figure 26: Accessory Connector Removal



| Label | Description |
|-------|------------------------------------|
| 1 | Insert Flat-blade Screwdriver here |
| 2 | Accessory Connector |

- 14** Remove the DC Connector retention clip by gently prying it out with a flat-blade screwdriver.

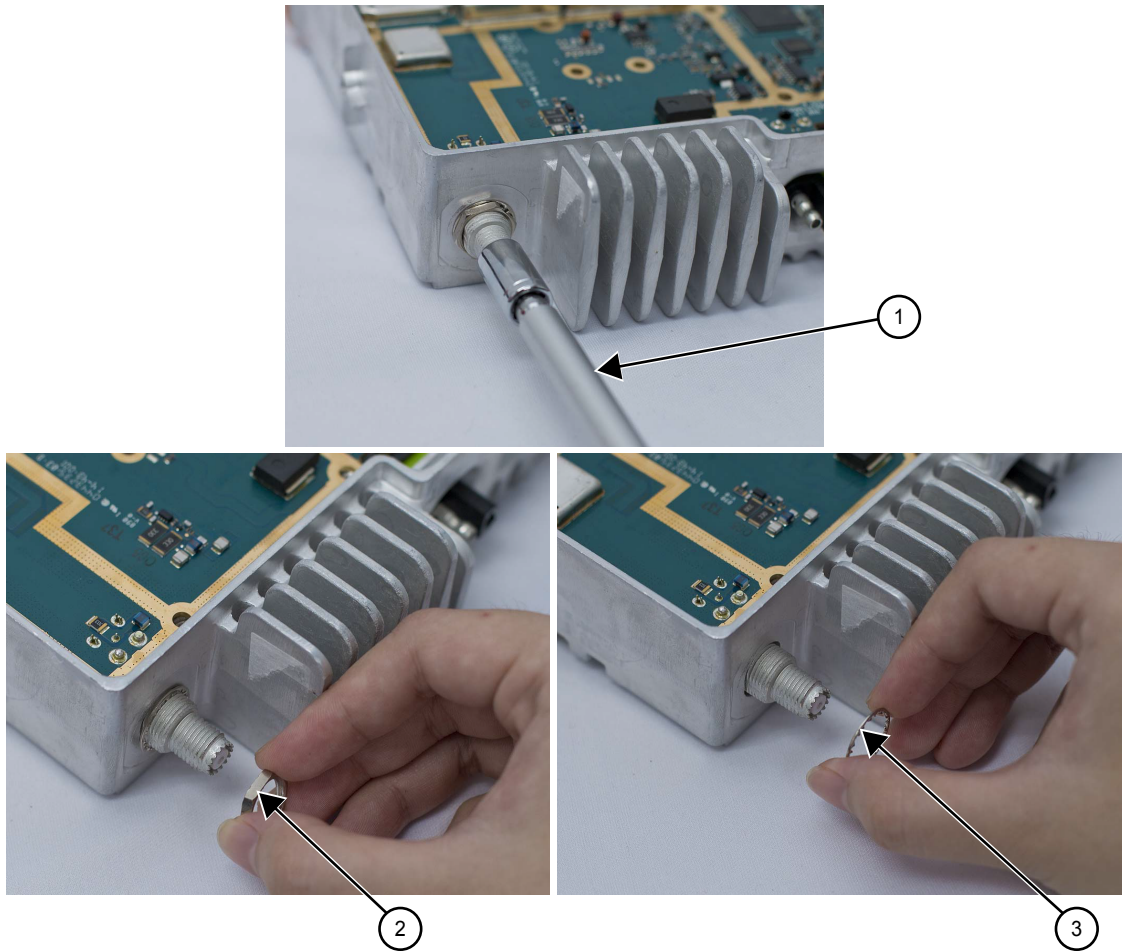
Figure 27: DC Connector Retention Clip Removal



| Label | Description |
|-------|-------------------|
| 1 | DC Retention Clip |

15 Remove the RF connector nut and lock washer using a 9/16 in. deep socket driver.

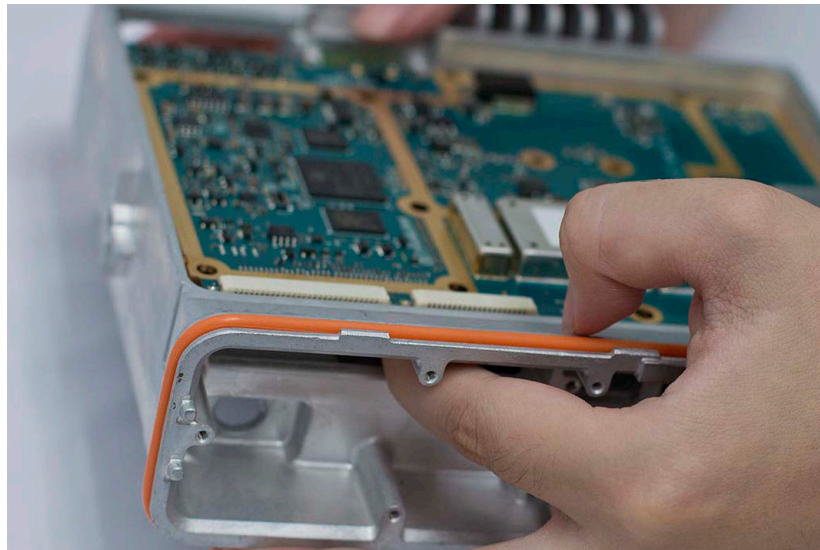
Figure 28: RF Connector Nut Removal



| Label | Description |
|-------|--------------------|
| 1 | Deep Socket Driver |
| 2 | RF Connector Nut |
| 3 | Lock Washer |

- 16** Remove the transceiver board by sliding a finger into the opening provided at the front of the radio and gently pressing up on the PCB between the connectors, lifting up the front of the transceiver board. Then, slide the transceiver board towards the front of the radio to allow the RF/DC connectors to clear the chassis. Handle the transceiver board by the edges only and store it in an antistatic bag.

Figure 29: Transceiver Board Removal

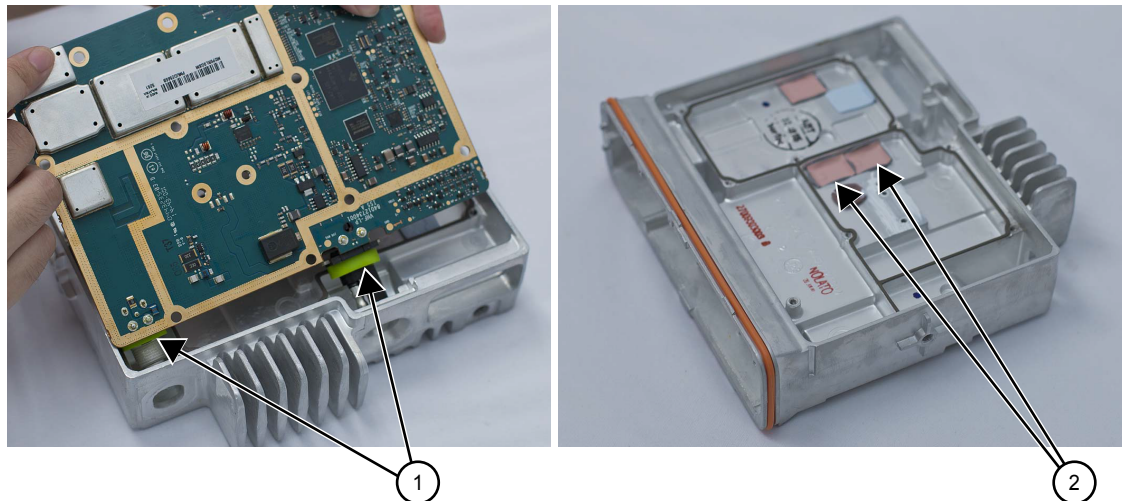


CAUTION: The thermal pads can act as an adhesive and cause stress to critical components on the transceiver board if the transceiver board is lifted too quickly.



NOTICE: If the RF/DC connector gaskets remain in the chassis, remove them and place them back on the connectors. Every time the Transceiver Board is removed, the Final Driver Thermal Pad must be replaced.

Figure 30: Removing Gaskets and Replacing Final Driver Thermal Pad



| Label | Description |
|-------|---------------------------|
| 1 | Gaskets |
| 2 | Final Driver Thermal Pads |

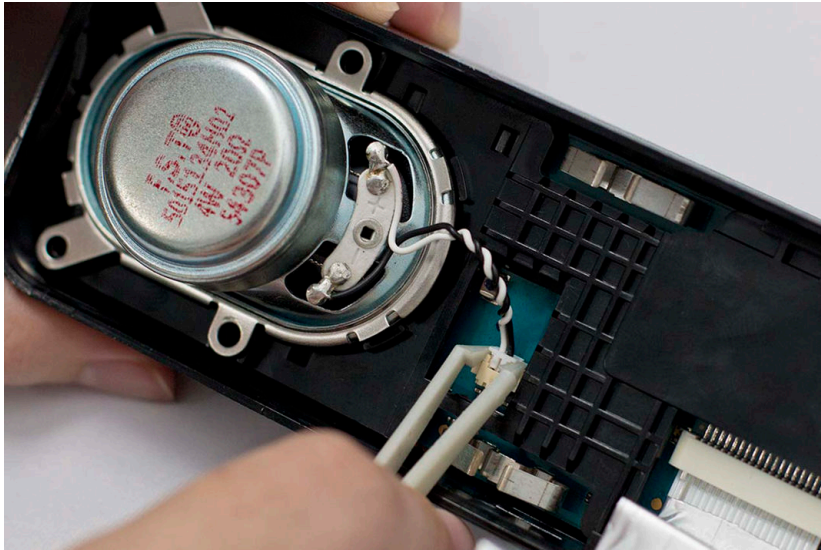
5.5.4

Disassembly of Color Display Control Head

Procedure:

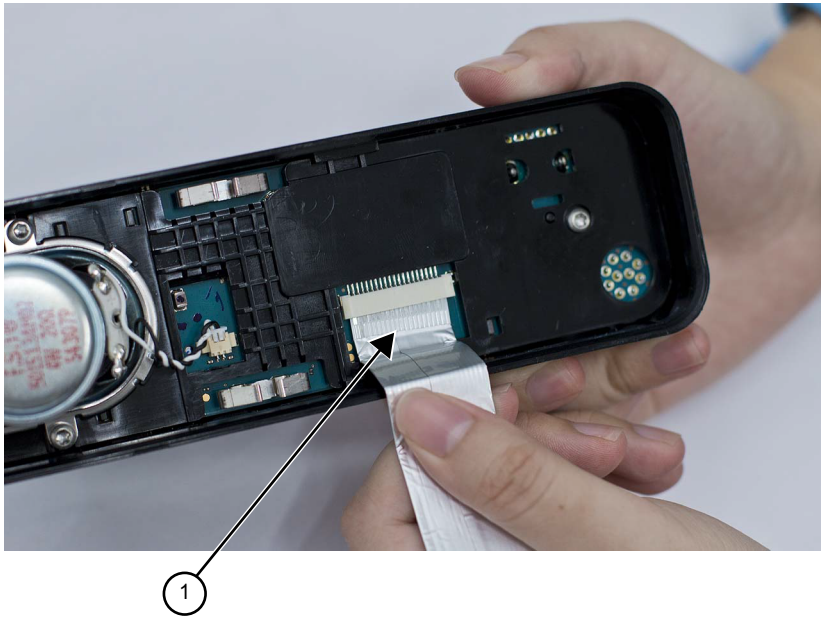
- 1 Disconnect the speaker plug from the control head board using a pair of tweezers.

Figure 31: Speaker Plug Removal



- 2 Unplug the control head flex from the control head board by gently pulling the flex out of the connector.

Figure 32: Control Head Flex Removal



| Label | Description |
|-------|-------------------|
| 1 | Control Head Flex |

- 3 Remove the volume/channel knob from the control head housing by lifting it with the volume/channel knob removal tool.

Figure 33: Volume/Channel Knob Removal



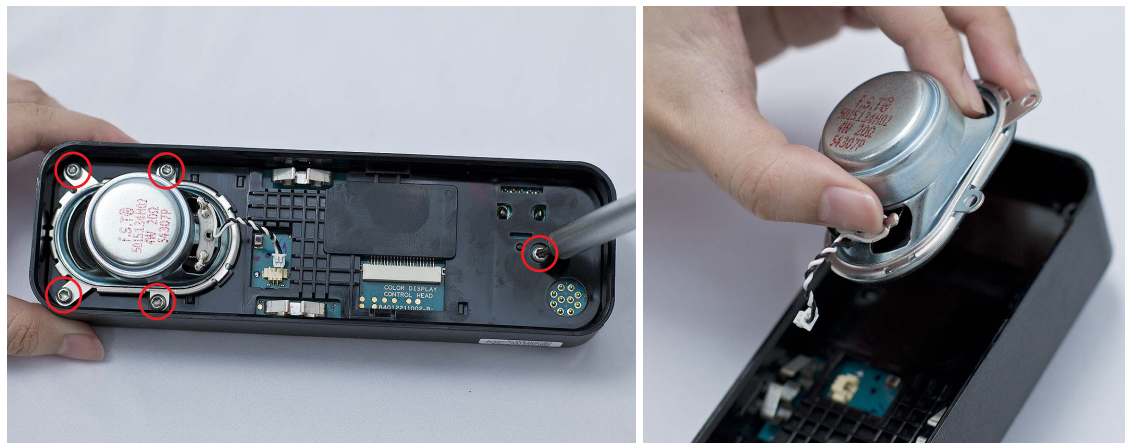
| Label | Description |
|-------|---------------------|
| 1 | Volume/Channel Knob |

- 4 Remove the five screws from the control head board using the T10 TORX™ driver.
- 5 Remove the speaker.



NOTICE: Remove the speaker retainer only if required.

Figure 34: Control Head Screws and Speaker Removal



- 6 Gently spread the side walls of the control head housing to release the PCB retainer tabs from the housing.

Figure 35: PCB Retainer Removal



- 7 Remove the control head board from the control head assembly by pressing on the keypad buttons and mic jack. Handle the control head board by the edges only and store it in an antistatic bag.


 **NOTICE:** Do not touch or contaminate the conductive contacts on the control head PCB.

Figure 36: Control Head Board Removal



| Label | Description |
|-------|--------------------|
| 1 | Control Head Board |

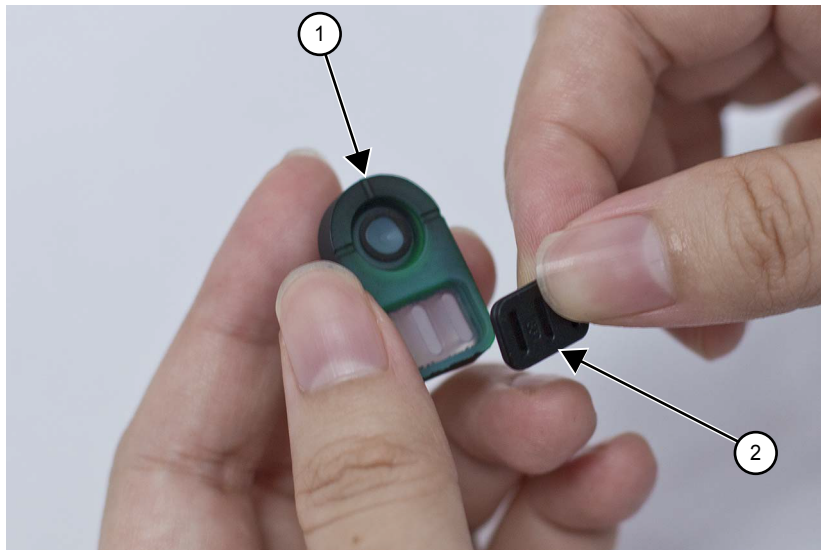
- 8 Remove the power button by lifting it from the control head housing.

Figure 37: Power Button Removal



- 9 Separate the light barrier from the power button, if required.

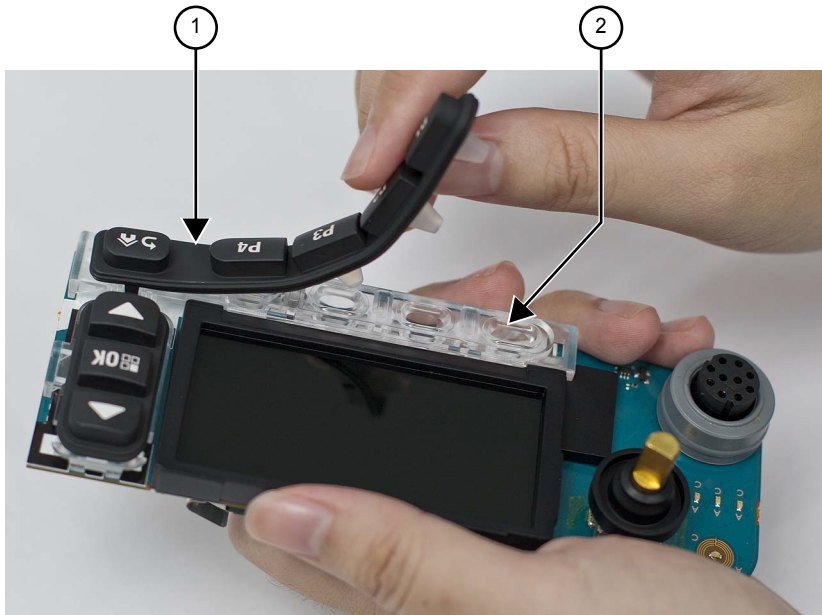
Figure 38: Light Barrier Removal



| Label | Description |
|-------|---------------|
| 1 | Power Button |
| 2 | Light Barrier |

- 10 Separate the keypad from the keypad frame.

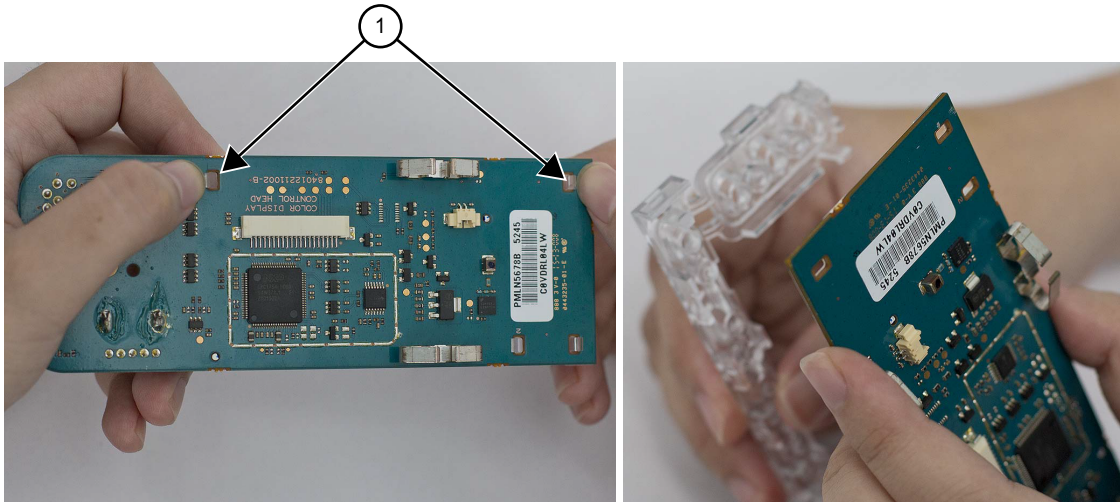
Figure 39: Separating Keypad from Keypad Frame



| Label | Description |
|-------|--------------|
| 1 | Keypad |
| 2 | Keypad Frame |

- 11** Remove the keypad frame from the control head board by compressing the retaining latch features.

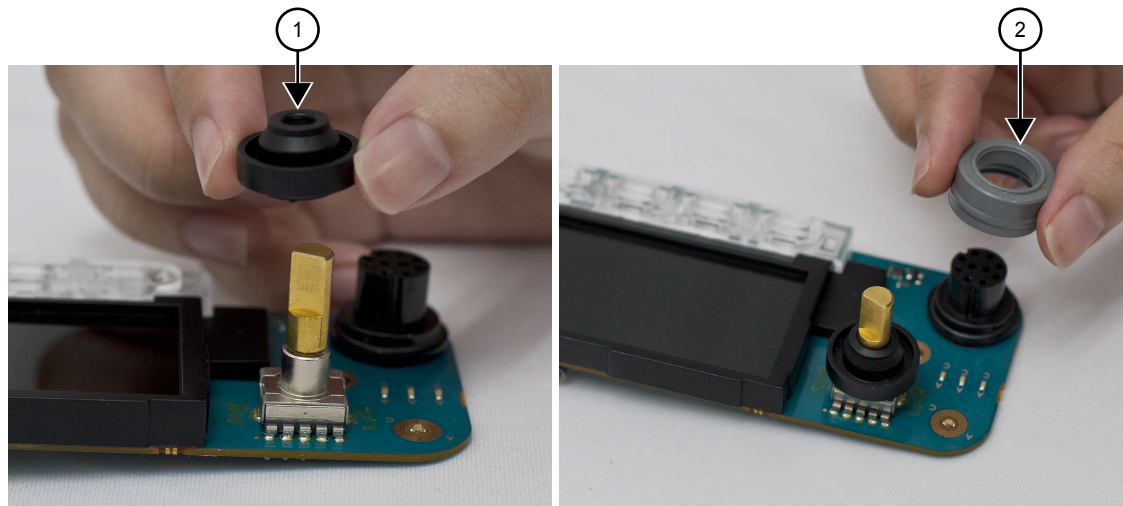
Figure 40: Keypad Removal



| Label | Description |
|-------|--------------------------|
| 1 | Retaining Latch Features |

- 12** Separate the volume encoder seal and mic jack seal from the control head board.

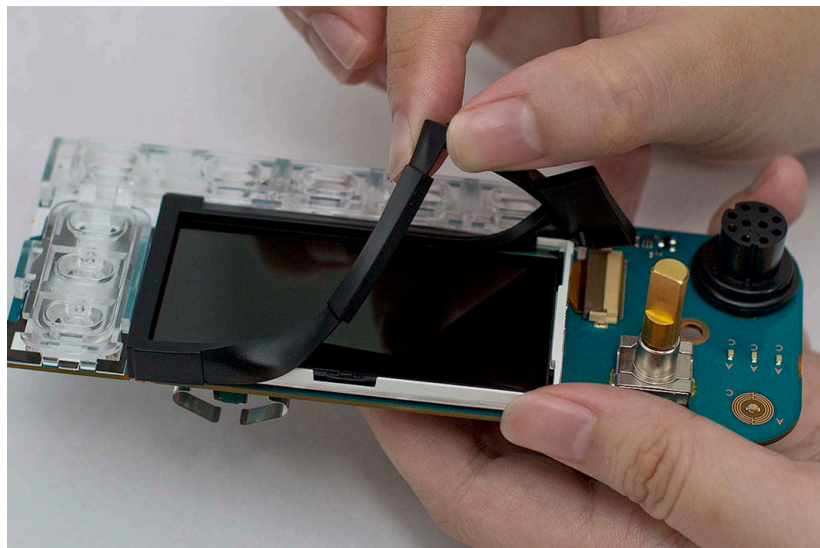
Figure 41: Volume Encoder Seal and Mic Jack Seal Removal



| Label | Description |
|-------|---------------------|
| 1 | Volume Encoder Seal |
| 2 | Mic Jack Seal |

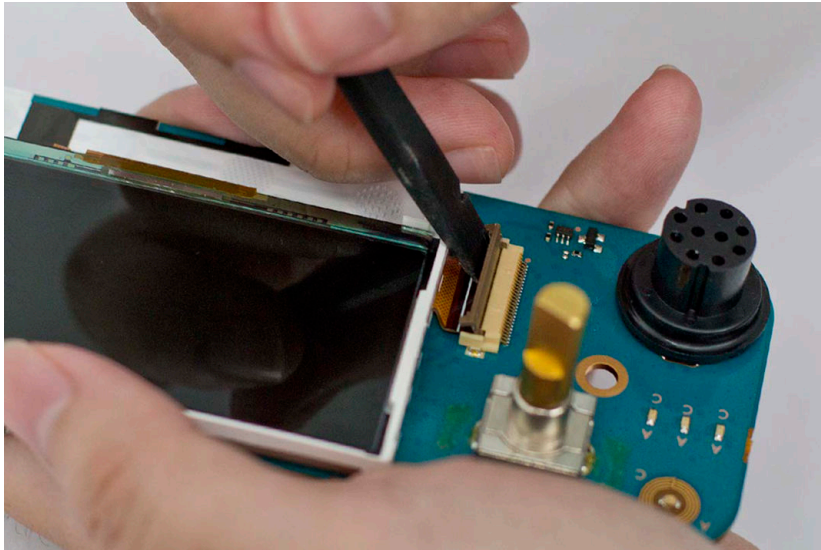
13 Separate the display pad gasket from the color display.

Figure 42: Display Pad Gasket Removal



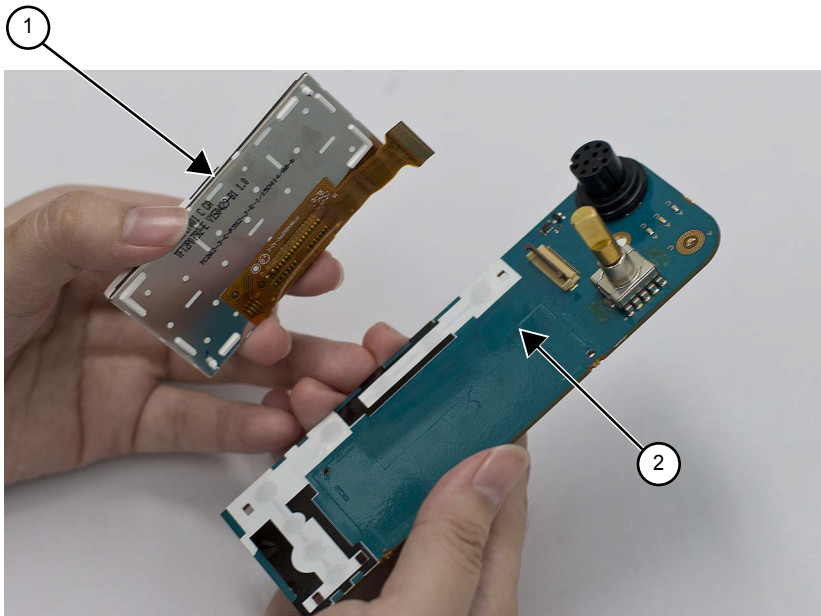
14 Disconnect the display flex from the connector on the PCB.

Figure 43: Display Flex Removal



15 Gently pull or lift on one side of the display to slowly separate the display from the adhesive.

Figure 44: Color Display Removal from PCB



| Label | Description |
|-------|---------------|
| 1 | Color Display |
| 2 | Adhesive |

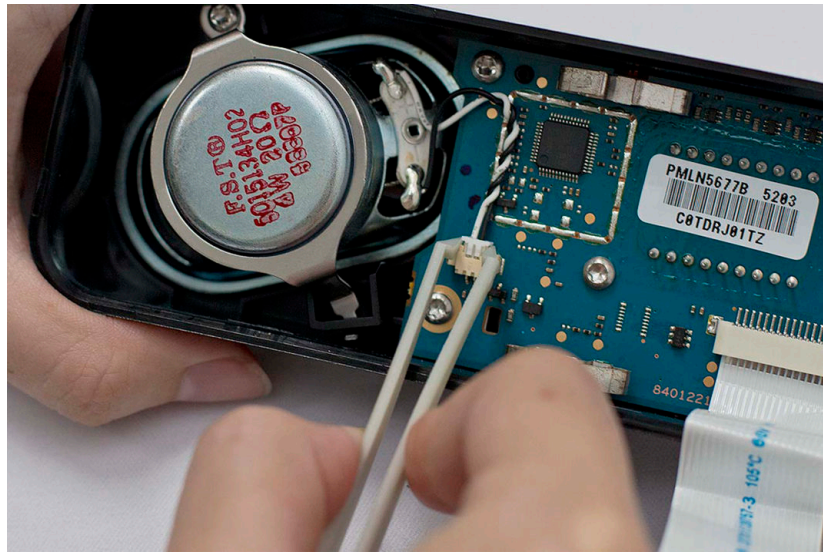
5.5.5

Disassembly of Numeric Display Control Head

Procedure:

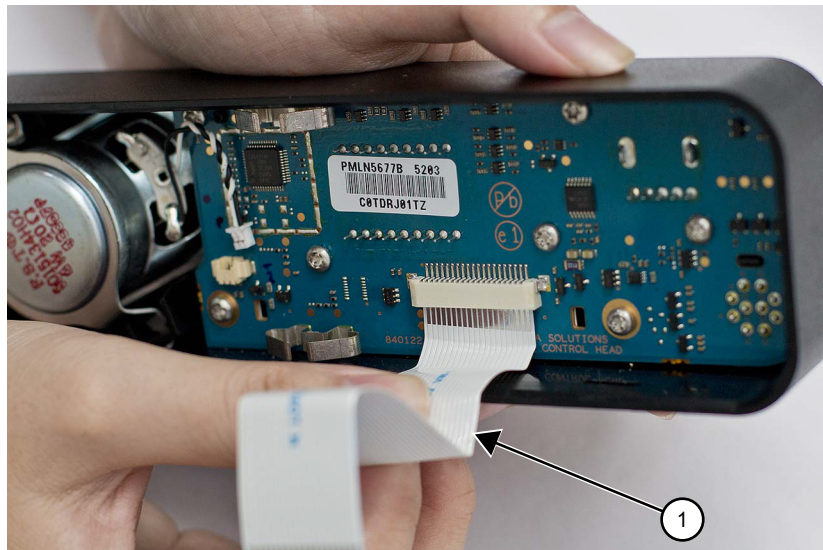
- 1 Disconnect the speaker plug from the control head board using a pair of tweezers.

Figure 45: Speaker Plug Removal



- 2 Unplug the control head flex from the control head board by gently pulling the flex out of the connector.

Figure 46: Control Head Flex Removal



| Label | Description |
|-------|-------------------|
| 1 | Control Head Flex |

- 3 Remove the volume/channel knob from the control head housing by lifting it with the volume/channel knob removal tool.

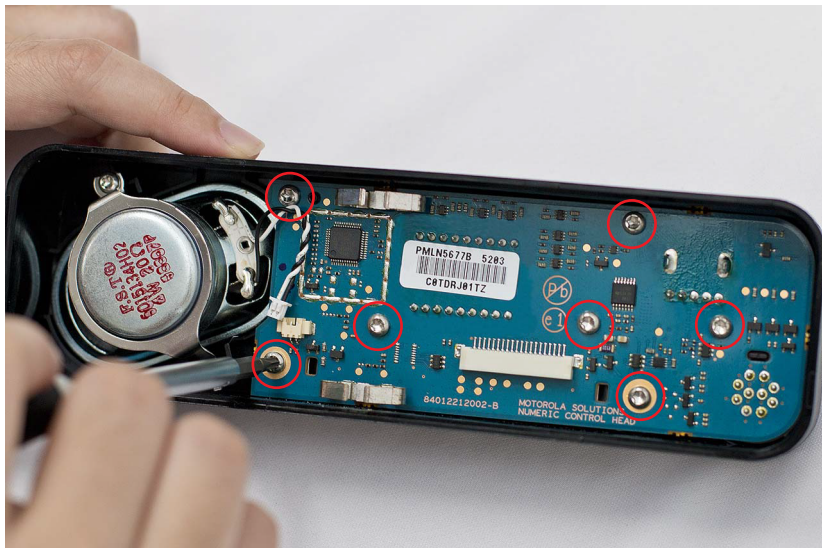
Figure 47: Volume/Channel Knob Removal



| Label | Description |
|-------|---------------------|
| 1 | Volume/Channel Knob |

- 4 Remove the seven screws from the control head board using the T10 TORX™ driver.

Figure 48: Control Head Board Screw Removal



- 5 Remove the control head board from the control head assembly by pressing on the mic jack. Handle the control head board by the edges only and store it in an antistatic bag.


 **NOTICE:** Do not touch or contaminate the conductive contacts on the control head board.

Figure 49: Control Head Board Removal



| Label | Description |
|-------|--------------------|
| 1 | Mic Jack |
| 2 | Control Head Board |

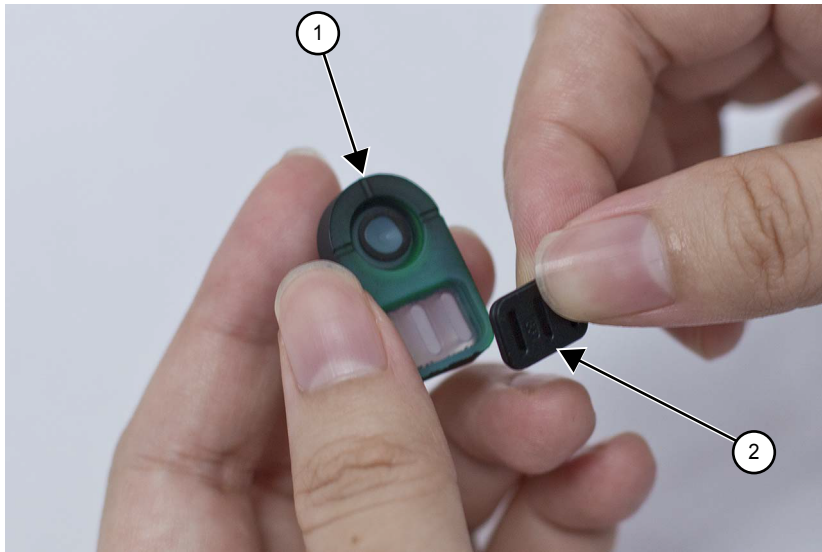
- 6 Remove the power button by lifting it from the control head housing.

Figure 50: Power Button Removal



- 7 Separate the light barrier from the power button, if required.

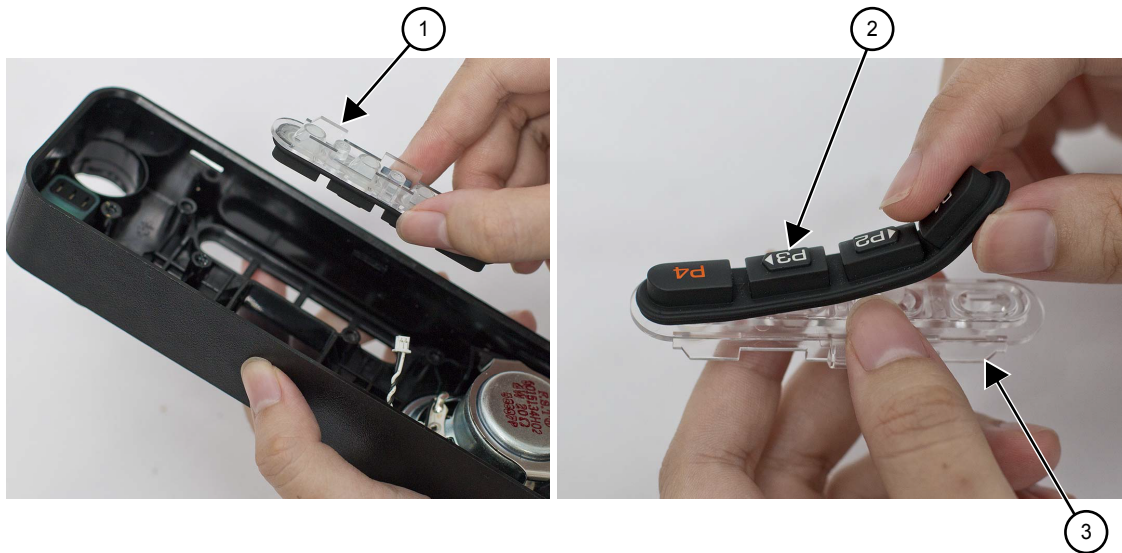
Figure 51: Light Barrier Removal



| Label | Description |
|-------|---------------|
| 1 | Power Button |
| 2 | Light Barrier |

- 8 Remove the keypad assembly from the control head housing by pushing on the keypad.
- 9 Separate the keypad from the keypad frame.

Figure 52: Power Button and Keypad Removal



| Label | Description |
|-------|-----------------|
| 1 | Keypad Assembly |
| 2 | Keypad |
| 3 | Keypad Frame |

Optional: If required, the speaker can be removed by removing the speaker retainer from the control head housing using the T10 TORX driver to remove the screw and unhook the retainer from the control head housing.

10 Remove the speaker from the control head housing.



NOTICE: Remove the speaker retainer only if required.

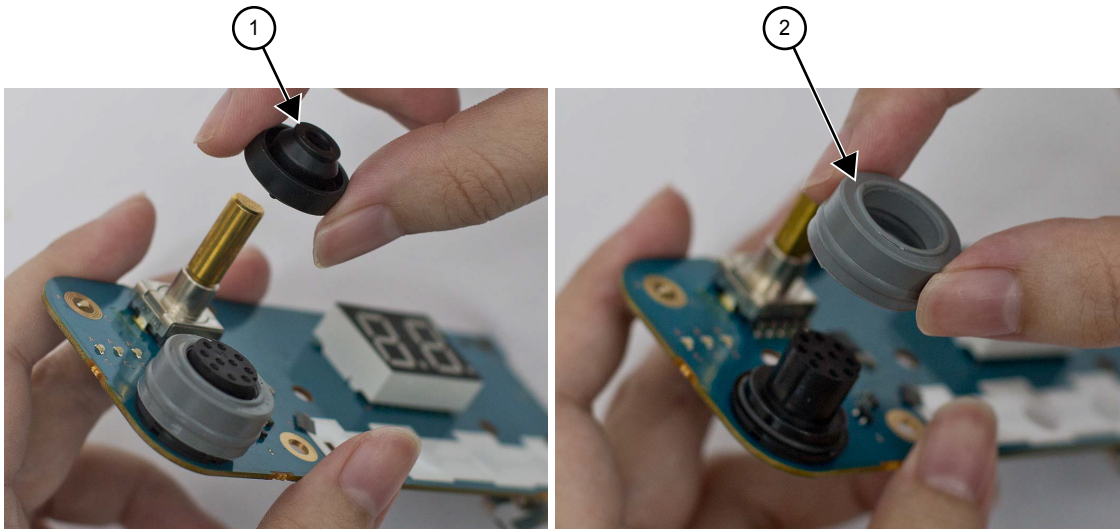
Figure 53: Speaker Removal (Optional)



| Label | Description |
|-------|------------------|
| 1 | Speaker |
| 2 | Speaker Retainer |

11 Separate the volume encoder seal and mic jack seal from the control head board.

Figure 54: Volume Encoder Seal and Mic Jack Seal Removal



| Label | Description |
|-------|---------------------|
| 1 | Volume Encoder Seal |
| 2 | Mic Jack Seal |

5.6

Detailed Radio Reassembly

The section describes the detailed reassembly procedure of your radio.

5.6.1

Color Display Control Head

Procedure:

- 1 Assemble the power button and light barrier and then place the subassembly inside the control head housing.

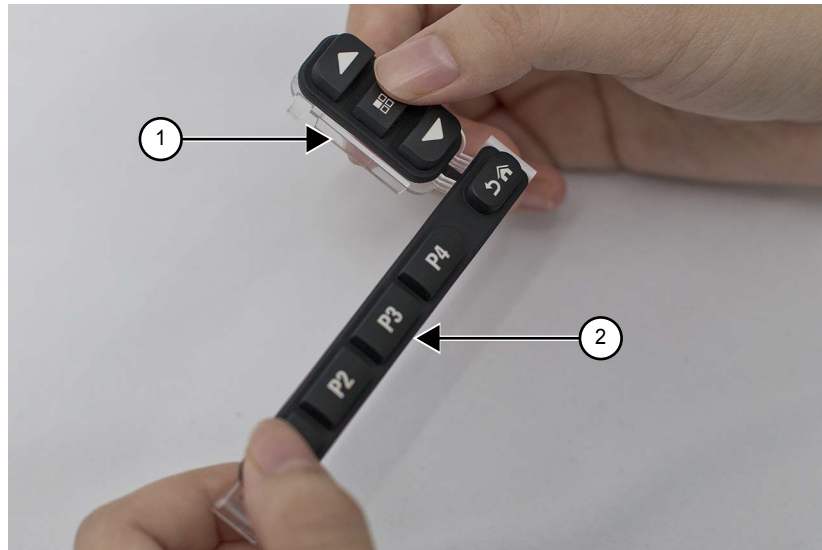
Figure 55: Power Button Placement



| Label | Description |
|-------|--------------|
| 1 | Power Button |

- 2 Assemble the keypad to the keypad frame.
 - a If attached to the control head board, remove by compressing the retaining latch features.

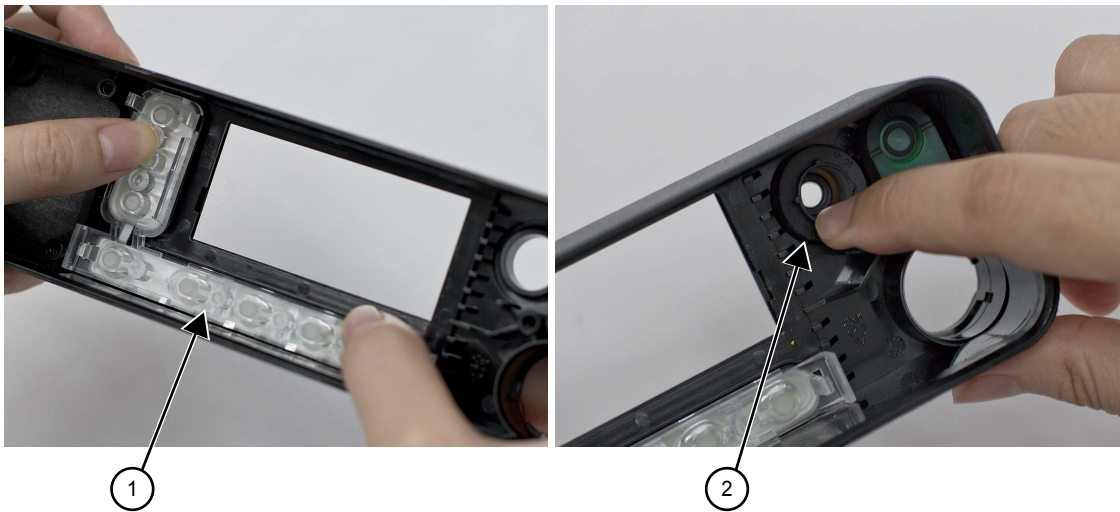
Figure 56: Keypad Assembly



| Label | Description |
|-------|--------------|
| 1 | Keypad Frame |
| 2 | Keypad |

- 3 Assemble the keypad frame assembly and volume encoder seal to the control head housing until fully seated.

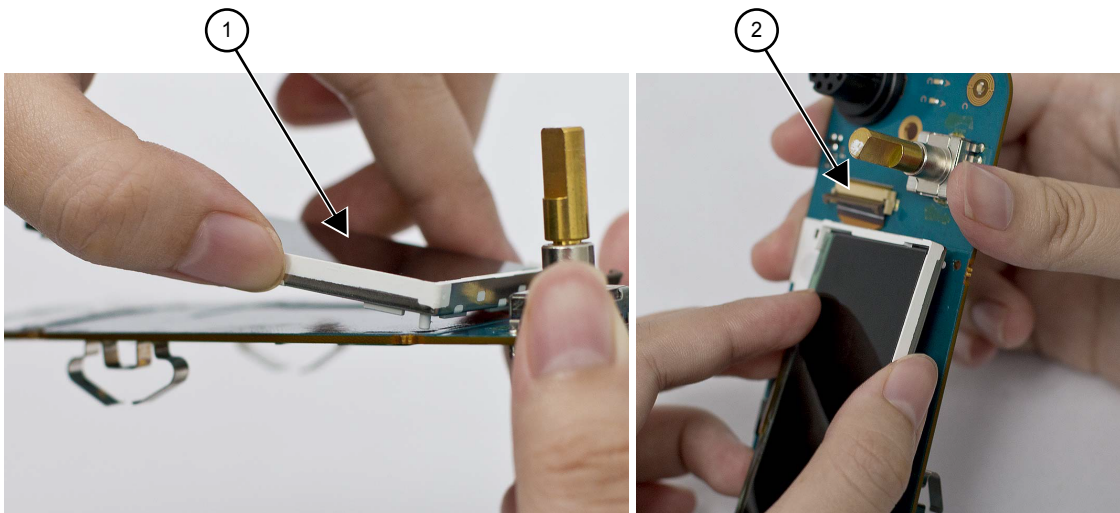
Figure 57: Assembly to Control Head Housing



| Label | Description |
|-------|-----------------------|
| 1 | Keypad Frame Assembly |
| 2 | Volume Encoder Seal |

- 4 Align the color display alignment pins to the PCB holes.
- 5 Insert the display flex to the connector on the PCB.

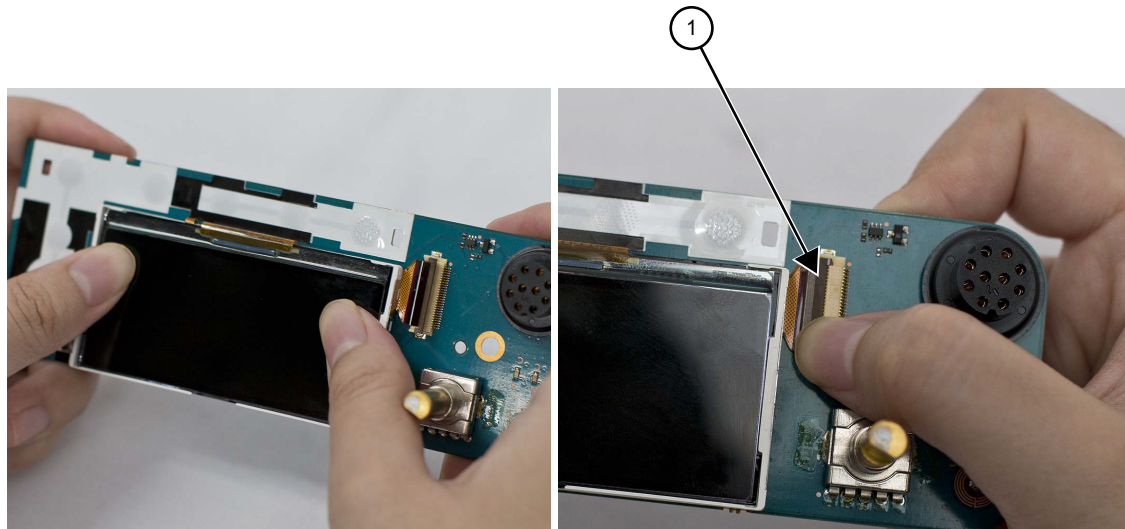
Figure 58: Assembling Color Display to PCB



| Label | Description |
|-------|---------------|
| 1 | Color Display |
| 2 | Connector |

- 6 Firmly press along the outer perimeter of the display to activate the adhesion of the display to the display adhesive.
- 7 Close the flex.

Figure 59: Pressing Along Outer Perimeter of Display and Closing Flex



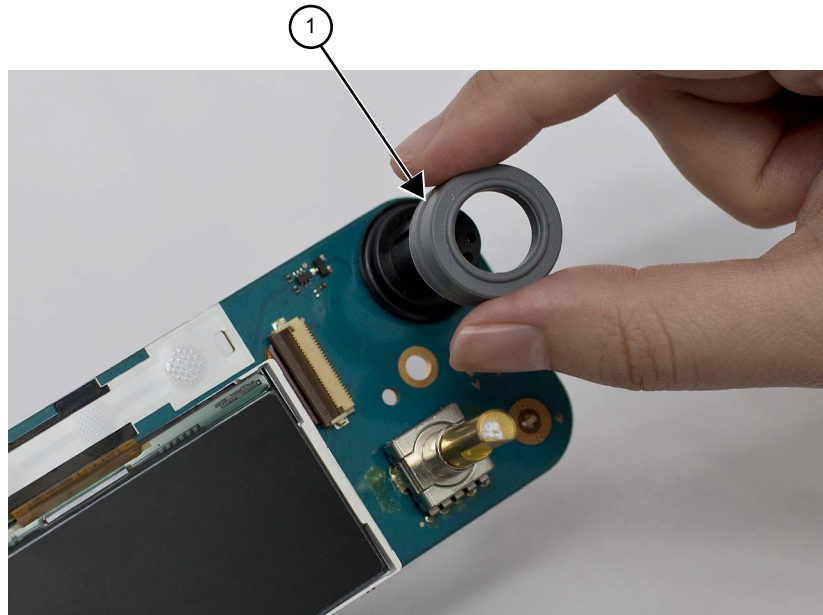
| Label | Description |
|-------|-------------|
| 1 | Close Flex |

- 8 Assemble the mic jack seal around the mic jack. Be sure to place mic jack seal flush to the PCB.



NOTICE: Make sure the mic jack is free from dust or debris.

Figure 60: Assembling Mic Jack Seal

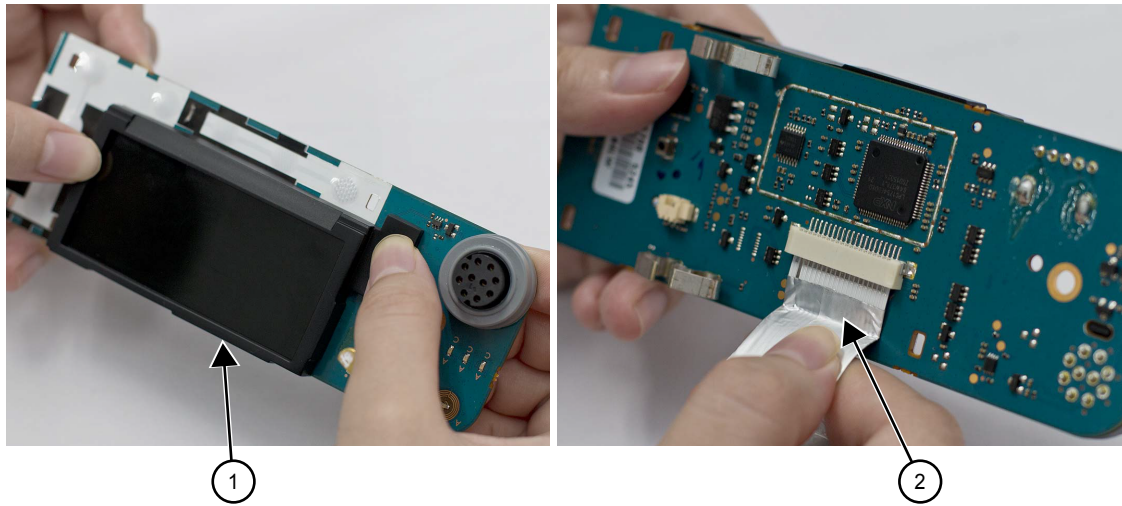


| Label | Description |
|-------|---------------|
| 1 | Mic Jack Seal |

- 9 Assemble the display pad gasket to the display.

- 10** Assemble the control head flex to the mating connector on the control head board, making sure it is fully seated.

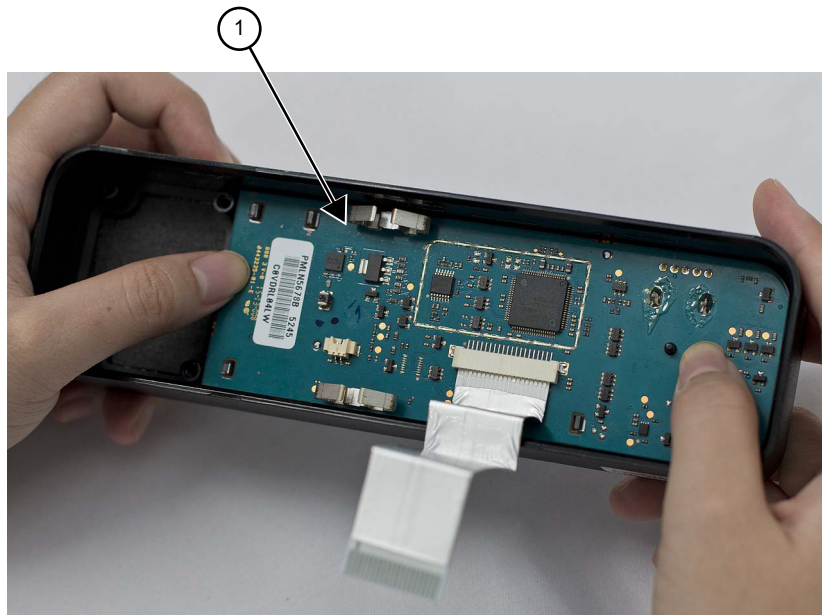
Figure 61: Assembling Display Pad Gasket and Control Head Flex



| Label | Description |
|-------|--------------------|
| 1 | Display Pad Gasket |
| 2 | Control Head Flex |

- 11** Assemble the control head board to the control head assembly.

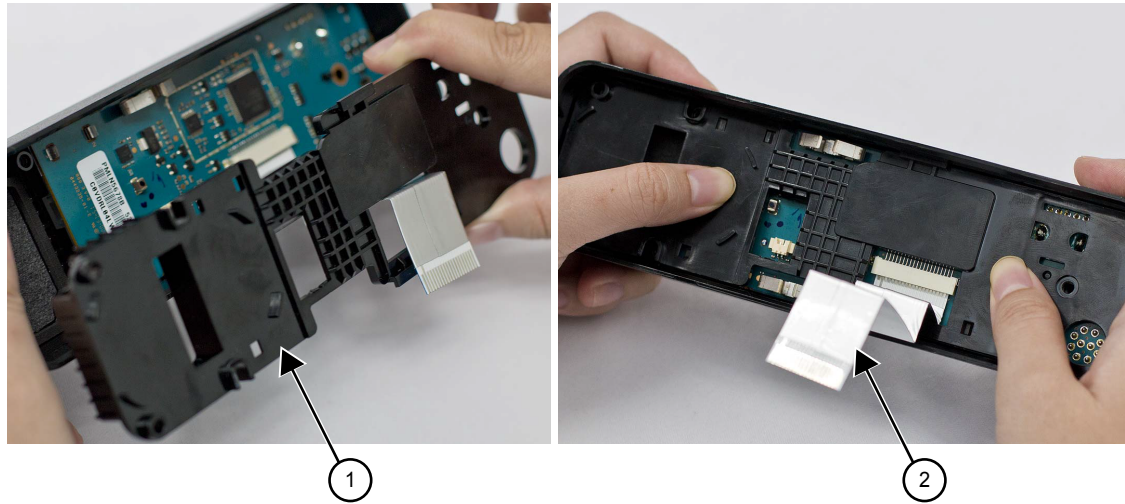
Figure 62: Assembling Control Head Board to Control Head Assembly



| Label | Description |
|-------|-----------------------|
| 1 | Control Head Assembly |

- 12** Assemble the PCB retainer to the control head assembly until it is fully seated. You will need to feed the control head flex through the PCB retainer.

Figure 63: Assembling PCB Retainer



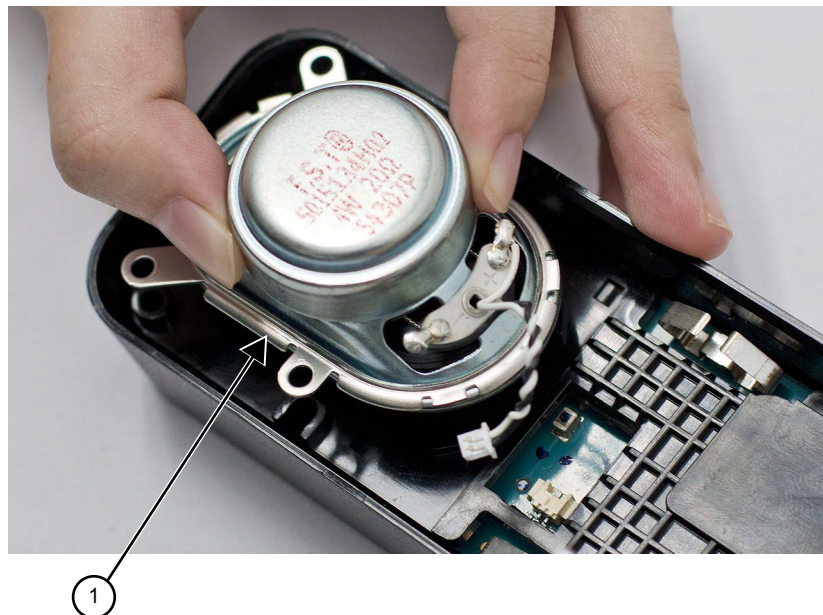
| Label | Description |
|-------|-------------------|
| 1 | PCB Retainer |
| 2 | Control Head Flex |

13 Assemble the speaker retainer to the speaker. It will snap over the speaker magnet.



NOTICE: Be sure to orient the speaker in the direction of the wire and connector towards the middle of the control head.

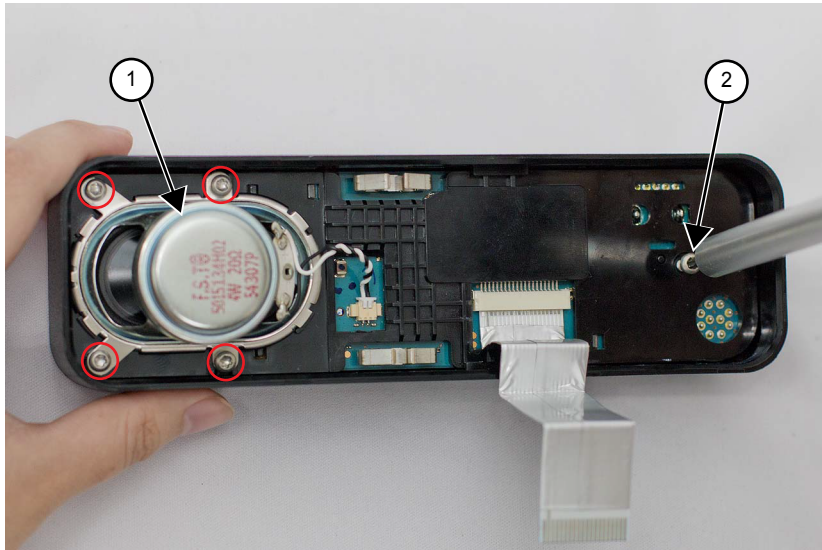
Figure 64: Assembling Speaker Retainer



| Label | Description |
|-------|------------------|
| 1 | Speaker Retainer |

14 Assemble the speaker to the control head assembly. Assemble the screws in a cross pattern with the single PCB screw installed last.

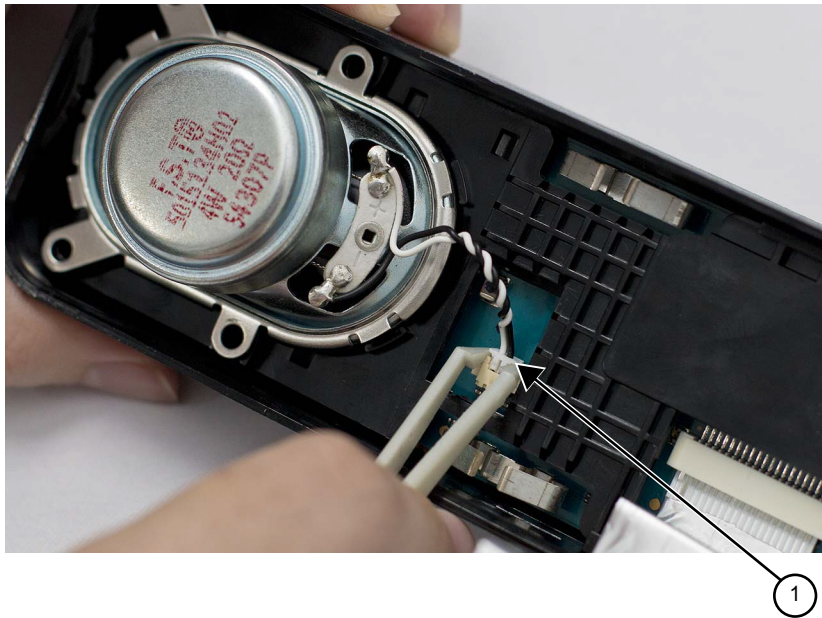
Figure 65: Assembling Speaker



| Label | Description |
|-------|-------------|
| 1 | Speaker |
| 2 | PCB Screw |

15 Connect the speaker plug to its mating connector on the control head board.

Figure 66: Assembling Speaker Plug



| Label | Description |
|-------|--------------|
| 1 | Speaker Plug |

16 Orientate the volume/channel knob so that the internal D-shaped opening matches the volume encoder shaft and press the volume/channel knob into the control head assembly until it is fully seated and the knob rotates freely.

Figure 67: Volume/Channel Knob Assembly



| Label | Description |
|-------|----------------------|
| 1 | Volume Encoder Shaft |
| 2 | Volume/Channel Knob |

5.6.2

Numeric Display Control Head

Procedure:

- 1 Assemble the power button and light barrier and then place the subassembly inside the control head housing.

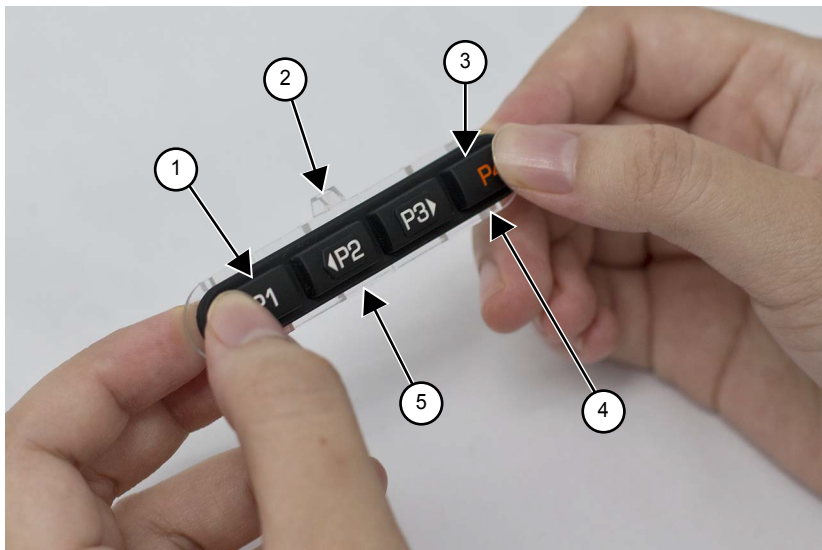
Figure 68: Power Button Placement



| Label | Description |
|-------|--------------|
| 1 | Power Button |

- 2 Assemble the keypad to the keypad frame. Note the orientation of keypad to keypad frame.

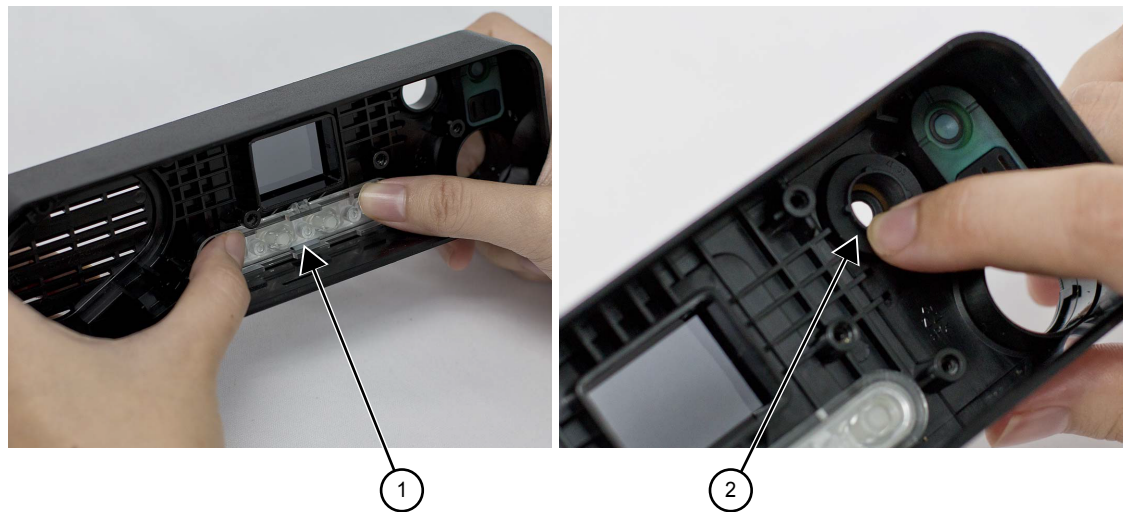
Figure 69: Keypad Assembly



| Label | Description |
|-------|-------------------------------------|
| 1 | Keypad |
| 2 | Alignment Feature |
| 3 | P4 Key (Red) |
| 4 | Keypad Frame |
| 5 | Lettering should Read Left to Right |

- 3 Assemble the keypad frame assembly and volume encoder seal to the control head housing until they are fully seated.

Figure 70: Assembly to Control Head Housing



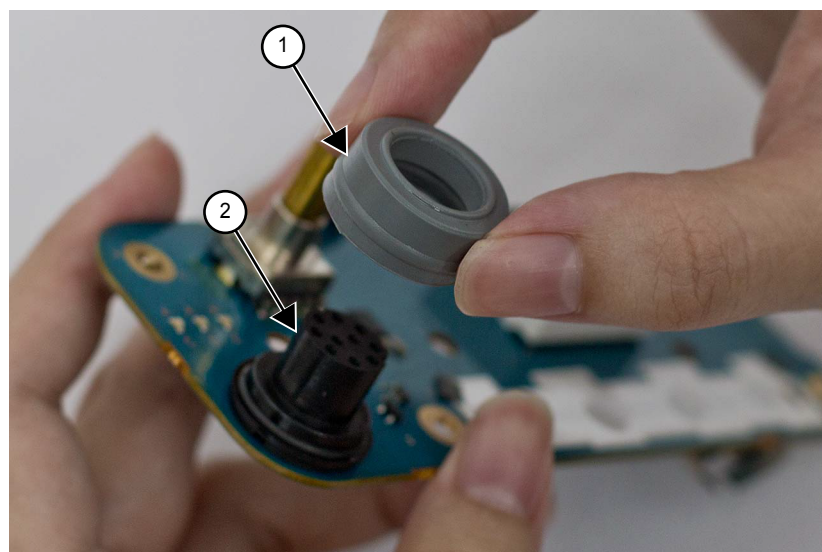
| Label | Description |
|-------|-----------------------|
| 1 | Keypad Frame Assembly |
| 2 | Volume Encoder |

- 4 Assemble the mic jack seal around the mic jack. Be sure to place mic jack seal flush to the PCB.




NOTICE: Make sure the mic jack is free from dust or debris.

Figure 71: Assembling Mic Jack Seal



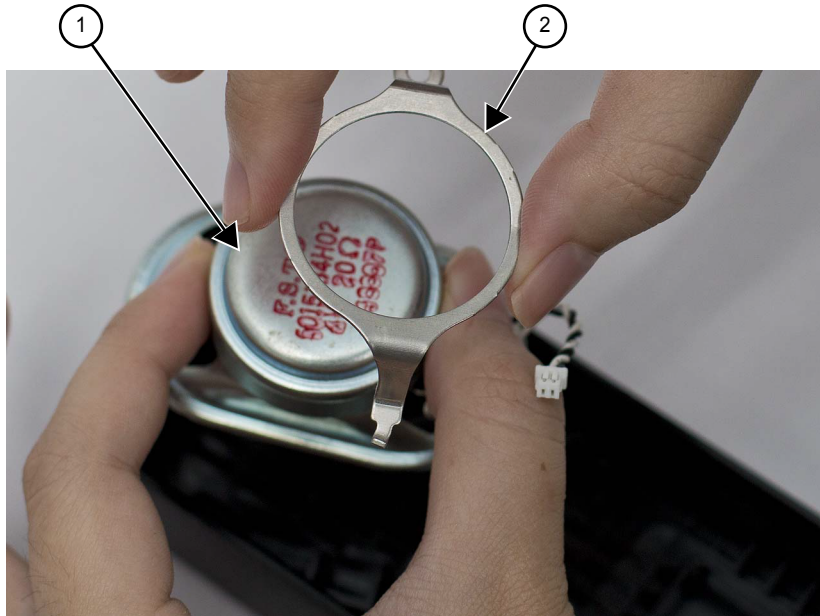
| Label | Description |
|-------|---------------|
| 1 | Mic Jack Seal |
| 2 | Mic Jack |

- 5 Assemble the speaker retainer to the speaker. It will snap over the speaker magnet.

 **NOTICE:** Be sure to orientate the speaker in the direction of the wire and connector towards the middle of the control head.

- 6 Assemble the speaker to the control head assembly.

Figure 72: Assembling Speaker



| Label | Description |
|-------|------------------|
| 1 | Speaker |
| 2 | Speaker Retainer |

- 7 Hook one side of the speaker retainer into the control head assembly.
- 8 Place a screw into the other end of the speaker retainer and using a T10 TORX™ driver, tighten the screw to 0.88 N-m (7.8 lbs-in).

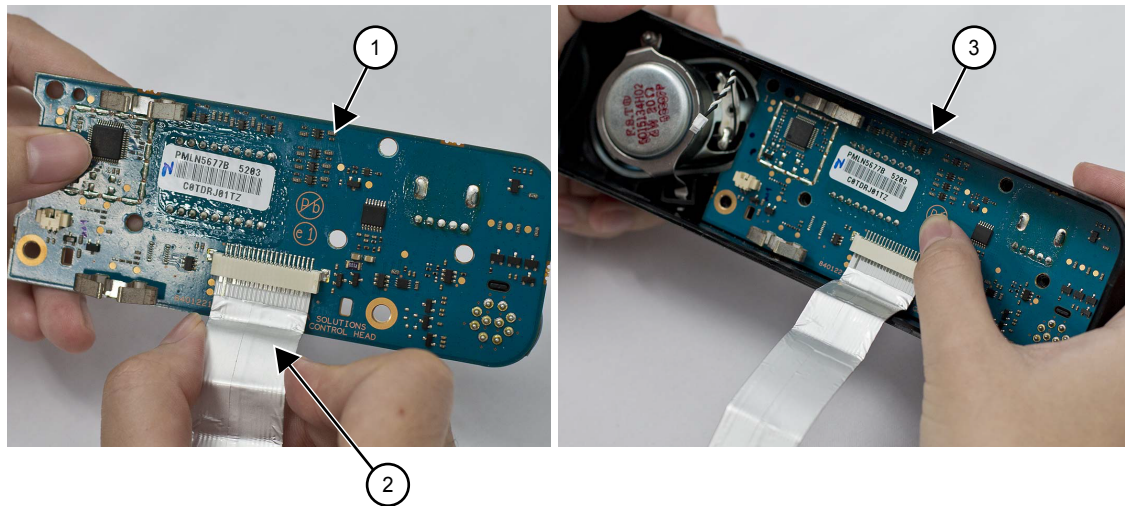
Figure 73: Speaker Retainer Assembly



| Label | Description |
|-------|------------------|
| 1 | Speaker Retainer |

- 9 Assemble the control head flex to the mating connector on the control head board, making sure it is fully seated.
- 10 Assemble the control head board to the control head assembly.

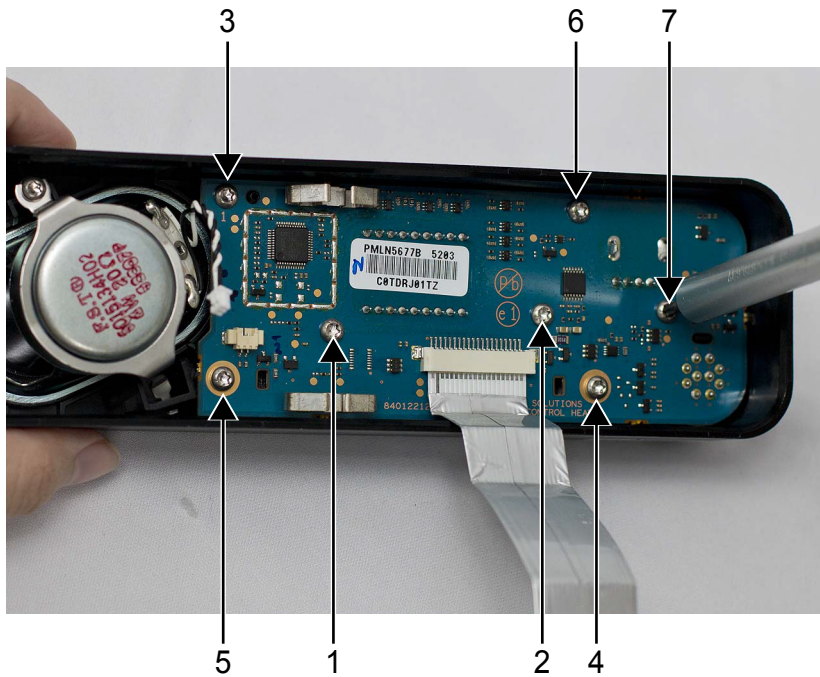
Figure 74: Assembling Control Head Board to Control Head Assembly



| Label | Description |
|-------|-----------------------|
| 1 | Control Head Board |
| 2 | Control Head Flex |
| 3 | Control Head Assembly |

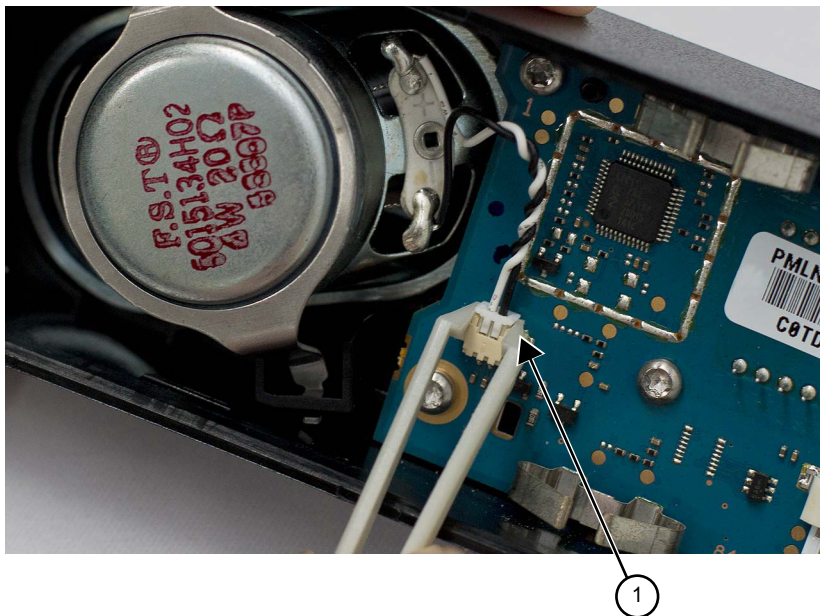
- 11 Using a T10 TORX driver, tighten the seven screws to 0.88 N-m (7.8 lbs-in) following the sequence.

Figure 75: Screw Sequence



12 Connect the speaker plug to its mating connector on the control head board.

Figure 76: Assembling Speaker Plug



| Label | Description |
|-------|--------------|
| 1 | Speaker Plug |

13 Orientate the volume/channel knob so that the internal D-shaped opening matches the volume encoder shaft and press the volume/channel knob into the control head assembly until it is fully seated and the knob rotates freely.

Figure 77: Volume/Channel Knob Assembly

| Label | Description |
|-------|----------------------|
| 1 | Volume Encoder Shaft |
| 2 | Volume/Channel Knob |

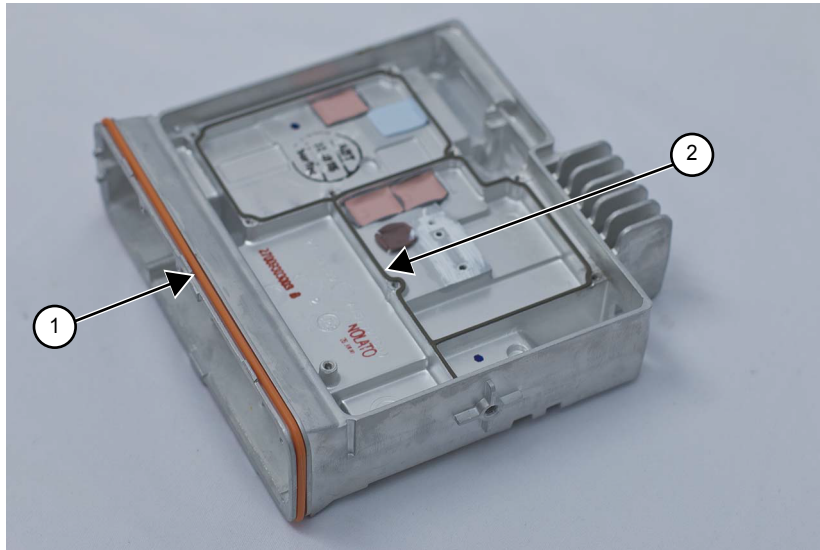
5.6.3

Radio Assembly

Prerequisites: Prior to reassembling the radio, inspect all seals and sealing surfaces for damage (nicks, cuts, and more.) or debris. Refer to the exploded view and bill of materials for the correct part numbers and replace parts, as necessary. Replace all new seals on their respective parts.

For both the die cast main shield and the chassis, thoroughly inspect the shield gasketing for damage and verify all thermal pads are in place and free from damage and debris. See [Thermal Pad Replacement Procedure on page 91](#) to replace damaged pads.

Figure 78: Thermal Pads and Shield Gasketing on Chassis and Die Cast Main Shield



| Label | Description |
|-------|---|
| 1 | Shield Gasketing on the Chassis |
| 2 | Shield Gasketing for the Die Cast Main Shield |

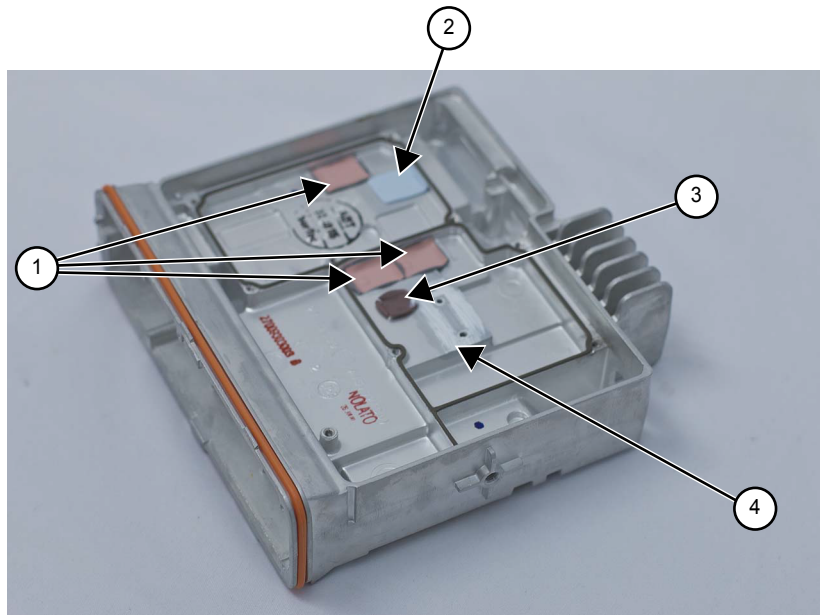
Procedure:

- 1 Thoroughly inspect the chassis and verify all thermal pads are in place and free from damage.



NOTICE: Every time the Transceiver Board is removed, the Final Driver Thermal Pad must be replaced.

Figure 79: Chassis with Thermal Pads



| Label | Description |
|-------|--|
| 1 | Regulator Thermal Pad (75012018001) |
| 2 | Audio PA Thermal pad (75012059001) |
| 3 | Final Driver Thermal Pad (75012058002) |
| 4 | Thermal Grease (111022A55) |

5.6.4

Thermal Pad Replacement Procedure

The following steps are applicable for Regulator Thermal Pad replacement, Audio PA Thermal Pad replacement, and Final Driver Thermal Pad replacement.

Procedure:

- 1 Do one of the following:
 - If for Regulator Thermal Pad replacement or Audio PA Thermal Pad replacement, use a plastic flat-edge tool to lift the pad from the chassis surface. Discard the old pad.
 - If for Final Driver Thermal Pad replacement, use a plastic flat-edge tool to lift each pad from the transceiver board. Discard the old pad.
- 2 Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary.



NOTICE: Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.

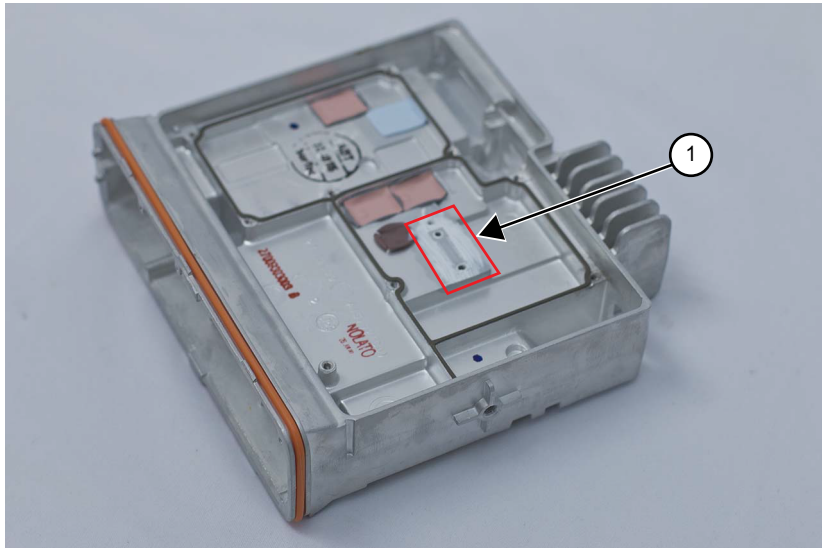
- 3 Once the surface is clean and dry, remove the new pad from the shipping liner, and place it on the chassis. See [Figure 79: Chassis with Thermal Pads on page 91](#).

5.6.5 Transceiver Board Reassembly

Procedure:

- 1 Apply thermal grease to the PA area.

Figure 80: Applying Thermal Grease

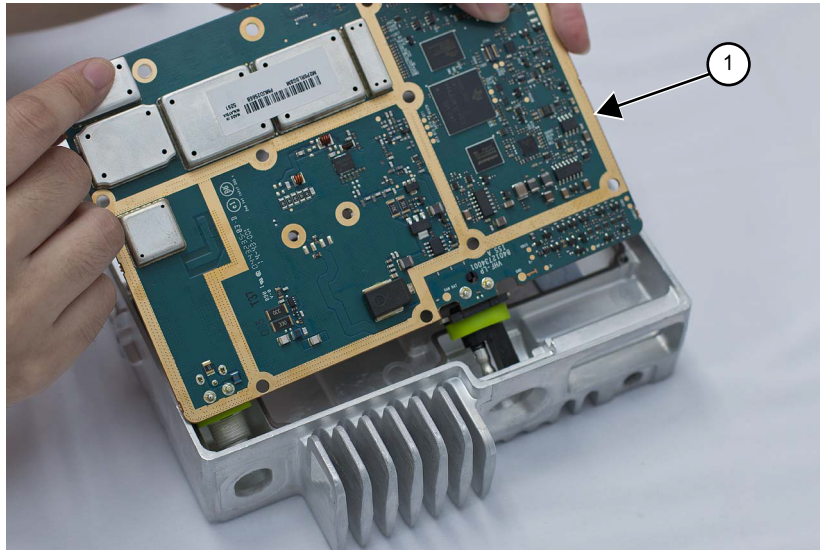


| Label | Description |
|-------|----------------------------|
| 1 | Thermal Grease (110022A55) |


- 2 Insert the transceiver board into the chassis by tilting the transceiver board (approximately 45 degrees) and sliding it into place, taking care to line up the RF and DC connectors with the openings in the back of the chassis.

Push the board down to fully seat it to the radio chassis and ensure that the transceiver board alignment slots are positioned in line with the chassis alignment bosses.

Figure 81: Placing the Transceiver Board in the Chassis

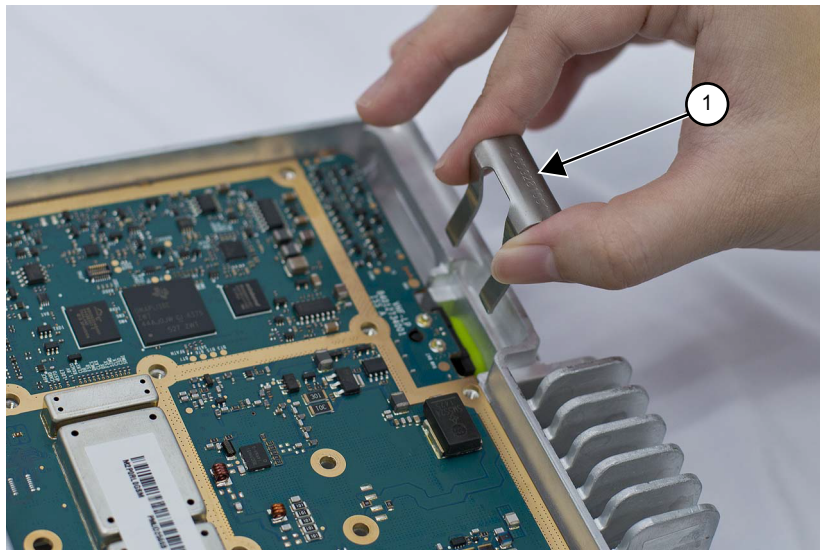


| Label | Description |
|-------|-------------------|
| 1 | Transceiver Board |

 **CAUTION:** Do not leave the transceiver board in the chassis for extended periods of time without the DC retention clip and RF lock washer and nut assembled, or damage to the board connectors may occur.

- 3 Insert the DC retention clip and fully seat it.

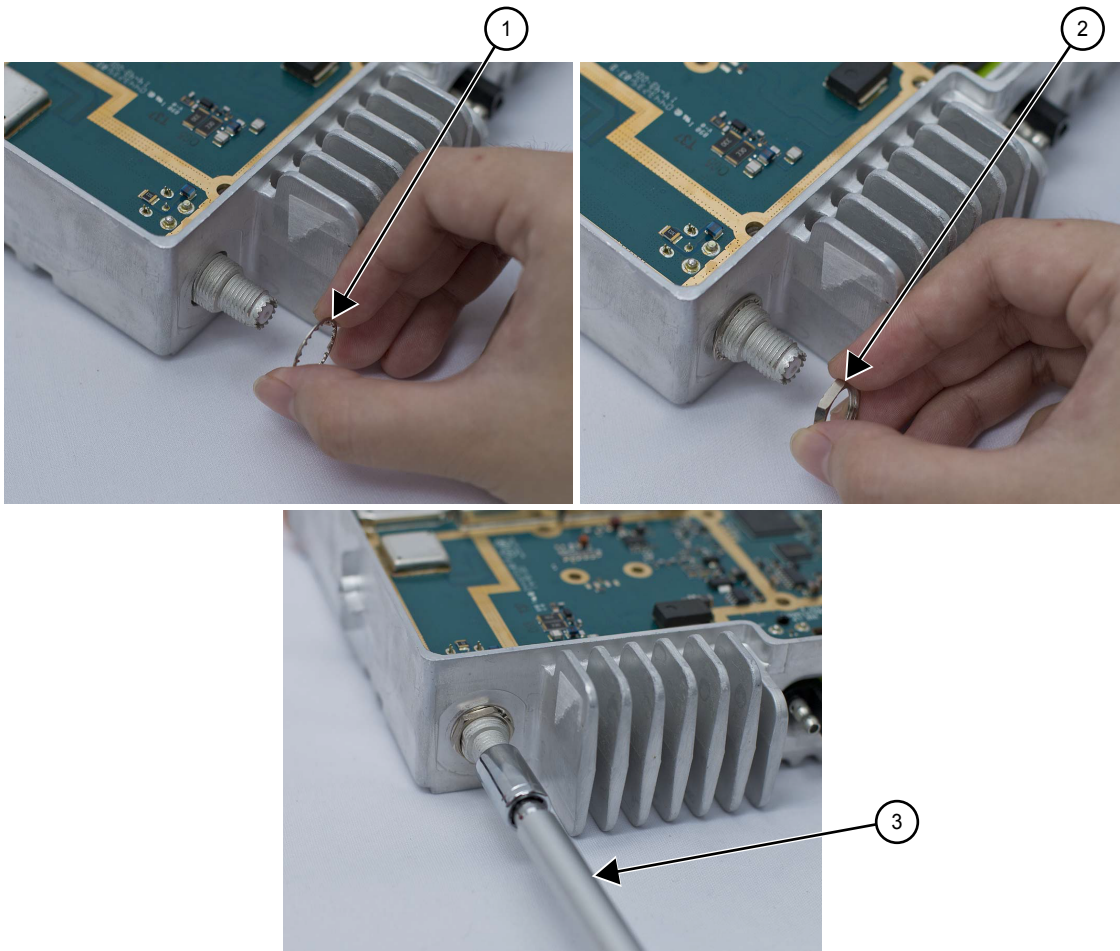
Figure 82: Inserting DC Retention Clip



| Label | Description |
|-------|-------------------|
| 1 | DC Retention Clip |

- 4 Using a 9/16 in. deep socket driver install the lock washer and nut to an initial torque of 0.9 N-m (8 lbs-in).

Figure 83: Inserting RF Lock Washer and Nut



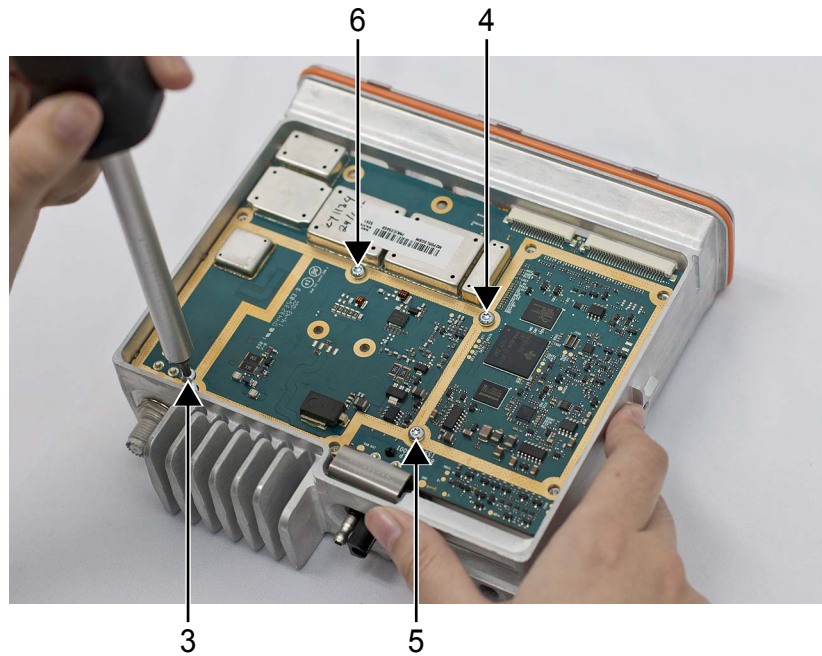
| Label | Description |
|-------|--------------------|
| 1 | Lock Washer |
| 2 | RF Connector Nut |
| 3 | Deep Socket Driver |

- 5 Using a T10 TORX™ driver insert four main shield thread forming screws (M3) at locations 3, 4, 5, and 6 to compress the PCB. Tighten the screws to 1.0 N-m (9 lbs-in).



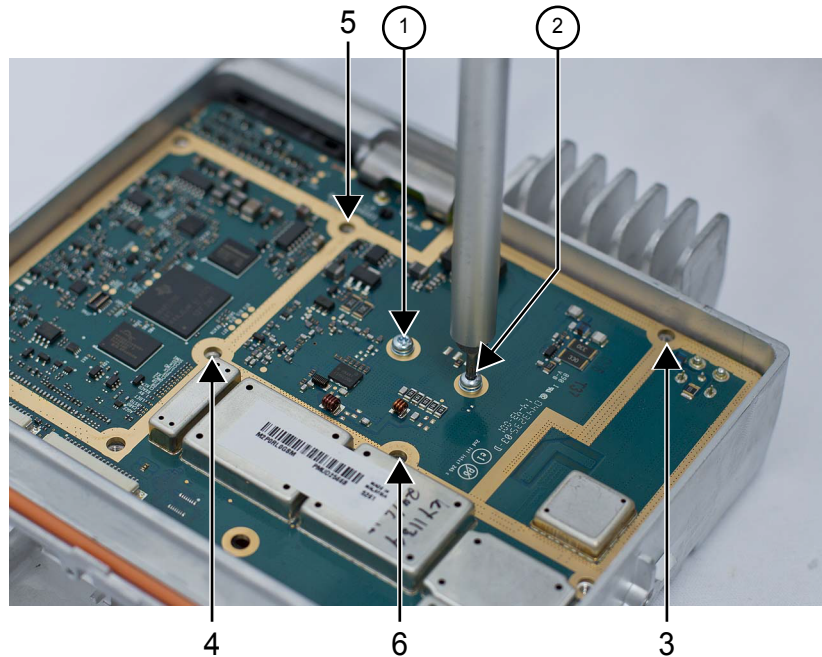
NOTICE: This step is required; otherwise, damage could result to the final transmitter PA device.

Figure 84: Screw Sequence to Compress PCB



- 6 While the board is pressed down, align the PA holes on PCB to mounting holes on chassis and insert two (M2.5) machine screws with washers. See the following image for PA Screw sequence. Use a T8 TORX to tighten the screws to 0.45 N-m (4 lbs-in).

Figure 85: Installing PA Screws

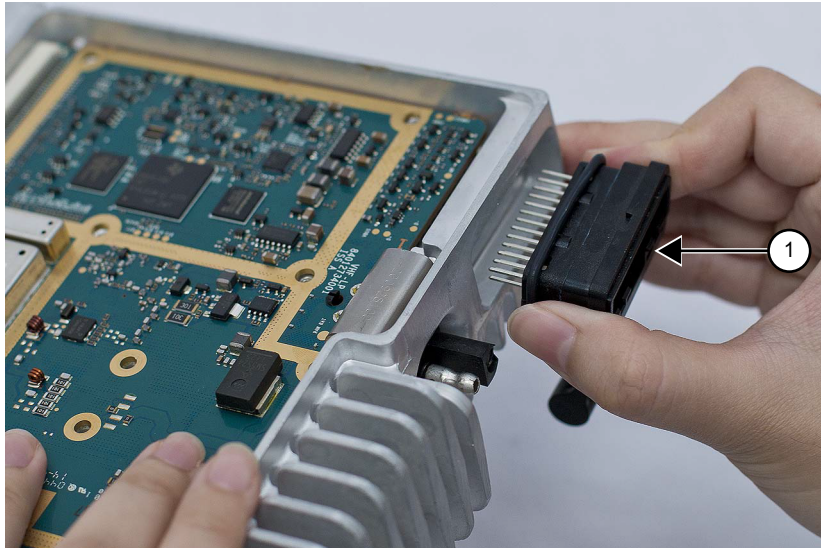


| Label | Description |
|-------|---------------------------|
| 1 | Install this screw first |
| 2 | Install this screw second |

- 7 Using a T10 TORX driver remove the screws from locations 3, 4, 5, and 6.

- 8 Insert the accessory connector into the radio assembly and press into place until the connector is flushed with the chassis.

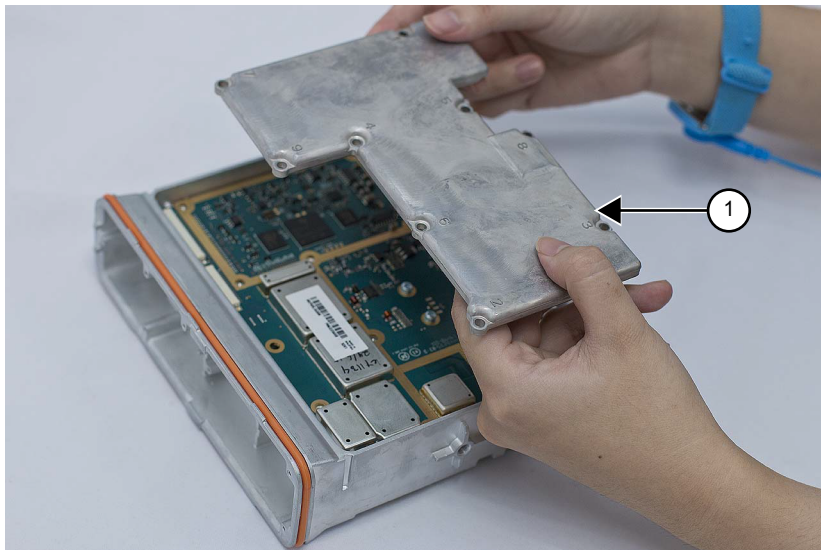
Figure 86: Inserting Accessory Connector



| Label | Description |
|-------|---------------------|
| 1 | Accessory Connector |

- 9 Place the main shield on the transceiver board and lock in place the accessory connector by aligning the main shield locking tabs to the pockets of the accessory connector.

Figure 87: Assembling Die Cast Main Shield onto Chassis

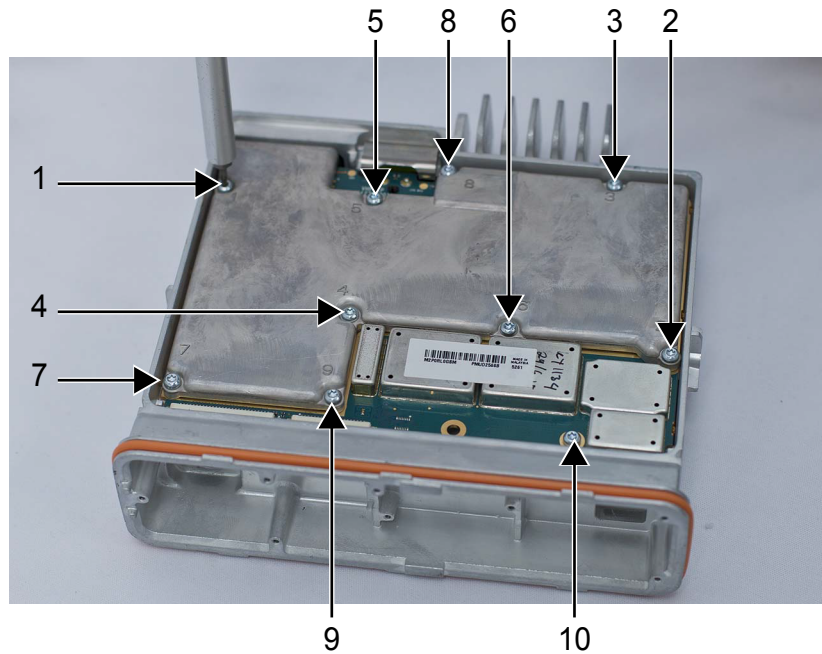


| Label | Description |
|-------|-------------|
| 1 | Main Shield |

- 10 Insert nine main shield thread forming screws (M3) through the shield and one thread forming screw (M3) through the board.

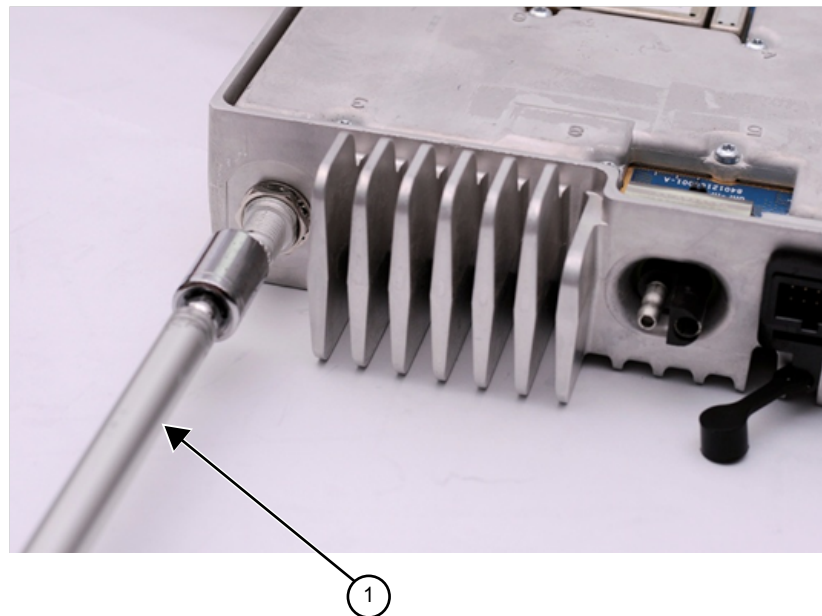
- 11 Use a T10 TORX driver following the sequence marked on the main shield and tighten all ten screws to 1.47 N-m (13 lbs-in).
- 12 Retighten the nine screws on the main shield a second time.

Figure 88: Screw Sequence to Tighten Die Cast Main Shield



- 13 Use a 9/16 in. deep socket driver to further tighten the nut to a final torque of 2.15 N-m (19 lbs-in).

Figure 89: RF Connector Nut Final Torque



| Label | Description |
|-------|--------------------|
| 1 | Deep Socket Driver |

- 14 Install the acoustic plug. An arrow is molded into the part to indicate the start side.

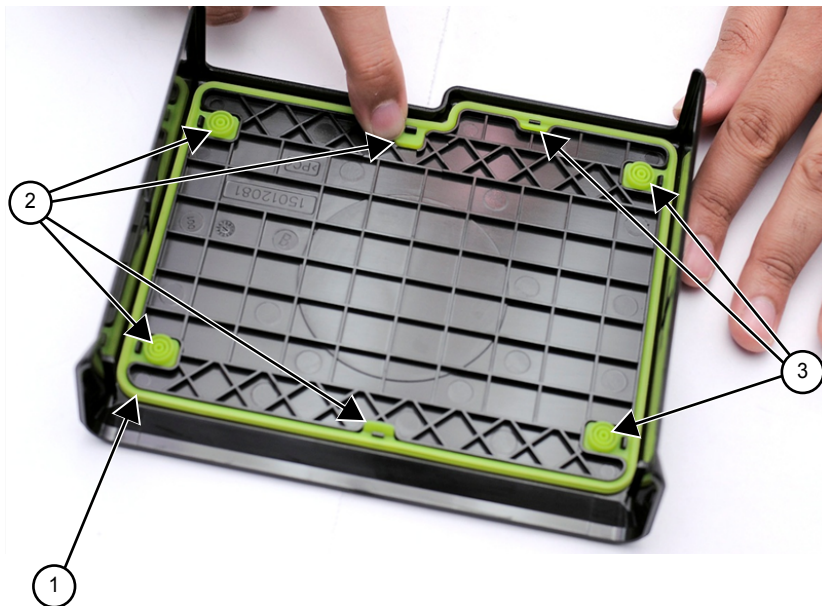
Figure 90: Acoustic Plug Installation



| Label | Description |
|-------|---------------|
| 1 | Acoustic Plug |
| 2 | Start Side |

15 Thoroughly inspect the cover assembly with seal attached. Ensure the seal is fully seated on the cover and the locking tabs engaged at all seven locations.

Figure 91: Inspection of Cover Assembly with Seal

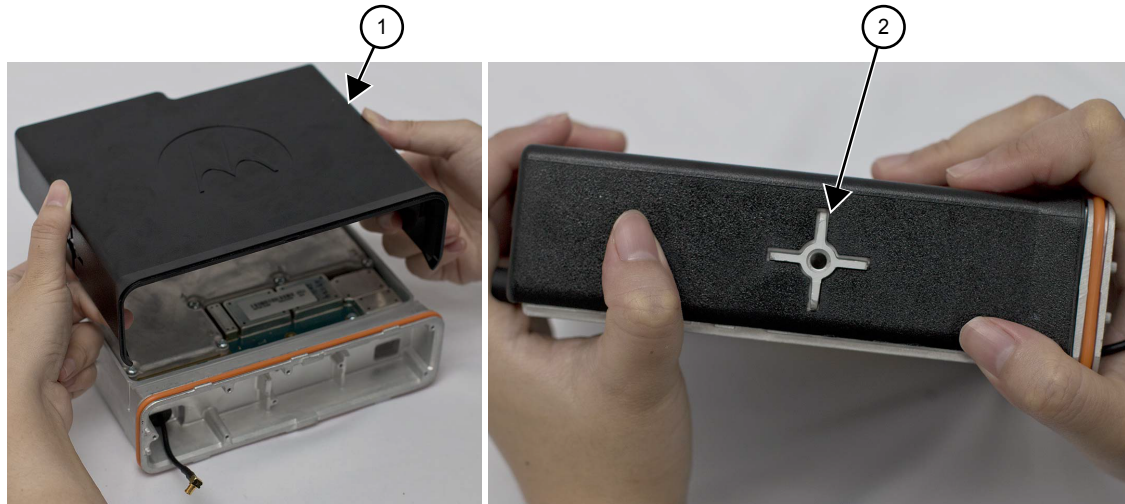


| Label | Description |
|---------|-------------|
| 1 | Seal |
| 2 and 3 | Locking Tab |

16 Gently spread both sides of the cover.

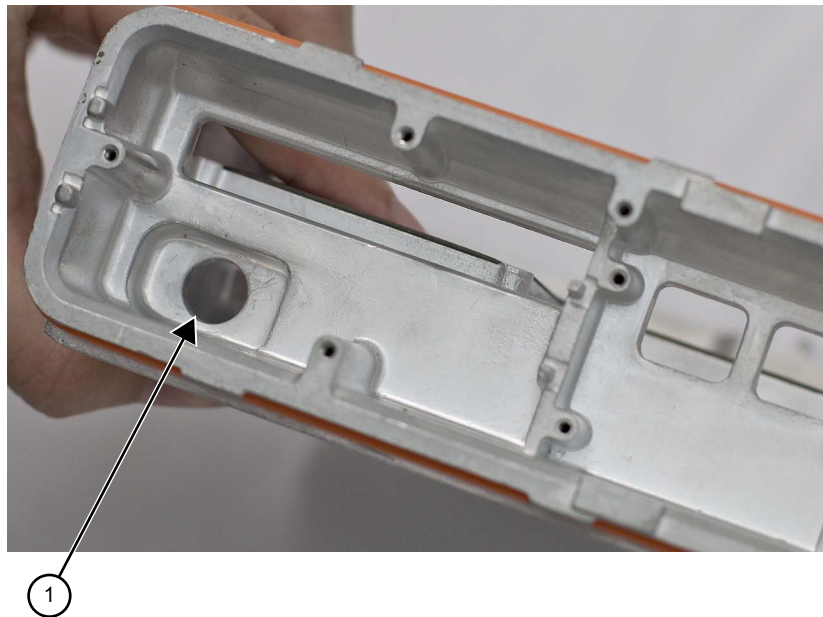
17 Align the top cover to the chassis and snap the cover in place uniformly. Ensure the alignment posts on the cover slide into the alignment slots on the chassis.

Figure 92: Assembling Cover onto Chassis



| Label | Description |
|-------|----------------|
| 1 | Main Cover |
| 2 | Alignment Post |

18 Assembly of the GNSS cable involves the following steps:



| Label | Description |
|-------|-----------------|
| 1 | Chassis Opening |



NOTICE: Skip steps a through d if the GNSS cable was not serviced.

a If attached, remove the nut and washer from the GNSS antenna connector.

- b Insert the GNSS cable assembly through the opening in the chassis. Orient the MCX Connector.

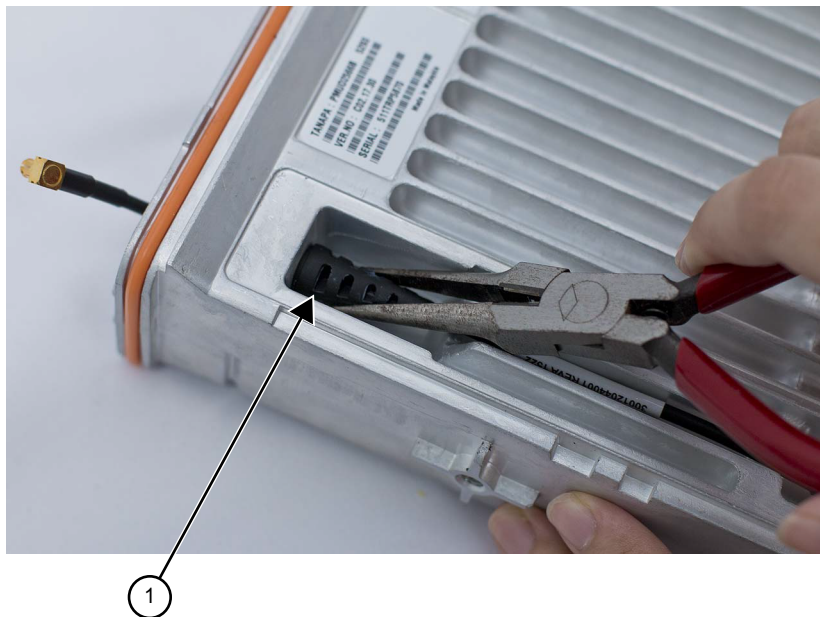
Figure 93: GNSS Cable Installation



| Label | Description |
|-------|---------------------|
| 1 | GNSS Cable Assembly |
| 2 | MCX Connector |

- c Pull the GNSS cable strain relief until it is fully installed.

Figure 94: Installing GNSS Cable Strain Relief



| Label | Description |
|-------|--------------------------|
| 1 | GNSS Cable Strain Relief |

- d Assemble the lock washer and the nut to the GNSS antenna connector. Using a 5/16 in. or 8 mm socket driver, tighten the nut to 1.7 N-m (15 lbs-in). See [Figure 95: GNSS Cable Installation on page 101](#).


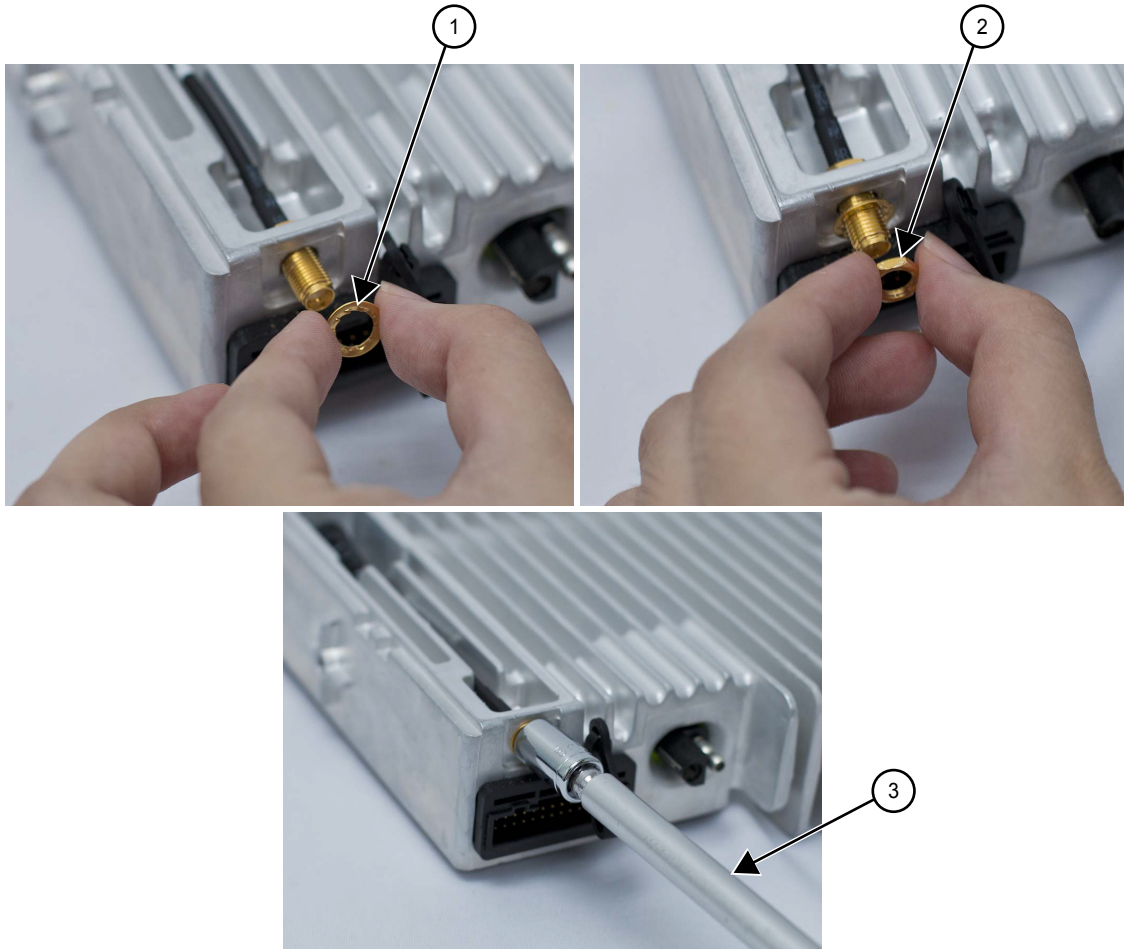
 **NOTICE:** Do not pull directly on cable wire.

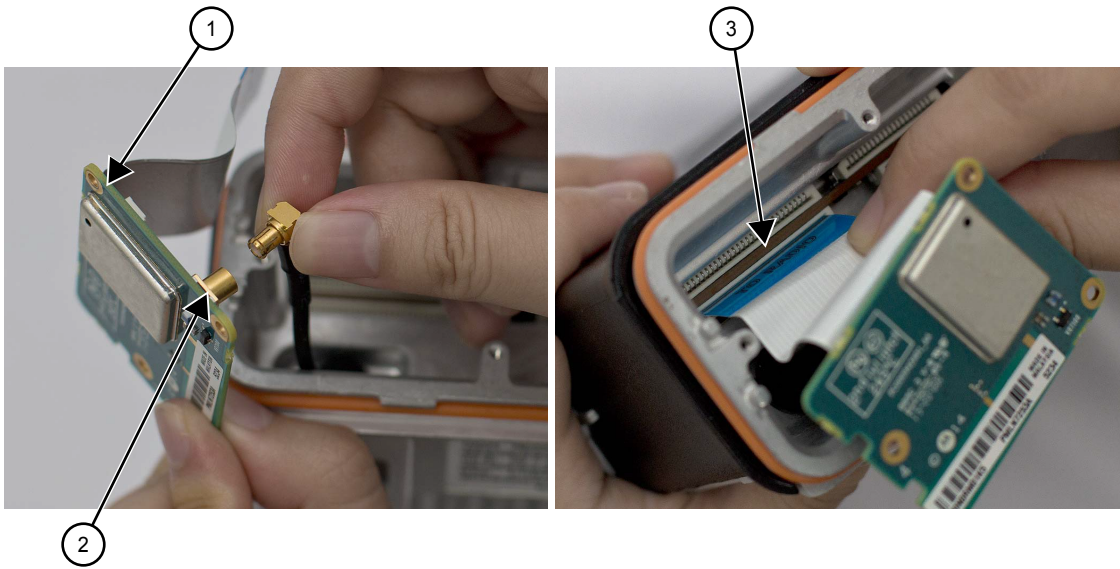
Figure 95: GNSS Cable Installation



| Label | Description |
|-------|--------------------|
| 1 | Lock Washer |
| 2 | Nut |
| 3 | Deep Socket Driver |

- e Connect the GNSS cable MCX connector to the expansion board.
- f Connect the flex cable from the expansion board to the main board connector.

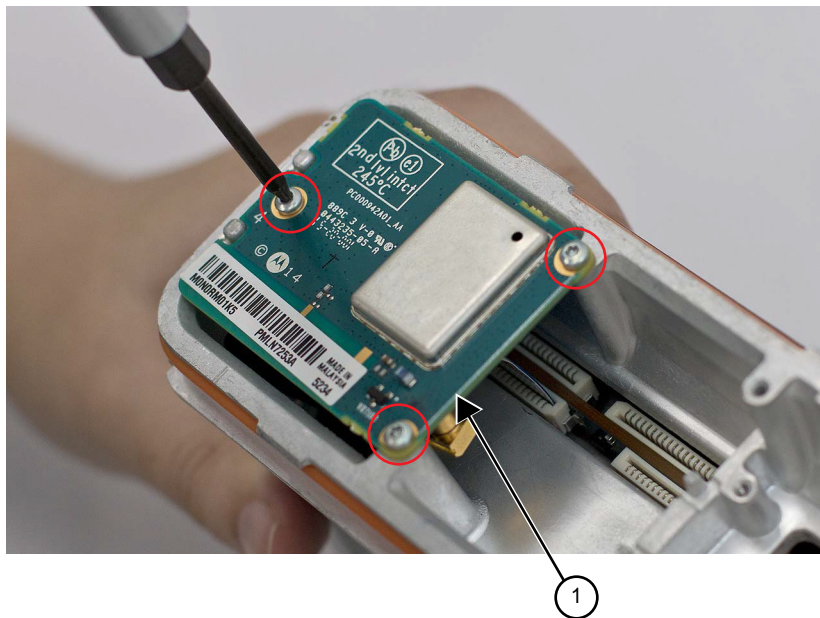
Figure 96: Flex Connection Connectors




| Label | Description |
|-------|---------------------------|
| 1 | Expansion Board |
| 2 | MCX Connector |
| 3 | Expansion Board Connector |

- g Using a T6 TORX driver, tighten the three screws to 0.28 N-m (2.5 lbs-in) to secure the expansion board to the chassis.


Figure 97: Expansion Board Assembly



| Label | Description |
|-------|-----------------|
| 1 | Expansion Board |

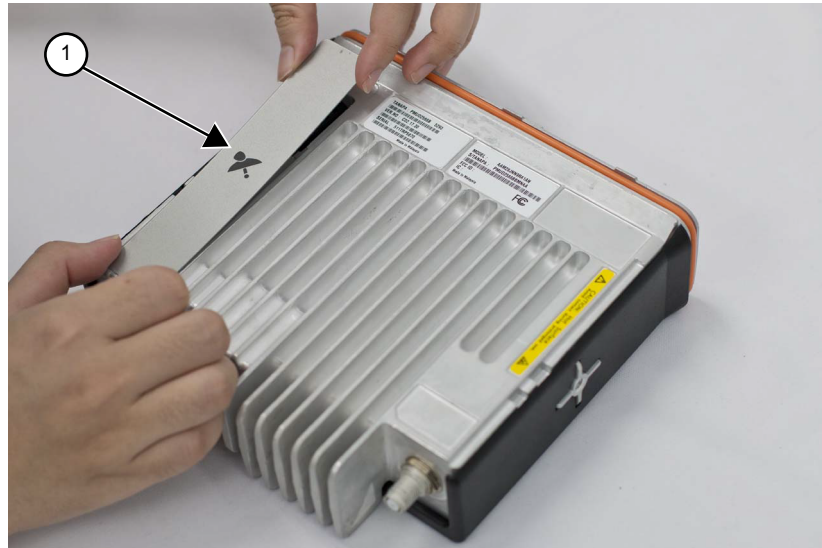
 **NOTICE:** Skip steps [step 18 h](#) through [step 18 j](#) if the GNSS nameplate was not serviced

- h** Clean chassis nameplate surface with alcohol prior to applying the GNSS nameplate.
- i** Peel off the paper liner to the GNSS nameplate. Place the long side of the GNSS nameplate against the long side of the recessed area on the chassis.


 **NOTICE:** If the GNSS nameplate is removed it will need to be replaced.

- j** Rotate the nameplate to the recessed surface and apply pressure.

Figure 98: GNSS Nameplate Assembly

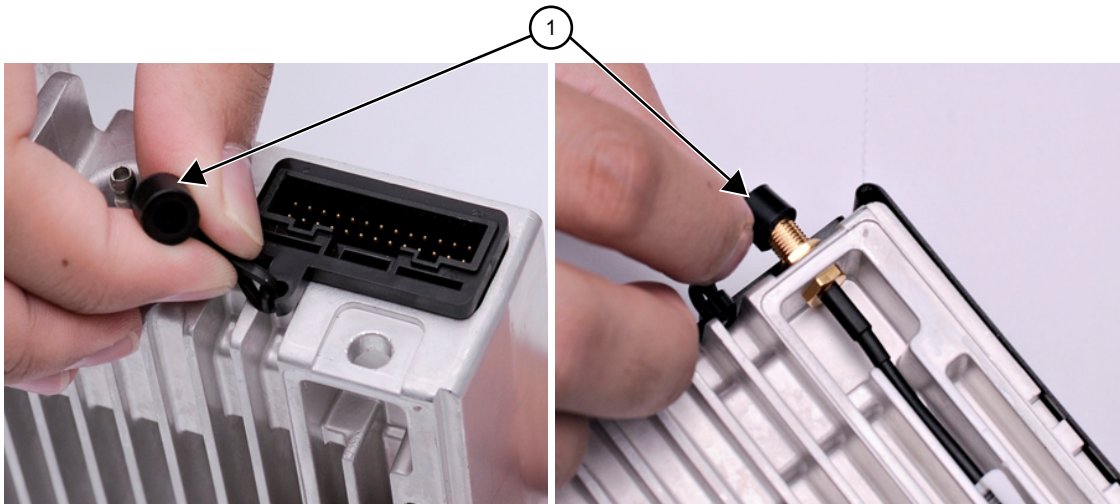


| Label | Description |
|-------|----------------|
| 1 | GNSS Nameplate |

 **NOTICE:** Skip step [step 18 k](#) if the GNSS cable was not serviced.

- k** Snap the GNSS dust cap (if not already installed) to the accessory connector retainer and place the GNSS dust cap over the GNSS antenna connector.

Figure 99: GNSS Antenna Connector Assembly



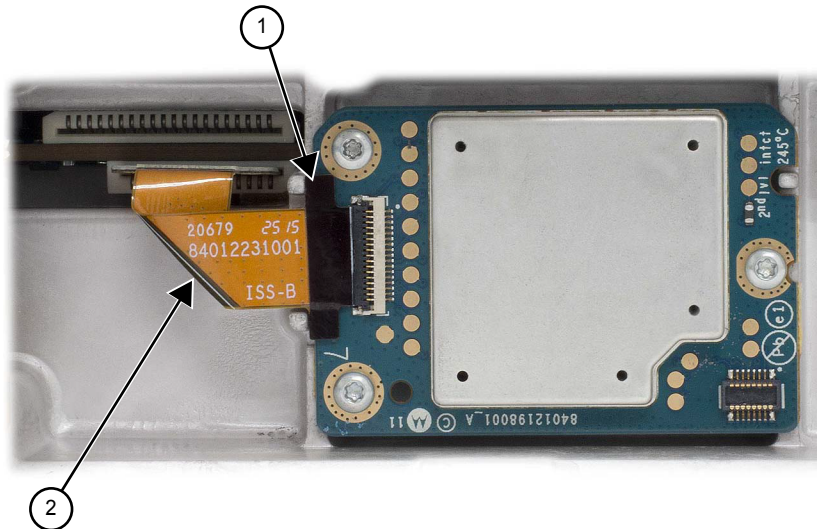
| Label | Description |
|-------|---------------|
| 1 | GNSS Dust Cap |

19 Orient the option board flex so that contacts face option board. Secure connector latch to option board.



NOTICE: The white line on flex should be aligned with connector latch.

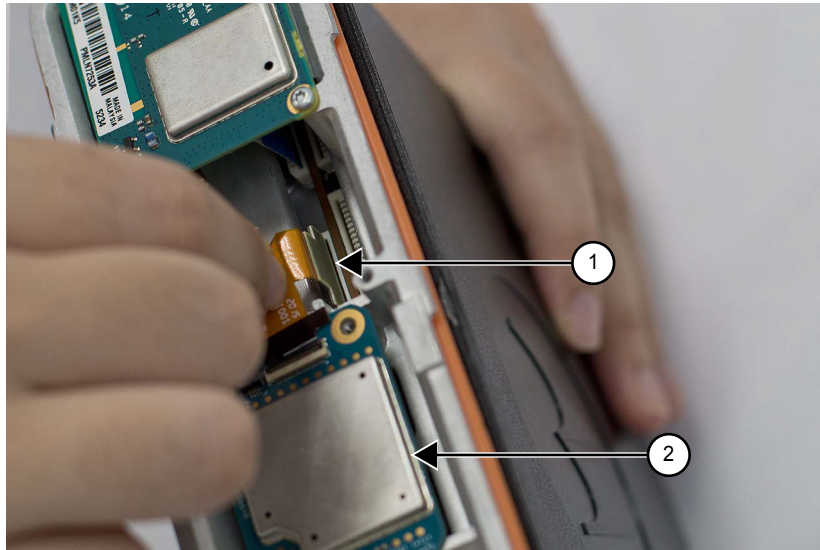
Figure 100: Orientation of Option Board Flex to Option Board



| Label | Description |
|-------|-------------------|
| 1 | Latch |
| 2 | Option Board Flex |

20 Maintaining the bend orientation, connect the flex cable from the option board to the main board connector.

Figure 101: Assemble Option Board to Radio Chassis (Image may not match exact product)



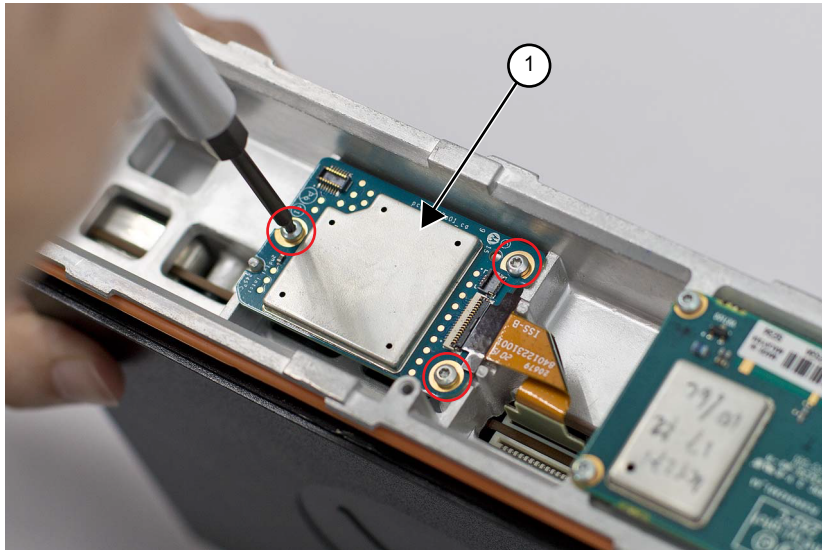
| Label | Description |
|-------|------------------------|
| 1 | Option Board Connector |
| 2 | Option Board |



NOTICE: The GOB software version can be checked using the Tuner. After the GOB is installed, the Tuner should be used to perform a "read" from the radio. If the GOB is installed correctly, the GOB software version will be displayed. If the GOB is not installed or if the GOB is installed incorrectly, the GOB software version will NOT be displayed.

- 21** Align option board to mounting holes ensuring that the flex tabs are against the chassis alignment posts.
- 22** Using a T6 TORX driver, tighten the three screws to 0.28 N-m (2.5 lbs-in) to secure the option board to the chassis.

Figure 102: Securing Option Board to Chassis



| Label | Description |
|-------|--------------|
| 1 | Option Board |

Regulatory Requirements

All MOTOTRBO radios are designed and engineered to meet all regulatory requirements for the country or region of sale. Any option board designed for the MOTOTRBO Option Board ADK must not compromise the regulatory compliance of the MOTOTRBO radio.

The third-party developer is responsible for providing all information, upon request by a regulatory authority, regarding any materials or substances used in the manufacture of an option board as it pertains to its end-of-life.

Please review the terms of the MOTOTRBO License Agreement for more information on the Licensed Developer or Application Partner responsibilities for regulatory compliance.

5.6.6

Assemble Control Head to Radio Assembly

Procedure:

- 1 If not already assembled, assemble the control head O-ring seal on the radio.

Figure 103: Assemble O-ring to Chassis (Image May Not Match Exact Product)



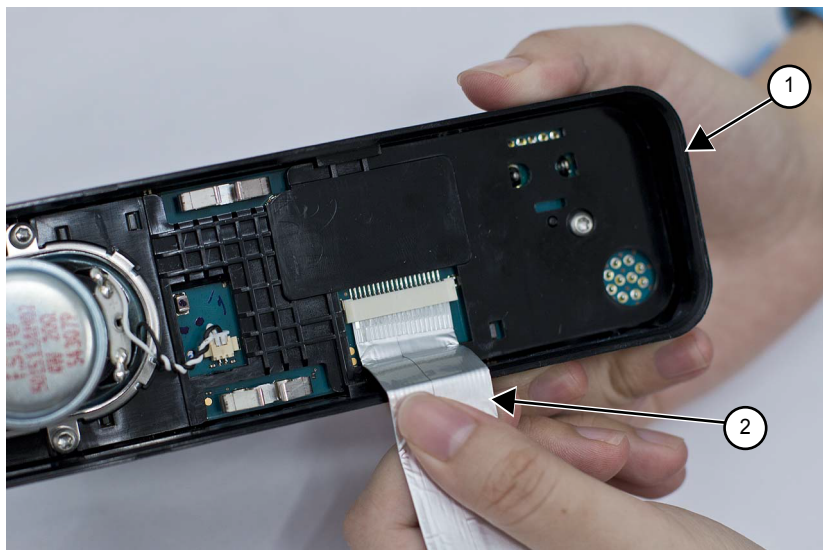
| Label | Description |
|-------|--------------------------|
| 1 | Control Head O-ring Seal |

- 2 Verify that the flex cable is fully seated in the connector on the control head assembly.



CAUTION: Make sure the Main Cover is assembled onto the Radio Chassis before assembling the Control Head onto the Radio Chassis. This will help prevent damage to the ground springs in the Control Head.

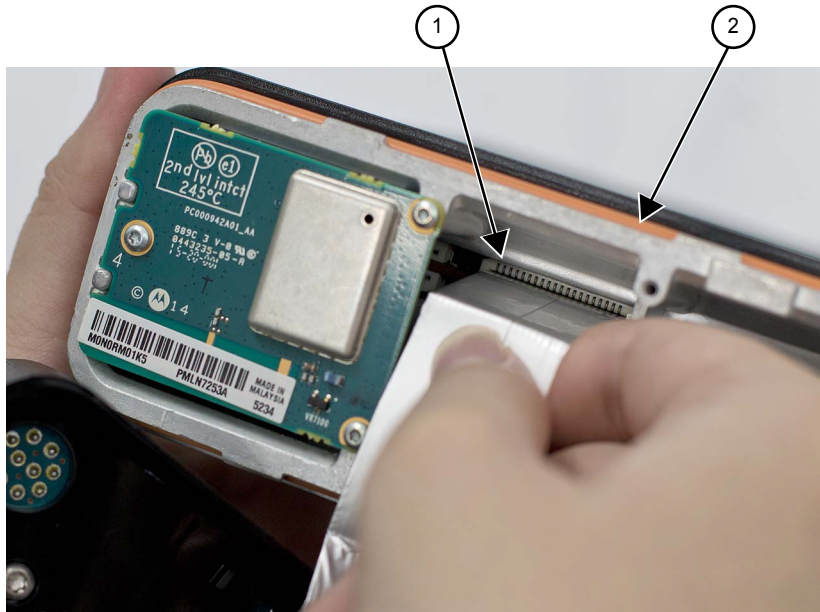
Figure 104: Flex Cable Connected



| Label | Description |
|-------|--------------|
| 1 | Control Head |
| 2 | Flex Cable |

- 3 Assemble flex cable to the flex connector in the radio assembly, making sure it is fully seated.

Figure 105: Assembling Flex Cable



| Label | Description |
|-------|------------------------|
| 1 | Control Head Connector |
| 2 | Radio Assembly |

- 4 Assemble the control head to the radio chassis by aligning one side of the control head assembly tabs to one side of the radio chassis tabs and then rotate the control head assembly until the other side engages.

Figure 106: Assemble Control Head to Radio Chassis



| Label | Description |
|-------|---------------|
| 1 | Radio Chassis |

| Label | Description |
|-------|--------------|
| 2 | Control Head |

- 5 Verify that the control head seal is not pinched and not visible. If a pinch is found, disassemble the control head, reseal the O-ring and reassemble the control head.

5.7

Exploded Mechanical Views and Parts Lists

This section provides details about the exploded views and the parts lists.

5.7.1

Radio Assembly Exploded View and Parts List

Figure 107: Radio Assembly Exploded View

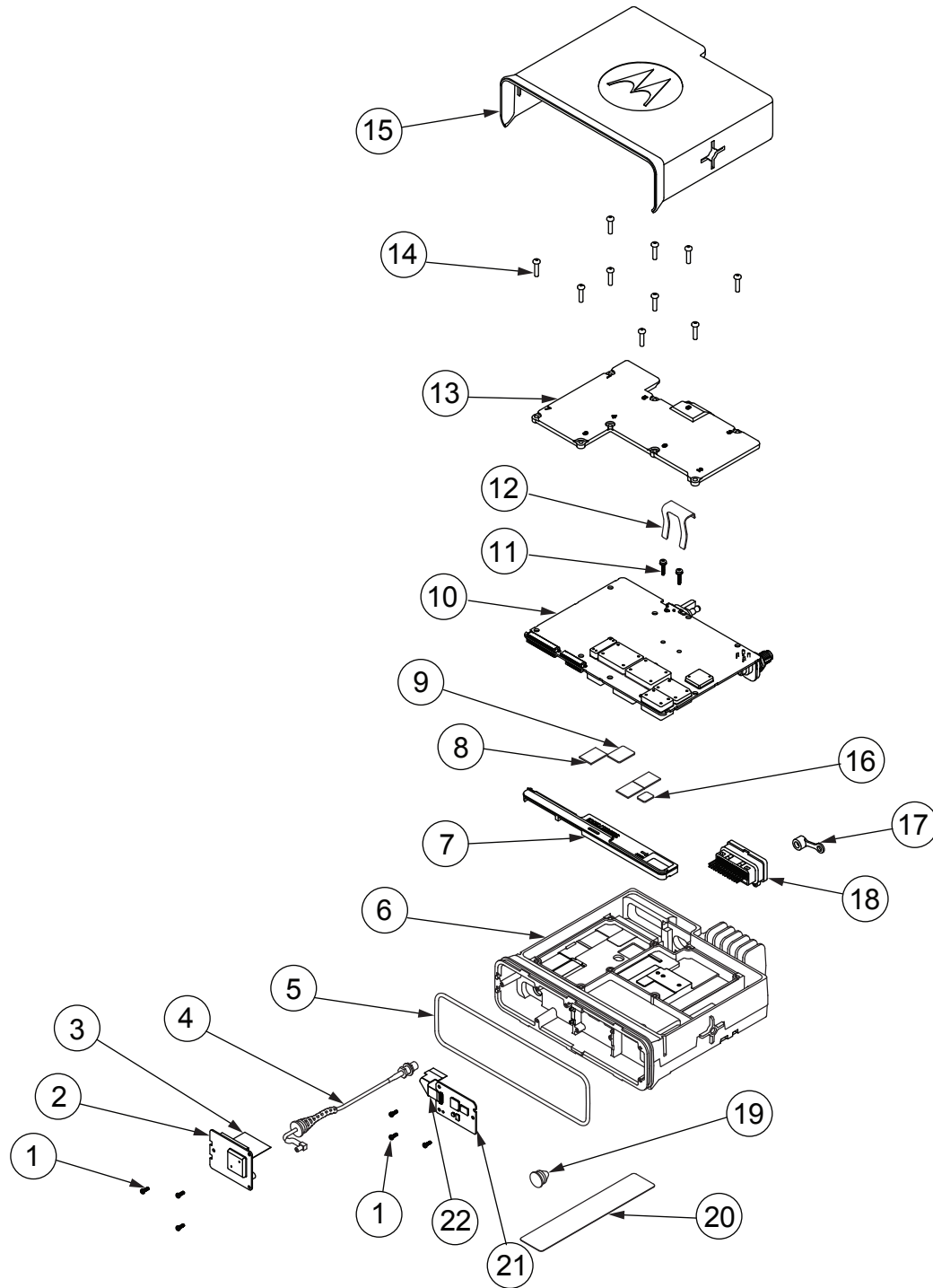


Table 29: Radio Exploded View Parts List

| Item No. | Description | Part Number |
|----------|-------------------------|-------------|
| 1 | Screw - M2 x 0.4 x 6 mm | 0310909E03 |

| Item No. | Description | Part Number |
|----------|---|---|
| 2 | Bluetooth/Wi-Fi/GNSS Expansion Board | PMLN7252_S* |
| 3 | Flex, Expansion Board | Included in PMLN7252_S |
| 4 | GNSS Cable Assembly | Included in PMLN7252_S |
| 5 | O-Ring, Control Head | 3216200H01 |
| 6 | Chassis, Die Cast | 27009303003 |
| 7 | Acoustic Plug | 32012172001 |
| 8 | Thermal Pad, Regulator (Quantity: 3) | 75012018001 |
| 9 | Thermal Pad, Audio PA | 75012059001 |
| 10 | PCB, Transceiver | See Model Charts on page 20 to identify proper board. |
| 11 | Screw - M2.5 x 0.45 x 12 mm with Washer | 03012037001 |
| 12 | Clip, DC Retention | 42009281001 |
| 13 | Main Shield, Die Cast | 26009377001 |
| 14 | Screw - M3 x 0.5 x 13 mm | 0310943J12 |
| 15 | Main Cover and Gasket Assembly | 15012083001 |
| 16 | Thermal Pad, Final Driver | 75012058002 |
| 17 | GNSS Dust Cap | 3216338H01 |
| 18 | Accessory Connector | 42009282001 |
| 19 | GNSS Plug (not required) | 32009445001 |
| 20 | GNSS Nameplate | 54012193001 |
| 21 | Generic Option Board | PMLN7324_S** |
| 22 | Flex, Option Board | 84012231001 |

**NOTICE:** *Includes:

- Item No. 1 (Screw - M2 x 0.4 x 6 mm)
- Item No. 2 (Bluetooth/Wi-Fi/GNSS Expansion Board)
- Item No. 3 (Flex, Expansion Board)
- Item No. 4 (GNSS Cable Assembly)
- Item No. 17 (GNSS Dust Cap)
- Item No. 20 (GNSS Nameplate)

**Includes:

- Item No. 1 (Screw - M2 x 0.4 x 6 mm)
- Item No. 21 (Generic Option Board)
- Item No. 22 (Flex, Option Board)

5.7.2

Control Head Exploded Views and Parts Lists

Figure 108: Color Display Control Head Exploded View

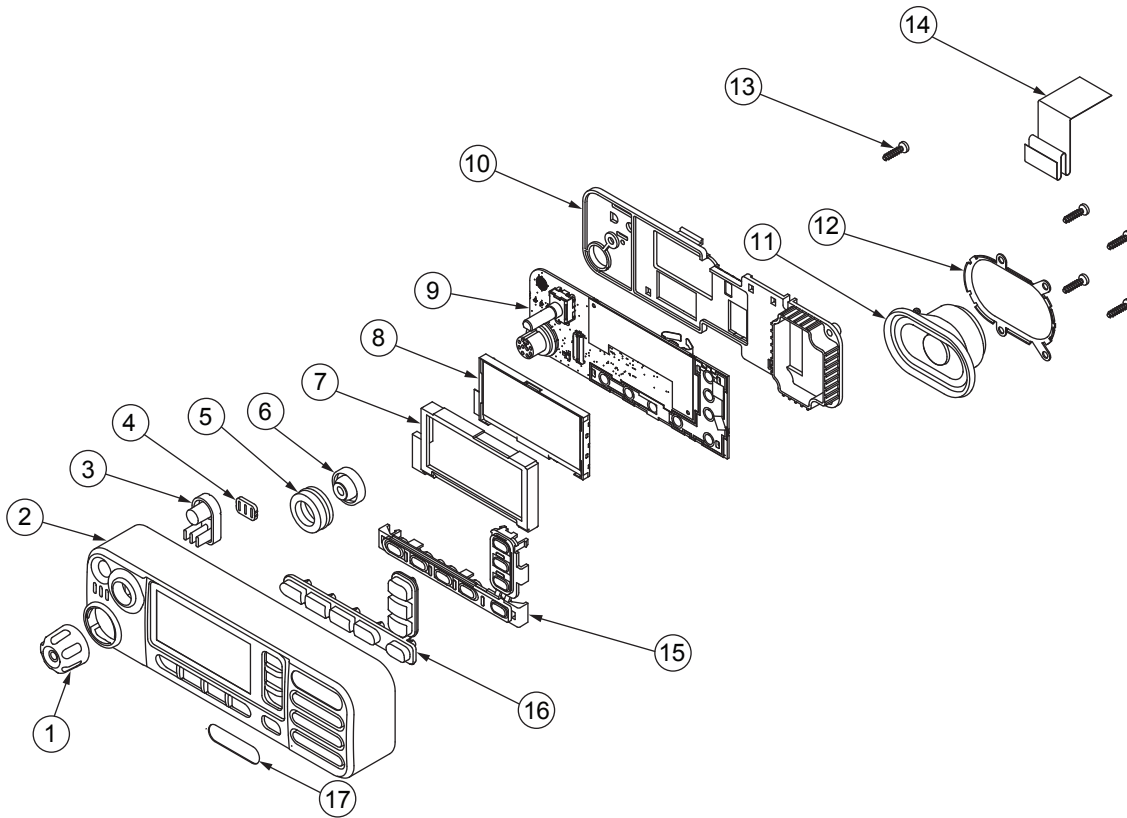


Table 30: Color Display Control Head (PMLN7501_) Exploded View Parts List

| Item No. | Description | Part No. |
|----------|------------------------------|-------------|
| 1 | Volume/Channel Knob Assembly | 36012018001 |
| 2 | Housing Assembly | 0104045J47 |
| 3 | Power Button | 38012007001 |
| 4 | Light Barrier, Power Button | 07012020001 |
| 5 | Mic Jack Seal | 3264133H01 |
| 6 | Volume Encoder Seal | 32012140001 |
| 7 | Color Display Pad Gasket | 32012094001 |
| 8 | Color Display | 72012017001 |
| 9 | PCB Assembly | 0104056J39 |
| 10 | PCB Retainer | 42012024001 |
| 11 | Speaker | 5015134H02 |
| 12 | Speaker Retainer | 42012023001 |
| 13 | Screw - K30 x 1.2 x 12 mm | 03012038001 |
| 14 | Control Head Flex Cable | PF001884A01 |

| Item No. | Description | Part No. |
|----------|-------------------------------------|-------------|
| 15 | Keypad Frame | 42012026001 |
| 16 | Keypad | 75012061001 |
| 17 | Nameplate Front Label for XPR 5550e | 33012017026 |

Figure 109: Numeric Display Control Head Exploded View

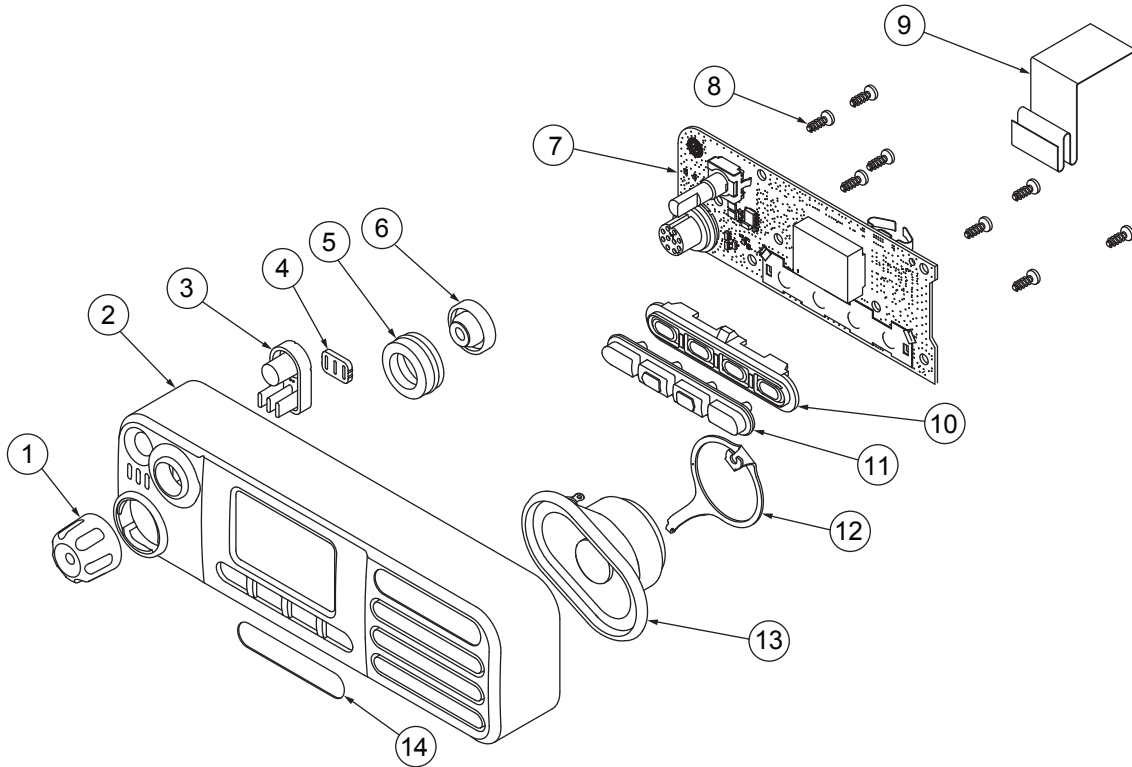


Table 31: Numeric Display Control Head (PMLN7500_) Exploded View Parts List

| Item No. | Description | Part No. |
|----------|------------------------------|-------------|
| 1 | Volume/Channel Knob Assembly | 36012018001 |
| 2 | Housing Assembly | 0104045J48 |
| 3 | Power Button | 38012007001 |
| 4 | Light Barrier, Power Button | 07012020001 |
| 5 | Mic Jack Seal | 3264133H01 |
| 6 | Volume Encoder Seal | 32012140001 |
| 7 | PCB Assembly | 0104056J59 |
| 8 | Screw - K30 x 1.34 x 8 mm | 0371370L01 |
| 9 | Control Head Flex Cable | PF001884A01 |
| 10 | Keypad Frame | 42012025001 |
| 11 | Keypad | 75012060001 |
| 12 | Speaker Retainer | 42012030001 |

| Item No. | Description | Part No. |
|----------|-------------------------------------|-------------|
| 13 | Speaker | 5015134H02 |
| 14 | Nameplate Front Label for XPR 5350e | 33012017028 |

5.8

Torque Chart

The following table lists the various nuts and 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 32: Torque Specifications for Nuts and Screws

| Part Number | Description | Driver/Socket | Torque | | |
|-------------|--------------------------------------|--------------------------------|--------|--------|-------|
| | | | N-m | lbs-in | kg-cm |
| 30012044001 | Nut, GPS Antenna Connector | 5/16 in. or 8 mm socket driver | 1.7 | 15 | 17.3 |
| 02012015001 | Nut, RF Connector | 9/16 in. deep socket driver | 2.15 | 19 | 21.9 |
| 03012038001 | Screw, K30 x 1.2 x 12 mm, Pan Head | T10 Torx | 0.88 | 7.8 | 9.0 |
| 0371370L01 | Screw, K30 x 1.34 x 8 mm, Pan Head | T10 Torx | 0.88 | 7.8 | 9.0 |
| 0310909E03 | Screw, M2 x 0.4 x 6 mm, Pan Head | T6 Torx | 0.28 | 2.5 | 2.9 |
| 03012037001 | Screw, M2.5 x 0.45 x 12 mm, Pan Head | T8 Torx | 0.45 | 4 | 4.6 |
| 0310943J12 | Screw, M3 x 0.5 x 13 mm, Pan Head | T10 Torx | 1.5 | 13 | 15 |

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 33](#) or exhibits an error code listed below, then the circuit board should be replaced. If repair requires knowledge of 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/test fixture along with the diagrams found in this section of the manual. See "Service Aids" for the appropriate Motorola Solutions service aids and tools part numbers.

6.1

High Power RF Precaution



CAUTION: The radio might transmit while the technician believes the radio is in receive mode under the following conditions: radio failure, digital affiliation, a defective PTT button, or other unintentional activations.

To avoid possible equipment damage, when performing both transmit and receive tests, a suitable attenuator rated at 100 W or more should always be used with test equipment connected to the RF connector. The only exception to this is when the equipment's input power rating is higher than the maximum output power of the radio.

6.2

Replacement Service Kit Procedures

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

If the service kit is replaced, it does not necessarily need to be retuned if it has been factory tuned. It should however be checked for performance before being placed into service. Of particular concern is the Bias DAC, which will need to be set for the appropriate final device bias current prior to keying up the radio. If the bias is not properly set it may be possible to 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.

6.3

Power-Up Error Codes

When the radio is turned on (powered-up), the radio performs cursory tests to determine if its basic electronics and software are in working order.

Problems detected during these tests are presented as error codes on the radio display. The presence of an error should prompt the user that a problem exists and that a service technician should be contacted.

Self-test errors are classified as either fatal or non-fatal. Fatal errors inhibit user operation; non-fatal errors do not. Use the following table to aid in understanding particular power-up error code displays.

Table 33: Power-Up Error Codes

| Error Code | Description | Error Type | Corrective Action |
|-------------------|--------------------------------|-------------------|---|
| ERROR 01/02 | FLASH ROM Codeplug Checksum | Non-Fatal | Reprogram the codeplug. |
| ERROR 01/22 | Tuning Codeplug Checksum | Non-Fatal | Reprogram the tuning partition. |
| FAIL 01/82 | FLASH ROM Codeplug Checksum | Fatal | Reprogram the codeplug. |
| FAIL 01/90 | General Hardware Error | Fatal | Turn the radio off, then on. If problem persists, send radio to the nearest Motorola Solutions Depot. |
| FAIL 01/92 | Security Partition Checksum | Fatal | Reprogram the security partition/codeplug. |
| FAIL 01/93 | FlashPORT AUTHENT CODE Failure | Fatal | Contact the depot. |
| FAIL 01/A2 | Tuning Codeplug Checksum | Fatal | Reprogram the tuning partition/codeplug. |
| FAIL 02/90 | RF Hardware Error | Fatal | Send radio to the nearest Motorola Solutions Depot. |

Chapter 7

Authorized Accessories List

Motorola Solutions provides a list of accessories to improve the productivity of your radio.

Antenna

- VHF, 136–144 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAD4006_)
- VHF, 146–150.8 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAD4007_)
- VHF, 150.8–162 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAD4008_)
- VHF, 162–174 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAD4009_)
- UHF, 403–430 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAE4002_)
- UHF, 450–470 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAE4003_)
- UHF, 470–527 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAE4004_)
- UHF, 406–420 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (HAE4010_)
- UHF, 450–470 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (HAE4011_)
- UHF, 470–494 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (HAE4012_)
- UHF, 494–512 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (HAE4013_)
- Combination GPS/UHF, 403–527 MHz, 2.0 dB Gain, Through-Hole Mount, Mini-U (HAE6019_)
- Combination GPS/UHF, 470–527 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAE6020_)
- UHF, 403–527 MHz, 2.0 dB Gain, Through-Hole Mount, Mini-U (HAE6022_)
- Combination GPS/UHF, 470–494 MHz, 3.0 dB Gain, Through-Hole Mount, Mini-U (HAE6024_)
- Combination GPS/UHF, 494–512 MHz, 3.0 dB Gain, Through-Hole Mount, Mini-U (HAE6026_)
- 800/900, 806–941 MHz, 5.0dB Gain, Through-Hole Mount, Mini-U (HAF4027_)
- Combination GPS+RF, 806–941 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (HAF4029_)
- Combination GPS+RF, 806–941 MHz, 3.0 dB Gain, Through-Hole Mount, Mini-U (HAF4030_)
- Combination GPS+RF, 806–941 MHz, 5.0 dB Gain, Through-Hole Mount, Mini-U (HAF4032_)
- Combination GPS+RF, 806–941 MHz, 5.0 dB Gain, Through-Hole Mount, Mini-U (HAF4033_)
- Combination GPS/UHF, 403–430 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (PMAE4030_)
- Combination GPS/UHF, 450–470 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (PMAE4031_)
- Combination GPS/UHF, 406–420 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (PMAE4032_)
- Combination GPS/UHF, 450–470 MHz, 3.5 dB Gain, Through-Hole Mount, Mini-U (PMAE4033_)
- Combination GPS/UHF, 450–470 MHz, 5.0 dB Gain, Through-Hole Mount, Mini-U (PMAE4034_)
- Fixed Mount GPS Active Antenna (PMAN4000_)
- Window Mount GPS Active Antenna (PMAN4001_)
- Magnetic Mount GPS Active Antenna (PMAN4002_)
- Combination GPS+RF, Base Only, Through-hole Mount, Mini-U (PMAN4004_)
- Combination GPS/VHF, 136–144 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (RAD4214_)
- Combination GPS/VHF, 146–150.8 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (RAD4215_)

- Combination GPS/VHF, 150.8–162 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (RAD4216_)
- Combination GPS/VHF, 162–174 MHz, 1/4 Wave, Through-Hole Mount, Mini-U (RAD4217_)
- Combination GPS/VHF, 146–172 MHz, 3.0 dB Gain, Through-Hole Mount, Mini-U (RAD4218_)
- UHF, 445–470 MHz, 5.0 dB Gain, Through-Hole Moun, Mini-U (with base) (RAE4004_RB)
- UHF, 445–470 MHz, 5.0 dB Gain, Through-Hole Mount, Mini-U (without base) (RAE4004_)

For use with base PMAN4004_ only:

- UHF, 494–512 MHz, 3.0 dB Gain, Through-Hole Mount (HAE6027_)
- UHF, 470–494 MHz, 3.0 dB Gain, Through-Hole Mount (HAE6028_)
- UHF, 403–527 MHz, 2.0 dB Gain, Through-Hole Mount (HAE6029_)
- UHF, 470–527 MHz, 1/4 Wave, Through-Hole Mount (HAE6030_)
- UHF, 403–430 MHz, 1/4 Wave (PMAE4039_)
- UHF, 450–470 MHz, 1/4 Wave (PMAE4041_)
- UHF, 406–420 MHz, 3.5 dB Gain (PMAE4040_)
- UHF, 450–470 MHz, 3.5 dB Gain (PMAE4042_)
- UHF, 450–470 MHz, 5.0 dB Gain (PMAE4043_)
- VHF, 162–174 MHz, 1/4 Wave (RAD4223_)
- VHF, 150.8–162 MHz, 1/4 Wave (RAD4224_)
- VHF, 146–150.8 MHz, 1/4 Wave (RAD4225_)
- VHF, 136–144 MHz, 1/4 Wave (RAD4226_)
- VHF, 146–172 MHz, 3.0 dB Gain (RAD4227_)

Audio Accessories

- HK200 Bluetooth Headset (89409N)
- Telephone Style Handset (HMN4098_)
- Operations Critical Wireless Earpiece, 12 in. Cable (NNTN8125_)
- Operations Critical Wireless Earpiece, 9.5 in. Cable (NNTN8126_)
- Operations Critical Wireless Push-to-Talk POD (NNTN8127_)
- Non-Secure Wireless Headset & Push-to-Talk Device with Push-to-Talk Audio, 12-Inch Cable (NNTN8189_)
- Bluetooth Accessory Kit, SP, 9.5 in. Cable (NNTN8190_)
- Wireless Covert Kit, includes two sets of 2-Wire Earbuds (1 Black and 1 White), 1-Wire Earbud (Black), and a 3.5 mm Adapter to plug into any off-the-shelf headphones (NNTN8296_) ¹¹
- Wireless Neckloop Y-adapter and retention hook for Completely Discreet Kit (NNTN8385_) ¹³
- Flexible Fit Swivel Earpiece with Boom Mic (PMLN7181_) ¹³
- Flexible Fit Swivel Earpiece with Boom Mic, Multipack (PMLN7203_) ¹³
- Completely Discreet Earpiece Kit (RLN4922_) ¹³
- XBT Behind-the-Neck, Non-secure Wireless Heavy Duty Headset (RLN6490_)
- XBT Overhead, Non-secure Wireless Heavy Duty Headset (RLN6491_)
- MOTOTRBO Bluetooth Accessory Kit with NA Power Supply (RLN6500_)

¹¹ Your radio is compatible with the accessories listed here. Contact your dealer for details.

- Swivel Earpiece with In-Line Microphone for Bluetooth Accessory Kit Pod, Pack of 3 (RLN6550_) ¹³
- Desktop Microphone (RMN5050_)
- Compact Microphone (RMN5052_)
- IMPRES 4-Way Navigation Keypad Microphone (RMN5127_)
- Heavy Duty Microphone with Enhanced Audio (RMN5053_)
- Visor Microphone with Enhanced Audio (RMN5054_)

Cables

- Compact Microphone Replacement Cable (3075336B07)
- Heavy Duty/Keypad Microphone Replacement Cable (3075336B10)
- Power Cable to Battery, 10-foot (3-metre) Cable, 15 amp (1–25 Watt) (HKN4137_)
- Power Cable to Battery, 10-foot (3-metre) Cable, 20 amp (1–45 Watt) (HKN4191_)
- Power Cable to Battery, 20-foot (6-metre) Cable, 20 amp (1–45 Watt) (HKN4192_)
- Mobile Front (MMP) Programming Cable (HKN6184_)
- MAP Programming Cable (PMKN4010_)
- MAP Programming and Test Cable (PMKN4016_)
- Mobile and Repeater Rear Accessory Connector Universal Cable (PMKN4018_)
- Mobile Mic Extension Cable, 10 feet (PMKN4033_)
- Mobile Mic Extension Cable, 20 feet (PMKN4034_)
- Remote Mount (3-metre) Cable (PMKN4143_)
- Remote Mount (5-metre) Cable (PMKN4144_)
- Ignition Sense Cable (RKN4136_)

Desktop Accessories

- US Line Cord (3060665A04)
- Radio Power Cable for GPN6145 (GKN6266_)
- Desktop Tray without Speaker (GLN7318_)
- Switchmode Power Supply (1 – 25 Watt Models) (CE marked) (GPN6145_)
- Power Supply and Cable (HPN4007_)
- Hardware Kit for Rear Accessory Connector (PMLN5072_)
- Desktop Tray with Speaker (RSN4005_)

Mounting Kits

- Screen Protector, Clear (single pack contains one unit) (AY000269A01_) ¹²
- In Dash (DIN) Mounting Kit (RLN6465_)
- Low Profile Trunnion Kit (RLN6466_)
- High Profile Trunnion Kit (RLN6467_)
- Key Lock Trunnion Kit (RLN6468_)
- Low Profile Trunnion – Bag (RLN6469_)

¹² Your radio is compatible with the accessories listed here. Contact your dealer for details.

- Remote Mount Transceiver Interface (PMLN6402_)
- Remote Mount Control Head Interface (PMLN6403_)

Miscellaneous Accessories

- Surge Protector, Tower Mount Kit (DQT1)
- Surge Protector, Coax Protector Bulkhead (DSISB50LNC2MA)
- PL259/Mini-U Antenna Adapter, 8 feet (2.4 metre) Cable (HKN9557_)
- Microphone Hang Up Clip (All Microphones) (HLN9073_)
- Universal Microphone Hang Up Clip (All Microphones) (HLN9414_)
- IMPRES Mobile MMP Non-PC Adapter (PMKN4072_)
- IMPRES Mobile MAP Non-PC Adapter (PMKN4070_)
- Generic Option Board (PMLN5718_S)
- Operations Critical Wireless 1-Wire Surveillance Kit with translucent tube (PMLN7052_) ¹³
- Push Button PTT (RLN5926_)
- Emergency Footswitch (RLN5929_)
-

Speakers

- 13 W External Speaker (RSN4002_)
- 7.5 W External Speaker (RSN4003_)
- 5 W External Speaker (RSN4004_)

¹³ Your radio is compatible with the accessories listed here. Contact your dealer for details.

Appendix A

Replacement Parts Ordering

Basic Ordering Information

Some replacement parts, spare parts, and/or product information can be ordered directly on Motorola Solutions local distribution organization or through Motorola Online. While parts may be assigned with a Motorola Solutions part number, this does not guarantee that they are available from Motorola Solutions Radio Products and Solutions Organization (RPSO). Some parts may have become obsolete and 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.

Orders for replacement parts, kits, and assemblies should be placed directly on Motorola Solutions local distribution organization or through Motorola Online. When ordering replacement parts or equipment information, the complete identification number should be included. 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, and sufficient description of the desired component to identify it.

Request for help in identification if non-referenced spare parts should be directed to the Customer Care organization of Motorola Solutions local area representation. Orders for replacement parts, kits, and assemblies should be placed directly on Motorola Solutions local distribution organization or by using Motorola Online.

Motorola Online

Motorola Online users can access our online catalog at <https://businessonline.motorolasolutions.com>.

To register for online access:

Please call 1-800-422-4210 (for U.S. and Canada Service Centers only). International customers can obtain assistance at <https://businessonline.motorolasolutions.com>.

Types of Orders

Mail Orders

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

Motorola
Solutions

7031 Columbia Gateway Drive

3rd Floor - Order Processing

Columbia, MD 21046

U.S.A.

Telephone Orders and Parts Identification

- RPSO
(United States and Canada)
7:00 AM to 7:00 PM (Central Standard Time)
-

Types of Orders

| | |
|------------|--|
| | Monday through Friday (Chicago, U.S.A.) 1-800-422-4210 1-847-538-8023 (United States and Canada) <ul style="list-style-type: none">• USFGMD 1-800-826-1913 Federal Government Parts - Credit Cards Only 8:30 AM to 5:00 PM (Eastern Standard Time) |
| Fax Orders | RPSO (United States and Canada) 1-800-622-6210 1-847-576-3023 (United States and Canada) USFGMD (Federal Government Orders) 1-800-526-8641 (For Parts and Equipment Pur- chase Orders) |

Product Customer Service

RPSO (United States and Canada)

1-800-927-2744



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

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, please send the radio to a Motorola Solutions Service Center as listed below.

| Types of Center | Address | Telephone Number |
|--|---|-------------------------------------|
| Motorola Solutions Service Centers | 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 | Toll Free: 1-800-543-3222 |

Appendix C

Limited Level 3 Servicing

Only Motorola Solutions Service Center or Motorola Solutions Authorized Dealers can perform Limited Level 3 Servicing.

Refer to "Disassembly/Reassembly Procedures" chapter for details of the following:

- Preventive maintenance (inspection and cleaning).
- Safe handling of CMOS and LDMOS devices.
- Repair procedures and techniques.

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.

C.1

Component Location and Parts List

Figure 110: PCB Top Side View

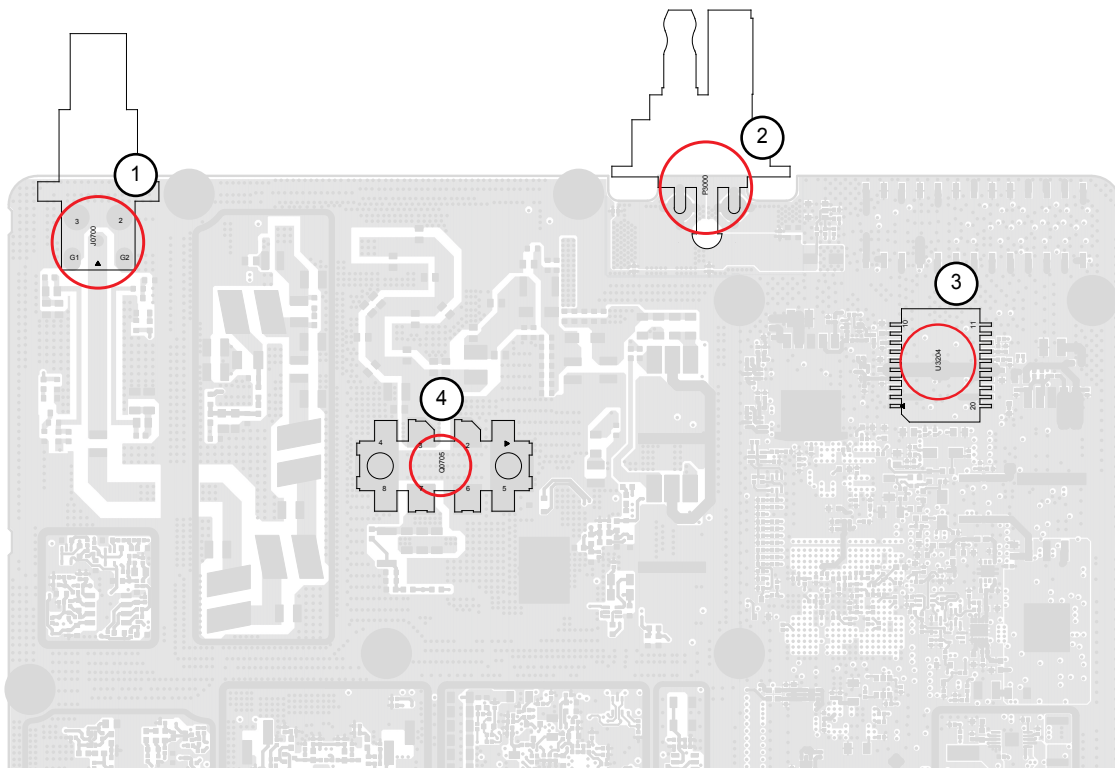


Figure 111: PCB Bottom Side View

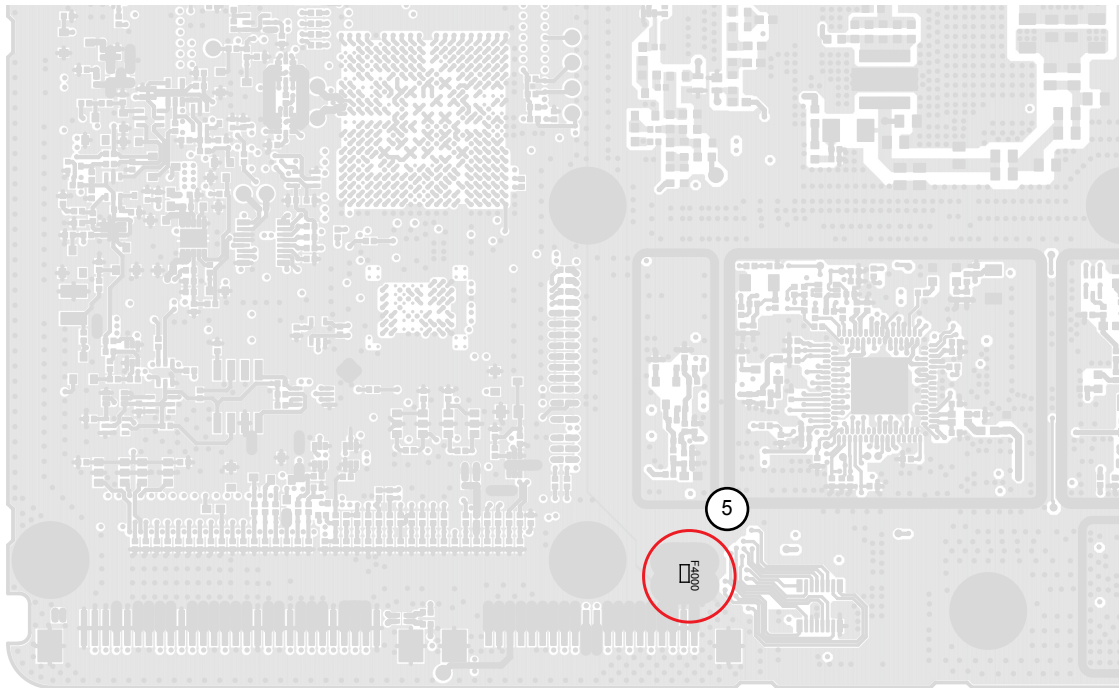


Table 34: Component Parts List

| No. | Circuit Ref. | Motorola Part Number | Description |
|-----|--------------|--|----------------------------------|
| 1 | J0700 | 09009348001 | Mini-UHF Connector |
| 2 | P3000 | 09009344001 | DC Power Connector |
| 3 | U3204 | 51009509001 | IC Audio Amplifier 1 Per Package |
| 4 | Q0702 | 48012067002 (VHF LP) 48012022001 (VHF HP) | RF MOSFET Power Transistor |
| | Q0705 | 48012067002 (UHF1 LP) 48012022001 (UHF1 HP/UHF2) 48012272002 (8/900 MHz) | |
| | | | |
| 5 | F4000 | 6515076H01 | Fast Blow 3A, 24V Fuse |

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.

Bluetooth (BT) A wireless protocol utilizing short-range communications over short distances.

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).

Global Navigation Satellite System (GNSS) GNSS uses satellites from the GPS, GLONASS, and BeiDou systems.

- Global Positioning System (GPS)
 - It includes Satellite-Based Augmentation System (SBAS).
 - Method of location based on reception of multiple satellite signals by a device on the ground or in an airplane.
- Global Navigation Satellite System (GLONASS)
- BeiDou Navigation Satellite System (BDS)
 - Chinese Satellite Navigation System.

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 a radio-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 CPS to communicate directly with the radio 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.

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.

Wireless Fidelity (Wi-Fi) A mechanism used to wirelessly connect electronic devices.