

PROFESSIONAL DIGITAL TWO-WAY RADIO SYSTEM



MOTOTRBO™ REPEATER BASIC SERVICE MANUAL

XPR™ 8300 REPEATER
XPR™ 8400 REPEATER



Foreword

This manual covers all models of the XPR™ 8300/XPR™ 8400 Repeater, unless otherwise specified. It 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 Authorized Dealers, self-maintained customers, and distributors.



These servicing instructions are for use by 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

ATTENTION!

Before using this product, XPR™ 8300/XPR™ 8400 Repeater, read the RF Exposure and Safety guide that ships with the repeater which contains important operating instructions for safe usage and RF energy awareness and control for Compliance with applicable Standards and Regulations.

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Notes

Document History

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

Edition	Description	Date
6816810H01-A	Initial Release.	Dec. 2006
6816810H01-B	Added VHF High Power Band Information.	June 2007
6816810H01-C	Added VHF Low Power and UHF Low Power Band Information.	Nov. 2007
6816810H01-D	Added 20 kHz information to Chapter 1 and UHF Band 2 models.	June 2008
6816810H01-E	Changed Channel Capacity from 1 to 16 for all bands in Section 1.9 Specifications. Changed Windows 2000/XP to Windows Vista/XP in Chapter 4, Sections 4.1 and 4.3 and added Repeater Alignment Procedure.	June 2009
6816810H01-F	Added statements “VHF/UHF Brick Version A Models” and “VHF/UHF Brick Version B Models” in related sections. Removed Repeater Alignment Procedure.	Sept. 2010
6816810H01-G	Added Appendix C, Digital Telephone Patch (DTP) Tuning Guideline.	May 2011
6816810H01-H	Added detailed process for replacing and initializing service kits for repeaters in Section 6.2 Replacement Service Kit Procedures.	June 2013
6816810H01-J	Added new Transmit Radio Service Kit PMTE4026_S to UHF2 Model Chart and PMTE4028_S to UHF1 HP Model Chart. Added new Receive Radio Service Kit PMTE4016_S to UHF2 Model Chart and PMTE4013_S to UHF1 HP Model Chart.	Mar. 2014

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Related Publications

XPR 8300/XPR 8380/XPR 8400 Repeater Installation Guide	6816814H01
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Commercial Warranty

Limited Warranty

MOTOROLA COMMUNICATION PRODUCTS

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MOTOROLA SOLUTIONS INC. ("MOTOROLA") warrants the MOTOROLA 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:

Repeater	Two (2) Years
Product Accessories	One (1) Year

Motorola, 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.

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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 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 at 1-888-567-7347 US/Canada.

V. What This Warranty Does Not Cover

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- B. Defects or damage from misuse, accident, water, or neglect.
- C. Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- D. Breakage or damage to antennas unless caused directly by defects in material workmanship.
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- F. Product which has had the serial number removed or made illegible.
- G. Freight costs to the repair depot.
- H. A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with MOTOROLA's published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from MOTOROLA.
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- J. Normal and customary wear and tear.

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- A. that MOTOROLA will be notified promptly in writing by such purchaser of any notice of such claim;
- B. that MOTOROLA will have sole control of the defense of such suit and all negotiations for its settlement or compromise; and
- C. should the Product or parts become, or in MOTOROLA's opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit MOTOROLA, 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.

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VII. Governing Law

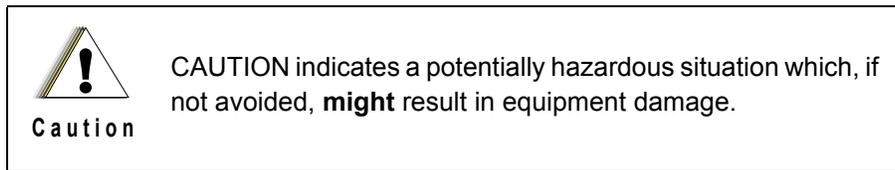
This Warranty is governed by the laws of the State of Illinois, USA.

Chapter 1 Introduction

1.1 Notations Used in This Manual

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

NOTE: An operational procedure, practice, or condition that is essential to emphasize.



1.2 Repeater Description

The XPR 8300/XPR 8400 repeater is available in the following frequency ranges and power levels.

Table 1-1. Frequency Ranges and Power Levels

Frequency Band	Bandwidth	Power Level
VHF	136–174 MHz	1–25 Watts 25–45 Watts
UHF B1	403–470 MHz	1–25 Watts 25–40 Watts
UHF B2	450–512 MHz	1–40 Watts

This repeater is among the most sophisticated two-way repeaters available. It has a robust design for 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 repeater communications solution.

1.3 MOTOTRBO Repeater Model Numbering Scheme

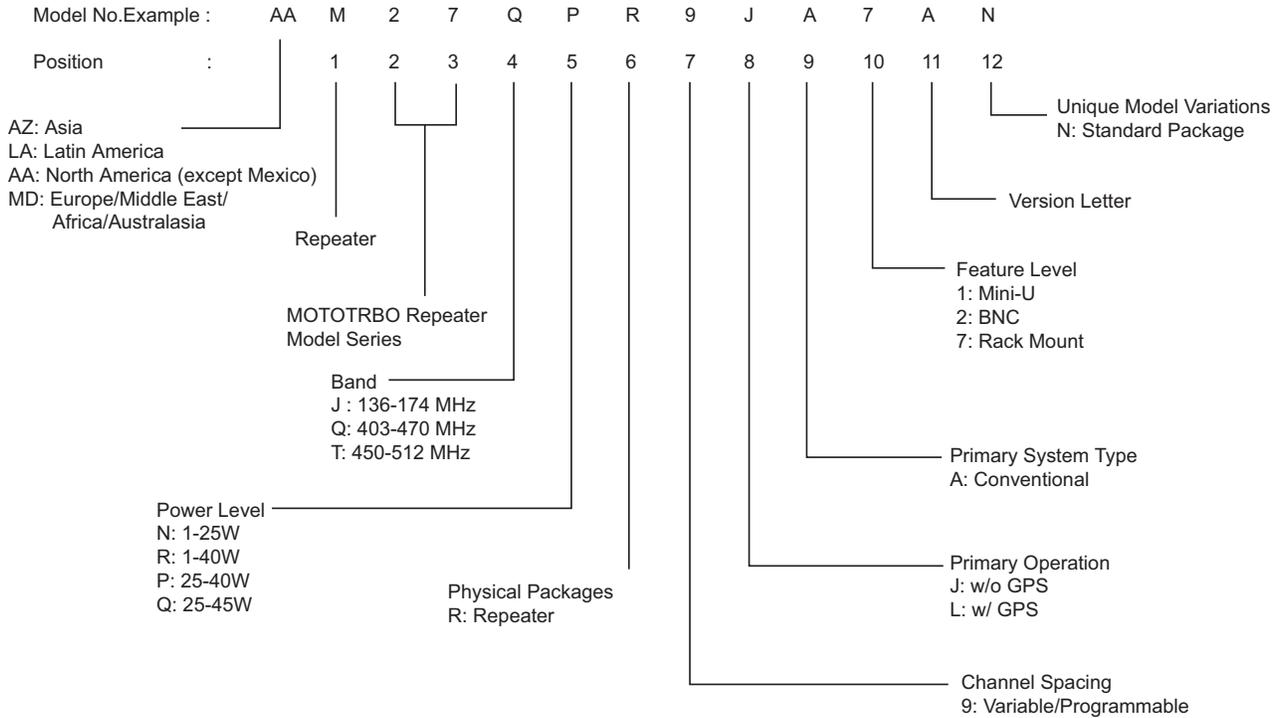


Figure 1-1. Repeater Model Numbering Scheme

1.4 VHF High Power MOTOTRBO Repeater (136–174 MHz) Model Chart

VHF 136–174 MHz, 25–45 W			
Model		Description	
AAM27JQR9JA7AN		136–174 MHz, 25–45 W, XPR 8300 8 MB Repeater	
AAM27JQR9JA7BN		136–174 MHz, 25–45 W, XPR 8400 32 MB Repeater	
	Item	Description	
X		PMLN5269_S	Repeater Indicator Board
X	X	PMLN5644_S	Connector Board Assembly
	X	PMLN5643_S	Repeater Indicator Board
X		PMTD4001_S	Repeater XCVR Service Kit
	X	PMTD4007_S	Repeater XCVR Service Kit
X	X	PMPN4001_	Power Supply
X	X	3087791G01	120V Line Cord
X	X	6816814H01	XPR 8300/XPR 8380/XPR 8400 Installation Guide
X	X	6881095C99	Product Safety and RF Exposure Booklet

X = Item Included

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

1.5 VHF Low Power MOTOTRBO Repeater (136–174 MHz) Model Chart

VHF 136–174 MHz, 1–25 W			
Model		Description	
AAM27JNR9JA7AN		136–174 MHz, 1–25 W, XPR 8300 8 MB Repeater	
AAM27JNR9JA7BN		136–174 MHz, 1–25 W, XPR 8400 32 MB Repeater	
	Item	Description	
X		PMLN5269_S	Repeater Indicator Board
X	X	PMLN5644_S	Connector Board Assembly
	X	PMLN5643_S	Repeater Indicator Board
X		PMTD4002_S	Repeater XCVR Service Kit
	X	PMTD4006_S	Repeater XCVR Service Kit
X	X	PMPN4001_	Power Supply
X	X	3087791G01	120V Line Cord
X	X	6816814H01	XPR 8300/XPR 8380/XPR 8400 Installation Guide
X	X	6881095C99	Product Safety and RF Exposure Booklet

X = Item Included

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

1.6 UHF1 High Power MOTOTRBO Repeater (403–470 MHz) Model Chart

UHF1 403–470 MHz, 25–40 W			
Model		Description	
AAM27QPR9JA7AN		403–470 MHz, 25–40 W, XPR 8300 8 MB Repeater	
AAM27QPR9JA7BN		403–470 MHz, 25–40 W, XPR 8400 32 MB Repeater	
	Item	Description	
X		PMLN5269_S	Repeater Indicator Board
X	X	PMLN5644_S	Connector Board Assembly
	X	PMLN5643_S	Repeater Indicator Board
X		PMTE4004_S	Repeater XCVR Service Kit
	X	PMTE4013_S	Repeater UHF1 RX Radio Service Kit
	X	PMTE4028_S	Repeater UHF1 TX Radio Service Kit
X	X	PMPN4001_	Power Supply
X	X	3087791G01	120V Line Cord
X	X	6816814H01	XPR 8300/XPR 8380/XPR 8400 Installation Guide
X	X	6881095C99	Product Safety and RF Exposure Booklet

X = Item Included

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

1.7 UHF1 Low Power MOTOTRBO Repeater (403–470 MHz) Model Chart

UHF1 403–470 MHz, 1–25 W			
Model		Description	
AAM27QNR9JA7AN		403–470 MHz, 1–25 W, XPR 8300 8 MB Repeater	
AAM27QNR9JA7BN		403–470 MHz, 1–25 W, XPR 8400 32 MB Repeater	
	Item	Description	
X		PMLN5269_S	Repeater Indicator Board
X	X	PMLN5644_S	Connector Board Assembly
	X	PMLN5643_S	Repeater Indicator Board
X		PMTE4005_S	Repeater XCVR Service Kit
	X	PMTE4014_S	Repeater XCVR Service Kit
X	X	PMPN4001_	Power Supply
X	X	3087791G01	120V Line Cord
X	X	6816814H01	XPR 8300/XPR 8380/XPR 8400 Installation Guide
X	X	6881095C99	Product Safety and RF Exposure Booklet

X = Item Included

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

1.8 UHF2 High Power MOTOTRBO Repeater (450–512 MHz) Model Chart

UHF2 450–512 MHz, 1–40 W			
Model		Description	
AAM27TRR9JA7AN		450–512 MHz, 1–40 W, XPR 8300 8 MB Repeater	
	AAM27TRR9JA7BN	450–512 MHz, 1–40 W, XPR 8400 32 MB Repeater	
	Item	Description	
X		PMLN5269_S	Repeater Indicator Board
X	X	PMLN5644_S	Connector Board Assembly
	X	PMLN5643_S	Repeater Indicator Board
X		PMTE4006_S	Repeater XCVR Service Kit
	X	PMTE4016_S	Repeater UHF2 RX Radio Service Kit
	X	PMTE4026_S	Repeater UHF2 TX Radio Service Kit
X	X	PMPN4001_	Power Supply
X	X	3087791G01	120V Line Cord
X	X	6816814H01	XPR 8300/XPR 8380/XPR 8400 Installation Guide
X	X	6881095C99	Product Safety and RF Exposure Booklet

X = Item Included

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

1.9 Specifications

General			
Specification	VHF	UHF1	UHF2
Channel Capacity	16		
Technical RF Output Low Power High Power	1–25 W 25–45 W	1–25 W 25–40 W	– 1–40 W
Frequency	136–174 MHz	403–470 MHz	450–512 MHz
Dimensions (HxWxL)	5.22" x 19" x 11.67" (132.6 mm x 482.6 mm x 296.5 mm)		
Weight	31 lbs (14 kg)		
Voltage Requirements	100–240 V AC 47–63 Hz (13.6 V DC)		
Current Drain: Standby:	1.0 A (100 V AC) 0.5 A (240 V AC) 1.0 A (typical)(13.4 V DC)		
Transmit: Low Power	3.0 A (100 V AC) 1.5 A (240 V AC) 10 A (typical)(13.4 V DC)		
High Power	4.0 A (100 V AC) 1.8 A (240 V AC) 12 A (typical)(13.4 V DC)		
Operating Temperature Range	-30°C to +60°C		
Max Duty Cycle	100%		
FCC Description	1–25 W: ABZ99FT3026 25–45 W: ABZ99FT3025	1–25 W: ABZ99FT4026 25–40 W: ABZ99FT4025	1–40 W: ABZ99FT4027
IC Description	1–25 W: 109AB-99FT3026 25–45 W: 109AB-99FT3025	1–25 W: 109AB-99FT4026 25–40 W: 109AB-99FT4025	1–40 W: 109AB-99FT4027

Receiver			
Specification	VHF	UHF1	UHF2
Frequency	136–174 MHz	403–470 MHz	450–512 MHz
Channel Spacing	12.5 kHz/20 kHz/25 kHz		
Frequency Stability (-30°C to +60°C)	±0.5 ppm		
Analog Sensitivity (12 dB SINAD)	0.30 μV 0.22 μV (typical)		
Digital Sensitivity	1% BER: 0.71 μV 0.32 μV (typical) 5% BER: 0.3 μV 0.22 μV (typical)		
Intermodulation (TIA603C)	78 dB	75 dB	
Adjacent Channel Selectivity: TIA603 TIA603C	65 dB @ 12.5 kHz, 80 dB @ 25 kHz 50 dB @ 12.5 kHz, 80 dB @ 25 kHz	65 dB @ 12.5 kHz, 75 dB @ 25 kHz 50 dB @ 12.5 kHz, 75 dB @ 25 kHz	
Spurious Rejection (TIA603C)	80 dB	75 dB	
Audio Distortion @ Rated Audio	3% typical		
Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ 20/25 kHz		
Audio Response	TIA603C		
Conducted Spurious Emission (TIA603C):	-57 dBm		

Transmitter			
Specification	VHF	UHF1	UHF2
Frequency	136–174 MHz	403–470 MHz	450–512 MHz
Channel Spacing	12.5 kHz/20 kHz/25 kHz		
Frequency Stability (-30°C to +60°C)	±0.5 ppm		
Power Output: Low Power High Power	1–25 W 25–45 W	1–25 W 25–40 W	– 1–40 W
Modulation Limiting	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz		
Digital Modulation Fidelity (4FSK)	FSK Error 5% FSK Magnitude 1%		
FM Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ 20/25 kHz		
Conducted/Radiated Emission	-36 dBm < 1 GHz -30 dBm > 1 GHz		
Adjacent Channel Power (TIA603C)	60 dB @ 12.5 kHz 70 dB @ 20/25 kHz		
Audio Response	TIA603C		
Audio Distortion	3%		
FM Modulation	12.5 kHz : 11K0F3E 25 kHz : 16K0F3E		
4FSK Digital Modulation	12.5 kHz Data Only : 7K60FXD 12.5 kHz Data & Voice : 7K60FXE		
Digital Vocoder Type	AMBE +2™		
Digital Protocol	ETSI TS 102 361-1 ETSI TS 102 361-2 ETSI TS 102 361-3		

Self-Quierer		
VHF	UHF1	UHF2
144 MHz	464.025 MHz	498.825 MHz
147.45 MHz	–	–
172.025 MHz +/- 5 kHz	–	–

Chapter 2 Test Equipment and Service Aids

2.1 Recommended Test Equipment

The list of equipment contained in Table 2-1 includes most of the standard test equipment required for servicing Motorola repeaters.

Table 2-1. Recommended Test Equipment

Equipment	Characteristic	Example	Application
Service Monitor	Can be used as a substitute for items marked with an asterisk (*)	Aeroflex 3920, or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter*	100 μ V to 300 V 5 Hz to 1 MHz 10 Mega Ohm Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements
RF Signal Generator*	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation 0 kHz to 10 kHz	Agilent N5181 (www.agilent.com) or equivalent	Receiver measurements
Oscilloscope*	2 Channels 50 MHz Bandwidth 5 mV/div to 20 V/div	Tektronix TDS1001b (www.tektronix.com) or equivalent	Waveform measurements
Power Meter and Sensor*	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements

2.2 Service Aids

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

Table 2-2. Service Aids

Motorola Part Number	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 repeater parameters, tune and troubleshoot repeaters.
PMKN4010_	Mobile & Repeater Rear Programming Cable	Connects the radio's rear connector to a USB port for radio programming and data applications.
PMKN4016_	Mobile & Repeater Rear Accessory Programming and Test Cable	Connects the radio's rear connector to a USB port for radio programming, data applications, testing and alignment.
PMKN4018_	Mobile & Repeater Rear Accessory Connector Universal Cable	Connects the radio's rear connector to accessory devices such as desk sets. Cable contains all 26 wires and is unterminated at the user end.

2.3 Programming Cables



Figure 2-1. Mobile & Repeater Rear Programming Cable PMKN4010_

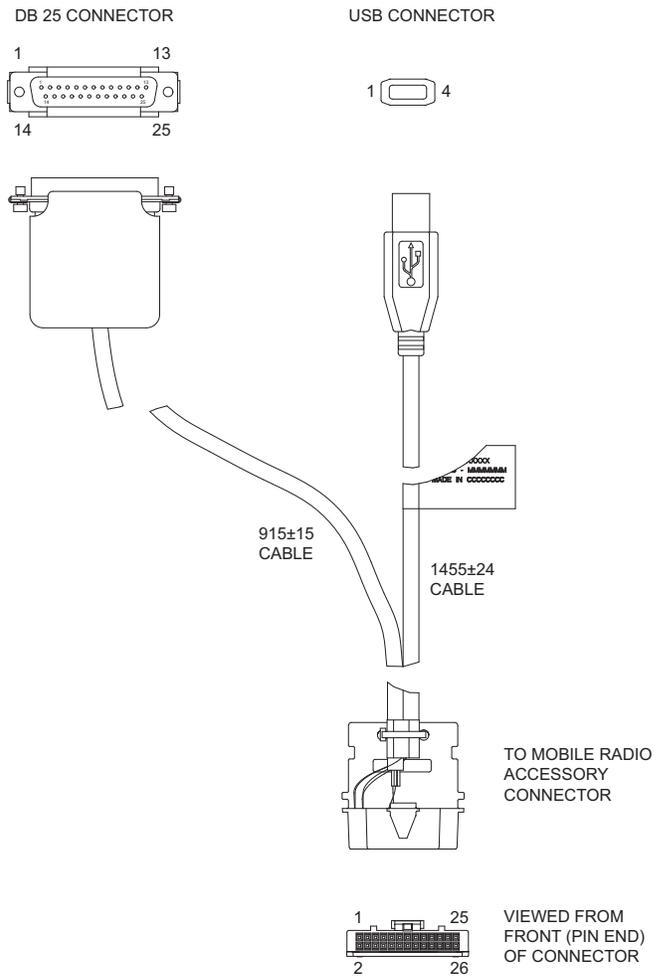


TABLE 2-3: WIRE DIAGRAM

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

Figure 2-2. Mobile & Repeater Rear Accessory Programming and Test Cable PMKN4016_

Notes

Chapter 3 Transceiver Performance Testing

3.1 General

The MOTOTRBO Repeater meets published specifications through their manufacturing process by utilizing high-accuracy laboratory-quality test equipment. The recommended field service equipment approaches the accuracy of the manufacturing equipment with few exceptions. This accuracy must be maintained in compliance with the manufacturer's recommended calibration schedule.

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

3.2 Setup

Supply voltage is 120/240 VAC. The equipment required for alignment procedures is connected as shown in the Repeater Tuning Equipment Setup Diagram, Figure 4-2.

Initial equipment control settings should be as indicated in Table 3-1. Table 3-2 lists Receiver Performance Checks information.

Table 3-1. Initial Equipment Control Settings

Service Monitor	Test Set
Monitor Mode: Power Monitor	Speaker set: A
RF Attenuation: -70	Speaker/load: Speaker
AM, CW, FM: FM	PTT: OFF
Oscilloscope Source: Mod Oscilloscope Horizontal: 10 mSec/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	

Table 3-2. Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comment
Rated Audio	Mode: GEN Output level: 1.0 mV RF Mod: 1kHz tone at 3 kHz deviation Monitor: DVM: AC Volts	Use tuner tool to program repeater to an appropriate test frequency with carrier squelch.	PTT to OFF (center), meter selector to Audio PA	Set volume to 7.75 Vrms via tuner tool.
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 1mV RF	As above	PTT to OFF (center), meter selection to Audio PA, speaker/load to speaker	Set volume to 7.75 Vrms via tuner tool.
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	out of TEST MODE; select a conventional system	As above	Unsquelch to occur at <0.25 μ V. Preferred SINAD = 9 - 10 dB

Chapter 4 Repeater Programming and Tuning

4.1 Introduction

This chapter provides an overview of the MOTOTRBO Customer Programming Software (CPS), as well as the Tuner application, which are all designed for use on Windows Vista/XP operating system. These programs are available in one kit as listed in Table 4-1. An Installation Guide is also included with the kit.

NOTE: Refer to the appropriate program on-line help files for the programming procedures.

Table 4-1. Repeater Software Program Kits

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

4.2 Customer Programming Software Setup

The Customer Programming Software setup, shown in Figure 4-1 is used to program the repeater.

NOTE: Refer to the appropriate program on-line help files for the programming procedures.

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

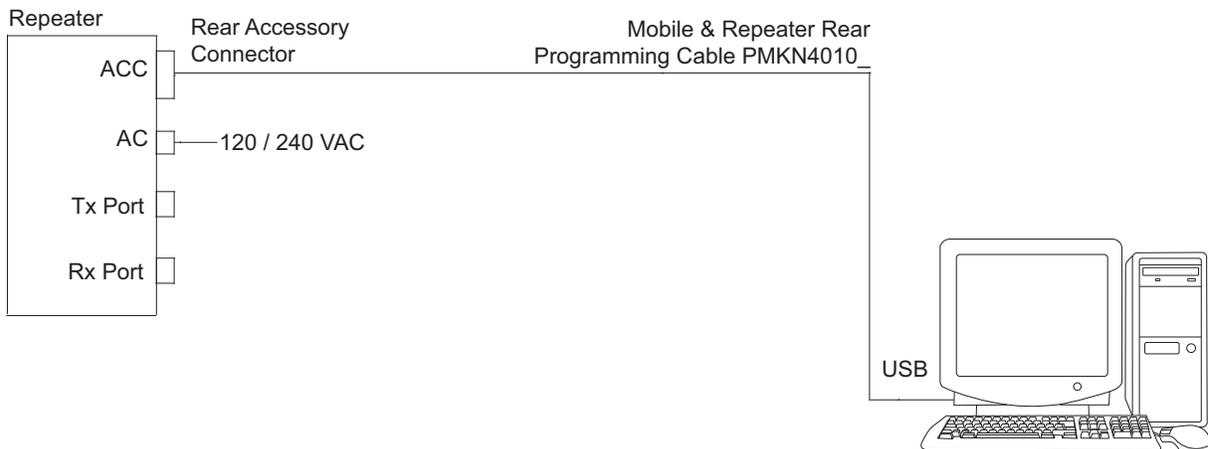


Figure 4-1. Customer Programming Software Setup from Rear Accessory Connector

4.3 Repeater Tuning Setup

A personal computer (PC), Windows Vista/XP and a tuner program (which is available as part of the MOTOTRBO CPS kit) are required to tune the repeater. To perform the tuning procedures, the repeater must be connected to the PC and test equipment setup as shown in Figure 4-2.

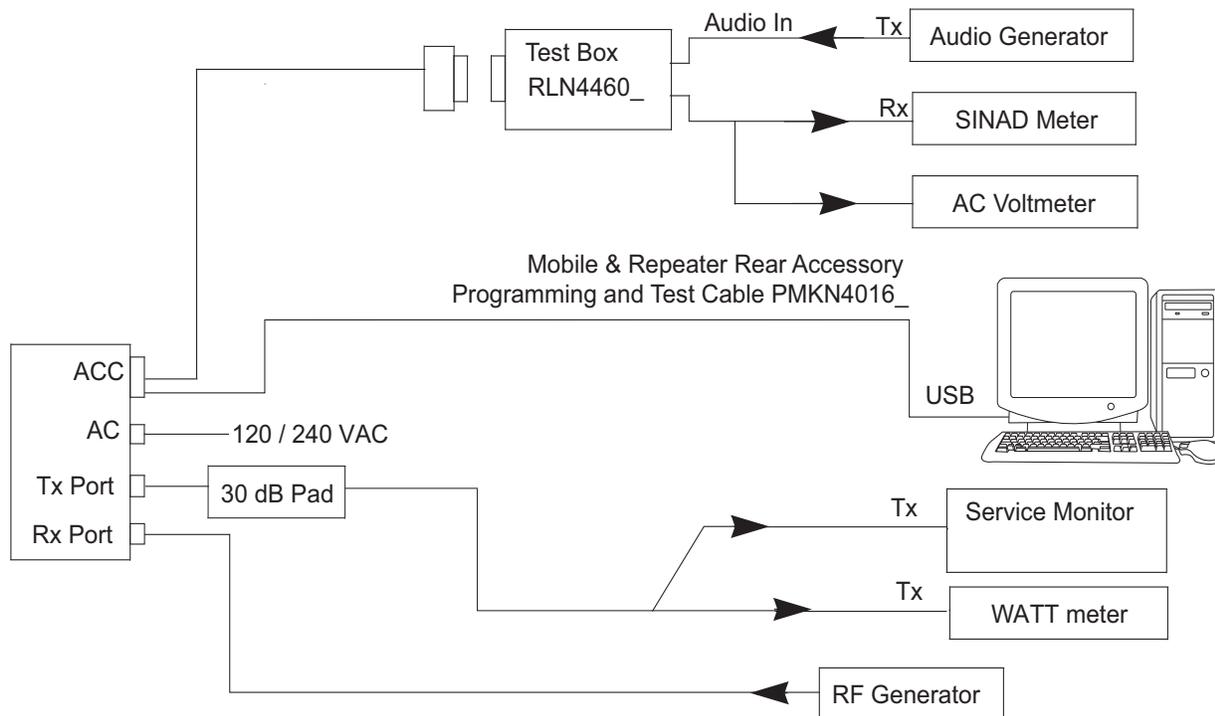


Figure 4-2. Repeater Tuning Equipment Setup

Chapter 5 Disassembly/Reassembly Procedures

5.1 Introduction

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 repeater.
- Disassembly and reassembly of the Transmit and Receive radios.

5.2 Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

5.2.1 Inspection

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

5.2.2 Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the repeater. External surfaces include the top cover and repeater enclosure.

Periodically clean smudges and grime from exterior enclosure. Use a soft, non-abrasive cloth moistened in a mild soap and water solution. Rinse the surface using a second cloth moistened in clean water, and clean any dirt or debris from the fan grill and louvers on the front side.

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

The only recommended agent for cleaning the external repeater 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).

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 repeater. 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. Once the cleaning process is complete, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the top cover and repeater enclosure.

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

5.3 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 repeaters, 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 the repeater without first referring to the following CAUTION statement.



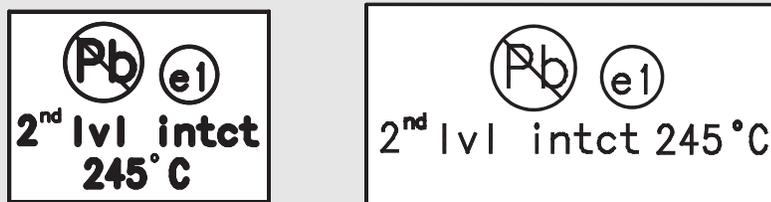
Caution

This repeater contains static-sensitive devices. Do not open the repeater 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. We recommend using a wrist strap, two ground cords, a table mat, a floor mat, 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 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.
- If at all possible, handle CMOS/LDMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

5.4 Repair Procedures and Techniques – General

NOTE Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards – examples shown below) 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 specified parts in this manual.



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 table:

Table 5-1. Lead Free Solder Wire Part Number List

Motorola 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"	1lb spool

Table 5-2. Lead Free Solder Paste Part Number List

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
1085674C03	NC-SMQ230	900–1000KCPs Brookfield (5rpm)	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 should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number and order the part from the nearest Motorola Radio Products and Solutions Organization listed in Appendix A of this manual.

Rigid Circuit Boards

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

When soldering near 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.

5.5 Disassembling and Reassembling the Repeater – General

The following tools are required for disassembling the repeater:

- Small Flat Blade Screwdriver
- TORX™ T30 Driver Bit
- TORX™ T25 Driver Bit
- TORX™ T20 Driver Bit
- TORX™ T15 Driver Bit
- TORX™ T10 Driver Bit
- 7 mm Magnetic Socket Driver (extension of >150 mm)
- 16 mm Deep Well Socket Driver
- 19 mm Deep Well Socket Driver

If a unit requires more complete testing or service than is customarily performed at the basic level, please send repeater to a Motorola Service Center listed in Appendix B.

The following disassembly procedures should be performed only if necessary.

5.6 Disassembly Procedures – Detailed

The following are typical procedures to remove and replace the Transmit radio, Receive radio, Repeater Indicator Board, connector board assembly and other miscellaneous parts.

1. Power cord and all external cables must be disconnected before opening up repeater.
2. Take the proper grounding precautions as stated in Section 5.3: Safe Handling of CMOS and LDMOS Devices on page 5-2.
3. When disassembling repeater, retain all screws for reuse.

5.6.1 Disassembly of Cover

1. Remove the five screws that retain the cover to the housing as shown in Figure 5-1 using a T20 TORX™ driver.

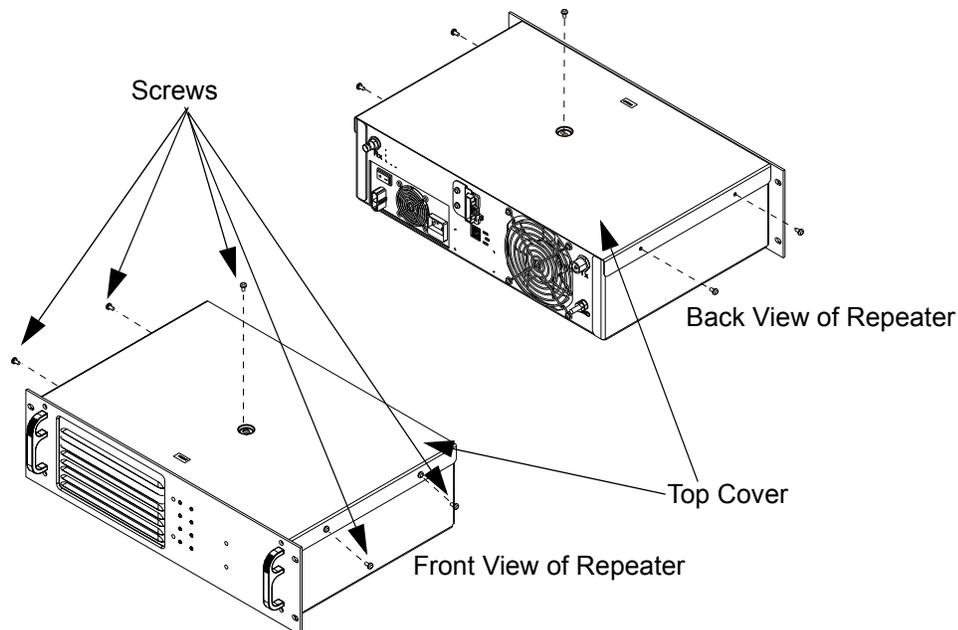


Figure 5-1. Removing Top Cover of Repeater Enclosure

5.6.2 Disassembly of Repeater Indicator Board

(Refer to Figure 5-2 or Figure 5-3 and Figure 5-4)

1. Disconnect the blue Ethernet cable from the Ethernet connector on the Repeater Indicator Board.
2. Disconnect the flex cable from the 30-position connector on the Repeater Indicator Board, noting orientation of cable which is identified with a solid black line. This is important for reassembly.

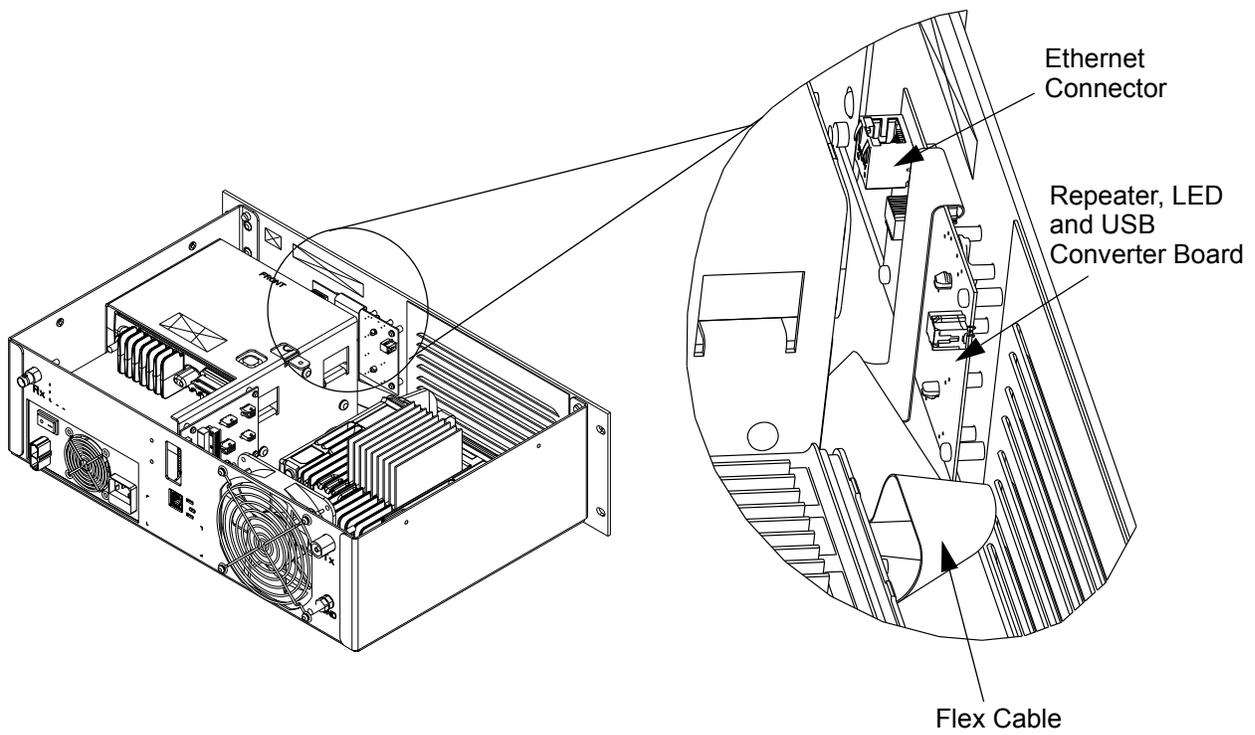


Figure 5-2. Disconnecting Ethernet Cable and Flex Cable

3. For PMLN5643_, remove the ribbon cable from the 8-pin connector as well.

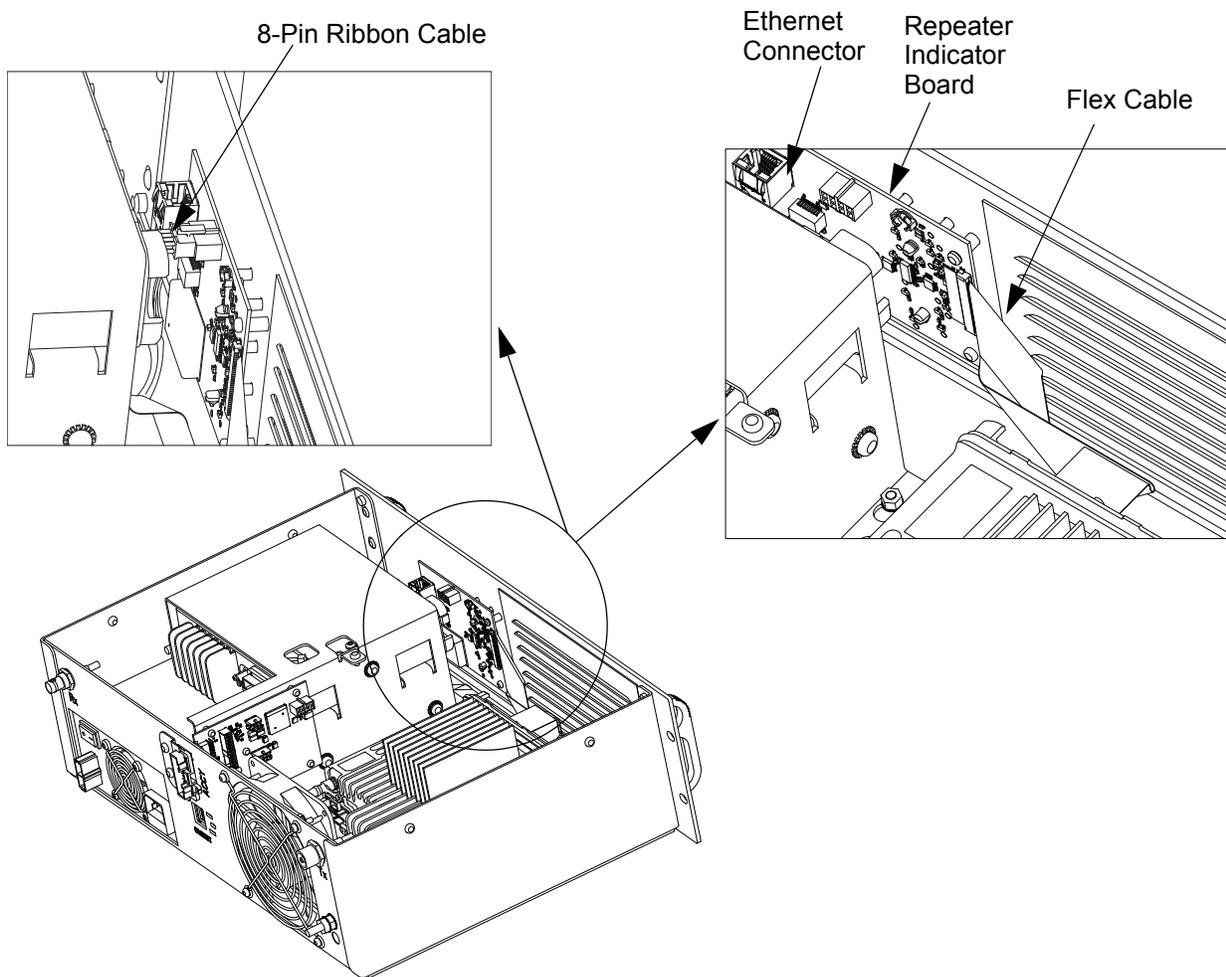


Figure 5-3. Disconnecting Ethernet Cable, Flex Cable and Ribbon Cable

4. Detach the front panel by removing the four M6 screws located on the front face of panel using a T30 TORX™ driver.
5. Place the front panel on a flat surface with the Repeater Indicator Board facing up.
6. Detach the Repeater Indicator Board from front panel by removing the four M3 screws using a T10 TORX™ driver.
7. Hold the Repeater Indicator Board on its outer edge with your finger tips, squeeze together the catch of each clip and slightly press them through the board to remove the light guide.

8. Store Repeater Indicator Board in an anti-static bag when it is not being serviced.

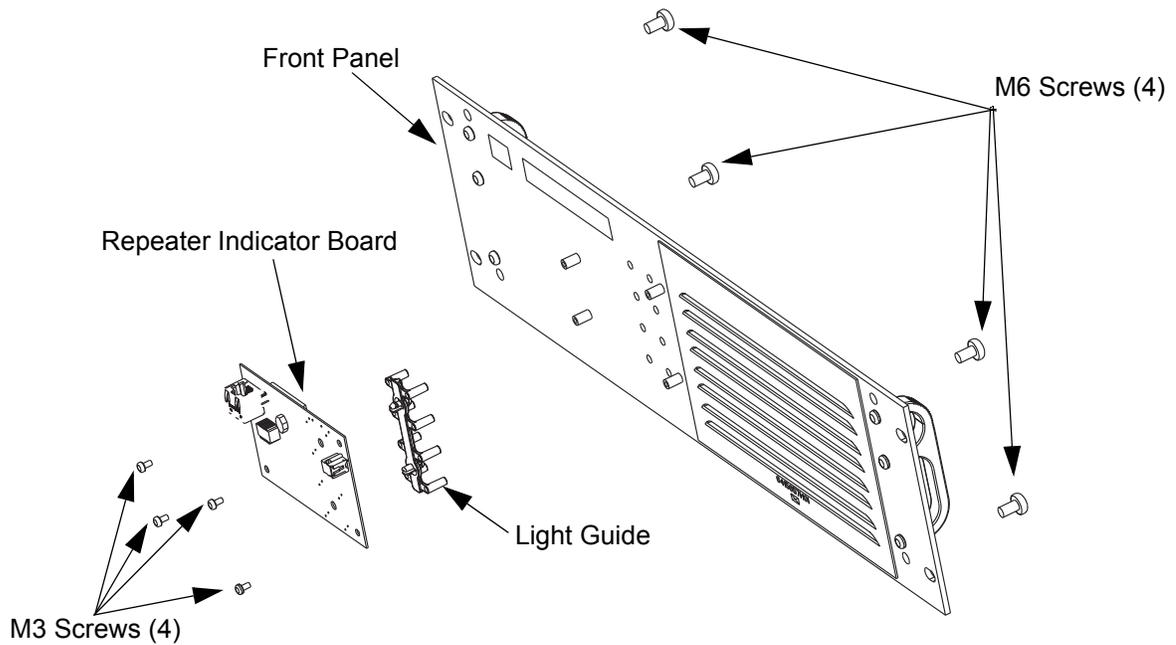


Figure 5-4. Repeater Indicator Board Disassembly

5.6.3 Disassembly of Fan

1. Unplug the fan cable from the mating connector on the connector board assembly.
2. Detach the fan assembly by removing the four screws that secure the fan grill and fan assembly to the back of the enclosure using a T15 TORX™ driver.
3. Carefully remove fan, noting position of arrow which identifies direction of air flow. This is important for reassembly.

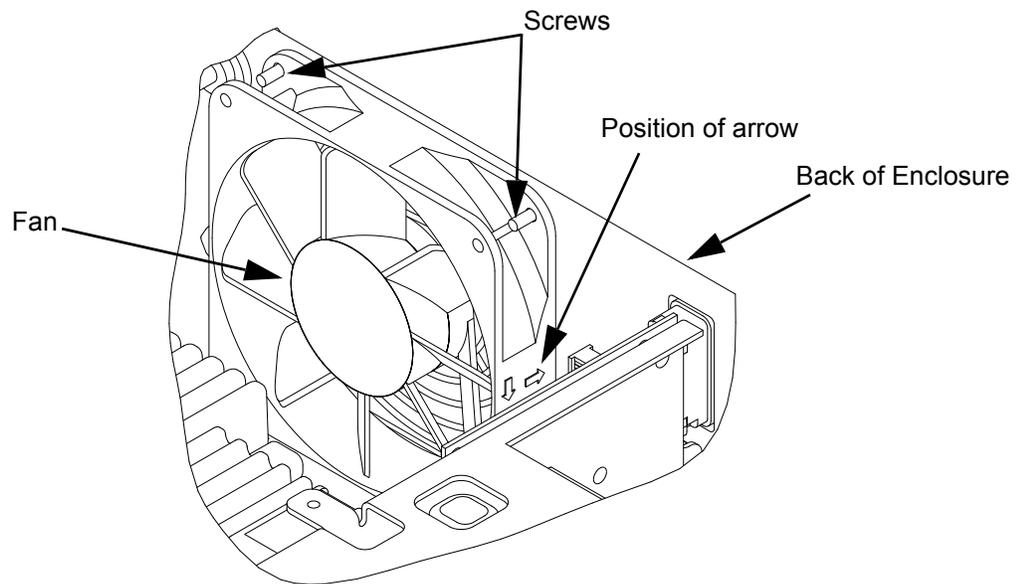


Figure 5-5. Fan Orientation

5.6.4 Removing Transmit Radio

(Refer to Figure 5-6)

1. Disconnect the flex cable from the 30-position connector on the Transmit radio, noting the orientation of the cable which is identified with a solid red line. This is important for reassembly.
2. Remove the flex cable (with double sided adhesive tape) from the power supply.
3. Make sure that the double sided adhesive tape **material** is completely removed from the power supply.
4. Disconnect the SSI flex cable from the connector on the Transmit radio, noting the orientation of the cable which is identified with a solid black line. This is important for reassembly.
5. Loosen the four M4 lock nuts that secure the Transmit radio assembly with a 7 mm socket driver.
6. Slide Transmit radio assembly slightly forward before lifting it out of the enclosure.
7. Disconnect the power cable from the Transmit radio.
8. Disconnect the antenna cable from the Transmit radio.
9. Disconnect the accessory connector from the Transmit radio.
10. Lift the Transmit radio assembly out of the enclosure and place on a flat surface.
11. Loosen and remove the two M5 screws and washers that secure the Transmit radio to the bracket using a T25 TORX™ driver.

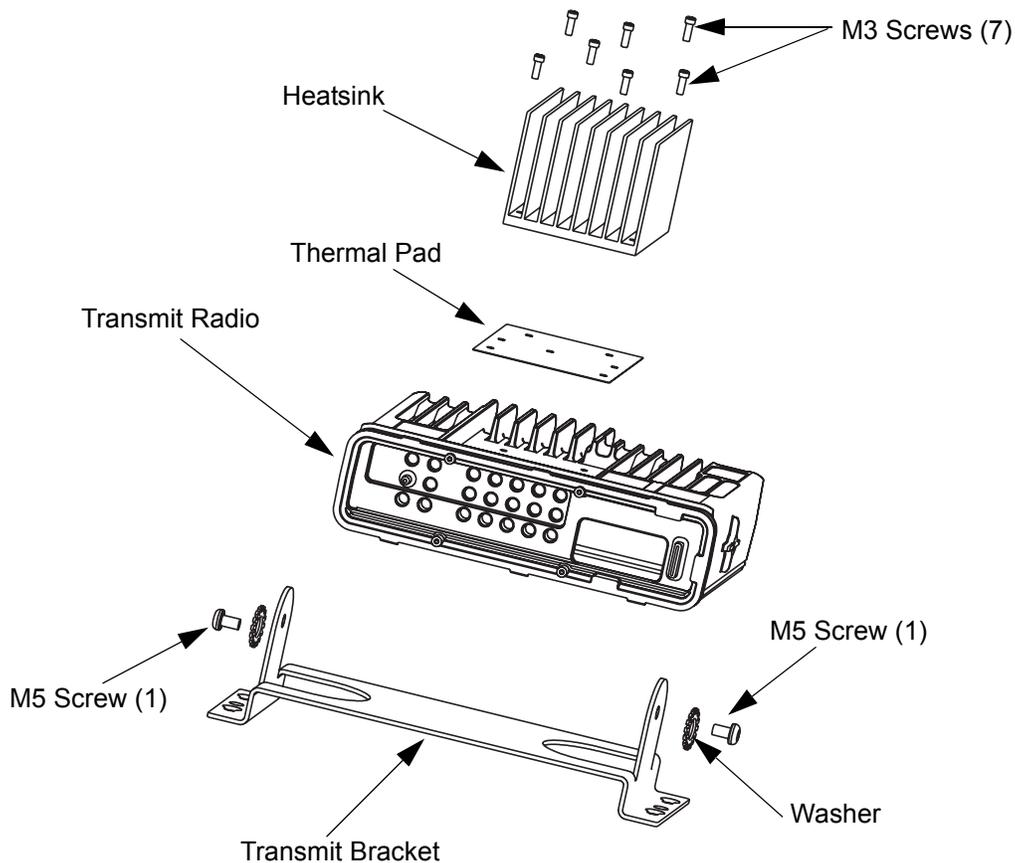


Figure 5-6. Tx Radio Disassembly

5.6.4.1 Removing Thermal Pad and Heatsink

(Refer to Figure 5-6)

1. Remove all of the seven screws which secure the heatsink to the Transmit radio using a T10 TORX™ driver.
2. Remove the heatsink from the Transmit radio.
3. Peel off and discard the thermal pad.
4. Replace all worn parts.

5.6.5 Removing Receive Radio, Power Supply and Connector Board Assembly

(Refer to Figure 5-7)

1. Disconnect the SSI flex cable from the connector on the Receive radio, noting the orientation of the cable which is identified with a dotted line. This is important for reassembly.
2. Disconnect the antenna cable from the Receive radio.
3. Disconnect the power cable from the Receive radio.
4. Remove the two screws securing the retainer clip using a T20 TORX™ driver.
5. Remove accessory connector from the back side of repeater by inserting a flat blade screwdriver into the slot located on the top of the connector.
6. Disconnect all of the cables from their mating connectors located on the connector board assembly.
7. Loosen the five M4 lock nuts that secure the Receive radio assembly with a 7 mm socket driver.

NOTE: The two lock nuts at the side on base will require a magnetic lock nut driver with extension of greater than 150 mm.

8. Slide Receive radio assembly slightly forward before lifting it out of the enclosure.

9. Take precaution not to damage the power supply or the connector board assembly and place assembly on a flat surface.

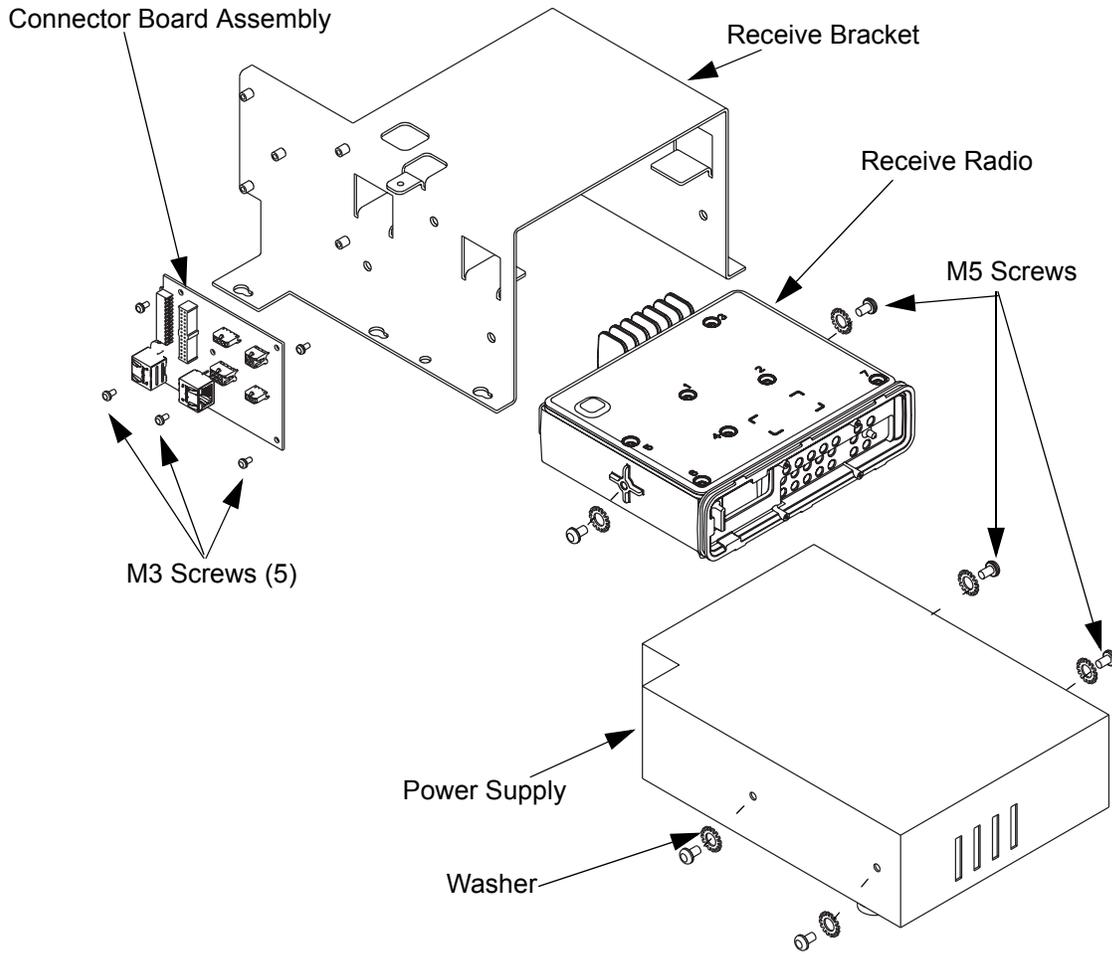


Figure 5-7. Receive Radio Removal

5.6.5.1 Disassembly of Receive Radio

(after Receive radio assembly is removed from repeater)

1. With assembly on a flat surface, loosen and remove the two M5 screws and washers that secure the Receive radio to the bracket using a T25 TORX™ driver.
2. Slide the Receive radio out of the bracket.

5.6.5.2 Disassembly of Connector Board Assembly

(after Receive radio assembly is removed from repeater)

1. With assembly on a flat surface, detach the connector board assembly from Receive radio assembly by removing the five M3 screws using a T10 TORX™ driver.
2. Store connector board assembly in anti-static bag when it is not being serviced.

5.6.5.3 Disassembly of Power Supply

(after Receive radio assembly is removed from repeater)

1. With assembly on a flat surface, loosen and remove the four M5 screws and washers that secure the power supply to the bracket using a T25 TORX™ driver.
2. Slide power supply out from bracket.
3. Disconnect Y-split cable from power supply before sending to manufacturer.

NOTE: Power Supply should be serviced by manufacturer.

5.7 Transmit and Receive Radio Disassembly – Detailed

To remove Transmit and Receive radios from the repeater, refer to Sections 5.6.4 and 5.6.5 accordingly.

5.7.1 Transceiver Board and Receiver Board Removal

1. Remove the seven screws from the die cast cover using the T20 TORX™ driver as shown in Figure 5-8.

NOTE: Do not remove the O-rings from the screws.

2. Lift the die cast cover from the chassis.

NOTE: For VHF bricks only: check that the two thermal pads on the heat sink block are intact. Replace them if damaged. Refer to Figure 5-19.

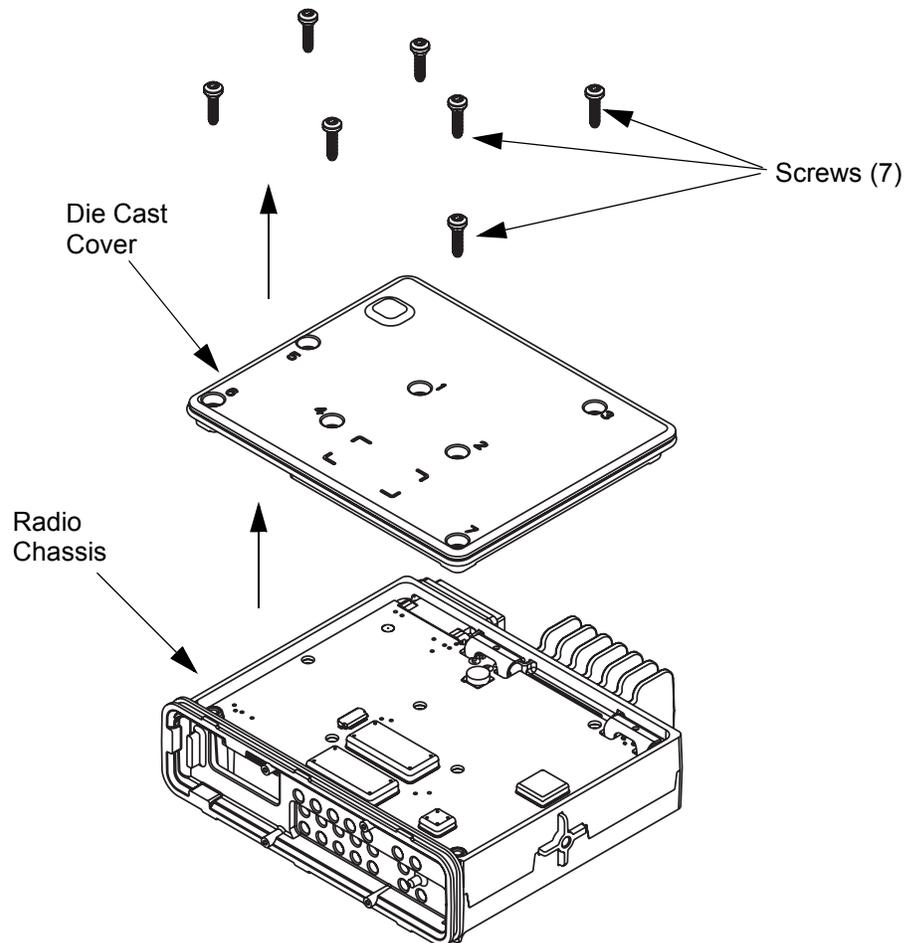


Figure 5-8. Die Cast Cover Removal.

3. Remove the rear accessory connector from the radio assembly by inserting a flat-blade screwdriver into the slot on the side of the connector as shown in Figure 5-9.



Caution The rear accessory connector should never be removed when the cover is still assembled to the radio.

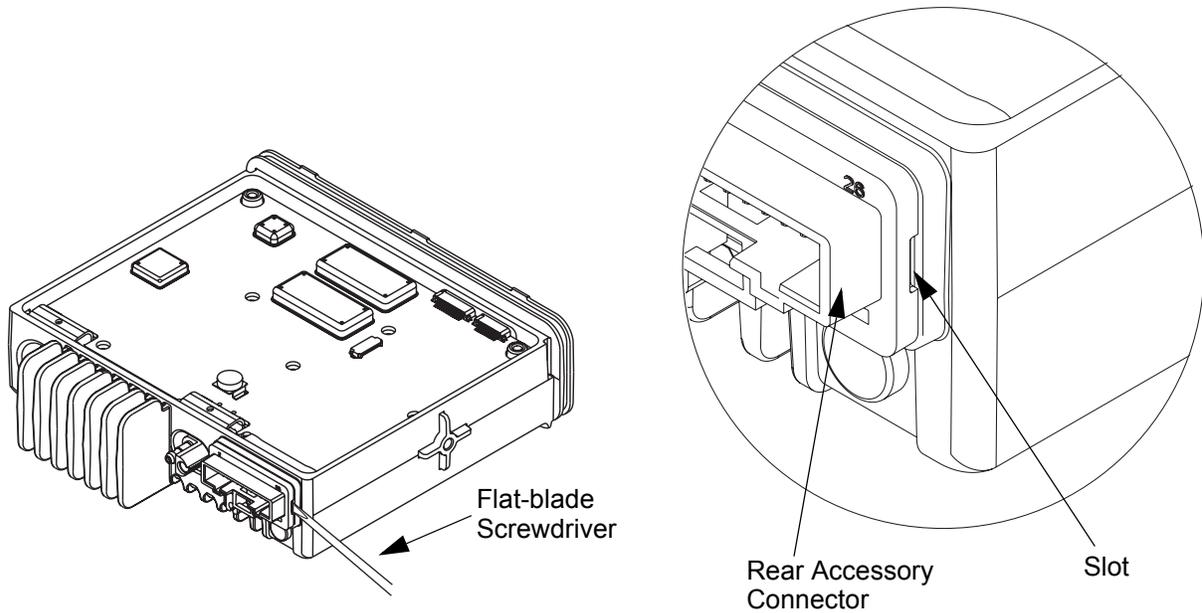


Figure 5-9. Rear Accessory Connector Removal

4. Remove the RF/DC retention clips by gently prying them out with a flat-blade screwdriver as shown in Figure 5-10.

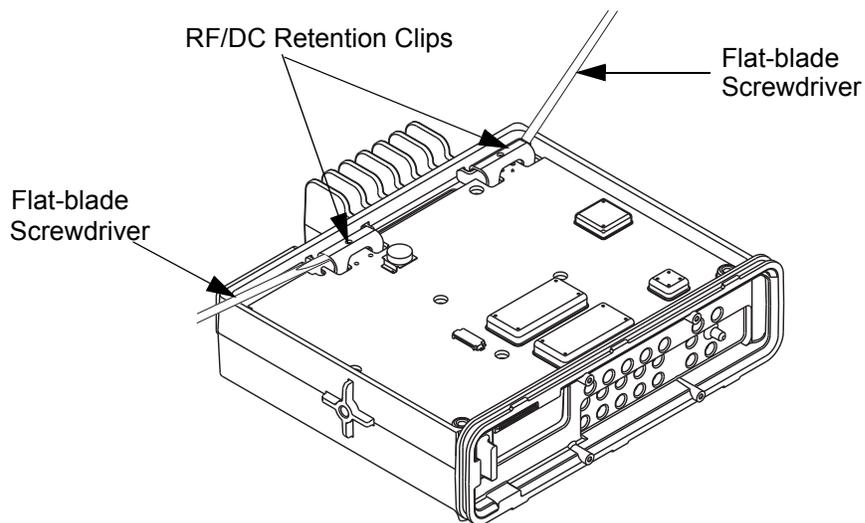


Figure 5-10. RF/DC Retention Clips Removal

5. Remove the transceiver board by sliding a finger into the opening provided at the front of the radio and gently press up on the 30-pin connector, lifting up the front of the board, as shown in Figure 5-11. 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.

NOTE: If the RF/DC connector gaskets remain in the chassis, remove them and place them back on the connectors.

	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.
Caution	

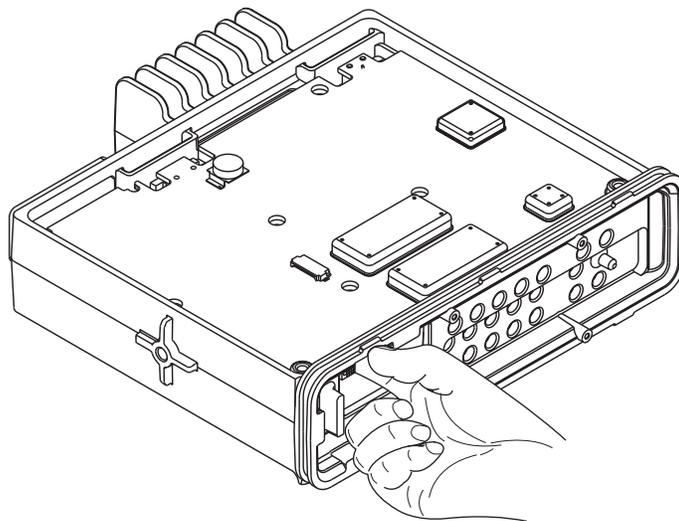


Figure 5-11. Transceiver Board Removal

5.8 Transmit and Receive Radio Reassembly – Detailed

The following reassembly procedures are applicable to both the Transmit and Receive radios.

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

For both the die cast cover 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 Section 5.8.2: Thermal Pad Replacement Procedure on page 5-22 to replace damaged pads.

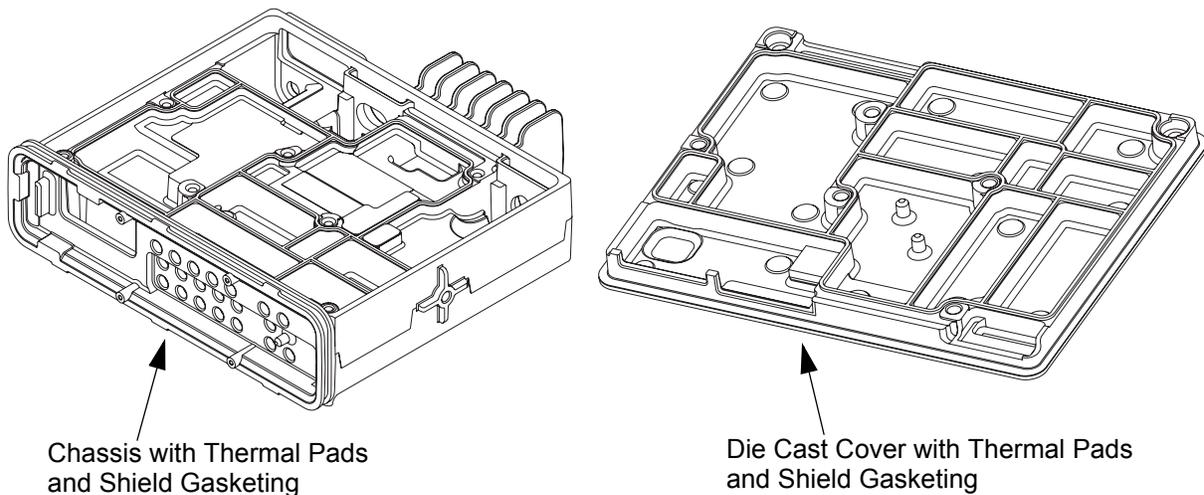


Figure 5-12. Thermal Pads and Shield Gasketing on Chassis and Die Cast Cover

2. Thoroughly inspect the transceiver board and verify all thermal pads are in place and free from damage. See Section 5.8.2: Thermal Pad Replacement Procedure on page 5-22 to replace damaged pads. For VHF/UHF 32 MB bricks, refer to Figure 5-14.

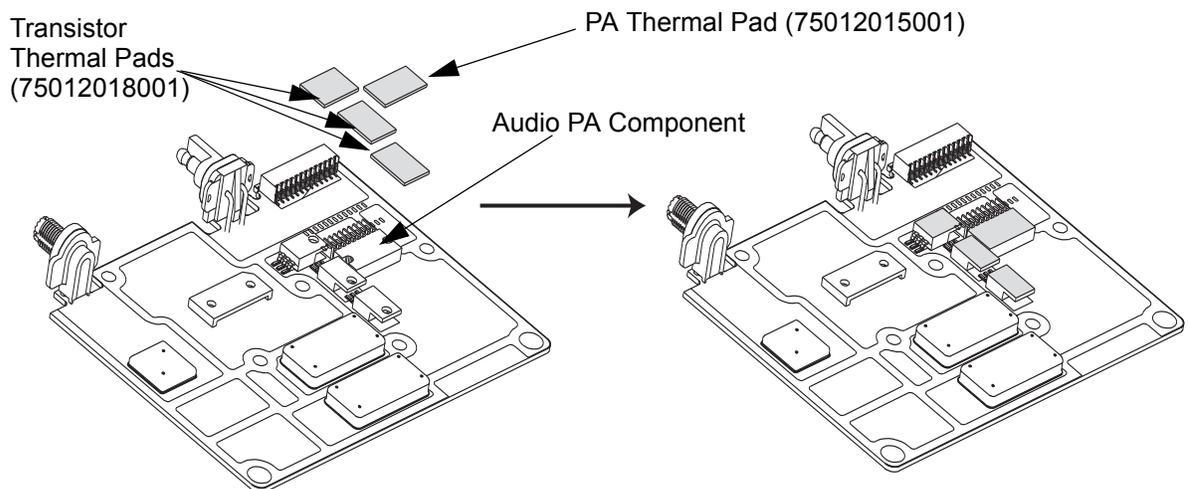


Figure 5-13. Transceiver Board with Thermal Pads

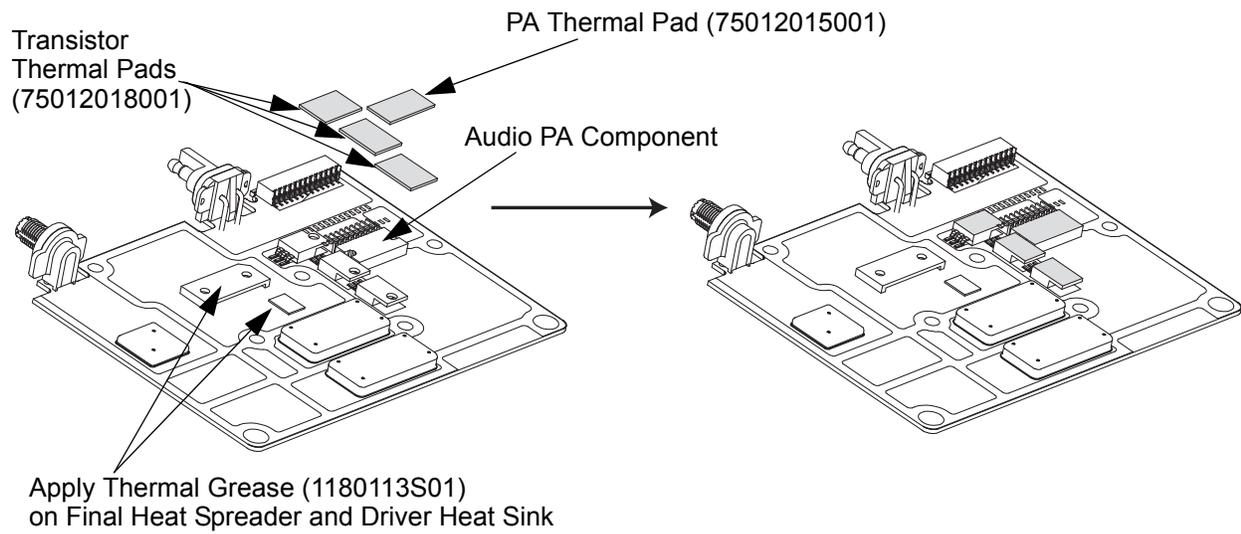


Figure 5-14. Transceiver Board with Thermal Pads (VHF/UHF 32 MB Bricks)

3. Assembly of the GPS Plug
Push the GPS plug into the chassis opening until it is fully seated. Refer to Figure 5-15.

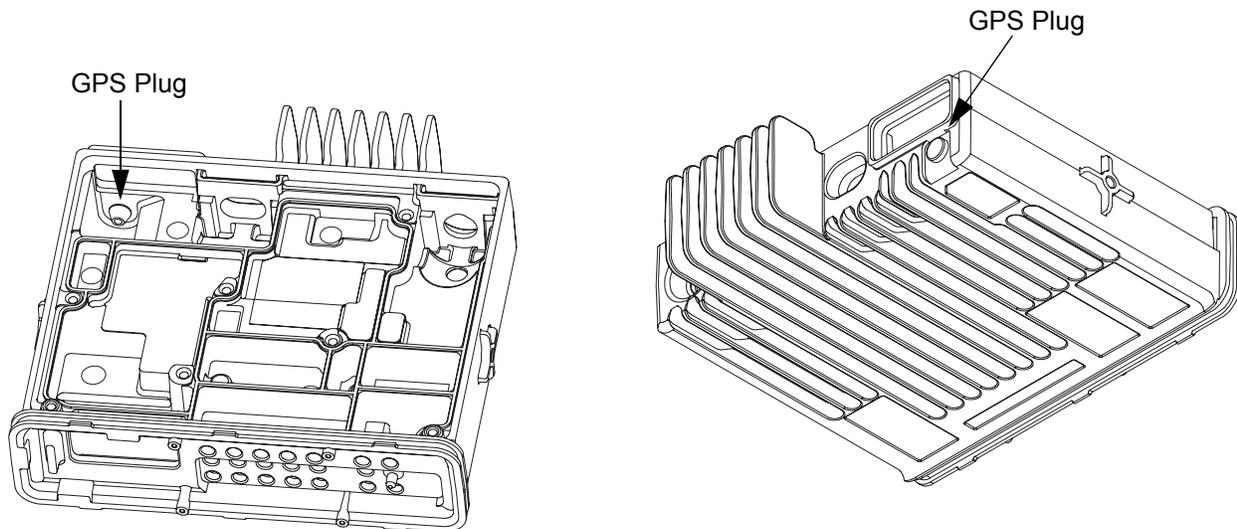


Figure 5-15. Replacing GPS Plug

5.8.1 Transceiver Board and Receiver Board Reassembly

1. Insert the transceiver board into the chassis by tilting the transceiver board (approximately 30 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.

Ensure that the transceiver board alignment holes are positioned over the chassis alignment bosses and then push the board down to fully seat.

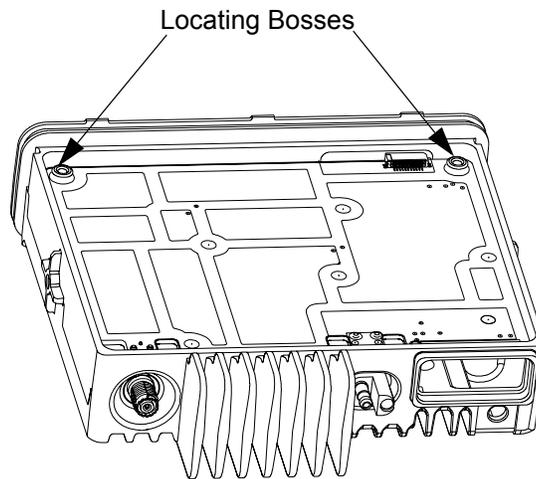


Figure 5-16. Placing the Transceiver Board in the Chassis



Caution

Do not leave the transceiver board in the chassis for extended periods of time without the RF/DC retention clips, or damage to the board connectors may occur.

2. Insert the RF/DC retention clips and fully seat them. The DC clip should be inserted first to properly locate the transceiver board. Refer to Figure 5-17.

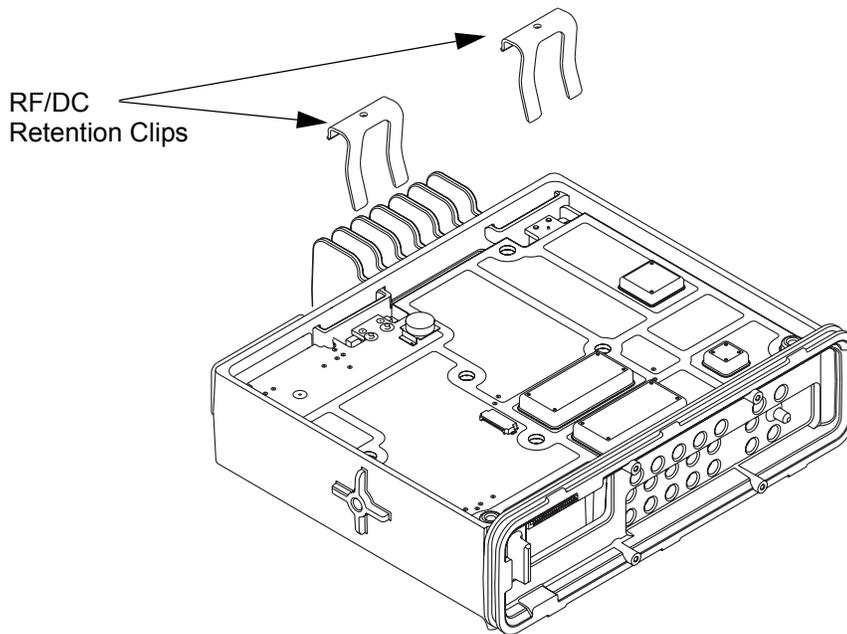


Figure 5-17. Inserting RF/DC Retention Clips

3. Insert the rear accessory connector into the radio assembly and press into place until the connector is flushed with the chassis. Refer to Figure 5-18.

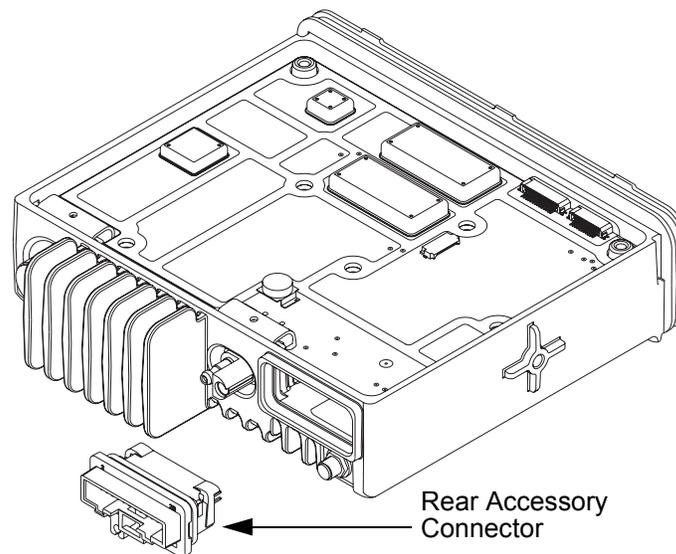


Figure 5-18. Inserting Rear Accessory Connector

4. Place the PA pad on to the die cast cover by aligning the two holes in the PA pad with the alignment pins on the die cast cover. For VHF 32 MBand UHF bricks, refer to Figure 5-20.

For VHF 8 MB bricks only: PA heat sink block and thermal pads need to be placed on to the pressure pad before it gets assembled to the die cast cover. Refer to Figure 5-19 and Figure 5-21.

- a. Remove thermal pad (7571835M01) from the shipping liner and place it on to the heat sink block by aligning the rounded corners. Remove the protective liner from the exposed side of the thermal pad.
- b. Insert the heat sink block with the thermal pad attached into the compartment on the PA pressure pad, until it is fully seated. The attached thermal pad should be fully visible after assembly.
- c. Remove thermal pad (7571836M01) from the shipping liner and place it on to the exposed metal surface of heat sink block by orienting the thermal pad so its shape matches the opening on the pressure pad.
- d. Remove the protective liner from the exposed side of the thermal pad (7571836M01).

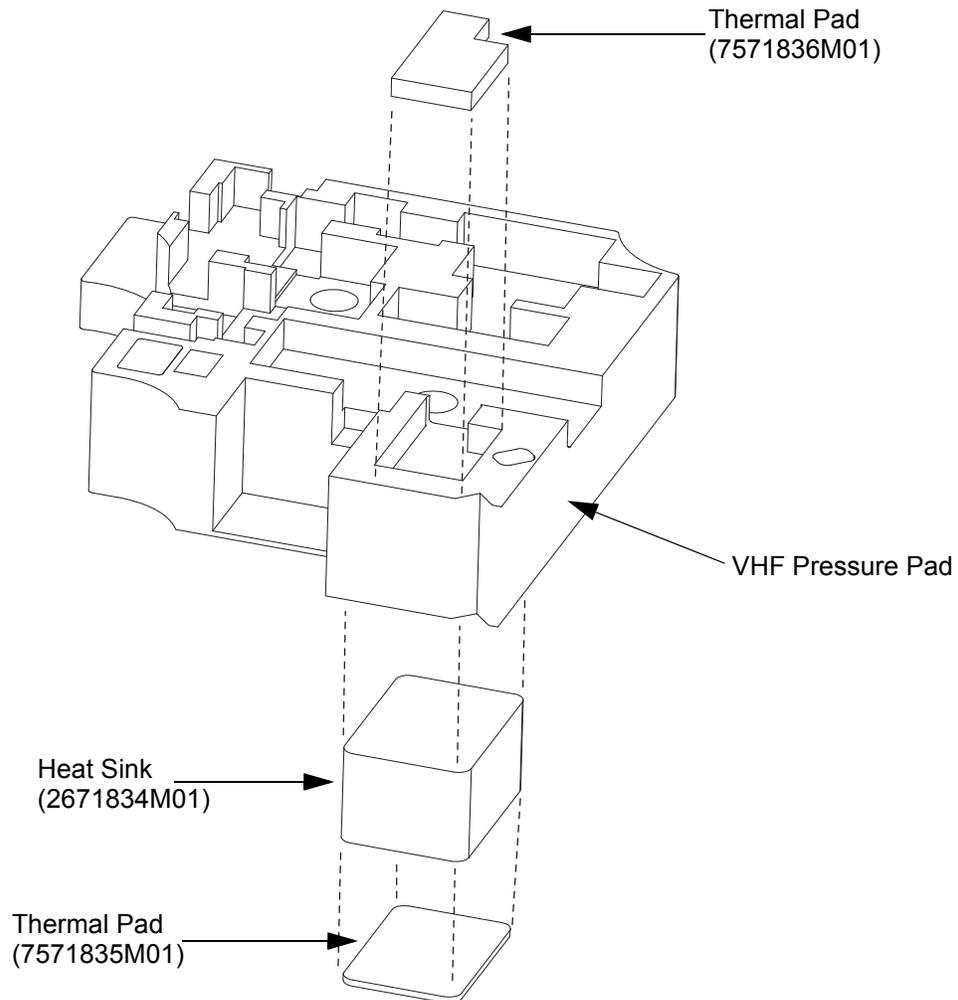


Figure 5-19. Assembling of PA Heat Sink System (VHF 8 MB Brick)

5. Fit the O-ring onto the die cast cover securely. Refer to either Figure 5-20 or Figure 5-21.

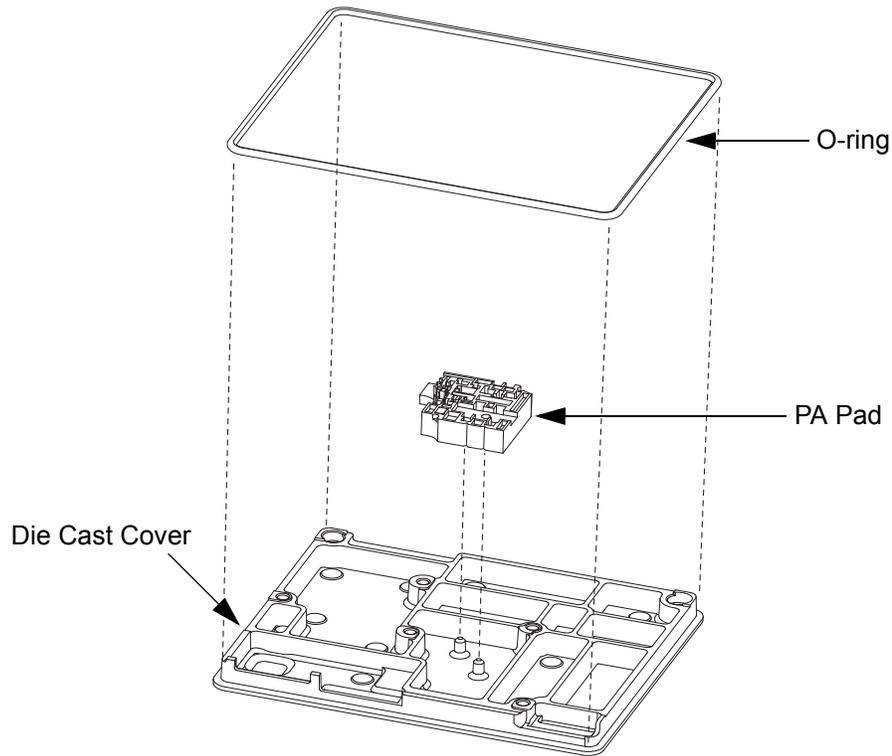


Figure 5-20. Assembling of PA Pad and O-ring (VHF 32 MB and UHF Bricks)

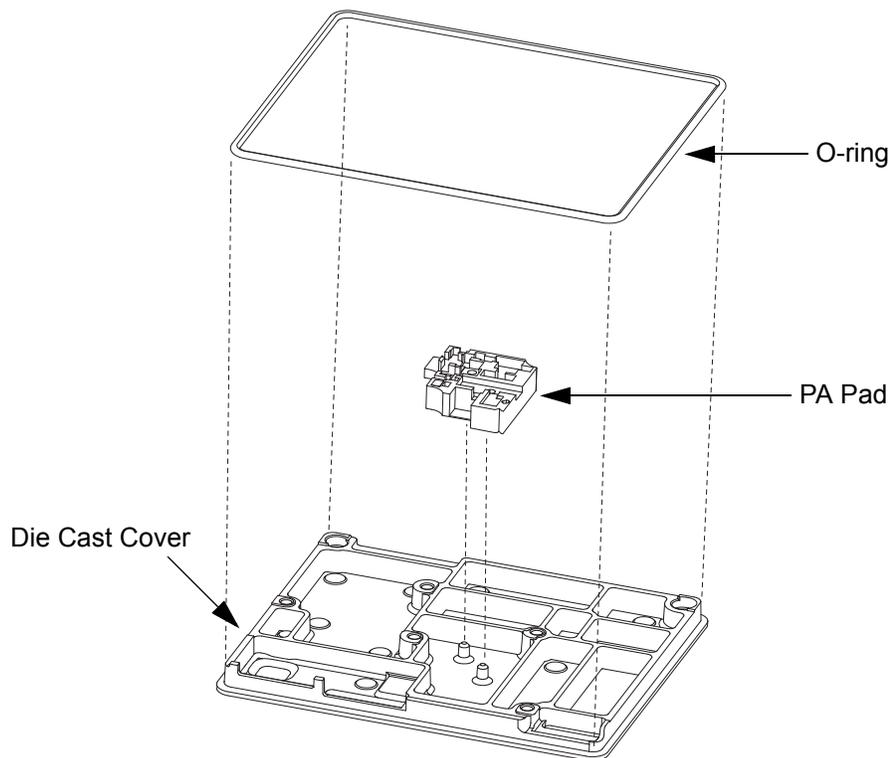


Figure 5-21. Assembling of PA Pad and O-ring (VHF 8 MB Brick)

- Place the die cast cover onto the chassis orienting the die cast cover so that screw holes 6 and 7 align with the bosses on the chassis as shown in Figure 5-22.

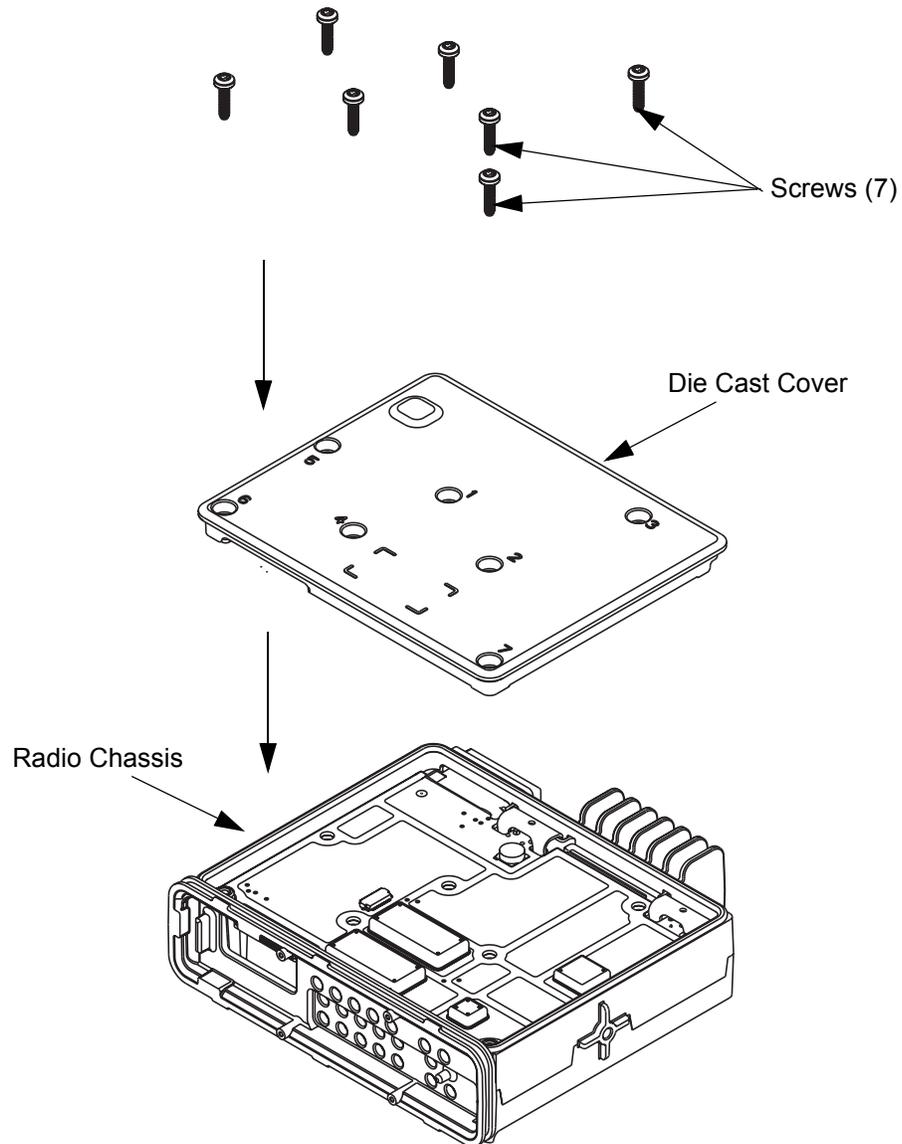


Figure 5-22. Assembling Die Cast Cover onto Chassis

7. Using a T20 TORX™ driver, tighten the seven screws between 2.94 N-m (26 lbs-in) in the order shown in Figure 5-23.
8. Repeat tightening the seven screws in the order shown otherwise the first three screws will likely be loose.

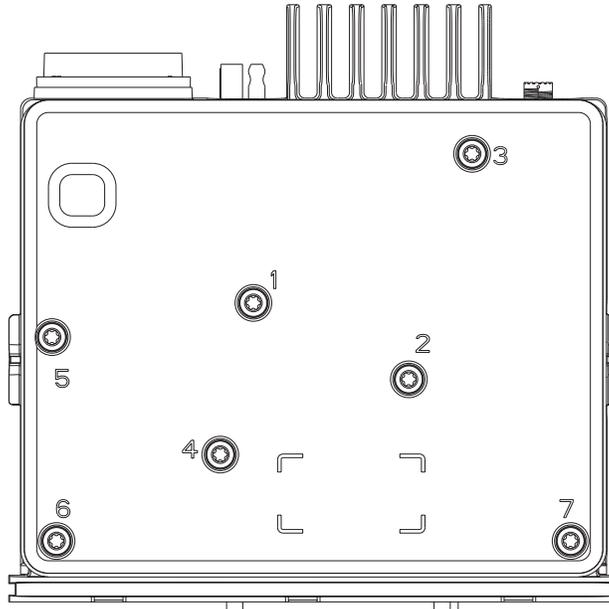


Figure 5-23. Screw Sequence to Tighten Die Cast Cover

5.8.2 Thermal Pad Replacement Procedure

A. Chassis Thermal Pad Replacement Procedure

Harmonic Filter Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift the pad from the chassis surface. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. 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 white side down on the chassis as shown in Figure 5-24.

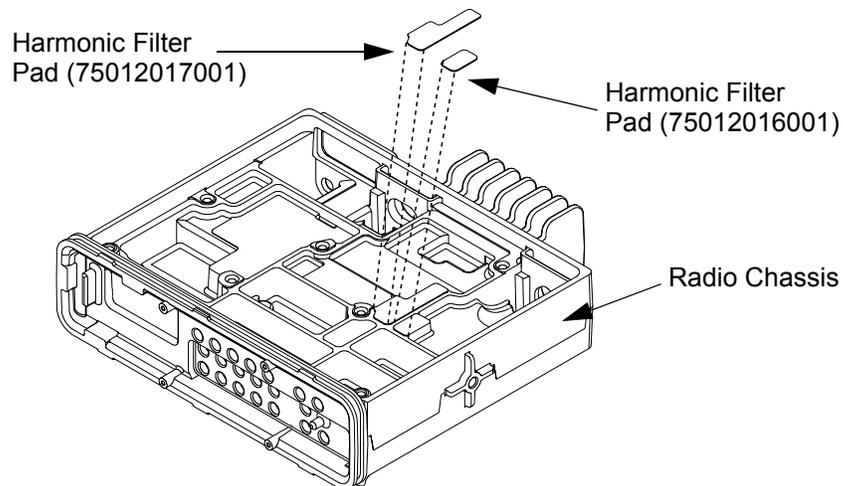


Figure 5-24. Replacing Thermal Pads

Driver Thermal pad Replacement (Not applicable to VHF/UHF 32 MB bricks)

1. Use a plastic flat-edge tool to lift the pad from the chassis surface. Discard the old pad.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. 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 the pad on to the chassis, aligning the edges of the pad with the edges of the chassis, as shown in Figure 5-25.

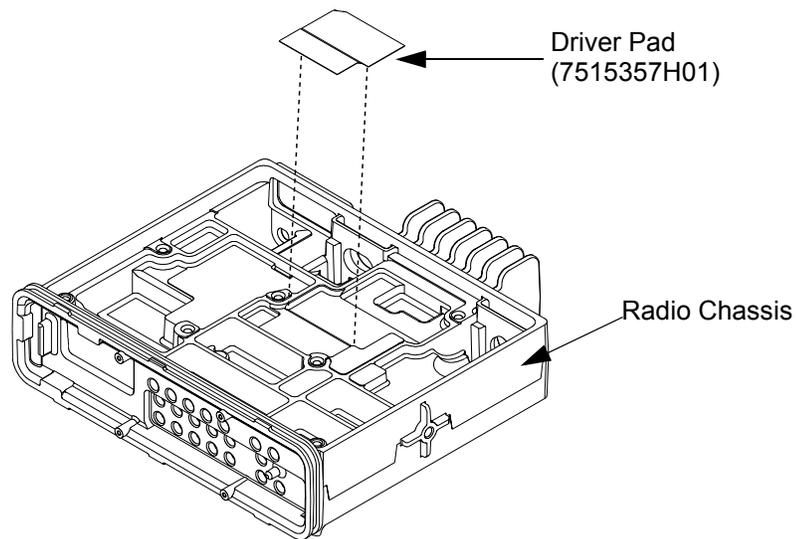


Figure 5-25. Aligning Driver Pad on Chassis

4. Apply even pressure to the pad and remove the protective liner.

B. Transceiver Board Thermal Pad Replacement Procedure

Transistor Thermal Pads and PA Thermal Pad Replacement

1. Use a plastic flat-edge tool to lift each pad from the transceiver board. Discard the old pads.
2. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary.
3. Once the surface is clean and dry, remove each new pad from the shipping liner, and place in the proper location on top of each transistor component and the audio PA with the white side down (see Figure 5-26). For VHF/UHF 32 MB bricks, refer to Figure 5-27.

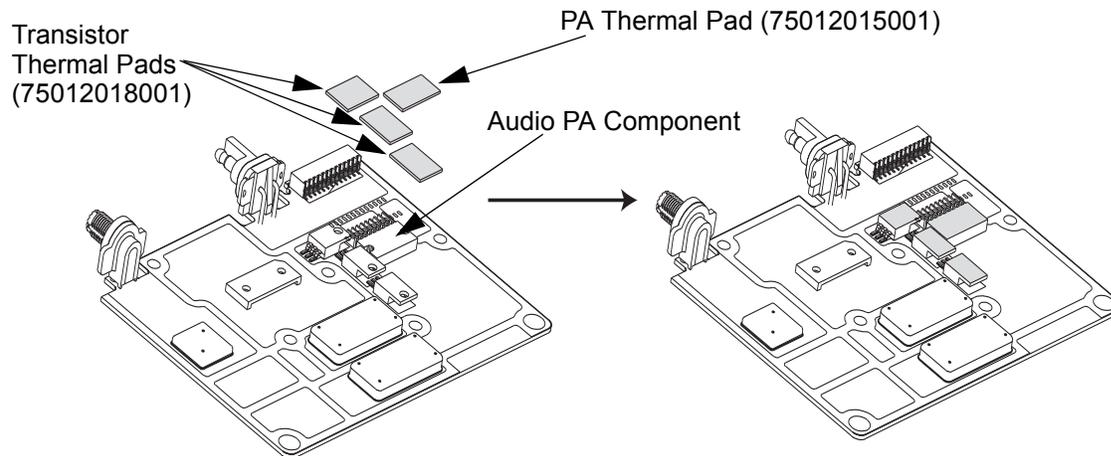


Figure 5-26. Placing Thermal Pads on PA and Transistor Components

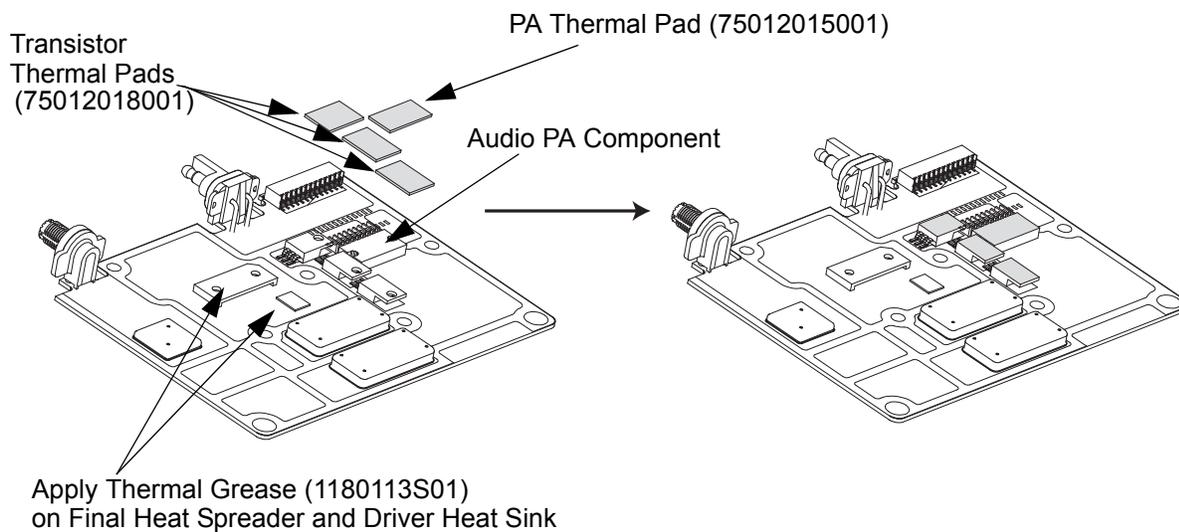


Figure 5-27. Placing Thermal Pads on PA and Transistor Components (VHF/UHF 32 MB Bricks)

5.8.3 Reassembly of Receive Radio, Power Supply and Connector Board Assembly

(Refer to Figure 5-7)

Visually inspect repeater enclosure to ensure that no metal shavings or debris are found.

5.8.3.1 Reassembly of Power Supply

1. Align the two mounting holes on each side of the bracket with the mounting holes on the power supply.
2. Secure the power supply and the bracket with four M5 screws and washers.
3. Tighten the four M5 screws to 3.0 N-m.
4. Firmly connect the single connection end of Y-split cable to power cable of power supply.

5.8.3.2 Reassembly of Receive Radio

1. Insert the Receive radio into the top half of the bracket.
2. Align mounting hole on each side of the receive chassis to the mounting holes on the bracket.
3. Secure the Receive radio and the bracket with two M5 screws and washers.
4. Tighten the two M5 screws to 3.0 N-m.

5.8.3.3 Reassembly of Connector Board Assembly

1. Align the five mounting holes on the connector board assembly onto the five standoffs on the receive bracket and install five M3 screws.
2. Tighten the five M3 screws to 1.0 N-m.

5.8.3.4 Reassembly of the Receive Bracket Assembly to the Enclosure

1. Align and mount the receive bracket assembly onto the five stud screws in the enclosure.
2. Ensure that the dimple locator (bump) on the enclosure is nested within the hole on the receive bracket before installing and tightening the lock nuts.
3. Tighten the five lock nuts to 2.0 N-m.

NOTE: The two lock nuts at the side on base will require a magnetic lock nut driver with extension of greater than 150 mm.

4. Connect the antenna cable to the Receive radio.
5. Insert the BNC connector of the antenna cable through the back panel of the enclosure and secure it using a lock washer and nut.
6. Tighten the nut to 2.3 N-m using a 16 mm deep well socket driver.
7. Firmly connect one of the connectors from the dual end of Y-split cable to the Receive radio.

NOTE: All cables (except the antenna cable), are routed at the bottom rear receive bracket.

8. Insert the accessory connector through the opening of the enclosure onto the edge of the connector board assembly.
9. Make sure that the accessory connector is completely inserted onto the connector board assembly and the back end surface of the accessory connector is flushed firmly against the back panel of enclosure.

10. Mount the retainer clip and secure it with two M4 screws.
11. Tighten the screws to 2.0 N-m.
12. Insert the solder terminal end of the SSI cable into the 11-position connector at the front face of Receive radio. A dashed black line is visible from the top view.

5.8.4 Reassembly of Transmit Radio

(Refer to Figure 5-6)

5.8.4.1 Replacing the Thermal Pad and Heatsink

1. Make sure that mating surfaces of Heatsink and Transmit radio are cleaned and free from any debris.
2. Align the holes on the thermal pad to the screw holes in the Transmit radio and place thermal pad onto the Transmit radio.
3. Align the holes on the heatsink to the screw holes in the Transmit radio and place heatsink onto the thermal pad.
4. Secure but do not tighten the seven screws previously removed.
5. When all seven screws are secured, tighten the screws to 1.0 N-m. Refer to Figure 5-23.

5.8.4.2 Reassembly of the Transmit Bracket Assembly to the Enclosure

1. Position the Transmit radio onto the transmit bracket so that the label "FRONT" on bracket is facing the front face of radio.
2. Align the mounting holes on the Transmit radio and the transmit bracket on both sides.
3. Attach and secure the M5 screws and washers on each side of the bracket.
4. Tighten the screws to 3.0 N-m, making sure the Transmit radio remains horizontal.
5. Align and mount the transmit bracket assembly onto the four stud screws in the enclosure.
6. Ensure that dimple locator (bump) on the enclosure is nested within the hole on the transmit bracket before installing and tightening the lock nuts.
7. Secure the four lock nuts (two on each side) onto the stud screws.
8. Tighten the four lock nuts to 2.0 N-m.
9. Connect the antenna cable to the Transmit radio.
10. Insert the N-Type connector of the antenna cable through the back panel of the enclosure and secure it using a lock washer and nut.
11. Tighten the nut to 2.3 N-m using a 19 mm deep well socket driver.
12. Firmly connect one of the connectors from the dual end of Y-split cable to the Transmit radio.
13. Connect the black colored end of accessory cable connector to rear of Transmit radio making sure that the locking connector tab is facing up.
14. Connect the white colored end of the accessory cable connector to the connector board assembly making sure that the locking connector tab is facing toward the front of repeater.

NOTE: Make sure that the accessory connectors at both ends are locked in place. A clicking sound can be heard from the locking tab.

15. Position accessory cable harness against side of fan body. See Figure 5-28.

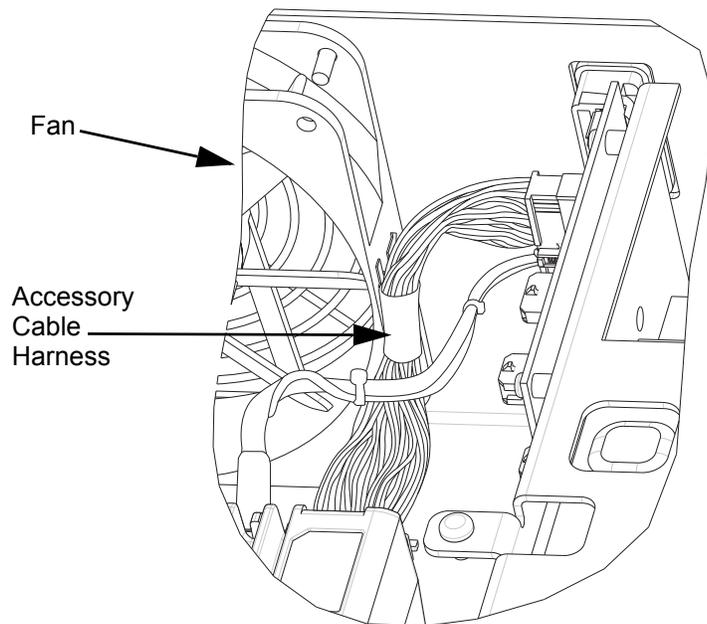
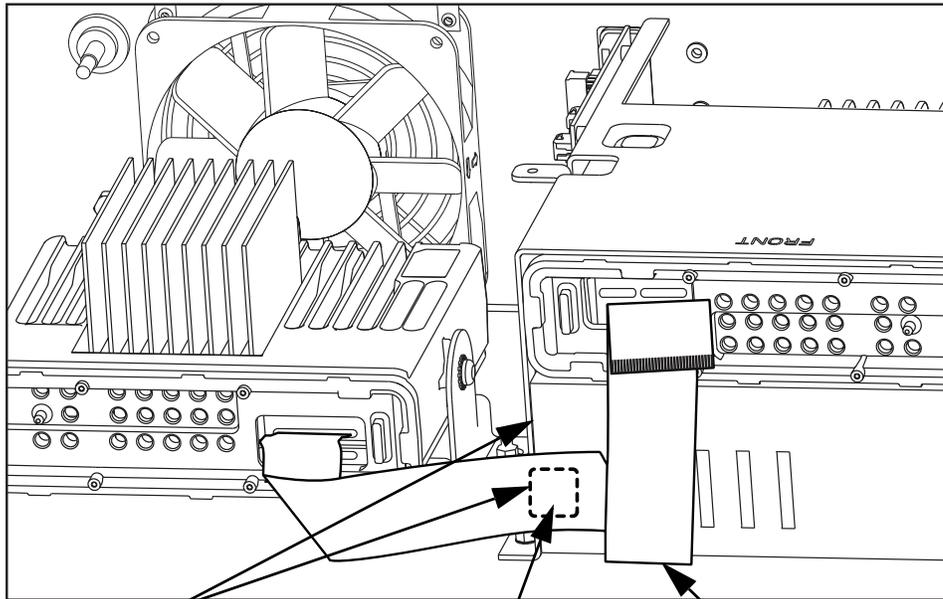


Figure 5-28. Assembly of Accessory Cable Harness

16. Insert the solder terminal end of the SSI flex cable (positioned bottom side of PCB) into the 11-position connector in the Transmit radio. A solid black line is visible from the top view.
17. Insert the solder terminal end of the flex cable (positioned top side of PCB) into the 30-position connector in the Transmit radio. A solid red line is visible from the top view.
18. On the flex cable, peel the paper on the back of the adhesive tape. (Not applicable for VHF/UHF 32 MB repeaters).
19. Make sure that the surface on the power supply is free of grease and debris where the flex cable adhesive tape will be applied. (Not applicable for VHF/UHF 32 MB repeaters).

20. Apply the adhesive tape so that the vertical left edge of the adhesive tape aligns with the left vertical edge of the power supply as shown in Figure 5-29. Notice that the bottom edge of the flat cable is touching or almost touching the bottom of the enclosure. (Not applicable for VHF/UHF 32 MB repeaters).



Note: Tape edge is located near edge of power supply

Adhesive tape location on the other side of cable

Note: This edge touching or almost touching the bottom of the enclosure

Figure 5-29. Mounting the Adhesive Tape Flex Cable to Power Supply

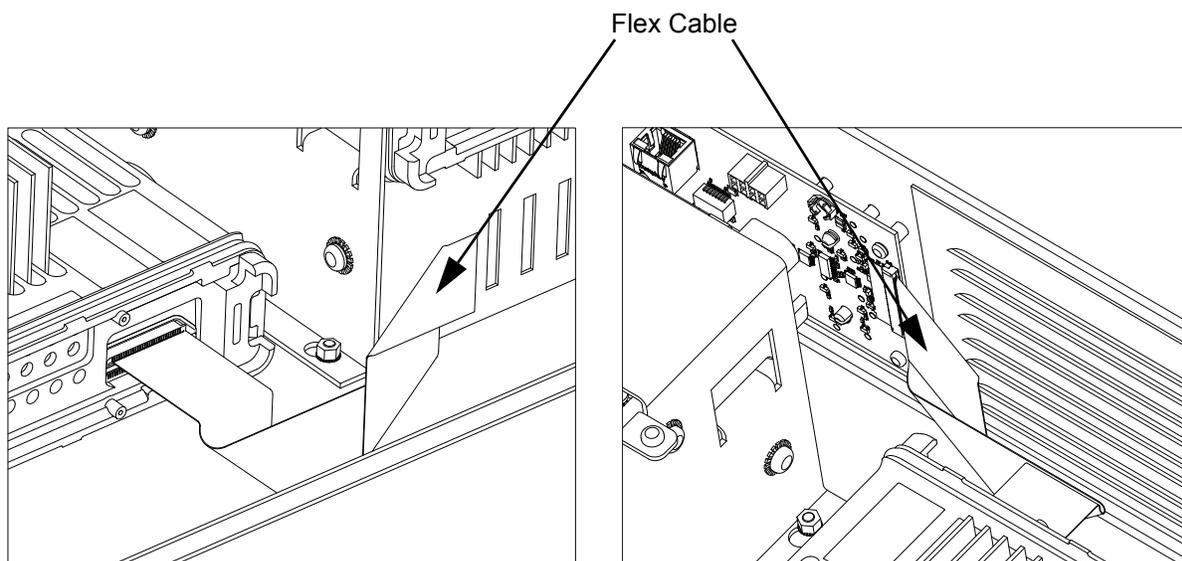


Figure 5-30. Flex Cable Assembly (VHF/UHF 32 MB Repeaters)

5.8.5 Reassembly of Fan

1. Position the fan in the enclosure with arrow pointing outward and the wires on the fan at the bottom right corner of the fan.

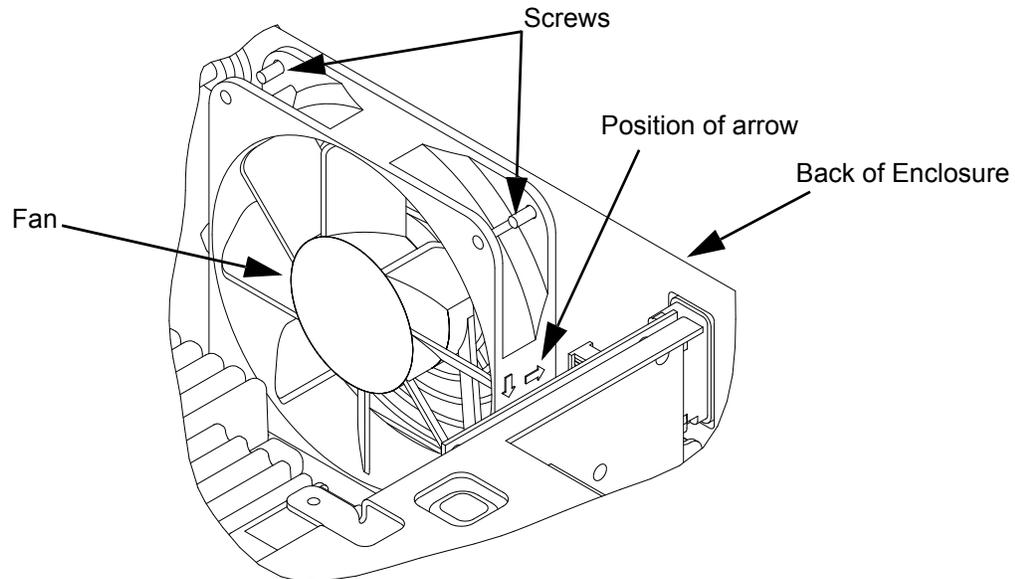


Figure 5-31. Fan Orientation

2. Position the fan grill outside of the enclosure aligning with the screw holes.
3. Install four 3.5 mm screws through the fan grill and the rear panel of the enclosure.
4. Secure the fan and tighten the four screws to 1.6 N-m and into threaded insert.
5. Plug the fan cable plug into the 4-position fan connector on the connector board assembly.

NOTE: It is recommended that you dress and tie wrap the blue Ethernet cable and the fan cables.

5.8.6 Reassembly of Repeater Indicator Board

(Refer to Figure 5-4)

1. Holding Repeater Indicator Board on outer edge, insert the clips of light guide into mounting holes, making sure the light guide snaps into place.
2. Align the four mounting holes on the Repeater Indicator Board onto the four standoffs on the front panel.
3. Install and secure the four M3 screws.
4. Tighten the four M3 screws to 1.0 N-m.
5. Use the four M6 screws to secure the front panel onto the enclosure. Tighten the screws to 3.7 N-m.
6. Connect the blue Ethernet cable from the Connector board onto the Ethernet connector on the Repeater Indicator Board.
7. Insert the flex cable onto the 30-position connector on the Repeater Indicator Board. The solder terminal end of the flex cable is faced towards the front panel. A solid black line is visible from the top view.
8. Connect the 8-pin DC cable from the Connector board onto the 8-pin connector on the Repeater Indicator Board (Applicable for VHF/UHF 32 MB repeaters only).

5.8.7 Reassembly of Cover

1. Place the cover on the enclosure.
2. Secure the two M4 screws on each side of the cover and one at the top. Tighten the screws to 2.0 N-m.

5.9 Repeater Exploded Mechanical Views and Parts Lists

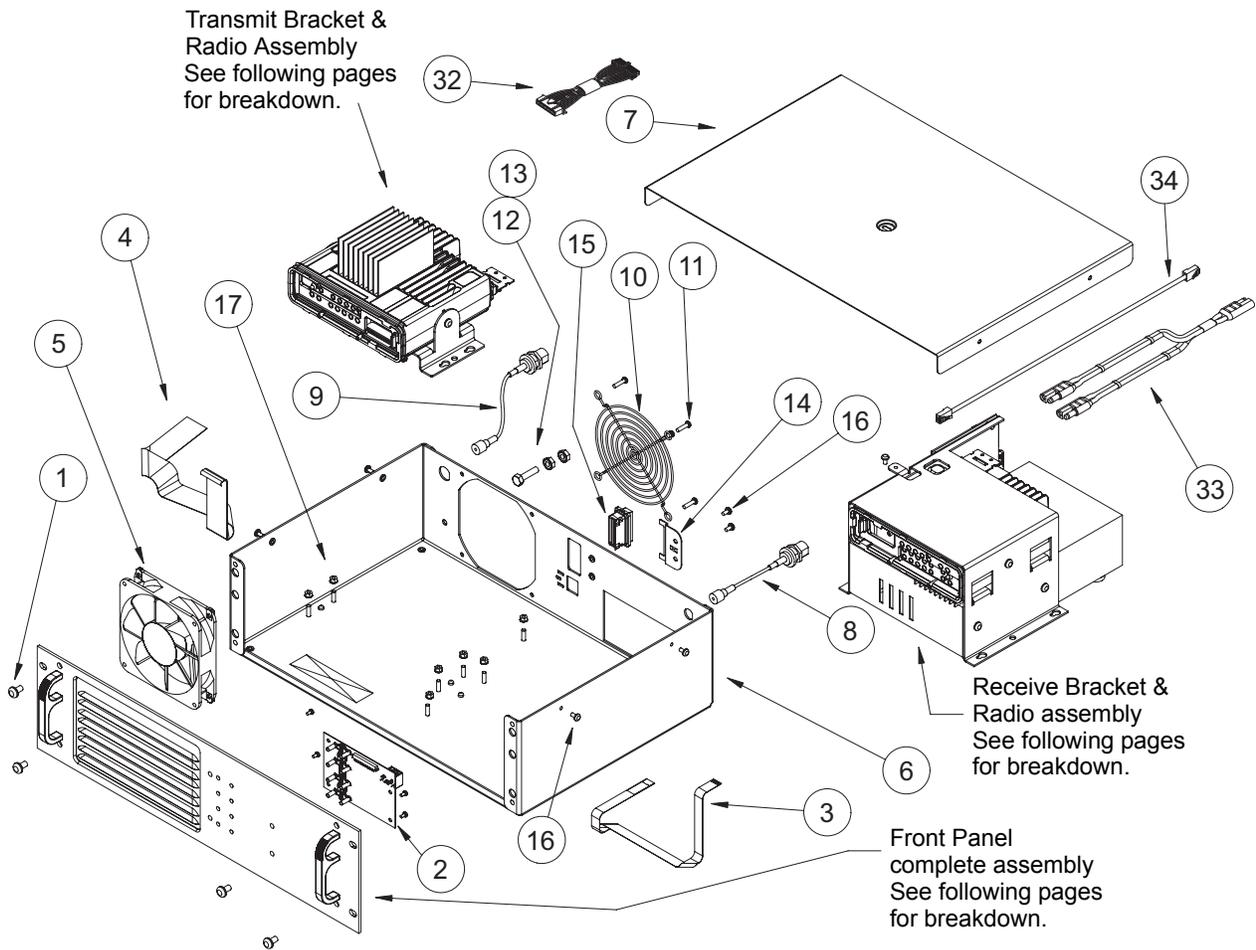


Figure 5-32. Repeater Assembly Exploded View

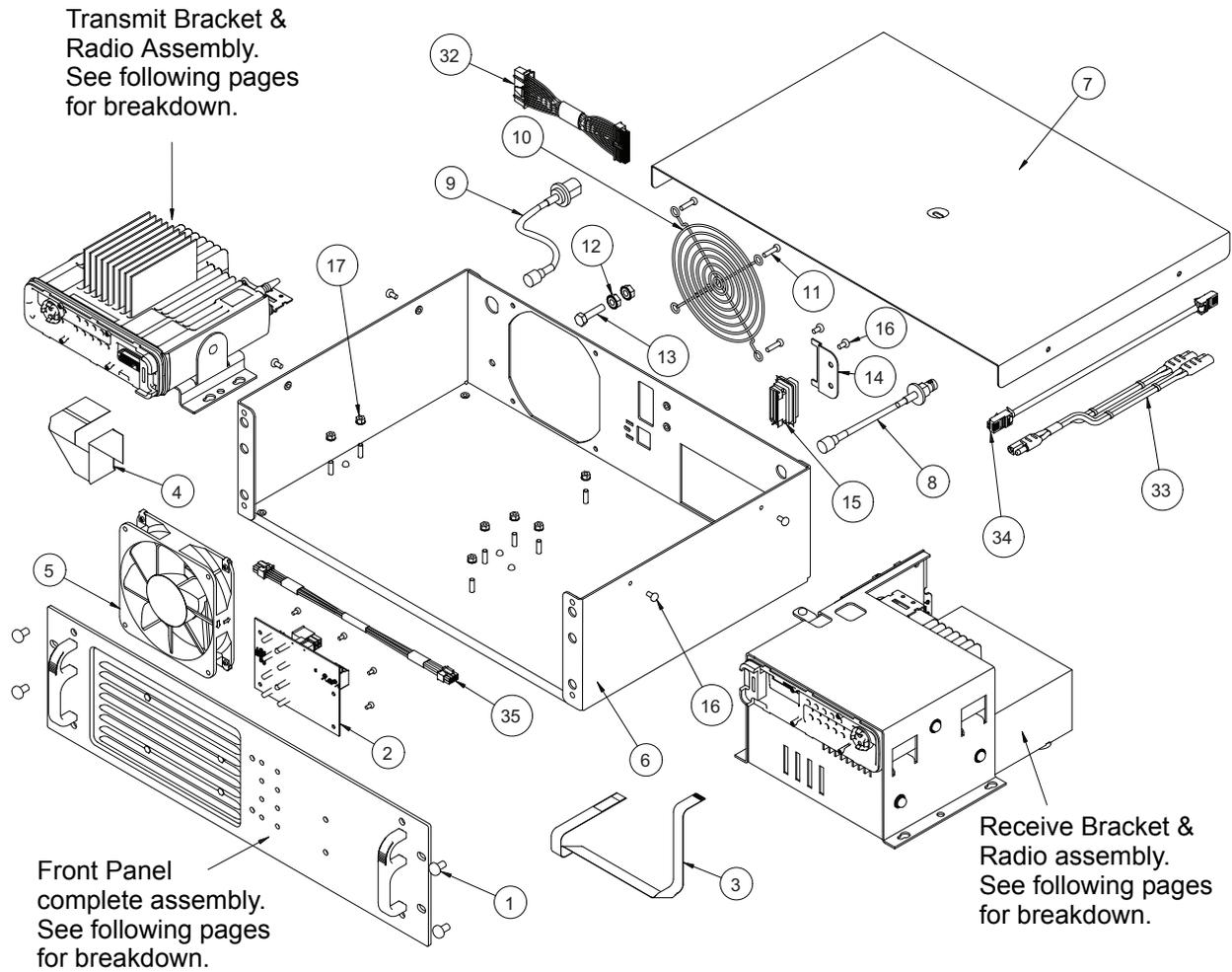


Figure 5-33. Repeater Assembly Exploded View (VHF/UHF 32 MB Repeaters)

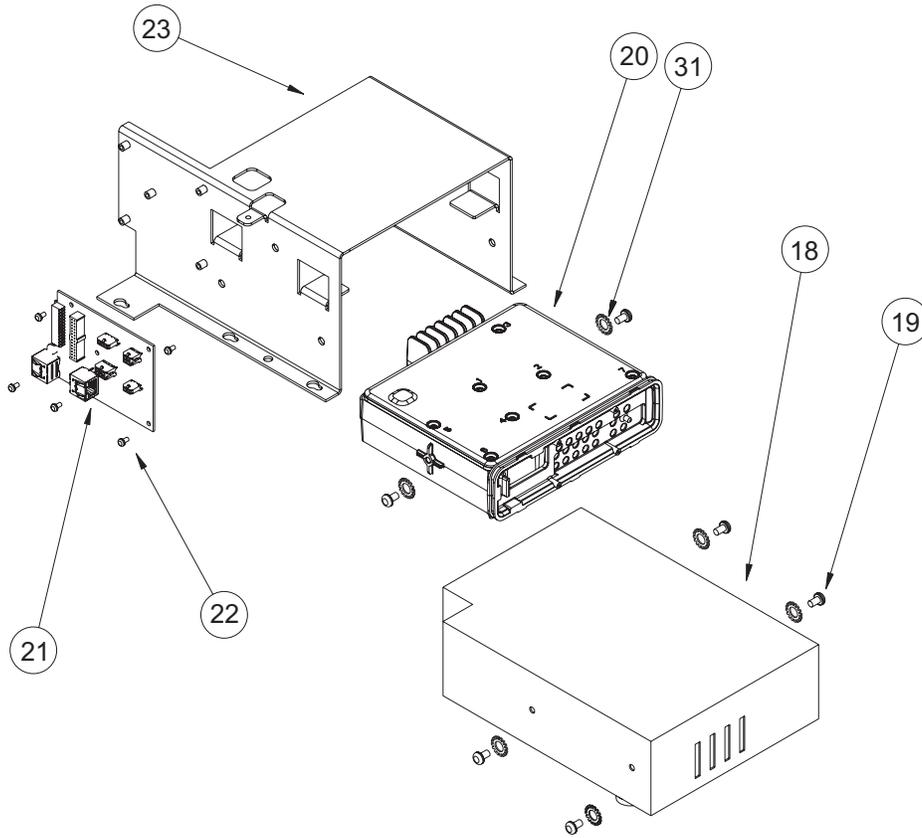


Figure 5-34. Receive Bracket and Radio Assembly Exploded View

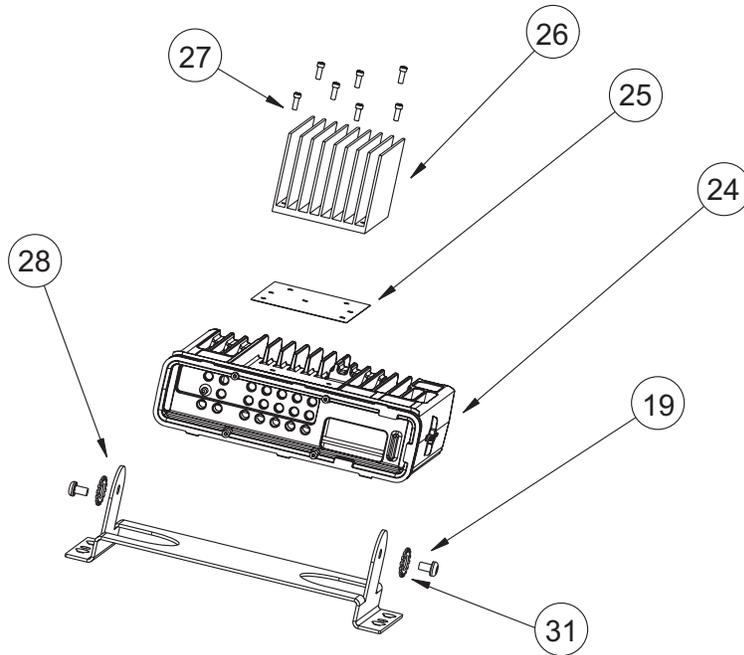


Figure 5-35. Transmit Bracket and Radio Assembly Exploded View

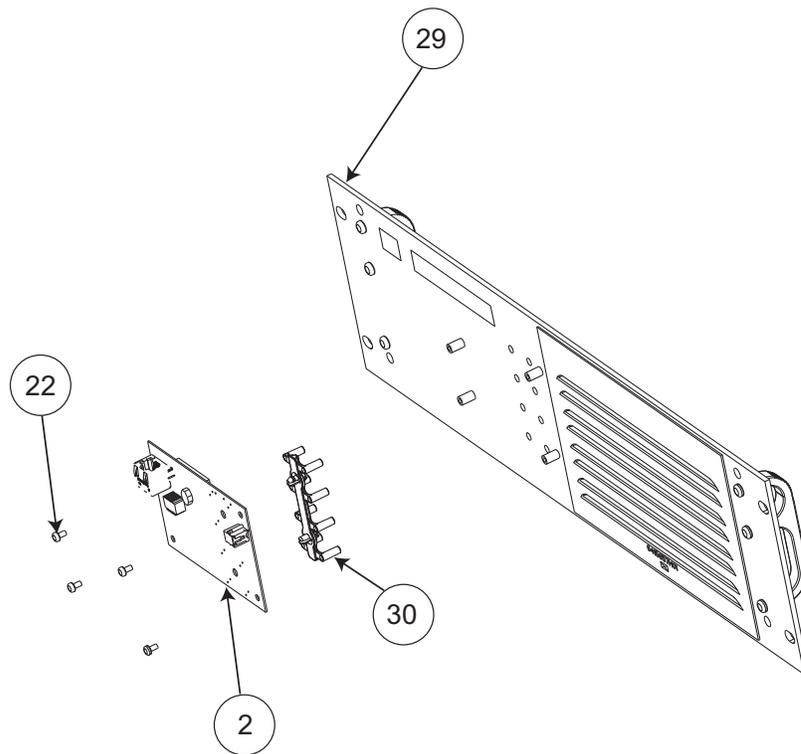


Figure 5-36. Front Panel Complete Assembly Exploded View

Table 5-3. Repeater Exploded View Parts List

Item No.	Description	Part Number
1	Screw, TT6x1.0x10, Starpan, EM6219 (black)	0312016A54
2	Repeater Indicator Board (VHF/UHF 8 MB Repeaters) Repeater Indicator Board (VHF/UHF 32 MB Repeaters)	PMLN5269_ PMLN5643_
3	Cable, Flex SSI	3015639H01
4	Cable, Flex 30-Position (VHF/UHF 8 MB Repeaters) Cable, Flex 30-Position (VHF/UHF 32 MB Repeaters)	3015634H01 3015634H02
5	Fan Assembly	5915618H01
6	Enclosure Assembly	1515837H01
7	Top Cover	1515655H01
8	Cable, RF Rx, W/BNC	3015574H01
9	Cable, RF Tx, W/N-Type	3015573H01
10	Fan Grill	1383852R01
11	Screw, TT3.5x0.6x16, Star SLT Pan	0371805M01
12	M6 Ground Nut	0285854Y01
13	M6 Ground Screw	0310909A95
14	Accessory Retainer Clip	4216361H01
15	Rear Accessory Connector	0178042A01

Table 5-3. Repeater Exploded View Parts List

Item No.	Description	Part Number
16	Screw, M4x0.7x13.0, Starpan STLZNC	0310909E63
17	Lock Nut M4	0285854Y02
18	Power Supply	PMPN4001_
19	Screw, M5x0.8x8.0, Starpan STLZNC	0310909A74
20	Receive Radio Brick Assembly	See Sections 1.4 through 1.8 to identify proper Repeater XCVR Service Kit.
21	Connector Board Assembly (For use with 8 MB and 32 MB Repeaters)	PMLN5644_
22	Screw, M3x0.5x5, Starpan STLZNC	0310909A30
23	RX Bracket Assembly	0715656H01
24	Transmit Radio Brick Assembly	See Sections 1.4 through 1.8 to identify proper Repeater XCVR Service Kit.
25	Thermal Pad	7515633H01
26	Heatsink	2615620H01
27	Screw, M3x0.5x10, Starpan STLZNC	0310909A33
28	Tx Bracket	0715654H01
29	Front Panel Assembly only (handles not included)	6415658H04
30	Light Guide	6116326H01
31	Washer	0400002647
32	Cable Assembly, Tx to Connector Board	3015570H01
33	Cable, Power, Y-Split	3085859M01
34	Cable, Ethernet	3015575H01
35	Cable, DC (VHF/UHF 32 MB Repeaters)	30009303001

5.10 Torque Chart

Table 5-4 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 repeater.

Table 5-4. Torque Specifications for Nuts and Screws

Part Number	Description	Driver/ Socket	Torque		
			N-m	lbs-in	kg-cm
0285854Y01	Grounding Nut, M6	10 mm dip socket	2.0	17.70	20.4
0285854Y02	Lock Nut, M4 x 0.8, ext tooth	7 mm socket	2.0	17.70	20.4
0310909A30	Screw, M3.0 x 0.5 x 5 mm	T10 Torx™	1.0	8.9	10.2
0310909A33	Screw, M3 x 0.5 x 10 mm	T10 Torx™	1.0	8.9	10.2
0310909A74	Screw, M5 x 0.8 x 8 mm	T25 Torx™	3.0	26.6	30.6
0371805M01	Screws, M3.5 x 0.5 x 16 mm	T15 Torx™	1.6	14.2	16.3
0310909A95	Grounding Screw, M6 x 1 x 25	T30 Torx™	2.0	17.7	20.4
0312016A54	Screws, TT6 x 1.0 x 10 mm Star Thread Rolling Screw	T30 Torx™	3.7	32.7	37.7
0310909E63	Screw, M4 x 0.7 x 7 mm, Slotted Star	T20 Torx™	2.0	17.7	20.4
3015574H01	BNC Type connector	16 mm deep well socket	2.3	20.4	23.5
3015573H01	N Type connector	19 mm deep well socket	2.3	20.4	23.5

Notes

Chapter 6 Basic Troubleshooting

6.1 Introduction

This chapter contains error codes and board replacement procedures. If the repeater does not pass all the performance checks in Chapter 3, then please send the repeater to a Motorola Service Center listed in Appendix B.

NOTE: To access the various connector pins, use the housing eliminator/test fixture along with the diagrams found in this section of the manual. (See Section, "Service Aids" on page 2-2, for the appropriate Motorola service aids and tools part numbers.)

6.1.1 High Power RF Precaution



Caution

The repeater 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 repeater.

6.2 Replacement Service Kit Procedures

Once a problem has been isolated to a specific board, install the appropriate service kit (see Model Charts on page 1-3), which is orderable from Motorola Solutions Parts Organization at 1-800-422-4210. Refer to <https://businessonline.motorolasolutions.com> for further information.

If a board is replaced, it does not need to be retuned if it has been purchased through Motorola Solutions Parts, as it is already factory tuned. It should however be checked for performance before being placed into service.



Caution

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

6.2.1 Replacing and Initializing Service Kits for XPR 8300/XPR 8400 Repeaters

1. Note the firmware version in the repeater, before beginning the service kit replacement.
2. It is recommended to archive the existing Codeplug that is programmed in the repeater.
3. Remove the Defective Transmit Radio per the instructions in Section 5.6.4 on page 5-8.
4. Verify the Firmware version in the new Transmit Radio. If it is the same as the existing Receive Radio, proceed to step 7.

NOTE: Ignition Sense voltage (13.5 Vdc) needs to be applied to pin 25 in order for the radio to power up (XPR 8400).

5. If the firmware version in the repaired Transmit Radio is newer than the version in the Receive Radio, the Receive Radio must be upgraded prior to installing the new replacement Transmit Radio. To upgrade the Receive Radio independently, remove the RSSI cable from the front of the transceiver and connect the programming cable directly to the Rear Accessory Connector of the Receive Radio.

NOTE: Ignition Sense voltage (13.5 Vdc) needs to be applied to pin 25 in order for the radio to power up (XPR 8400). Use the CPS to upgrade the Receive Radio to the same version as the new Transmit Radio.



Caution

When upgrading the repeater radios individually, you must ALWAYS use the Repeater firmware package from MOL. Never attempt to upgrade a repeater radio with the Mobile firmware packages.

6. If the replacement Transmit Radio has an older version than the original Receive Radio, repeat the above upgrade process with the replacement Transmit Radio.
7. Install the new Transmit Radio according to the reassembly instructions in Section 5.8.4 on page 5-26.
8. The replacement Transmit Radio will require the Serial Number of the Repeater to be entered before it can be read or programmed with the CPS. Connect the repeater to the MOTOTRBO Tuner and follow the instructions to enter the serial number noted on the back label of the repeater, into the newly installed Transmit Radio. Tuning is not required, as the Transmit and Receive Radios have been factory tuned for both TX and RX parameters
9. After powering on the repeater and verifying functionality, either program with the existing archive, or read and reprogram the repeater with a new configuration. (This is necessary since the programming information is stored in the Transmit Radio.

6.3 LED Indicator Descriptions

Table 6-1. LED Indicator Descriptions

LED	Status	Description
Power	Solid GREEN	Repeater powered by AC
	Solid RED	Repeater powered by back-up battery
	Off	Repeater powered off
Repeater Disable	Solid RED	Repeater function disabled
	Blinking RED	Repeater in self test mode
	Off	Repeater in normal operational mode
Digital	Solid BLUE	Repeater in Digital mode
Analog	Solid YELLOW	Repeater in Analog mode
TX-A	Solid GREEN	Repeater transmitting (Analog)
	Solid GREEN	Repeater transmitting on Slot A (Digital)
RX-A	Solid YELLOW	Repeater receiving (Analog)
	Solid YELLOW	Repeater receiving on Slot A (Digital)
TX-B	Solid GREEN	Repeater transmitting on Slot B (Digital)
RX-B	Solid YELLOW	Repeater receiving on Slot B (Digital)

6.4 Ethernet LED Indicator Descriptions

Table 6-2. Ethernet LED Indicator Descriptions

LED	Status	Description
Yellow	Solid YELLOW	Link valid
	Blinking YELLOW	Tx/Rx activity
Green	Solid GREEN	100 Mbits speed
	Off	10 Mbits speed

NOTE: Table 6-2 is only applicable for VHF/UHF 32 MB Repeaters.

Notes

Chapter 7 Accessories

7.1 Introduction

Motorola provides the following approved accessories to improve the productivity of your repeater.

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

7.1.1 Antennas

Part No.	Description
RDD4527_	VHF 3 dB Gain Antenna 150–158 MHz
RDE4554_	3.8 dB Gain Omni Antenna 488–512 MHz
RDE4555_	3.8 dB Gain Omni Antenna 470–488 MHz
RDE4556_	3.8 dB Gain Omni Antenna 450–470 MHz
RDE4557_	3.8 dB Gain Omni Antenna 403–420 MHz

7.1.2 Cables

Part No.	Description
PMKN4010_	Mobile & Repeater Rear Programming Cable
PMKN4016_	Mobile & Repeater Rear Accessory Programming and Test Cable
PMKN4018_	Mobile & Repeater Rear Accessory Connector Universal Cable
RKN4152_	Battery Back-up Cable

7.1.3 Miscellaneous Accessories

Part No.	Description
PMLE4476_	Wall Mount Kit for MOTOTRBO Repeater
PMLE4548_	Rack Mount for 1 duplexer and 1 preselector
RRX4032_	Tower Mounting Hardware for RRX4038
RRX4038_	RF Surge Suppressor
RFE4000_	Untuned Duplexer, 450–470 MHz
HFE8400_	Untuned Duplexer, 406–450 MHz
HFE8401_	Untuned Duplexer, 470–512 MHz
HFE8454_	Untuned Duplexer, 490–527 MHz
HFE8459_	UHF Preselector, 440–474 MHz

Part No.	Description
HFE8460_	UHF Preselector, 474–527 MHz
HFD8188_	VHF Duplexer, 144–155 MHz (min & max freq sep 4.5 MHz/6 MHz)
HFD8189_	VHF Duplexer, 155–162 MHz (min & max freq sep 4.5 MHz/6 MHz)
HFD8190_	VHF Duplexer, 162–174 MHz (min & max freq sep 4.5 MHz/6 MHz)
HFD8461_	VHF Preselector, 144–160 MHz
HFD8462_	VHF Preselector, 160–174 MHz

Appendix A Replacement Parts Ordering

A.1 Basic Ordering Information

Some replacement parts, spare parts, and/or product information can be ordered directly. While parts may be assigned with a Motorola part number, this does not guarantee that they are available from Motorola Radio Products and Solutions Organization (RPSO). Some parts may have become obsolete and no longer available in the market due to cancelations by the supplier. If no Motorola part number is assigned, the part is normally not available from Motorola, or is not a user-serviceable part. Part numbers appended with an asterisk are serviceable by Motorola Depot only.

A.2 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>

A.3 Mail Orders

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

Motorola
7031 Columbia Gateway Drive
3rd Floor - Order Processing
Columbia, MD 21046
U.S.A.

A.4 Telephone Orders

Radio Products and Solutions Organization*
(United States and Canada)
7:00 AM to 7:00 PM (Central Standard Time)
Monday through Friday (Chicago, U.S.A.)
1-800-422-4210
1-847-538-8023 (United States and Canada)

U.S. Federal Government Markets Division (USFGMD)
1-877-873-4668
8:30 AM to 5:00 PM (Eastern Standard Time)

A.5 Fax Orders

Radio Products and Solutions Organization*
(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 Purchase Orders)

A.6 Parts Identification

Radio Products and Solutions Organization*
(United States and Canada)
1-800-422-4210

A.7 Product Customer Service

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

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

Appendix B Motorola Service Centers

B.1 Servicing Information

If a unit requires further complete 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 Service Center as listed below or your nearest Authorized Service Center.

B.2 Motorola Service Center

1220 Don Haskins Drive
Suite A
El Paso, TX 79936
Tel: 915-872-8200

B.3 Motorola Federal Technical Center

10105 Senate Drive
Lanham, MD 20706
Tel: 1-800-969-6680
Fax: 1-800-784-4133

B.4 Canadian Technical Logistics Center

181 Whitehall Drive
Markham, Ontario,
L3R 9T1
Toll Free: 800-543-3222

Notes

Appendix C Digital Telephone Patch (DTP) Tuning Guideline

C.1 MRTI2000

C.1.1 Hardware Connection

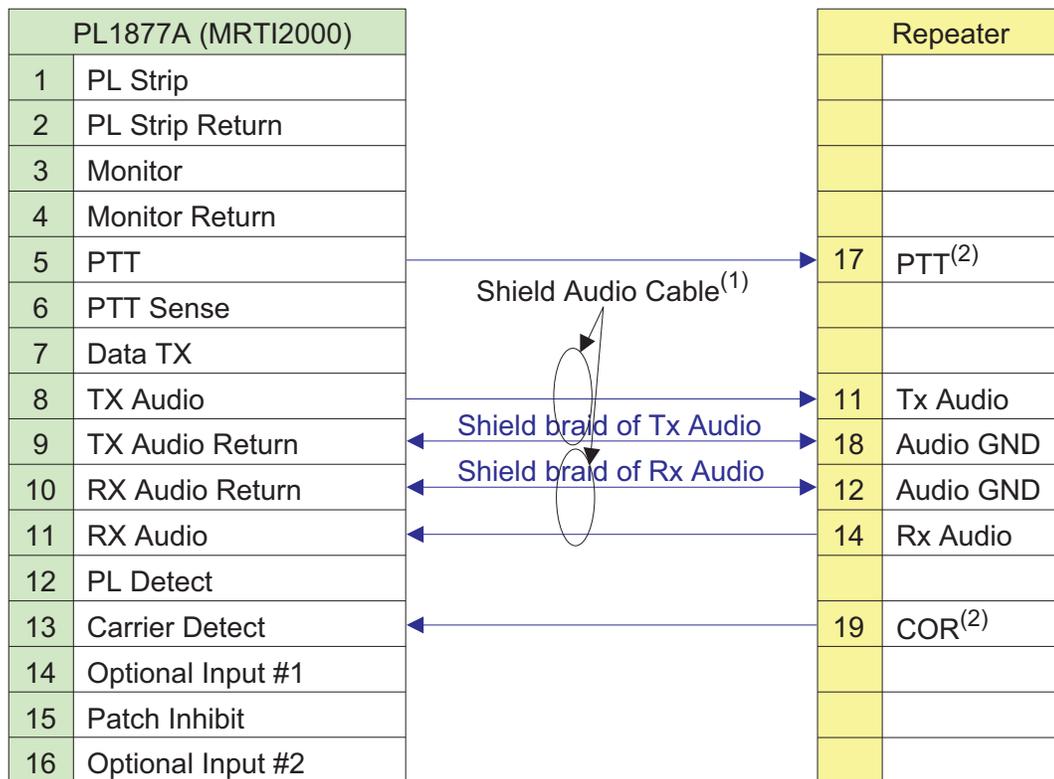


Figure C-1. MRTI2000 and Repeater Hardware Connection

1. Apply shielded audio cable for Tx and Rx Audio connections to avoid any possible interference to speech signal. The connection of the shielded cable braid is indicated in Figure C-1.
2. The GPIO pin for PTT and COR function is configured in the CPS. Confirm that the CPS setting matches the Pin information. See “Figure C-1. MRTI2000 and Repeater Hardware Connection” on page C-1.

IMPORTANT: Refer to the MRTI2000 service manual (Pub. 43004-019B) to install and program the phone patch for initial setup. See Section “C.1.3 Programming and Tuning” on page C-2 for more information on how to setup the Digital Telephone Patch application.

C.1.2 Jumpers on Phone patch

JU202 – out (default), to support low Rx Audio input level.

C.1.3 Programming and Tuning

C.1.3.1 Programming the Phone Patch with PC Tool provided by Gai-Tronics

Figure C-2 configures RX audio path, Figure C-3 configures the phone patch to work under Half-Duplex mode and Figure C-4 configures the Access and Deaccess code.

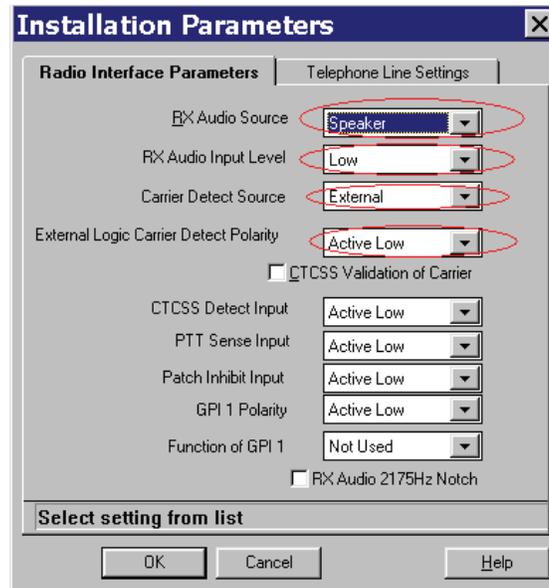


Figure C-2. MRTI2000 Rx Audio Path Setting

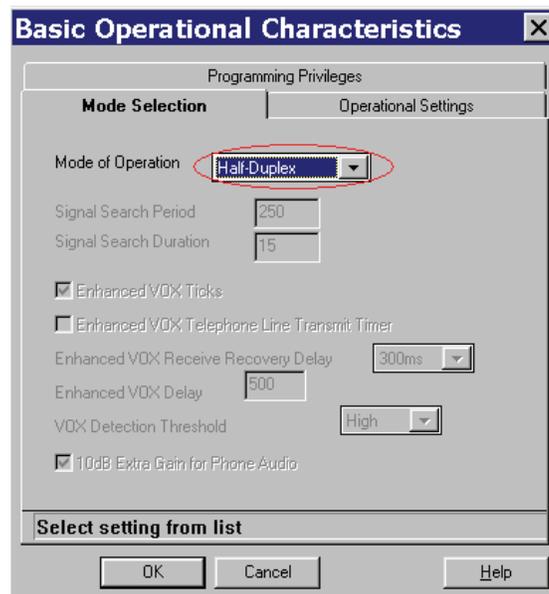


Figure C-3. MRTI2000 Operation Mode Setting

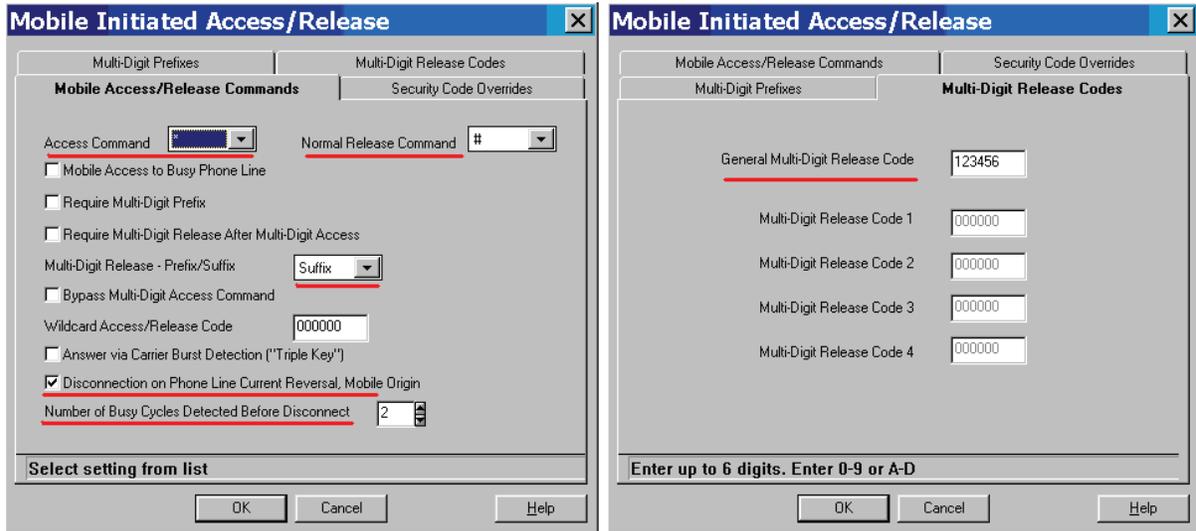


Figure C-4. MRTI2000 Access/Deaccess Setting

C.1.3.2 Enter Diagnostic Test Mode

1. To enter Diagnostic Test Mode, simultaneously press the UP and DOWN buttons.
2. To enter another test when at Diagnostic Test Mode, press the PATCH ON/OFF button.
3. To exit, press both the UP and PATCH ON/OFF buttons simultaneously.

NOTE: Each time a new test is selected, a test timer is set to 15 minutes. If this timer reaches zero, the patch resets itself to idle, ready for normal operation.

C.1.3.3 TX Softpot Adjustment

1. Press both the UP and DOWN buttons simultaneously to enter Diagnostic Test 1. This procedure also activates PTT, and generates a 1000 Hz tone to the transmitter.
2. Press the UP or DOWN button to adjust the transmit level. Monitor the Tx Audio line to reach 226 mVpp at Tx Audio line.
3. After the desired level is achieved, press the PATCH ON/OFF button. The value set remains stored in memory unless it is changed through an adjustment in Test 1.
4. To exit the test, press the UP and PATCH ON/OFF buttons simultaneously.

C.1.3.4 Mobile-to-Phone Audio Path

1. Rx Audio path setting is performed as indicated in Figure C-2, no additional tuning is required.

C.2 Zetron M30

C.2.1 Hardware Connection

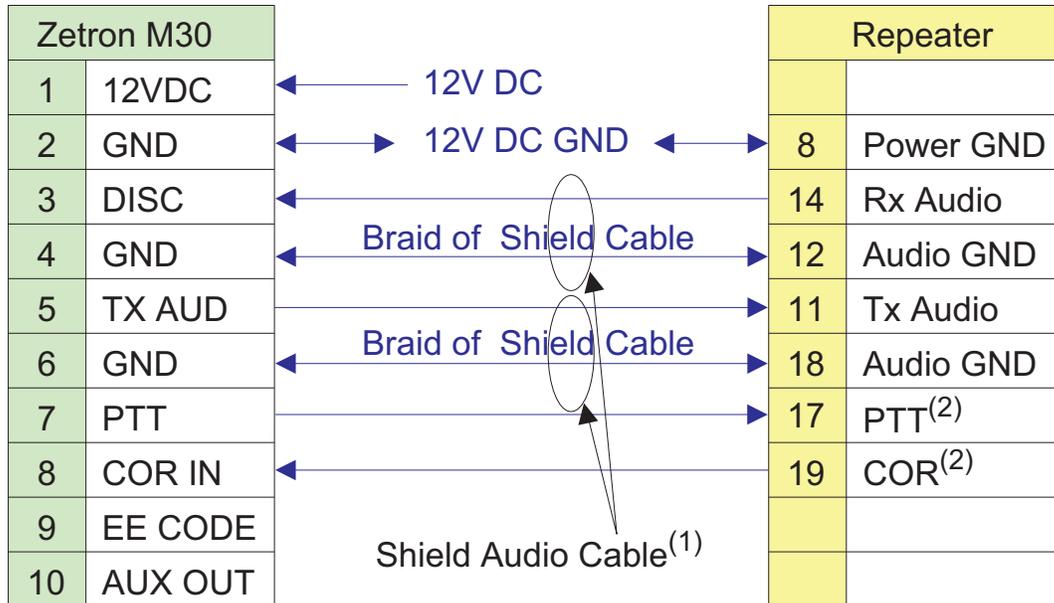


Figure C-5. Zetron M30 Hardware Connection

1. Apply shielded audio cable for Tx and Rx Audio connections to avoid any possible interference to speech signal. The connection of the shielded cable braid is indicated in Figure C-5.
2. The GPIO pin for PTT and Carrier Operated Relay (COR) function is configured in the CPS. Confirm that the CPS setting matches the Pin information. See “Figure C-5. Zetron M30 Hardware Connection” on page C-4.

IMPORTANT: Refer to the Zetron M30 service manual (part number 025-9140P) to install and program the phone patch for initial setup. See Section “C.2.3 Setting up the Zetron Input and Output Signal Levels” on page C-5 for more information on how to setup the Digital Telephone Patch application.

C.2.2 Jumpers on Phone patch

JP8 – C, COR polarity, low active

JP7 – B, external COR

C.2.3 Setting up the Zetron Input and Output Signal Levels

There are two ways to access the required Zetron M30 test mode. The method using a DTMF telephone is described in detail, to access using a PC or terminal please refer to Zetron manual.

Equipment Required:

- MOTOTRBO radio
- Local DTMF (Touch-Tone) phone and analog PSTN phone line
- Oscilloscope
- Signal Generator (optional - dependent on tuning method used. See section C.2.3.6 on page C-6)
- Audio Box (optional - dependent on tuning method used. See section C.2.3.6 on page C-6)

C.2.3.1 Hardware Setup and Basic Check

1. Connect Phone Patch to the repeater according to Figure C-5.
2. Connect analog telephone line from the PSTN or from a local PBX to the phone patch.
3. Power up both. The power LED should be lit on both.

C.2.3.2 Force a Reset, Recover to Factory Default Setting

1. Press down the “connect” button on the front of the Analog Phone Patch (APP), then power up.
2. Hold the “connect” button until the phone light starts blinking (about four seconds), then release the button.

C.2.3.3 Enter Program Mode

1. Dial the line number of APP.
2. Hold for about 14 rings until a two-beep prompt tone is heard.
3. Enter the program mode access code, “12123”.

NOTE: Disconnect the repeater to enter program mode to avoid Base Radio (BR) assertion of Carrier Operated Relay (COR) even when BR is powered off.

C.2.3.4 Program to Half Duplex Mode and COR to Answer

1. Enter 40# – Program operation mode to “Half Duplex Mode”
2. Enter 60# – Program mobile answer mode to “COR To Answer”

C.2.3.5 Set Transmit Audio Gain

1. Enter programming mode C.2.3.3.
2. At jumper JP-3 in the “B” (LOW Gain), enter the DTMF command “92#”.
3. The transmitter is keyed and a 1 kHz test tone is generated for 30 seconds.
4. Using the oscilloscope to monitor the Tx Audio line tone signal, adjust the Transmit Level pot (R5) to 226 mVpp at Tx Audio line.
5. If the desired deviation of 226 mVpp cannot be achieved, move JP-3 to the “A” (HI Gain) position and repeat step 2 to step 4 above.

C.2.3.6 Set Receive Level

Receive Level setting impacts the speech volume heard at the phone end. The settings below are recommended and adjustment is allowed depending on requirement. Two calibration methods are available. Use either Method 1 or Method 2 to do the tuning.

- **Method 1** – Since the Motorola repeater has the same Rx Audio output level under digital and analog mode, refer to the Zetron M30 service manual, (Chapter 5 Installation) to set the Rx level under analog mode first and then switch to digital mode directly when the setting is ready. No additional setting is required.

- **Method 2** – Tuning with injected sine tone from MOTOTRBO subscriber, under digital mode. Equipment: Oscilloscope, MOTOTRBO Portable/Mobile subscriber, Audio Box (Motorola part number: RLN4460B), Signal Generator

NOTE: Disable “Digital Mic AGC” on MOTOTRBO subscriber with the CPS before calibration.

1. Enter programming mode C.2.3.3.
2. Open the shell of M30 and connect the oscilloscope probe to U1 PIN 14.
3. Setup DTP connection and verify that phone call is setup correctly.
4. If a MOTOTRBO Portable radio is used,
 - a. Configure the Signal Generator to output 1031 Hz sine tone, amplitude set as 22.6 mVpp (8 mVrms).
 - b. Inject the signal to the Audio Box audio input port.
 - c. Attach the Audio Box GCAI connector to the accessory port of the MOTOTRBO subscriber .
 - d. Setup a phone call and during the phone call, assert PTT knob on Audio Box to transmit from radio, phone should hear the tone.
5. If a MOTOTRBO Mobile radio is used,
 - a. Configure the Signal Generator to output 1031 Hz sine tone, amplitude set as 226.3 mVpp (80 mVrms).
 - b. Inject the signal to the MOTOTRBO mobile radio rear port, PIN 11 Tx Audio, Signal Generator's ground connects to MOTOTRBO mobile radio rear port, PIN 18 Audio ground.
 - c. Setup a phone call and during the phone call, assert MOTOTRBO mobile radio's external PTT with rear port PIN 17 PTT to transmit from radio, phone should hear the tone.
6. While MOTOTRBO subscriber radio (Portable or Mobile) is transmitting with the tone, verify that the repeater Rx Audio output is close to 1.0 Vpp and adjust the RECEIVE GAIN (R4) on M30 for a 1.0 Vpp tone signal at U1 PIN 14. If this level with JP-1 in position A is not reached, move it to position B.

C.3 Zetron M735

C.3.1 Hardware Connection

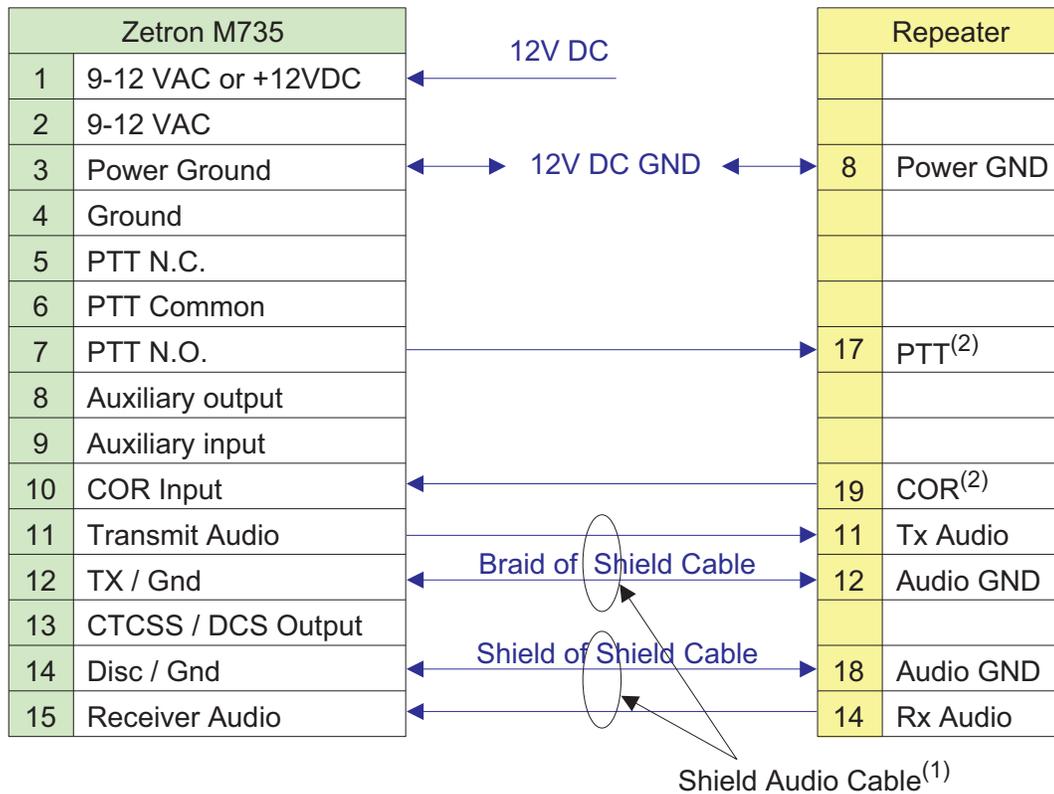


Figure C-6. Zetron M735 Hardware Connection

1. Apply shielded audio cable for Tx and Rx Audio connections to avoid any possible interference to speech signal. The connection of the shielded cable braid is indicated in Figure C-6.
2. The GPIO pin for PTT and COR function is configured in the CPS. Confirm that the CPS setting matches the Pin information. See "Figure C-6. Zetron M735 Hardware Connection" on page C-7.

IMPORTANT: Refer to the Zetron M735 service manual (part number 025-9369E.1) to install and program the phone patch for initial setup. See Section "C.3.3 Setting up the Zetron Input and Output Signal Levels" on page C-8 for more information on how to setup the Digital Telephone Patch application.

C.3.2 Jumpers on Phone patch

JP21 – B, External COR

JP31 – A, negative COR

JP24 – A, flat output at Tx Audio

C.3.3 Setting up the Zetron Input and Output Signal Levels

There are two ways to access the required Zetron M735 test mode. The method using a DTMF telephone is described in detail, to access using a PC or terminal please refer to Zetron manual.

Equipment Required:

- MOTOTRBO radio
- Local DTMF (Touch-Tone) phone
- Oscilloscope

C.3.3.1 Hardware Setup and Basic Check

1. Connect Phone Patch to the repeater according to Figure C-6.
2. Connect analog telephone line from the PSTN or from a local PBX to the phone patch.
3. Power up both, the power LED should be lit on both.

C.3.3.2 Enter Program Mode

Either,

1. Call up the Model 735 phone number.
2. When prompted by the Model 735 (925 Hz beep) to over-dial a user number or ANI, enter the program access code (12735 by default).

CAUTION: A high pitched modem tone is heard. Enter the DTMF # which will stop the Model 735 from looking for a modem. After that, five short beeps are heard to confirm access to the DTMF programming mode.

Or,

1. Connect M735 to a PC via RS-232 cable
2. Open the settings menu and select Communications.
3. Then set the following parameters:
 - Baud rate = 2400
 - Data bits = 8
 - Stop bits = 1
 - Parity = None
 - Flow Control = XON/XOFF
 - COM Port = the port the modem is connected to or configured for these parameters set up the basic rules of communication between the modem and the PC. If there is no connection, change the Baud rate to 4800.

C.3.3.3 Force a Reset

Enter command 1 10# [2 beeps] 12345# to confirm [5 beeps]

C.3.3.4 Set Tx Audio Level

1. Enter programming mode C.3.3.2.
2. Input command 111#, the transmitter will be keyed, and a 250 Hz tone will be generated from the transmitter. Each time any DTMF digit other than “#” or “*” is pressed, the Model 735 will cycle to the next tone in the list (250, 500, 1K, 2K, 3K).
3. Press a key twice to go to the 1 kHz tone. Monitor Tx Audio output signal with oscilloscope. Adjust R60 (TX AUD) to reach 226 mVpp for the 1 kHz tone. JP25 can be used to increase or decrease the output if needed. JP25 in position A increases the output and decreases it in position B. Once the level is set for a 1 kHz tone, cycle through the tones and verify a flat response. JP24 can be used to set the tones for a flat response.
4. Press # to exit the test mode.
5. Setup a Radio to Phone call, monitor the ring back tone and busy disconnect tone from the phone line at Tx Audio PIN, and make sure there is no clipping or other distortion on the signals.

C.3.3.5 99# Exit Program Mode

C.3.3.6 Discriminator Input Level Adjust

Receive Level setting impacts the speech volume heard at the phone end. The settings below are recommended and adjustment is allowed depending on requirement. Two calibration methods are available. Use either Method 1 or Method 2 to do the tuning.

- **Method 1** – Since the Motorola repeater has the same Rx Audio output level under digital and analog mode, refer to the Zetron M735 service manual, (Section II Installation) to set the Rx level under analog mode first and then switch to digital mode directly when the setting is ready. No additional setting is required.
- **Method 2** – Tuning with injected sine tone from MOTOTRBO subscriber under digital mode. Equipment: Oscilloscope, MOTOTRBO Portable/Mobile subscriber, Audio Box (Motorola part number: RLN4460B), Signal Generator

NOTE: Disable “Digital Mic AGC” on portable subscriber with CPS.

1. Enter programming mode C.3.3.2.
2. Open the shell of M735 and connect the oscilloscope probe to TP4 on M735 board.
3. Setup DTP connection and verify that phone call is setup correctly.

4. If a MOTOTRBO Portable radio is used,
 - a. Configure Signal Generator to output 1031 Hz sine tone, amplitude set as 22.6 mVpp (8 mVrms).
 - b. Inject the signal to the Audio Box audio input port.
 - c. Attach the Audio Box GCAI connector to the accessory port of the MOTOTRBO subscriber.
 - d. Setup a phone call and during the phone call, assert PTT knob on Audio Box to transmit from radio, phone should hear the tone.
5. If a MOTOTRBO Mobile radio is used,
 - a. Configure Signal Generator to output 1031 Hz sine tone, amplitude set as 226.3 mVpp (80 mVrms).
 - b. Inject the signal to MOTOTRBO mobile radio rear port, PIN 11 Tx Audio, Signal Generator's ground connects to MOTOTRBO mobile radio rear port, PIN 18 Audio ground.
 - c. Setup a phone call and during the phone call, assert MOTOTRBO mobile radio's external PTT with rear port PIN 17 PTT to transmit from radio, phone should hear the tone.
6. While MOTOTRBO subscriber radio (Portable or Mobile) is transmitting with the tone, verify that the repeater Rx Audio output is close to 1.0 Vpp and then adjust R59 on M735 for a 1.0 Vpp tone signal at TP4.

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.

Term	Definition
Analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
Band	Frequencies allowed for a specific purpose.
CMOS	Complementary Metal Oxide Semiconductor.
CPS	Customer Programming Software: 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.
DPL	Digital Private-Line: A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
FCC	Federal Communications Commission.
Frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
GPIO	General-Purpose Input/Output.
IC	Integrated Circuit: 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.
IF	Intermediate Frequency.
kHz	kilohertz: One thousand cycles per second. Used especially as a radio-frequency unit.
LCD	Liquid-Crystal Display: 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.
LDMOS	Laterally Diffused Metal Oxide Semiconductor.
LED	Light Emitting Diode: An electronic device that lights up when electricity is passed through it.
MDC	Motorola Digital Communications.

Term	Definition
MHz	Megahertz: One million cycles per second. Used especially as a radio-frequency unit.
Paging	One-way communication that alerts the receiver to retrieve a message.
PC Board	Printed Circuit Board. Also referred to as a PCB.
PL	Private-Line Tone Squelch: 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 RS232.
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).
RF	Radio Frequency: The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
RX	Receive.
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.
TOT	Time-out Timer: A timer that limits the length of a transmission.
TPL	Tone Private Line.
Transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
Transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
TX	Transmit.
UHF	Ultra-High Frequency.
USB	Universal Serial Bus: An external bus standard that supports data transfer rates of 12 Mbps.
VHF	Very High Frequency.
VIP	Vehicle Interface Port.
XPR	Refers to Digital Professional Repeater model names in the MOTOTRBO Professional Digital Two-Way Radio System.



Motorola Solutions, Inc.
1303 East Algonquin Road
Schaumburg, Illinois 60196 U.S.A.

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www.motorolasolutions.com/mototrbo



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