

PROFESSIONAL DIGITAL TWO-WAY RADIO SYSTEM



MOTOTRBO™ BASE STATION/REPEATER BASIC SERVICE & INSTALLATION MANUAL

SLR 8000



en

de-DE

fr-FR

it-IT

es-ES

tr-TR

pl-PL

ru-RU

ar-EG

Foreword

This manual covers all versions of the MOTOTRBO SLR 8000 Base Station/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 module 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.

General Safety Precautions

See "General Safety and Installation Standards and Guidelines," on page iii.

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Notes

General Safety and Installation Standards and Guidelines

ATTENTION!




WARNING

WARNING: For safe installation, operation, service and repair of this equipment, follow the safety precautions and instructions described below, as well as any additional safety information in Motorola's product service and installation manuals and the Motorola R56 Standards and Guidelines for Communications Sites manual . To obtain copies of these materials, please contact Motorola as directed at the end of this section. After installation, these instructions should be retained and readily available for any person operating or servicing this base station/repeater or working near it.




Failure to follow these safety precautions and instructions could result in serious injury or property damage.

The installation process requires preparation and knowledge of the site before installation begins. Review installation procedures and precautions in the Motorola R56 manual before performing any site or component installation. Personnel must use safe work practices and good judgment, and always follow applicable safety procedures, such as requirements of the Occupational Safety and Health Administration (OSHA), the National Electrical Code (NEC), and local codes.

The following are additional general safety precautions that must be observed:

- To continue compliance with any applicable regulations and maintain the safety of this equipment, do not install substitute parts or perform any unauthorized modifications.
- All equipment must be serviced by Motorola trained personnel.
- If troubleshooting the equipment while the power is on, be aware of live circuits which could contain hazardous voltage.
- Do not operate the radio transmitters unless all RF connectors are secure and all connectors are properly terminated.
- All equipment must be properly grounded in accordance with the Motorola R56 and specified installation instructions for safe operation.
- Slots and openings in the cabinet are provided for ventilation. Do not block or cover openings that protect the devices from overheating.
-  Some equipment components can become extremely hot during operation. Turn off all power to the equipment and wait until sufficiently cool before touching.
- Maintain emergency first aid kits at the site.
- Never store combustible materials in or near equipment racks. The combination of combustible material, heat and electrical energy increases the risk of a fire hazard.

Equipment shall be installed in a site that meets the requirements of a "restricted access location," per (UL60950-1 & EN60950-1), which is defined as follows: "Access can only be gained by service persons or by users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and access is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location."

-  Burn hazard. The metal housing of the product may become extremely hot. Use caution when working around the equipment.
-  RF energy burn hazard. Disconnect power in the cabinet to prevent injury before disconnecting and connecting antennas.
- Shock hazard. The outer shields of all Tx and Rx RF cables outer shields must be grounded per Motorola R56 manual.
- Shock hazard. DC input voltage shall be no higher than 60 VDC. This maximum voltage shall include consideration of the battery charging "float voltage" associated with the intended supply system, regardless of the marked power rating of the equipment.
- All Tx and Rx RF cables shall be connected to a surge protection device according to Motorola R56 manual. Do not connect Tx and Rx RF cables directly to an outside antenna.
-  Compliance with National and International standards and guidelines for human exposure to Electromagnetic Energy (EME) at Transmitter Antenna sites generally requires that persons having access to a site shall be aware of the potential for exposure to EME and can exercise control of exposure by appropriate means, such as adhering to warning sign instructions. See this installation manual and Appendix A of Motorola R56.

This product complies with the requirements set forth by the European R&TTE regulations and applicable CENELEC standards concerning human exposure to Electromagnetic Energy (EME) at Transmitter Antenna sites. "Appendix E" in this manual includes an EME exposure analysis of a typical system configuration for this product.

For a different system configuration than the typical configuration, compliance with applicable EME exposure standards (current versions of the EN50384 and EN50385 standards for occupational and general public exposure, respectively) can be evaluated by either employing the method illustrated in the typical system configuration EME exposure analysis included in "Appendix E" in this manual, or employing another suitable method among those described in the current version of the EN50383 standard.

Once the occupational and general public compliance boundaries are determined, means to ensure that workers and people are outside the respective boundaries, for instance using appropriate signage or restricted access, should be implemented; if this is not possible or practically achievable for the specific system configuration, the configuration should be modified in order to make it possible. The R56 Standards and Guidelines for Communications Sites manual provides examples of signage that can be used to identify the occupational or general public compliance boundaries.

Refer to product specific manuals for detailed safety and installation instructions. Manuals can be obtained with product orders, downloaded from <https://emeaonline.motorolasolutions.com>, or purchased through the Motorola Aftermarket & Accessory Department.



WARNING

This is a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

Part 68 Information

Part 68 FCC Guideline

This section applies when the SLR 8000 Base Station/Repeater is equipped with the optional Wireline Interface Board.

This equipment complies with Part 68 of the FCC rules and the requirements adopted by the ACTA. On the rear of this equipment is a label that contains, among other information, the registration number:

US: ABZNINANSLR8000

If requested, this number must be provided to the telephone company.

The connector used to connect this equipment to the premises wiring and telephone network must comply with the applicable FCC Part 68 rules and requirements adopted by the ACTA. A compliant connector is provided with this product. See Installation instructions for details.

REN: N/A

Connector: RJ1DC

Authorized Network Port: 04NO2

Service Order Code: 7.0Y

If the equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice is not practical, the telephone company will notify you as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice in order for you to make necessary modifications to maintain uninterrupted service.

If you experience trouble with this equipment, please refer to "Appendix B" for repair and warranty information. If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

None of the circuit boards in this equipment are field repairable. For assistance in sending the boards back for repair, please contact the Service Center listed in "Appendix B".

This equipment cannot be used on public coin phone service provided by the telephone company. Connection to party line service is subject to state tariffs. Contact the state public utility commission, public service commission or corporation commission for information.

MOTOTRBO SLR 8000 Base Station/Repeater Supplemental Safety and Installation Requirements

ATTENTION!

The MOTOTRBO SLR 8000 Base Station/Repeater must be installed in a suitable, in-building enclosure. A restricted access location is required when installing this equipment into the end system.

The base station/repeater contains a Class 1 built-in power supply component. It is equipped with an appliance inlet for connecting to an AC input, as well as DC input terminals which meet SELV DC circuit requirements.

When installing the equipment, all requirements of relevant standards and local electrical codes must be fulfilled.

The maximum operating ambient temperature of this equipment is 60 °C. The maximum operating altitude is 5000 meters above sea level.

The 15.75 VDC output from the power supply to the PA is at an energy hazard level (exceeds 240 VA). When installing into the end system, care must be taken so as not to touch the output wires.

When the SLR 8000 Base Station/Repeater is used in a DC reverting system, the DC power supply must be located in the same building as the MOTOTRBO SLR 8000 Base Station/Repeater, and it must meet the requirements of a SELV circuit.

Environmental Information

Material Content

Note The Motorola MOTOTRBO SLR 8000 Base Station/Repeater system and its subsystems have been created in compliance with the environmental goals of the European Union's **Restriction of Hazardous Substances (RoHS 2)** Directive 2011/65/EU and the **Waste Electrical and Electronic Equipment (WEEE)** Directive 2012/19/EU as well as Motorola's corporate goals to minimize environmental impact of its products.

This Motorola policy is reflected throughout the entire design, procurement, assembly, and packaging process.

In support of these efforts to provide environmentally-responsible products, please comply with the information in the following sections regarding product disposal for systems being replaced.

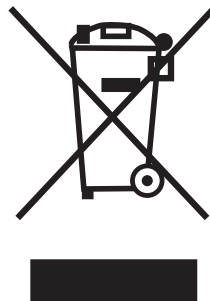
Disposal of your Electronic and Electric Equipment

Please do not dispose of electronic and electric equipment or electronic and electric accessories with your household waste. In some countries or regions, collection systems have been set up to handle waste of electrical and electronic equipment.

In European Union countries, please contact your local equipment supplier representative or service center for information about the waste collection system in your country.

Disposal Guideline

The following symbol on a Motorola product indicates that the product should not be disposed of with household waste.



Document History

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

Edition	Description	Date
MN002299A01-AA	Initial Release	May 2016

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Related Publications

MOTOTRBO SLR 8000 Quick Start Guide MN002302A01

Summary of Bands Available

Table below lists the SLR 8000 Base Station/Repeater bands available in this manual. For details, see Model Chart section.

Frequency Band	Bandwidth	Power Level
VHF	136 – 174 MHz	1 – 100 W
UHF	400 – 470 MHz	1 – 100 W

Notes

Chapter 1 SLR 8000 Base Station/Repeater

1.1 Notations Used in This Manual

Throughout the text in this publication, you will notice the use of WARNING, CAUTION and Note 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 which is essential to emphasize.



Caution

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



WARNING

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



Symbol indicates areas of the product that pose potential burn hazards.

1.2 Description

The Motorola SLR 8000 Base Station/Repeater provides a modular, flexible analog and digital station designed for today's communication systems and for the future. The station is available for use in these configurations:

- Analog Conventional
- Analog Voting
- Digital (MOTOTRBO)
 - MOTOTRBO DMR Tier 2 Conventional – Single-Site
 - MOTOTRBO DMR Tier 2 Conventional – IP Site Connect
 - MOTOTRBO Capacity Plus Single-Site Trunking
 - MOTOTRBO Capacity Plus Multi-Site Trunking
 - MOTOTRBO Connect Plus Trunking
 - MOTOTRBO Capacity Max Trunking
 - MOTOTRBO Digital Voting
 - MOTOTRBO Dynamic Mixed Mode (DMM)

- LTR Trunking
- Passport Trunking
- MPT1327 Trunking

Note Certain software features enabled via the CPS can be configured with the Online Help or with a regional representative. Refer to the regional Ordering Guide to determine the features available within the respective regions.

The SLR 8000 can either be configured as a stand-alone base station/repeater or as a base station/repeater connected to a back-end network, as in the case of operating in IP Site Connect mode. As a base station/repeater, it listens on one uplink frequency, and then re-transmits on a downlink frequency, thus providing the RF interface to the field subscribers. When configured for analog station operation, the repeater or base station is designed to operate with most existing analog systems, which enables a smooth migration to the MOTOTRBO system.

When configured for digital operation, the base station/repeater offers additional services. The digital base station/repeater operates in TDMA mode, which essentially divides one channel into two virtual channels using time slots; therefore the user capacity is doubled. The base station/repeater utilizes embedded signaling to inform the field radios of the busy/idle status of each channel (time slot), the type of traffic, and even the source and destination information.

The SLR 8000 facilitates the field replaceable unit (FRU) concept of field repair to maximize system uptime. The FRU concept also aids in allowing the end user/ maintainer to lower their inventory costs. The base model SLR 8000 FRUs are as follows:

- Modem FRU
- Power Amplifier FRU
- Power Supply FRU
- Front Panel FRU

See [Figure 1-1](#) for the front view and [Figure 1-2](#) for the rear view of SLR 8000 Base Station/ Repeater. [Figure 1-3](#) shows the front view portion of the base station/repeater without the top cover and [Figure 1-4](#) shows the front view portion of the base station/repeater without the top cover, bottom cover, and front panel.

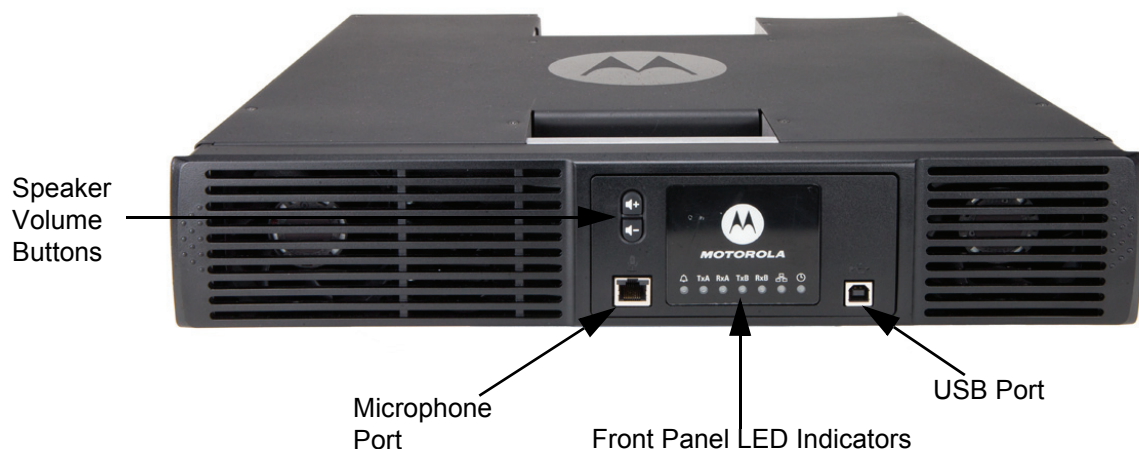
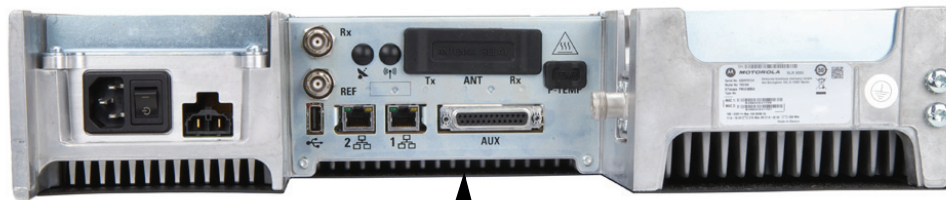


Figure 1-1 Front view of the SLR 8000 Base Station/Repeater



Back Panel Interface Connectors and Power Switch

Figure 1-2 Rear view of the SLR 8000 Base Station/Repeater (with no options installed)

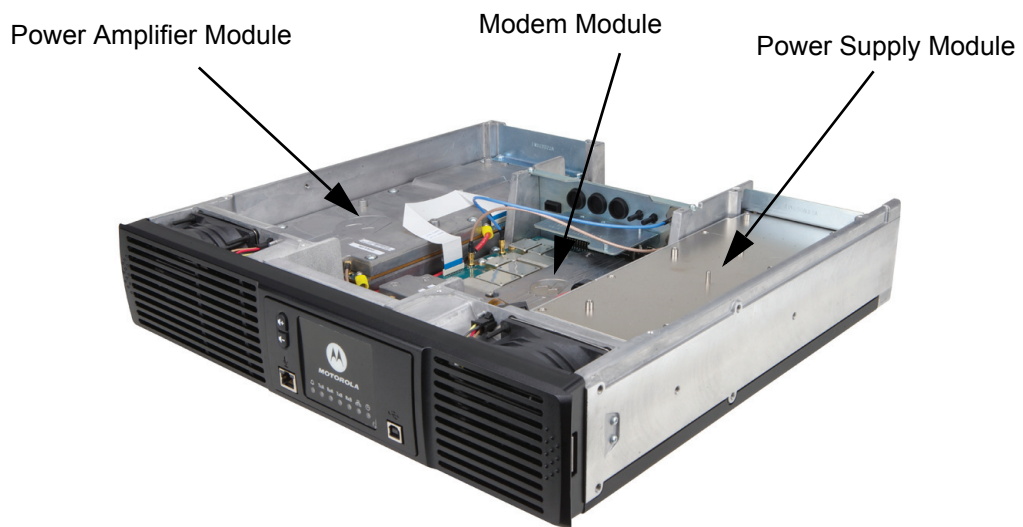
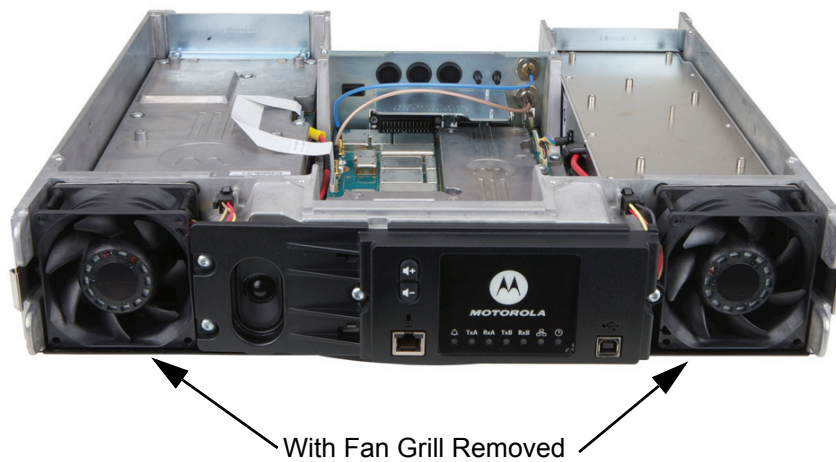


Figure 1-3 Front view (without top cover) of the SLR 8000 Base Station/Repeater (with no options installed)



With Fan Grill Removed

Figure 1-4 Front view (without top and bottom covers) of the SLR 8000 Base Station/Repeater

1.3 Operating Features

The following are the standard features of an SLR 8000 model:

- MOTOTRBO Conventional Operation (2-Slot TDMA, 4FSK Modulation)
- Analog Conventional Operation (FM)
- Continuous Duty Cycle Operation over -30 °C to +60 °C
- Meets or exceeds the following standards:
 - TIA603D
 - ETSI 086
 - ETSI 113
 - ETSI TS 102 361-1 Part 1: DMR Air Interface Protocol
 - ETSI TS 102 361-2 Part 2: DMR Voice and Generic Services and Facilities
 - ETSI TS 102 361-3 Part 3: DMR Packet Data Protocol
- AMBE +2™ Digital VOCODER
- Synthesized Frequency Generation
- Female N-type Antenna Connector (Tx)
- Female BNC Antenna Connector (Rx)
- Ethernet Port (Network)
- Front mounted USB Port (Service)
- 12 configurable GPIO ports (Digital)
- 4 configurable GPI ports (Analog)*
- 2 configurable GPO ports (Analog)*
- Power for third party controllers (1 Amp)
- 1.5 PPM Frequency Stability (Temperature AND 1-Year Aging) (VHF and UHF)
- External Reference Capability
- Switching Power Supply operates from 100 – 240 VAC (47 – 63 Hz)
- Multi-Power Source configurable (AC, DC, or AC with Battery Revert)
- Integrated 5 A battery charger
- Station Diagnostic Tests – Fixed Set of Tests run upon Start-up
- Physical Dimensions: 3.5" H x 19" W x 17" D (89 x 483 x 438 mm) 2RU
- Weight: 31 pounds (14.06 kg) excluding cabinet or other peripheral equipment

Note (*) Not supported in initial release.

Motorola Network Interface:

- IP Site Connect
- Repeater Diagnostics and Control (RDAC)
- Linked Capacity Plus
- Connect Plus
- Capacity Max

Third Party Controller Interface:

- Phone Patch
- Multi-Coded Squelch Interface (Repeater Panel)
- Tone Remote Adapter
- LTR Trunking
- Passport Trunking
- MPT1327 Trunking

Note The SLR 8000 Base Station/Repeater only supports the third party controllers noted above when it is configured in analog mode. The exception is phone patch in digital mode.

Optionally, the SLR 8000 Base Station/Repeater may be configured with

- Internal Pre-selector
- Internal Antenna Relay
- External Duplexer
- External Dual Circulator Tray
- Integrated Tone Remote Control (with Wireline option)
- Integrated DC Remote Control (with Wireline option)
- Integrated E&M Remote Control (with Wireline option)
- Analog Voting (with Wireline option)
- Simplex operation (Tx=Rx)
- Wireline Capability

In addition, the following features are also included. These features are shipped in a preset condition, but may be altered through the use of the CPS.

- 64 Tx/Rx Frequencies – Factory Programmed with 1 Tx, 1 Rx
- 12.5 kHz, 20 kHz (VHF), and 25 kHz Channel Bandwidth – Factory Programmed to 12.5 kHz
- 1 Tx and 1 Rx (PL or DPL) Squelch Code per channel – Factory Programmed to CSQ
- Base Station Identification (BSI) – Factory Programmed as “BLANK” (“BLANK” disables BSI)
- Push-To-Talk (PTT) Priority – Factory Programmed to Repeat Path

1.4 Frequency Ranges and Power Levels

The SLR 8000 Base Station/Repeater is available in the following frequency ranges and power levels as specified in [Table 1-1](#).

Table 1-1 SLR 8000 Frequency Ranges and Power Levels

Frequency Band	Bandwidth	Power Level
VHF	136 – 174 MHz	1– 100 W
UHF	400 – 470 MHz	1– 100 W

1.5 Specifications

Table 1-2 shows the specifications of the SLR 8000 Base Station/Repeater.

Table 1-2 SLR 8000 Base Station/Repeater General Specifications (All Bands)

Parameter	Specifications
Number of Channels	64
Frequency Generation	Synthesized
Input Voltage AC	100 – 240 VAC (47 – 63 Hz)
Input Voltage DC	11 – 15.5 VDC or 21.6 – 32 VDC
Power Supply Type	Switching
Station Weight	31 lbs (14.06 kg)
Temperature Range	-30 °C to +60 °C (-22 °F to +140 °F)
Humidity Range	RH of 95%, non-condensing at 50 °C (122 °F)
Antenna Connectors	Tx: N-Type Rx: BNC
Modes of Operation	Half-Duplex/ Duplex/ Simplex
Rack Unit	2
Height	3.5" (89 mm)
Width	19" (483 mm)
Depth	17.25" (438 mm)

Table 1-3 SLR 8000 Base Station/Repeater Specifications

Parameter	Specifications	
	VHF	UHF
Input Power (All Modulations) *		
Standby (AC Line 117 V / 220 V)	0.25 A / 0.3 A	
100 W Transmit at Rated Power (AC Line 117 V / 220 V)	2.05 A/1.1 A	2.0 A/1.05 A
50 W Transmit at Rated Power (AC Line 117 V / 220 V)	1.45 A / 0.8 A	1.25 A/0.7 A
Standby (13.6 VDC) / (27.2 VDC)	0.9 A / 0.5 A	
100 W Transmit at Rated Power (27.2 VDC)	8.6 A	8.2 A
50 W Transmit at Rated Power (13.6 VDC)	12.5 A	11.2 A
Frequency Reference		
Internal Frequency Stability (PPM)	0.5 PPM (temperature)	
External Reference Capable	Yes	
Frequency Bands		
Electronic Bandwidth	136 – 174 MHz	400 – 470 MHz
Receiver		
Selectivity 25 kHz / 12.5 kHz (TIA603D)	83 dB/ 52 dB	78 dB/ 52 dB
Selectivity 25 kHz / 12.5 kHz (TIA603)	80 dB/ 75 dB	
Selectivity 25 kHz / 12.5 kHz (ETSI)	70 dB/ 63 dB	
Sensitivity (12 dB SINAD)	0.3 uV	
Sensitivity (12 dB SINAD) with Antenna Relay and/or Preselector	0.35 uV	
Sensitivity (5% BER)	0.25 uV	
Sensitivity (5% BER) with Optional Preselector	0.29 uV	
Intermodulation Rejection (TIA603D)	85 dB	
Intermodulation Rejection (ETSI)	70 dB	
Spurious Rejection (TIA603D)	85 dB	
Spurious Rejection (TIA603D) with Optional Preselector	90 dB	
Spurious Rejection (ETSI)	75 dB	
Conducted Spurious Emissions	-57 dBm	
Audio Distortion	<3%	

Table 1-3 SLR 8000 Base Station/Repeater Specifications (Continued)

Parameter	Specifications	
	VHF	UHF
Audio Response	Per TIA/ ETSI	
FM Hum and Noise 25 kHz / 12.5 kHz	50 dB/ 45 dB	
Transmitter		
Rated Output Power (Continuous Duty) 13.6 VDC/ 27.2 VDC	1 – 50 W/ 1 – 100 W	
Intermodulation Attenuation	55 dB	
Adjacent Channel Power 25 kHz / 12.5 kHz	75 dB/ 60 dB	
Modulation Fidelity (4FSK)	FSK Error 5% FSK Magnitude 1%	
Wideband Noise (1 MHz) @ Rated Pout	-152 dBc/ Hz	
Rated System Deviation	±2.5 kHz @ 12.5 kHz ±5.0 kHz @ 25 kHz	
Spurious Harmonics and Emissions	-40 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Distortion	< 3%	
Audio Response	Per TIA/ ETSI	
FM Hum and Noise 25 kHz / 12.5 kHz	-50 dB/ -45 dB	
FCC Identifier	ABZ99FT3095	ABZ99FT4098
FCC Emission Designators	11K0F3E 16K0F3E 7K60FXD 7K60F7D 7K60FXE 7K60F7E 7K60F7W	

All specifications noted above are in accordance to their respective TIA603D, ETSI 300 – 086, and ETSI 300 – 113 standards unless otherwise noted.

Note (*) Typical performance under the following conditions (when applicable): Battery charging disabled, nominal VSWR conditions (VSWR <1.5:1), and no installed hardware options.

1.6 Theory of Operation

The SLR 8000 Base Station/Repeater provides the radio frequency (RF) link between the base station/repeater and the subscriber radios. The base station/repeater acquires inbound signals via its external receive (Rx) antenna and then amplifies, filters and demodulates the signals into data or voice packets. From that point, the data is either forwarded to the base station/repeater's transmitter to subscriber radios, and/or the data is delivered via a wired interface for distribution to networked base station/repeaters, consoles, or other networked infrastructure.

The SLR 8000 Base Station/Repeater consists of a Modem, Power Amplifier (PA), Front Panel and Power Supply (PS). These modules are also known as Field Replaceable Units (FRU).

- The Modem module is comprised of three subsystems, which are the Receiver subsystem, Exciter subsystem, and Station Control subsystem. At a high level, these subsystems are further explained below:
 - a. The Receiver subsystem is a dual heterodyne Receiver which receives the RF signal from the subscriber's transmitter. It then converts the resulting final intermediate frequency (IF) from an analog signal to that of a digital word in IQ signal format. Finally, the Receiver delivers the IQ signal, via the SSI bus, to the Station Control subsystem for demodulation. Additionally, the Receiver subsystem also provides for its own metering and diagnostics via software, as well as self-contained calibration (no field tuning is needed for the Receiver subsystem).
 - b. The Exciter subsystem converts a two-port base band data signal, sent over the SSI bus from the Station Control subsystem, to an analog signal representation. The analog signal is then modulated with a low power RF transmitter carrier that is generated by the Exciter subsystem. The power modulated RF carrier is then amplified and delivered to the PA at an intermediate level of approximately +40 dBm for further amplification. The Exciter subsystem and PA constitute the transmitter of the SLR 8000 Base Station/Repeater. Additionally, the Exciter subsystem also provides its own metering and diagnostics via software, as well as a self-contained calibration (no field tuning is needed for the Exciter subsystem).
 - c. The heart of the Station Control subsystem is the Texas Instruments DM8148 Host/ DSP processor. In general, the SCM controls the entire coordination of the base station/repeater functions. Specifically, the Station Control subsystem provides for the following functionalities:
 - Contains and runs the preloaded base station/repeater software
 - Manages inbound and outbound RF and Audio traffic
 - Provides an on-board USB port for local configuring, alignment and diagnostics via the following applications:
 - Customer Programming Software (CPS)
 - Tuner application
 - Base station/repeater Diagnostic and Control (RDAC) software
 - Provides an Ethernet port for IP site connectivity and remote RDAC
 - Provides GPIO connectivity for third party controller interfaces
 - Provides for analog base station/repeater audio connectivity
 - Data and Control to the Receiver subsystem via the SPI and SSI respectively
 - Data and Control to the Exciter subsystem via the SPI and SSI respectively
 - Control of the PA's set power via the SPI
 - Configuration and fault management of all subsystems including the PS and PA

- Generates the internal station reference
 - Provides control of the front panel module's indicator LEDs.
- d. The PA module amplifies the intermediate level modulated RF signal from the Modem. It then delivers the amplified signal to the transmitter antenna port at a power level within the rated power band of the base station/repeater, for transmission to the subscriber radios. In addition to its primary task of amplification, the PA provides the following hardware functions for the base station/repeater.
- Harmonic attenuation
 - Inter-modulation attenuation (IMA) suppression
 - VSWR detection
 - RF power control (primary means)
 - Meters for diagnostics
 - Power rollback for temperature, VSWR, and voltage
 - Self-Contained calibration (no field alignment is needed for PA).
- e. The Front Panel module provides LED indications for general assessment of the status and operational condition of the base station/repeater. Additionally, the front panel also provides a USB service port for configuration and alignment of the base station/repeater.
- f. The PS Module provides DC power to the Modem, PA and Front Panel. It can also be used to provide auxiliary power (nominal 15.75 VDC) to a number of third party controllers. Additionally, it can operate in three different input modes:
- AC Input Only
 - DC Input Only
 - AC with Battery Revert.

In addition to providing power to the noted FRU and controllers, the PS also provides the following:

- AC Failure detect signaling to the Modem
 - Output over-current protection
 - Integrated 2 stage 5 amp battery charger.
- Specifically, the Wireline board provides for the following:
 - Tone Remote Control
 - DC Remote Control
 - E&M Remote Control
 - 4-wire balanced audio connection
 - 2-wire balanced audio connection
 - Analog Voting
 - Tn-nR Functionality
 - Further details can be found in the individual sections of the respective FRU chapters of this manual.

1.7 Basic Base Station/Repeater Level Troubleshooting – RDAC and LEDs

Diagnostic tests are available for the Modem, PA, and Power Supply Modules. If a problem occurs during station operation, it is logged as an alarm that is read with the Base Station/Repeater Diagnostic and Control application (RDAC). See [Figure 1-5](#) for the RDAC diagnostic screen.

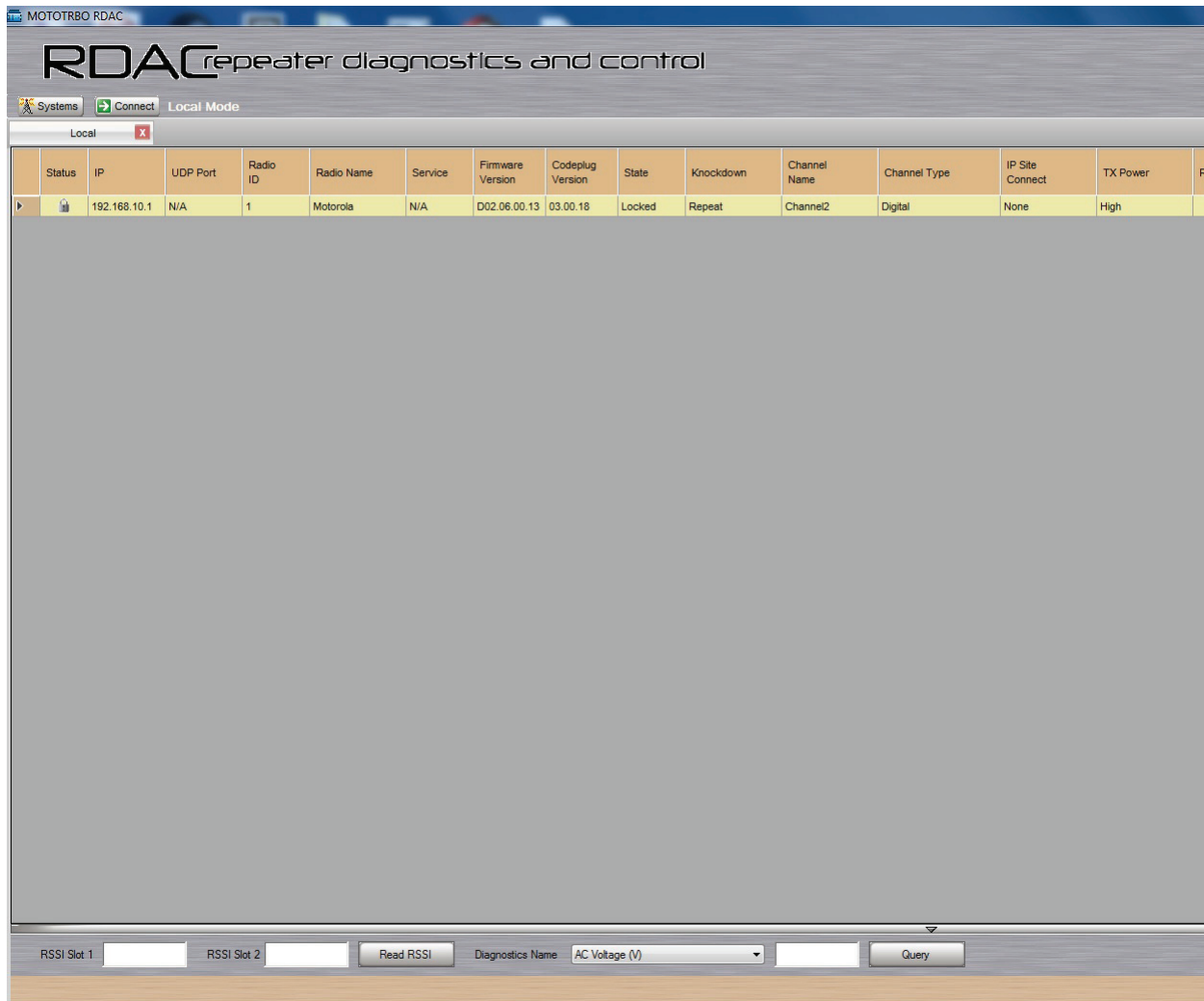


Figure 1-5 RDAC Diagnostic Screen

The station operator will then evaluate the problem locally or remotely, as the station maintains an Alarm Log with the name of the alarm that has failed since the last power up. Via the RDAC application's Alarm Log, the alarm messages will aid in identifying the FRU that failed along with the fault condition.

After booting up the base station/repeater, the 7 LEDs (Power/ Status, Tx Slot 1, Tx Slot 2, Rx Slot 1, Rx Slot 2, Network, and Reference LEDs) will flash in unison.

The general status and condition of the SLR 8000 Base Station/Repeater can be obtained by observing the seven LED indicators on the front panel. [Table 1-4](#) shows the LED symbols and their meaning, while [Table 1-5](#) identifies the information conveyed via the LED indicators.

Table 1-4 Front Panel LED indicators




LED	Definition
	Status
Tx A	Tx Slot 1
Rx A	Rx Slot 1
Tx B	Tx Slot 2
Rx B	Rx Slot 2
	Ethernet Link/ Network Connectivity
	Reference

Table 1-5 SLR 8000 Front Panel LED Definitions

LED Function Name	LED Color	LED State	Status Indication
Power/Status	Off	Off	Off
	Green	Flashing	Operating Normally, with DC power
		Solid	Operating Normally, with AC power
	Red	Flashing	Base Station/Repeater is Disabled (by customer)
		Solid	Not Operational – Major Alarm
	Amber	Flashing	Check Alarm Log – Alarm occurred and cleared but remains latched (configurable)(*)
Solid		Base Station/Repeater Operational – Minor Alarm	
Tx A	Off	Off	Transmitter is not transmitting
	Green	Solid	Tx slot A or Analog (at desired power)
	Amber	Solid	Tx slot A or Analog (at less than desired power)
	Red	Solid	Tx Fail
		Flashing	Tx Inhibit (*)
Rx A	Off	Off	No receive carrier detected
	Green	Solid	Rx Slot A or Analog (qualifier met)
	Amber	Solid	Rx Slot A or Analog (non-qualified)

Table 1-5 SLR 8000 Front Panel LED Definitions (Continued)

LED Function Name	LED Color	LED State	Status Indication
Tx B	Off	Off	Transmitter is not transmitting
	Green	Solid	Tx slot B or Analog (at desired power)
	Amber	Solid	Tx slot B or Analog (at less than desired power)
	Red	Solid	Tx Fail
		Flashing	Tx Inhibit (*)
Rx B	Off	Off	No receive carrier detected
	Green	Solid	Rx Slot B or Analog (qualifier met)
	Amber	Solid	Rx Slot B or Analog (non-qualified)
Ethernet/ Network Connectivity	Off	Off	No Ethernet connection
	Green	Solid	Connectivity/ Linked
		Flashing	Attempting to connect to the system
Reference	Off	Off	No External Reference is present
	Green	Solid	Locked to External Reference (1 pps (*), 5 MHz, 10 MHz)

Note All LEDs flashing in unison indicate the base station/repeater is booting up. The RDAC application will be needed when the Status LED is red (solid or flashing). This status indicates a minor or major alarm. The RDAC application is used to identify the specific alarm and probable diagnosis to aid in identifying the FRU at fault.

Note (*) Not supported in initial release.

1.8 Model Chart

1.8.1 VHF High Power

SLR 8000, VHF, 136 – 174 MHz		
Model		Description
T8319A		SLR 8000 Base Station/Repeater, 1 – 100 W
	Item	Description
X	WAED4538_	SLR 8000 VHF Modem Service Kit
X	PMTD1360_S	SLR 8000 VHF Power Amplifier Service Kit/FRU
X	PMPN4053_S	SLR 8000 Power Supply Unit Service Kit/FRU
X	PMLN6822_S	SLR 8000 Front Panel Service Kit/FRU
X	3087791G04	Power Cord, Euro
X	3087791G07	Power Cord, UK
X	3087791G10	Power Cord, Australia/NZ
X	MN002302A01	Quick Start Guide

Option		Description
X	CA02965AA	Add: VHF (136 – 174 MHz)

x = Indicates compatibility with model(s)

1.8.2 UHF1 High Power

SLR 8000, UHF, 400 – 470 MHz		
Model		Description
T8319A		SLR 8000 Base Station/Repeater, 1 – 100 W
	Item	Description
X	WAEE4534_	SLR 8000 UHF 1 Modem Service Kit
X	PMTE4000_S	SLR 8000 UHF Power Amplifier Service Kit/FRU
X	PMPN4053_S	SLR 8000 Power Supply Unit Service Kit/FRU
X	PMLN6822_S	SLR 8000 Front Panel Service Kit/FRU
X	3087791G04	Power Cord, Euro
X	3087791G07	Power Cord, UK
X	3087791G10	Power Cord, Australia/NZ
X	MN002302A01	Quick Start Guide

Option		Description
X	CA02962AA	Add: UHF1 (400 – 470 MHz)

x = Indicates compatibility with model(s)

Notes

Chapter 2 SLR 8000 Satellite Receiver

2.1 Description

The main purpose of the Satellite Receiver is to eliminate “dead zones” in a communications system by improving the “talk-in” coverage on a particular receive frequency when used in a receiver voting system.

The Motorola SLR 8000 Base Station/Repeater is not offered as an exclusive Satellite Receiver only model, rather the SLR 8000 can be configured via the CPS to operate as a Satellite Receiver in a receive only mode of operation. As such, the context of this chapter will assume that the SLR 8000 Base Station/Repeater is configured as a Satellite Receiver.

2.2 Operating Features

The features are identical to the SLR 8000 Base Station/Repeater, with the exception that all transmitter related functions are not applicable. See [Chapter 1: SLR 8000 Base Station/Repeater](#) for more details.

2.3 Frequency Ranges

The supported frequency ranges are identical to the SLR 8000 Base Station/Repeater’s receive frequency ranges. See [Chapter 1: SLR 8000 Base Station/Repeater](#) for more details.

2.4 Specifications

The specifications are identical to the SLR 8000 Base Station/Repeater, with the exception that all transmitter related specifications are not applicable. See [Chapter 1: SLR 8000 Base Station/Repeater](#) for more details.

2.5 Configuration

Other than setting the general personality configurations, one must additionally set the “Operation Mode” parameter under the “General Settings” menu in the CPS to that of “Digital Satellite Receiver” or “Analog Satellite Receiver”. See Figure 2-1 for the screenshot of the “Operation Mode” parameter.

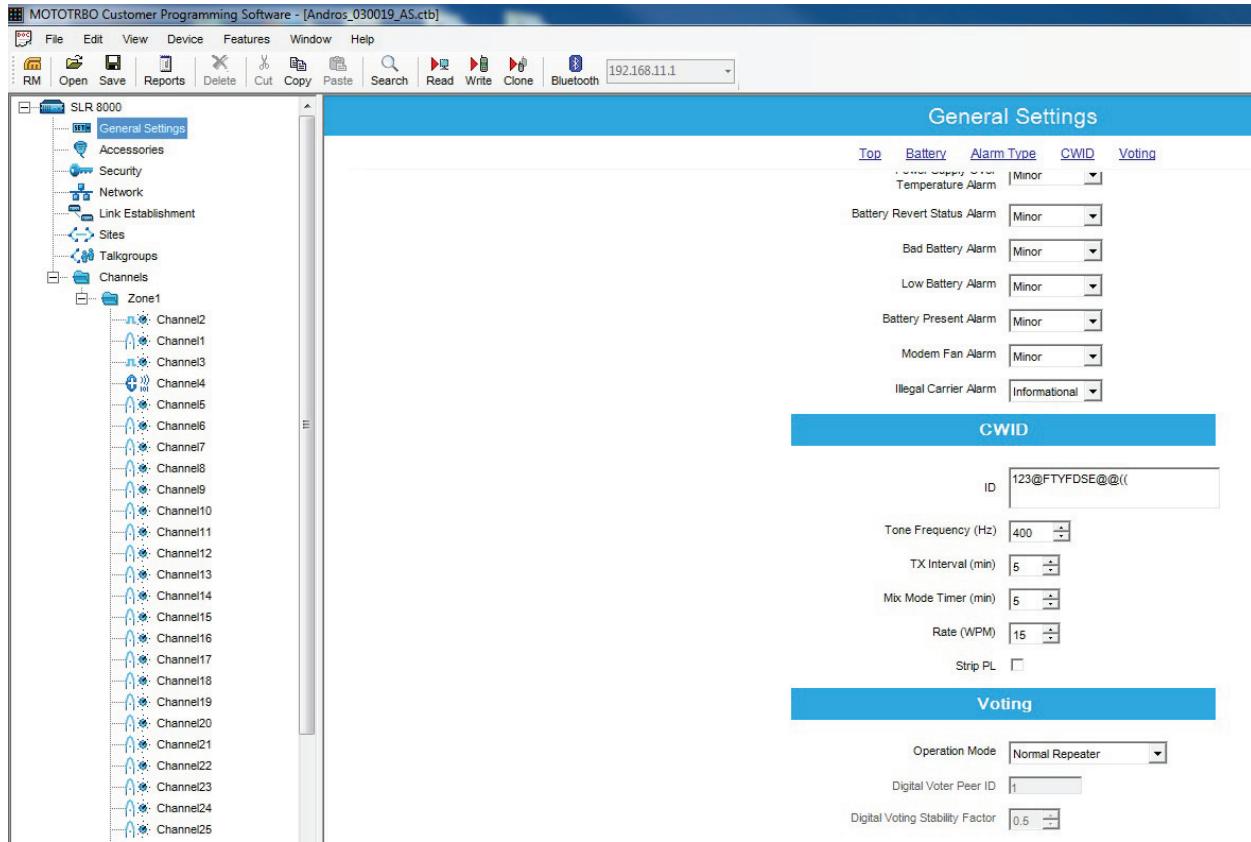


Figure 2-1 “Operation Mode” configuration for Satellite Receiver Functionality

2.6 Basic Station Level Troubleshooting – RDAC and LEDs

The troubleshooting procedures are similar to the SLR 8000 Base Station/Repeater with regards to the control, power supply, and receiver sub-systems. See [Chapter 1: SLR 8000 Base Station/Repeater](#) for more details.

Note When configured for receiver only operation, the SLR 8000 Base Station/Repeater does not support any transmitter sub-system functions. As such, disregard all references to the transmitter section in [Chapter 1: SLR 8000 Base Station/Repeater](#). This includes any transmitter related topics in the RDAC and the front panel LEDs.

2.7 Satellite Receiver System (Analog)

The SLR 8000 Satellite Receiver connects to either a Spectra-TAC™ comparator, DigiTAC™ comparator or a Voter Gateway Unit (VGU). [Figure 2-2](#) shows a typical voting system and the connections of the SLR 8000 Satellite Receivers.

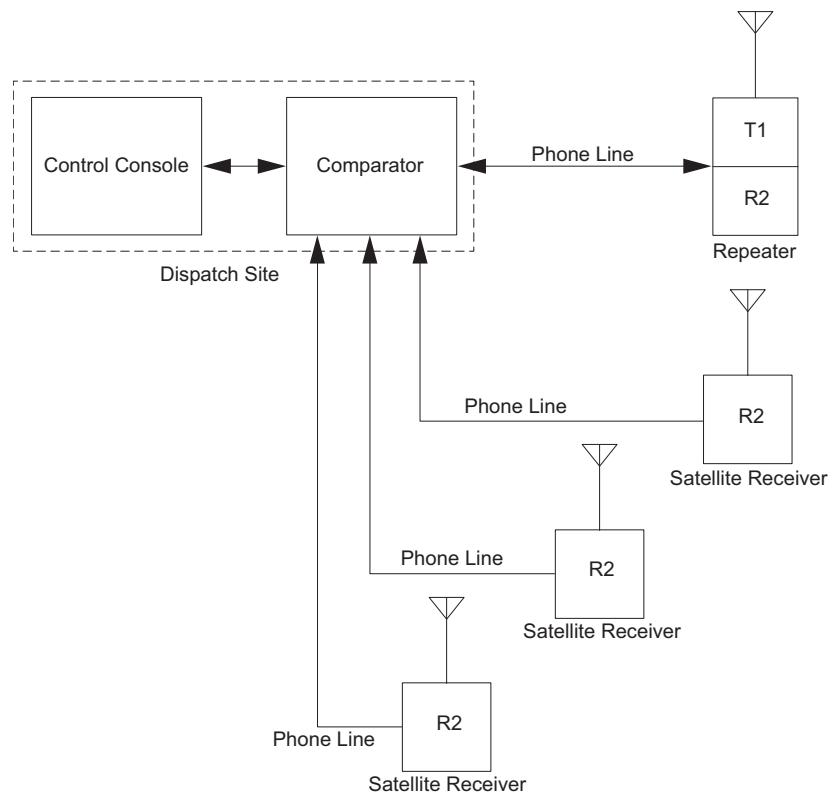


Figure 2-2 Satellite Receiver Connections Within a Voting System

Notes

Chapter 3 SLR 8000 Modem

3.1 Description

The Modem Module is described in this section. A general description, identification of inputs and outputs, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level.

3.1.1 General Description

The Modem Module consists of a single printed circuit board in a clamshell housing assembly. It provides the receiver, exciter and station control functionality for the base station/repeater. Additionally, most external connections to the station are connected directly to the modem module.

3.1.2 Input and Output Connections

Figure 3-1 shows the Modem Module input and output external connections.

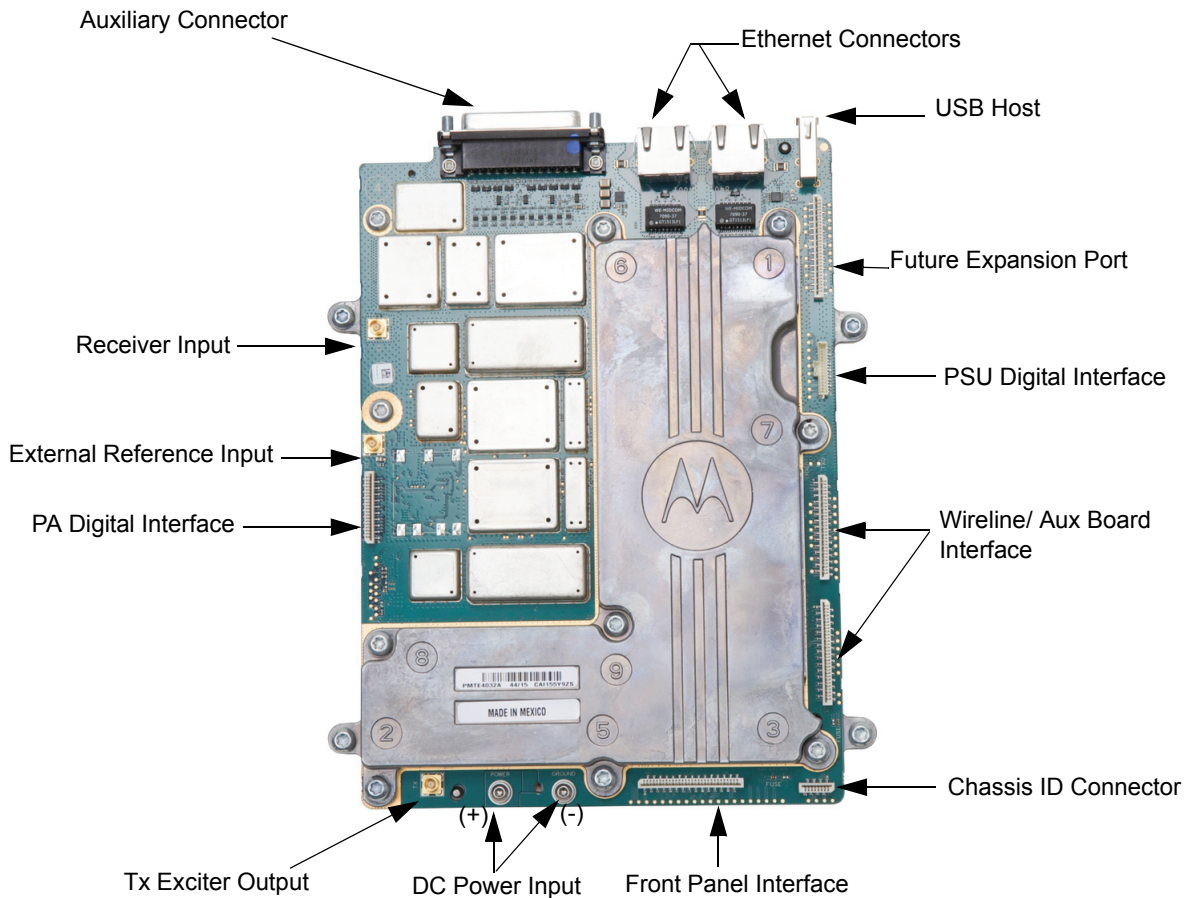


Figure 3-1 Modem Module Connector Locations

3.1.3 Frequency Bands

The Modem Module covers the following bands with unique models:

- 136 – 174 MHz
- 400 – 470 MHz

3.2 Receiver Subsystem

3.2.1 Description

The Modem Module includes the receiver circuitry for the station. A cable connects the board connector to a BNC connector located on the rear panel of the base station/repeater. See [Figure 3-1](#) for the location of this connector. The receiver section performs highly-selective bandpass filtering and dual down-conversion of the desired RF signal. A custom Receiver IC then performs an analog-to-digital conversion of the desired received signal and outputs the digitized signal to the controller section via a serial synchronous interface. Included in the receiver section is:

- Frequency Synthesizer Circuitry – Consists of a phase-locked loop and Voltage-Controlled Oscillator (VCO), generates the first LO injection signal.
- Varactor-tuned Preselector Filter(s) – Provides bandpass filtering of the station Receiver RF input.
- Receiver Front End Circuitry – Performs filtering, amplification, and the first down conversion of the Receiver RF signal.
- Receiver-specific piece of transceiver IC Circuitry – Consists of receiver-specific parts of a transceiver IC which performs the second down conversion, filtering, amplification, and analog-to-digital conversion of the receive signal.
- Analog to Digital Converter (ADC) Circuitry – Converts analog Receiver status signals to digital format for transfer to the controller circuitry located on the Modem Module.

3.2.2 Specifications

Table 3-1 Specifications of Receiver Subsystem

Parameter	Specifications	
	VHF	UHF
Frequency Bands	136 – 174 MHz	400 – 470 MHz
Selectivity 25 kHz/ 12.5 kHz (TIA603D)	83 dB/ 52 dB	78 dB/ 52 dB
Selectivity 25 kHz/ 12.5 kHz (TIA603)	80 dB/ 75 dB	
Selectivity 25 kHz/ 12.5 kHz (ETSI)	70 dB/ 63 dB	
Sensitivity (12 dB SINAD)	0.3 uV	
Sensitivity (5% BER)	0.25 uV	
Intermodulation Rejection (TIA603D)	85 dB	
Intermodulation Rejection (ETSI)	70 dB	
Spurious Rejection (TIA603D)	85 dB	
Spurious Rejection (ETSI)	75 dB	
Audio Distortion	<3%	
FM Hum and Noise 25 kHz/ 12.5 kHz	50 dB/ 45 dB	

3.3 Transmitter Exciter Subsystem

3.3.1 Description

The Exciter Subsystem in the Modem Module (in conjunction with the Power Amplifier Module) provides the transmitter functions for the station. The Exciter circuitry generates a low-level modulated Radio Frequency (RF) signal which is input to the Power Amplifier (PA) module for further amplification and output to the transmit antenna. A coaxial cable is used to connect the Tx exciter output to the PA module. See [Figure 3-1](#) for the exact location of this connector. The Exciter Module interfaces directly with the controller section, which provides control signals and monitoring, and routes transmit data to the Exciter.

The RF carrier is generated by a frequency synthesizer consisting of synthesizer circuitry and Voltage-Controlled Oscillator (VCO) circuitry. Exciter circuit control signals, monitoring, and audio processing are handled by the controller section of the Modem Module. The power leveling circuitry of the transmitter system is located in the Power Amplifier Module and passed onto the exciter stages through the PA-Modem interface flex cable. See [Figure 3-1](#) for the location. Included in the exciter section are:

- Frequency Synthesizer Circuitry – Consists of a phase-locked loop and Voltage-Controlled Oscillator (VCO), generates a modulated RF signal at the transmitter carrier frequency.
- RF Isolation Switch – Allows the controller section to turn on/off the Exciter RF input signal which greatly reduces the signal supplied to the Power Amplifier module.
- Analog to Digital Converter (ADC) Circuitry – Converts the analog Exciter status signals to the digital format for transfer, upon request, to the controller section of the Modem Module.
- Low Level Amplifiers – Amplify and buffer the modulated RF signal from the VCO for delivery to the Power Amplifier Module.

3.3.2 Specifications

Table 3-2 Specifications of Transmitter Exciter Subsystem

Parameter	Specifications	
	VHF	UHF
Frequency Range	136 – 174 MHz	400 – 470 MHz
Electronic Bandwidth	Full Bandwidth	
Output Power (maximum)	12 W	
Harmonics	-20 dBc	

3.4 Station Control Subsystem

3.4.1 Description

The Station Control Subsystem is described in this section. A general description, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided.

The Controller circuitry performs the digital signal processing, data formatting and audio routing for the station and provides the external interfaces to the rest of the site.

The Controller section consists of 7 main ICs. These are:

- Texas Instrument DM8148 Host/DSP Processor
- EMMC Flash memory
- DDR3 memory
- Texas Instruments Power Management IC
- NOR Flash
- 2-TI AIC3204 Codecs

General controller functionality includes:

- Data and Control interface to the transceiver ICs
- Audio interface with CODEC ICs
- UART interface to expansion board
- Intermodule communication (SPI, I2C)
- Two Ethernet ports
- USB Device port
- USB Host port
- External physical interfaces (connectors, LEDs, external references etc.)
- Station Reference Control

3.4.2 High Stability Reference Block

The high-stability reference block can be used to enhance the 0.5 ppm Voltage Controlled Temperature Compensated Crystal Oscillator. The block diagram is shown below in [Figure 3-2](#). An external reference can be applied to lock the on board VCTCXO. This function can be enabled via the customer programming software. The connection is made via a cable connecting a BNC connector on the rear panel to a connector on the modem module. The location of the connector on the modem module can be found in [Figure 3-1](#).

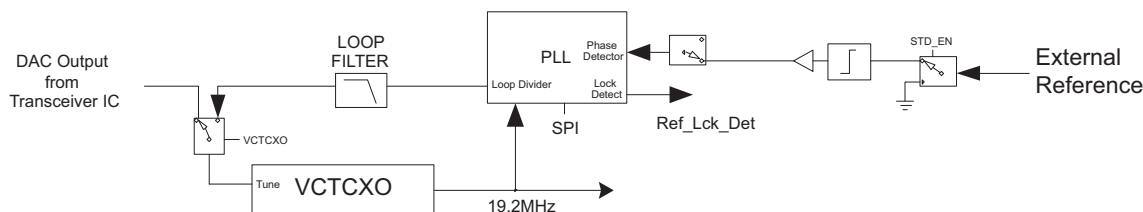


Figure 3-2 High Stability Reference Circuit

3.4.3 Audio

The analog audio stages are used exclusively for external accessories connected through the rear DB25 accessory connector.

The critical components of the audio circuit are the TI DM8148 processor and a pair of Texas Instruments AIC3204 dual channel audio codecs. [Figure 3-3](#) details the specific interconnects between the critical components.

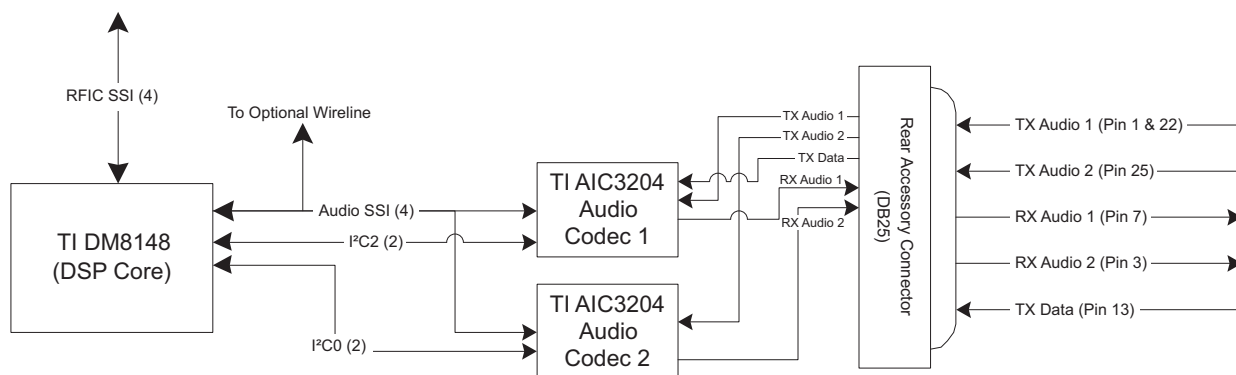


Figure 3-3 Audio Block Diagram

The base station/repeater digital audio is handled primarily by the DM8148 processor. The TX RFIC generates a 24.576 MHz master clock (MCLK) that the DM8148 uses to drive its McASP SSI interface for the audio codecs. The bulk of the audio processing is done in the DaVinci's DSP core. The audio codecs contain DACs and ADCs and handle the conversion of the digital audio to analog audio and vice versa.

There are 2 TX audio lines routed in from the rear accessory connector. These are TX Audio 1 (Pins 1 and 22, used for analog and slot 1 digital), and TX Data (Pin 13).

For the RX outputs, there is only 1 which is connected to the accessory connector. RX Audio 1 on pin 7 (to be used for analog and slot 1 digital).

3.5 Station Control Interface

3.5.1 Front Panel Interface Connector

Refer [Section 6.3.1 on page 6-2](#) for details.

3.5.2 Rear Panel Connections

Refer [Section 7.2.5 on page 7-4](#) to [Section 7.2.8 on page 7-7](#) for details.

3.5.3 Power Amplifier Interface Connector

The digital interface to the power amplifier module utilizes a 20-pin vertical LIF connector. See [Figure 3-1](#) for the locations of these connectors. [Figure 3-4](#) shows the pin number locations.

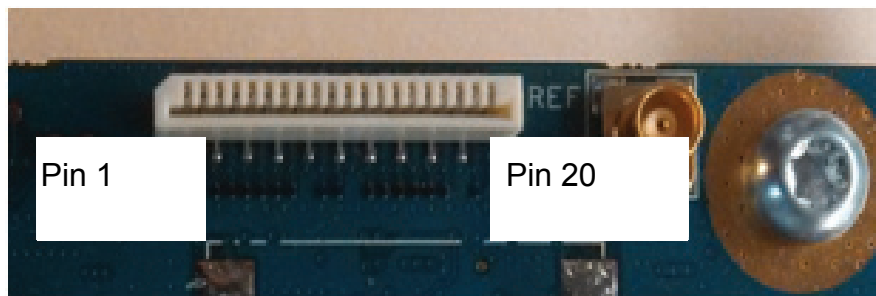


Figure 3-4 Power Amplifier Interface Connector Pin Locations

3.5.4 Power Supply Interface Connector

The power supply digital interface utilizes a 15-pin Pico-Clasp™ connector. The location is detailed in [Figure 3-1](#). [Figure 3-5](#) shows the pin number locations.

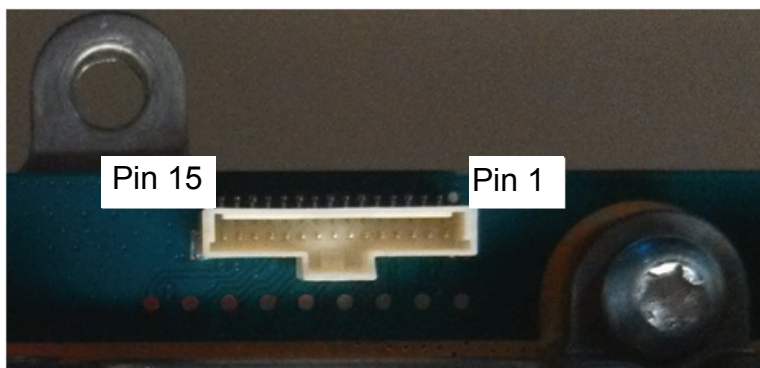


Figure 3-5 Power Supply Interface Connector Pin Locations

3.5.5 Expansion Board Interface Connector

The expansion board interface utilizes a 30-pin vertical LIF connector. The location is detailed in [Figure 3-1](#). [Figure 3-6](#) shows the pin number locations.

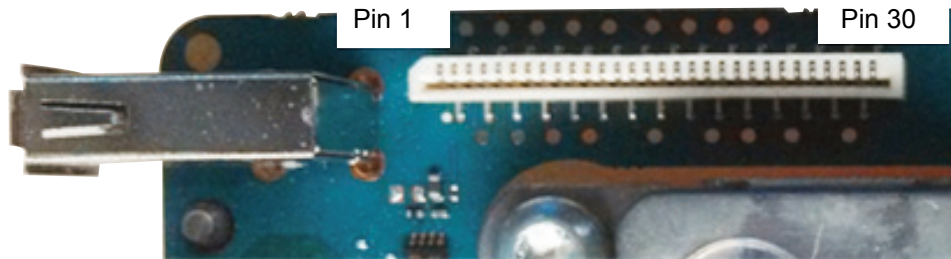


Figure 3-6 Expansion Board Interface Connector Pin Locations

3.5.6 Chassis ID Interface Connector

The Chassis ID utilizes an 8-pin vertical LIF connector. The location is detailed in [Figure 3-1](#). [Figure 3-7](#) shows the pin number locations. The base station/repeater chassis information is necessary for warranty and purchased software features so this must be connected.

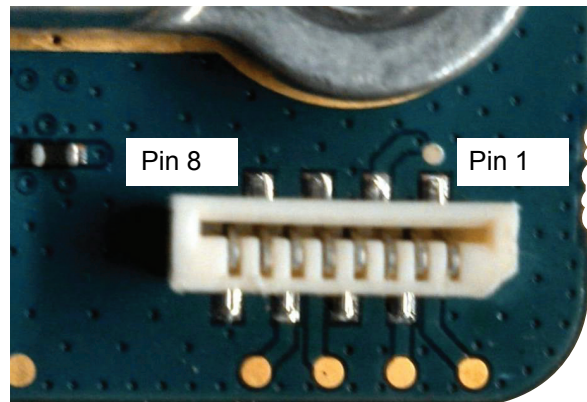


Figure 3-7 Chassis ID Interface Connector Pin Locations

3.5.7 Wireline/ Aux Board Interface Connector

Refer to [Chapter 13: SLR 8000 Wireline](#) for details.

Notes

Chapter 4 SLR 8000 Power Amplifier

4.1 Description

The Power Amplifier Module is described in this section. A general description, identification of inputs and outputs and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level.

4.2 General Description

The Power Amplifier (PA) is a forced convection-cooled RF power amplifier. It accepts a low-level modulated RF signal from the Exciter Module, and amplifies it for transmission via the site transmit antenna port. The PA is non-linear, and is therefore used for Continuous Wave (CW) applications only. The output power is continually monitored and regulated by a feedback and control loop, with a power output control voltage being generated by the transmitter control circuitry located on the PA. All configuration and control signals are connected to the modem module via the flex connected between the modules.

Note The power amplifier cooling fan is replaceable and external to the power amplifier itself. See [Chapter 11: SLR 8000 Maintenance and Disassembly/Reassembly](#) for replacement details.

4.3 Input and Output Connections

Figure 4-1 shows the PA input and output connections.

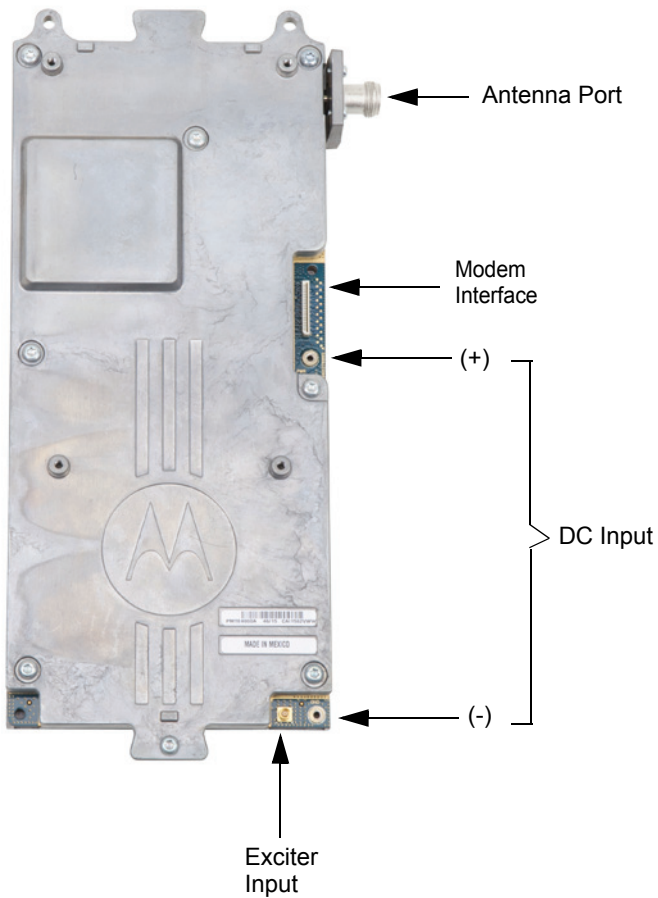


Figure 4-1 Input and Output Connections

4.4 Frequency Ranges

The power amplifier module models cover the following bands:

- 136 – 174 MHz
- 400 – 470 MHz

4.5 Specifications

Table 4-1 shows the specifications of SLR 8000 Base Station/Repeater's Power Amplifier (PA).

Table 4-1 Specifications of Power Amplifier

Parameter	Specifications	Specifications
	VHF	UHF
Operational Frequency Range	136 – 174 MHz	400 – 470 MHz
Minimum Input Return Loss (Tx mode)	15 dB	
Rated RF Input Power	40 dBm	
Maximum Standby Power Consumption	0.5 W	
Rated RF Output Power Range	1 – 100 W	
Supply Nominal Voltage * (Transmit Power Dependent)	11 – 15.75 VDC	
Maximum Current Draw	14.0 A	

Note (*) When the SLR 8000 Base Station/Repeater is operating from a 12 VDC source, the PA input voltage follows the base station/repeater's DC input source. When operating from a 12 VDC source, the output power will be limited to 50 W maximum.

4.6 Modem Interface

The digital interface to the modem module utilizes a 20-pin vertical LIF connector. Its location is shown in Figure 4-1. See Figure 4-2 for front panel interface connector pin locations.

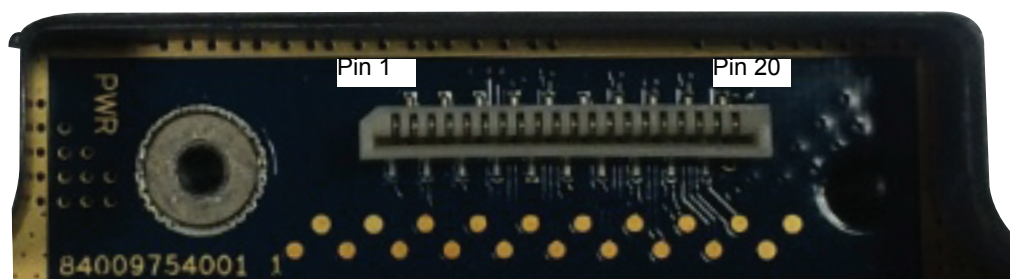


Figure 4-2 Modem Interface Connector Pin Locations

Notes

Chapter 5 SLR 8000 Power Supply

5.1 Description

In this chapter, a general description, performance specifications, and identification of the inputs and outputs are given for the power supply. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (See [Chapter 11: SLR 8000 Maintenance and Disassembly/Reassembly](#) for detailed removal or installation procedures for all modules in the SLR 8000 Base Station/Repeater.)

5.1.1 General Description

The power supply, with front-to-rear airflow, operates from either an AC or DC input and provides the DC operating voltage for the SLR 8000 Base Station/Repeater. The power supply also provides an integrated battery charger to maintain the charge on a negatively grounded 12 VDC (nominal) or 24 VDC (nominal) battery system. [Figure 5-1](#) displays the front and rear views of the SLR 8000 Power Supply.

Additionally, the power supply affords the following performance features:

- Power Factor Correction (PFC) – aids in lowering the ampacity requirements of the AC power source.
- Over-Voltage Protection (OVP) – lowers the risk of damaging the base station/repeater should input AC or DC levels approach damaging levels.
- Over-Current Protection (OCP) – aids in preventing a cascaded failure within the base station/repeater.
- Reverse Polarity Protection – aids in preventing damage to the base station/repeater due to installation mishaps.
- Configurable Battery Charger Voltage – tailors the float voltage to your battery manufacturer's charging recommendations.
- Configurable Low Voltage Disconnect (LVD) – tailors the battery disconnect voltage to your battery manufacturer's recommendations.
- Configurable Power Source Preference – when both AC and DC sources are present (and within their respective operational bounds), this feature allows one to select the primary power source the base station/repeater uses.
- Configurable DC Power Source – allows the selection of either a 12 VDC or 24 VDC power system.
- Battery Revert – should the AC source be interrupted, this function allows the power supply to seamlessly transfer to a DC source until the AC source is restored. This results in uninterrupted radio service for as long as DC power can be provided.

Note A user supplied external battery system is required to support the battery backup feature so that when the AC power fails, the SLR 8000 Base Station/Repeater can be powered from a DC battery source if it is connected to the Power Supply.

Note The power supply cooling fan is replaceable and external to the power supply itself. See [Chapter 11: SLR 8000 Maintenance and Disassembly/Reassembly](#) for replacement details.

Front View (relative to front of base station/repeater)

Rear View (relative to rear of base station/repeater)

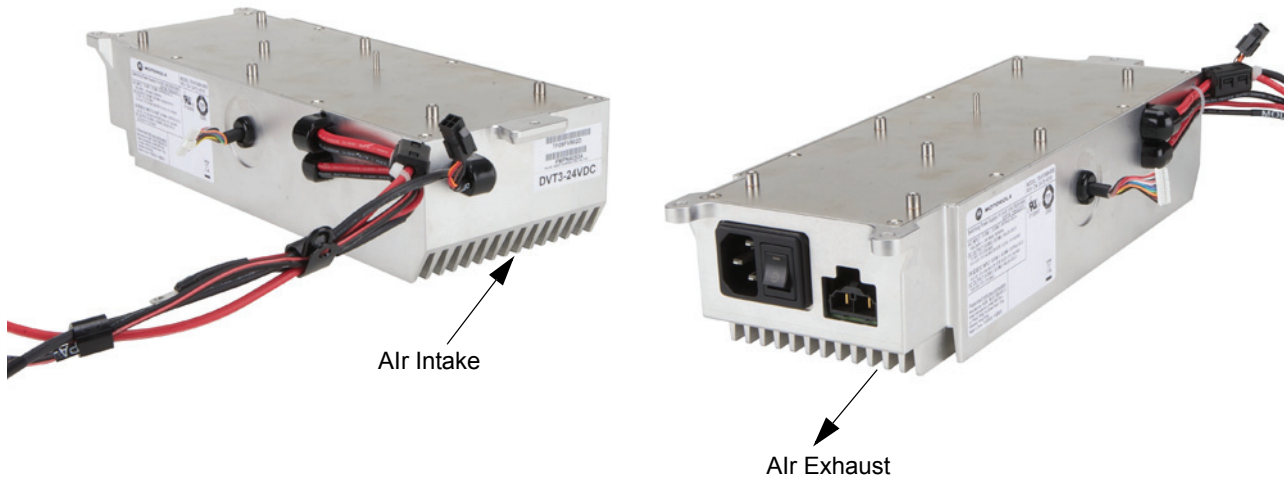


Figure 5-1 Front and Rear Views of the SLR 8000 Power Supply

5.2 Specifications

Table 5-1, Table 5-2 and Table 5-3 show the electrical performance specifications for the Power Supply.

Table 5-1 Power Supply AC Performance Specifications

Parameter	Value or Range
Input Voltage Range	100 – 240 VAC
Input Frequency Range	47 – 63 Hz
Steady State Output Voltage	Transmit Power dependent 11 – 15.75 VDC
Output Current (Max)	27 A (excluding charger current)
Output Ripple:	25 mVp-p @ 25 °C (77 °F)

Table 5-2 Power Supply DC Performance Specifications

Parameter	Value or Range
Input Voltage Range (24 V System)	20.6 – 32 VDC
Input Voltage Range (12 V System)	11 – 15.5 VDC
Steady State Output Voltage (24 V System)	Transmit Power dependent (11 – 15.75 VDC)
Steady State Output Voltage (12 V System)	Input voltage dependent (0 – 0.4 V below input)
Output Current (Max)	27 A
Output Ripple	25 mV p-p, @ 25 °C (77 °F)

Table 5-3 Power Supply Battery Charger Performance Specifications

Parameter	Value or Range
Charging Voltage Range (24 V System)	27.0 – 28.4 VDC (default 27.6 VDC: configurable)
Charging Voltage Range (12 V System)	13.5 – 14.2 VDC (default 13.8 VDC: configurable)
Charging Current (Max)	5 A (in addition to output current)

Note The battery charger will not charge 12 volt or 24 volt systems, if the battery potential drops below 10 volts or 20 volts respectively.

5.3 Power Supply Interface

5.3.1 Power Source Inputs

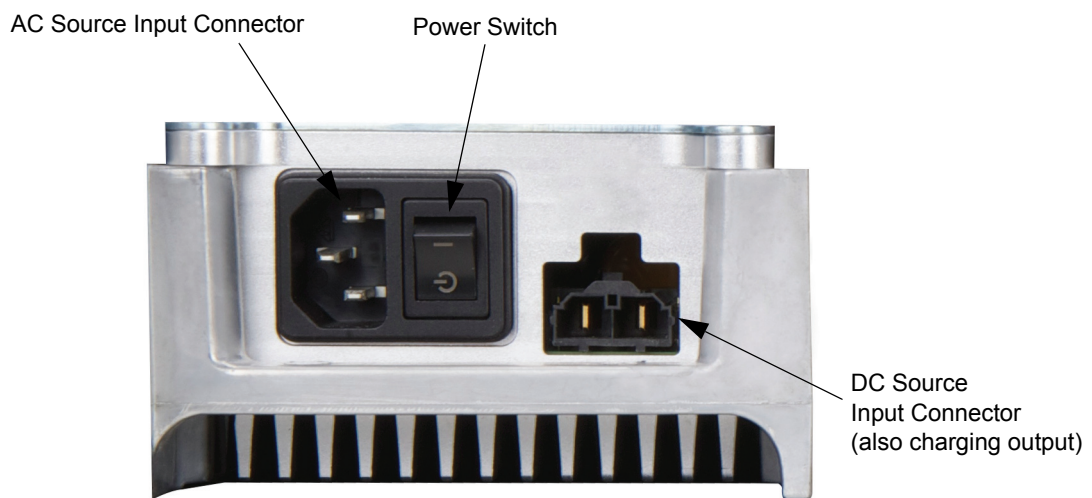


Figure 5-2 Power Source Inputs

Note When the power switch is in standby, all outputs are disabled (regardless of input source(s) connected). This includes the charger output as well (if charging is enabled).

5.3.2 Power Supply Outputs

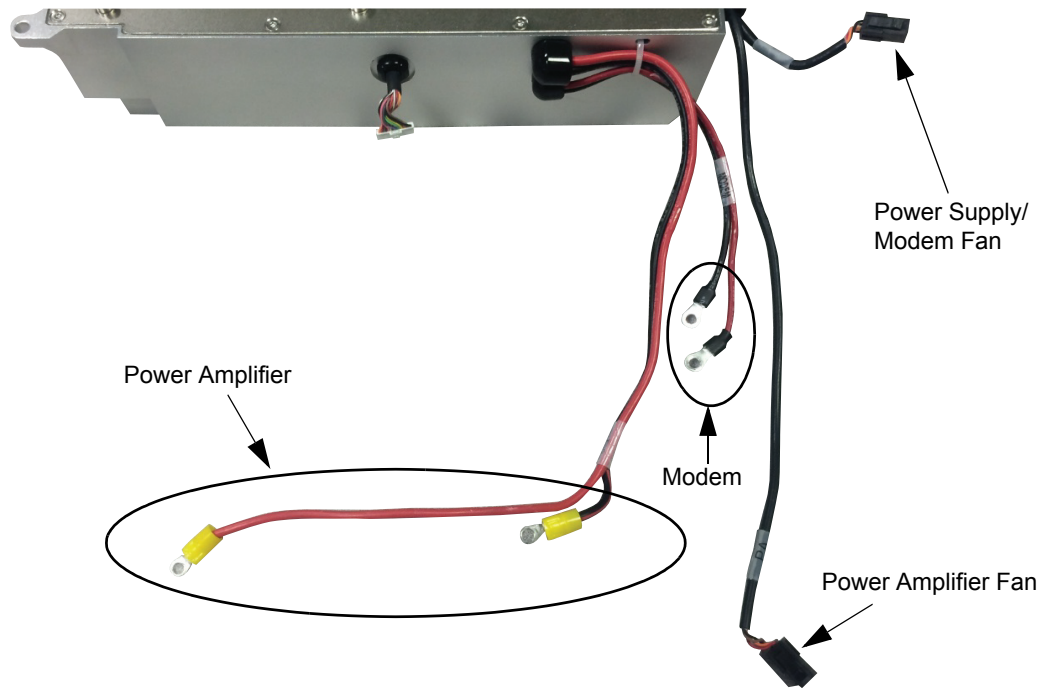


Figure 5-3 Power Supply Outputs

5.3.3 Power Supply Digital Interface

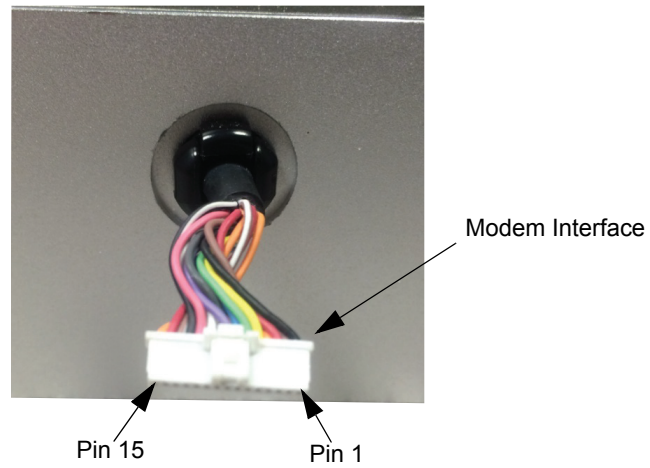


Figure 5-4 Power Supply Digital Interface

5.3.4 Power Supply Output Cable Signaling

Table 5-4 Power Supply Output Cable Signalling

Output Load	Signal
Power Amplifier	Red – 11 – 15.75 VDC
	Black with Red Strip – Ground
Modem	Red – 11 – 15.75 VDC
	Black with Red Strip – Ground
Power Amplifier Fan	Red – 8 –12 VDC (nominal)
	Black – Ground
	Yellow – Fan speed detect
	Brown – Fan speed control
Power Supply/ ModemFan	Red – 8 –12 VDC (nominal)
	Black – Ground
	Yellow – Fan speed detect
	Brown – Fan speed control

Notes

Chapter 6 SLR 8000 Front Panel

6.1 Description

The Front Panel Module is described in this section. A general description, identification of inputs and outputs and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level.

6.1.1 General Description

The Front Panel board user interface includes 7 LED indicators, an integrated speaker with volume control, a microphone port, and a USB device port. The board is connected to the modem via a 30-pin flex cable.

The LED indicators inform the user of the state of the base station/repeater, while the USB device port is used to interface with the base station/repeater through the Customer Programming Software (CPS). The speaker and microphone service interface is intended to yield a qualitative assessment of both analog and digital audio quality.

6.2 Input and Output Connections

Figure 6-1 shows the various front panel Input and Output connections.

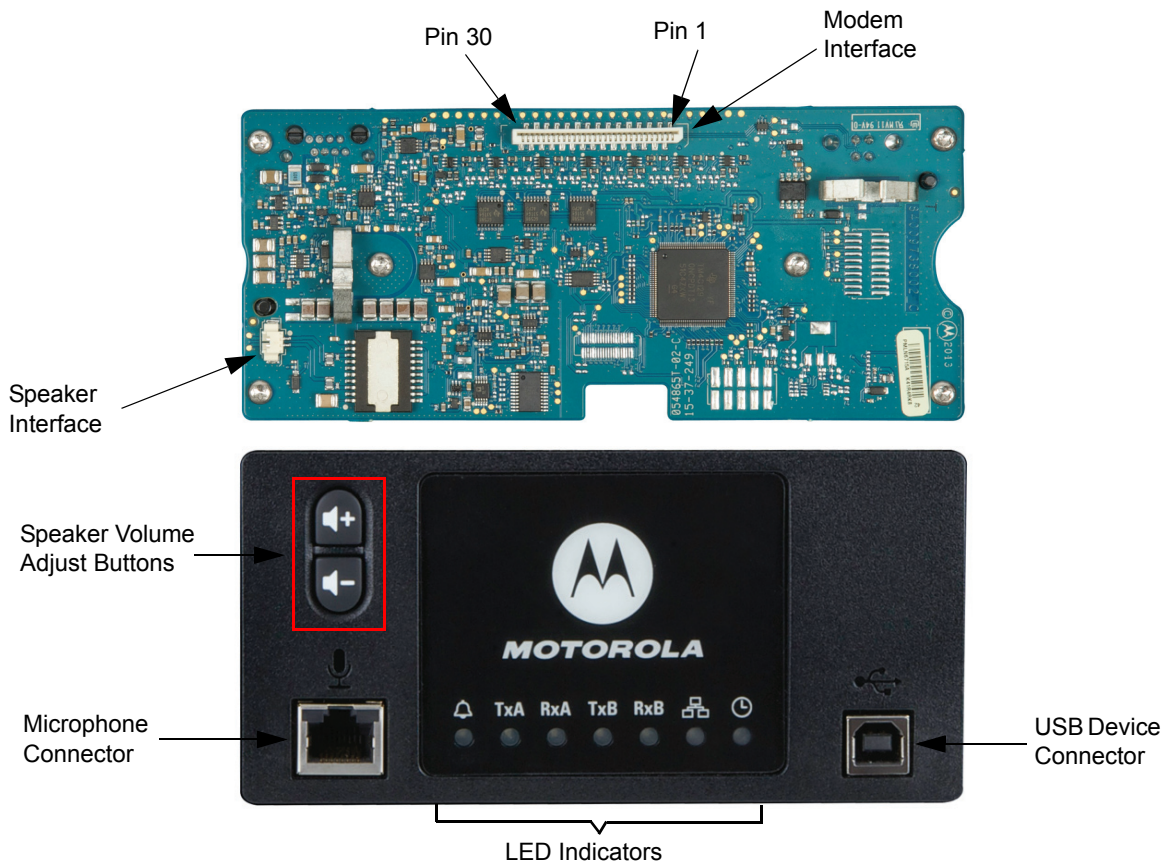


Figure 6-1 Front Panel Input and Output Connections

6.3 Interfaces

6.3.1 Modem Interface

The interface to the modem is made via a 30-pin flex cable. The connector on the front panel board is a 30-pin horizontal LIF connector. The location can be seen in [Figure 6-1](#).

6.3.2 User/ Service Interface

6.3.2.1 USB

The Front Panel USB device port is the interface used for connecting the base station/repeater to a computer in order to use the Customer Programming Software. See [Figure 6-1](#) for the location. A standard “Type A” to “Type B” USB cable facilitates the connection.

6.3.2.2 LED Indicators

The Front Panel houses seven LED indicators used for displaying the state of the base station/repeater. For state details, refer to [Table 1-5 on page 1-12](#).

6.3.2.3 Speaker Volume Adjust Buttons

The front panel assembly contains an integrated speaker which is controlled via the two front panel speaker volume adjust buttons.

The Front Panel speaker audio is supported in both analog and digital modes of operation. In digital modes of operation, via CPS configuration the user has the ability to configure the Front Panel speaker audio for either slot 1, slot 2, or a mix of slot 1 and slot 2 audio.

6.3.2.4 Microphone

The Front Panel port (RJ45-Jack) is designed for interface to the GMMN4063 microphone. Modulation sensitivity for 60% rated system deviation is typically 56 mVrms (158 mVpp).

The Front Panel microphone port is supported in both analog and digital modes of operation. In digital modes of operation, via CPS configuration the user has the ability to configure the Front Panel microphone audio for either slot 1 or slot 2.

Note Operation of the Front Panel Speaker and Microphone in digital modes of operation requires an optionally purchased software license. The optional software license allows Front Panel Speaker Audio support in all digital system types, with the Front Panel Microphone Audio support limited to single-site digital conventional operations (i.e. non-IP Site Connect conventional).

Chapter 7 SLR 8000 Back Panel

7.1 Description

The Back Panel interface provides the electrical interconnection interface between the SLR 8000 Base Station/Repeater and the end user's system. This includes the connectors necessary to interface the base station/repeater to RF peripheral equipment, power system, system controllers, LANs, as well as other communications and maintenance equipment. This section provides a general description, identification of inputs/ outputs, and a pin-out listing for all connectors, including information on signal names, functions, and levels.

7.1.1 General Description

Figure 7-1a and Figure 7-1b show the various interface connector locations. Table 7-1 lists the connector types as well as its primary function.

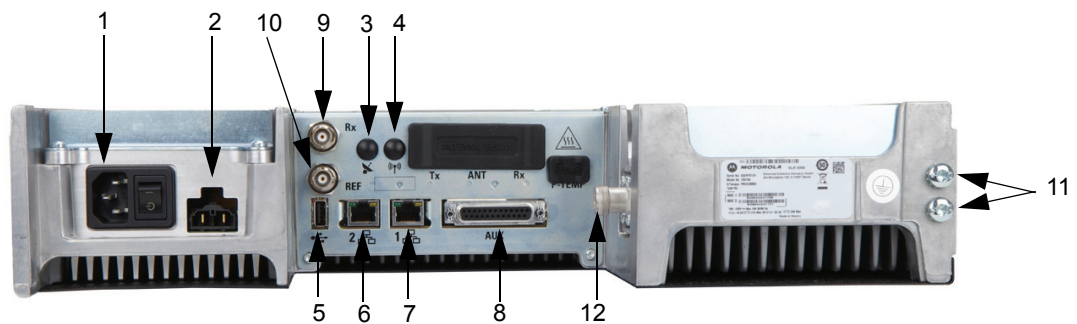


Figure 7-1a Back Panel Connector Names and Locations (with no options installed)

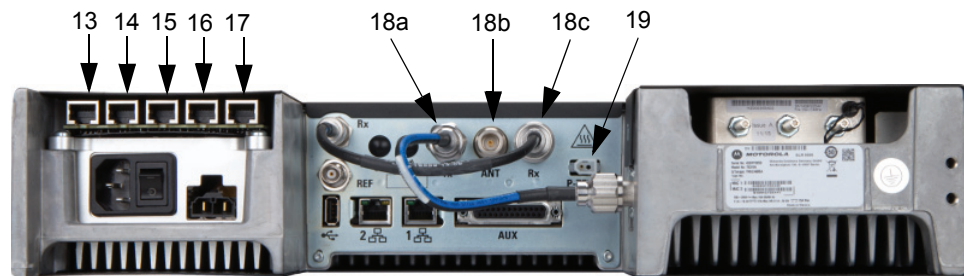


Figure 7-1b Back Panel Connector Names and Locations (with Wireline/Aux, Antenna Relay and Preselector Options installed)

Table 7-1 Connector Type and Primary Function

Location	Connector Type	Function(s)
1	C14 (IEC 60320)	AC Power Inlet and Base Station/Repeater Power Switch
2	Molex 42818-0212	DC Power Inlet and DC Charger Outlet
3	Option Dependent	Option Dependent 1 (future)
4	Option Dependent	Option Dependent 2 (future)
5	Type A Socket	USB
6	RJ-45 – Jack	Ethernet 2 (future)
7	RJ-45 – Jack	Ethernet 1
8	DB25 – Female	Aux: Rx Audio, Tx Audio, PTT, COR, Accessory Power, 1 PPS, and GPIO
9	BNC – Female	Receiver RF (Rx)
10	BNC – Female	Frequency Reference Input (REF)
11	T30 TORX Screw	Bonding Ground Connection
12	N-Type – Female	Transmitter RF (Tx)
13	RJ-45 – Jack	Wireline #1 – Balanced Rx and Tx Audio with E&M – (Optional)
14	RJ-45 – Jack	Wireline #2 – Balanced Rx and Tx Audio with E&M – (Optional & future)
15	RJ-45 – Jack	GPIO 1 – (Optional & future)
16	RJ-45 – Jack	GPIO 2 – (Optional & future)
17	RJ-45 – Jack	GPIO 3 – (Optional & future)
18a	N-Type-Female	RF Antenna Relay – Transmitter RF – (Optional)
18b	N-Type-Female	RF Antenna Relay – Antenna RF – (Optional)
18c	N-Type-Female	RF Antenna Relay – Receiver RF – (Optional)
19	Molex 43020-0200	External Circulator Temperature Sense - (Optional)

7.2 Back Panel Interfaces

7.2.1 AC Power Inlet

The AC power inlet connector is of the C14 type socket (IEC 60320) and accepts interface to C13 type plugged (IEC 60320) power cords. [Figure 7-2](#) shows the location of the pins and [Table 7-2](#) lists the functional characteristics of the connector's pins.



Figure 7-2 AC Power Inlet Connector and Base Station/Repeater Power Switch

Table 7-2 AC Power Inlet Connector

Location	Pin Assignment	Type	Signal Characteristics
1	Earth	Power	100 – 240 VAC (Line to Neutral) 4 A (max)
2	Line		
3	Neutral		

7.2.2 DC Power Inlet / DC Charger Outlet

The DC power inlet / DC charger outlet connector is a Molex 42818-02012 panel mount receptacle and accepts interface to Molex 42816-0212 plugs. [Figure 7-3](#) shows the location of the pins and [Table 7-3](#) lists the functional characteristics of the connector's pins.

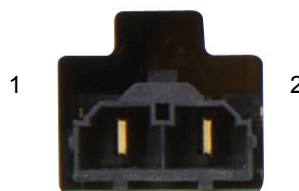


Figure 7-3 DC Power Inlet/ DC Charger Outlet Connector

Table 7-3 DC Power Inlet/ DC Charger Outlet Connector

Location	Pin Assignment	Type	Signal Characteristics
1	Positive	Power	11 – 14.4 VDC 17 A (max)
2	Negative		

7.2.3 Option 1/GNSS

Not supported at this time (No connection).



Figure 7-4 Option 1/GNSS Connector

7.2.4 Option 2/WLAN

Not supported at this time (No connection).



Figure 7-5 Option 2/WLAN Connector

7.2.5 USB

Not supported at this time. Type A socket (Host Connection) that supports the USB 2.1 protocol standard. [Figure 7-6](#) shows the location of the pins and [Table 7-4](#) lists the functional characteristics of the connector's pins.

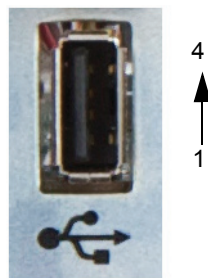


Figure 7-6 USB Connector

Table 7-4 USB Connector

Location	Pin Assignment	Type	Signal Characteristics
1	VBUS	USB Physical Layer	+5 VDC
2	D-		3.6 V differential data
3	D+		
4	GND		Ground

7.2.6 Ethernet 1

Fully compliant with IEEE and 802.3 and 802.3u standards. Supports 10 Base-T, 100 Base-Tx rates, full duplex, half duplex mode and flow control. [Figure 7-7](#) shows the location of the pins and [Table 7-5](#) lists the functional characteristics of the connector's pins.

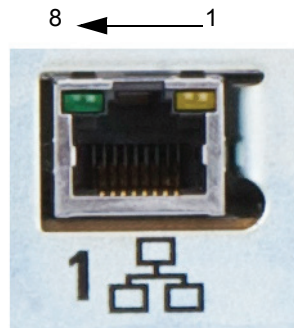


Figure 7-7 Ethernet 1 Connector

Table 7-5 Ethernet 1 Connector

Location	Pin Assignment	Type	Signal Characteristics
1	Ethernet Tx+	Ethernet Physical Layer	5 V differential data
2	Ethernet Tx-		
3	Ethernet Rx+		
4	Unused		N/A
5	Unused		N/A
6	Ethernet Rx-		5 V differential data
7	Unused		N/A
8	Unused		N/A

7.2.7 Ethernet 2

Not supported at this time. Fully compliant with IEEE 802.3 and 802.3u standards. Supports 10 Base-T, 100 Base-Tx rates, full duplex, half duplex mode and flow control. [Figure 7-8](#) shows the location of the pins and [Table 7-6](#) lists the functional characteristics of the connector's pins.

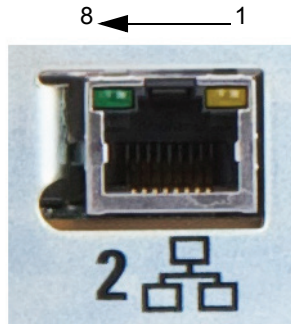


Figure 7-8 Ethernet 2 Connector

Table 7-6 Ethernet 2 Connector

Location	Pin Assignment	Type	Signal Characteristics
1	Ethernet Tx+	Ethernet Physical Layer	5 V differential data
2	Ethernet Tx-		
3	Ethernet Rx+		N/A
4	Unused		N/A
5	Unused		5 V differential data
6	Ethernet Rx-		N/A
7	Unused		N/A
8	Unused		N/A

7.2.8 Auxiliary (Aux)

This connection supports the analog interface to the SLR 8000 Base Station/Repeater, which includes audio, station control, station indicators, accessory power, and provisions for timing used in various system implementations. [Figure 7-9](#) shows the location of the pins and [Table 7-7](#) lists the functional characteristics of the connector's pins.

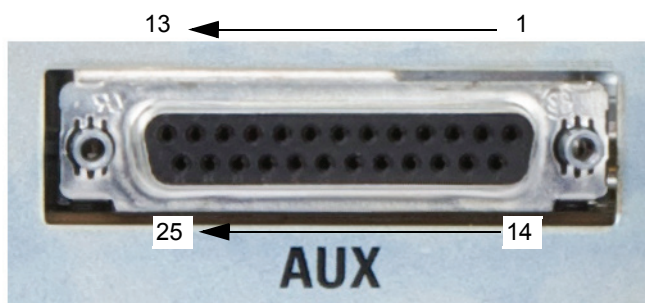


Figure 7-9 Auxiliary Connector

Table 7-7 Auxiliary Connector

Location	Pin Assignment	Type	Signal Characteristics
1	Tx Audio 1	Audio	Transmit Audio – Nominal input level is 80 mVrms for 60% deviation with scaling factor set to 100%. 600 Ω input impedance.
2	GPIO 1	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
3	*Rx Audio 2	Audio	Receiver Audio – Nominal output level is 330 mVrms (into a 50 k Ohm load) with a 60% deviation receive signal. 1000 Ω output impedance.
4	GPIO 2	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
5	GPIO 10/ *Analog Input 2	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC Analog: 0 – 5 VDC
6	GPIO 9/ *Analog Input 1	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC Analog: 0 – 5 VDC

Table 7-7 Auxiliary Connector (Continued)

Location	Pin Assignment	Type	Signal Characteristics
7	Rx Audio 1	Audio	Receiver Audio – Nominal output level is 330 mVrms (into a 50 k Ohm load) with a 60% deviation receive signal. 1000 Ω output impedance.
8	GPIO 6	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
9	Ground		
10	GPIO 7/ *Analog RSSI Out	Digital or Analog	<u>Digital:</u> Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC <u>Analog RSSI:</u> Typically 0.5 VDC for -120 dBm to 2.7 VDC for -60 dBm carrier. Variation with carrier level at approximately 50 mV/dBm.
11	GPIO 11/ *Analog Input 3	Digital or Analog	<u>Digital:</u> Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC Analog: 0 – 5 VDC
12	GPIO 12/ *Analog Input 4	Digital or Analog	<u>Digital:</u> Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC Analog: 0 – 5 VDC
13	Tx Data	Digital or Analog	Transmit Data/ PL/ DPL – Nominal input level is 80 mVrms for 20% deviation with scaling factor set to 100%. 600 Ω input impedance.
14	*1 PPS In/ Out	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
15	GPIO 3	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
16	Ground		
17			
18			
19			

Table 7-7 Auxiliary Connector (Continued)

Location	Pin Assignment	Type	Signal Characteristics
20	Fused B+	Power	The B+ is 13.6 VDC when base station/repeater is sourced by AC, and can range from 11 – 14.4 VDC when sourced by DC. 1 A (max).
21	GPIO 8/ *Analog Output 2	Digital or Analog	Digital: Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC Analog: 0 – 5 VDC
22	Tx Audio 1	Audio	Transmit Audio – Nominal input level is 80 mVrms for 60% deviation with scaling factor set to 100%. 600 Ω input
23	GPIO 4	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
24	GPIO 5	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10 k pull-up to 5 V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
25	* Tx Audio 2	Audio	Transmit Audio – Nominal input level is 80 mVrms for 60% deviation with scaling factor set to 100%. 600 Ω input

Note (*) Not supported in initial release.

7.2.9 Frequency Reference

The Frequency Reference port is a BNC (female) type connector. [Figure 7-10](#) depicts the Frequency Reference connector.



Figure 7-10 Frequency Reference Connector

Various external frequency reference signal types can be provided to the SLR 8000 Base Station/ Repeater for normal operation. [Table 7-8](#) provides a list of acceptable input signal types as well as their permissible levels

Table 7-8 Frequency Reference

Frequency (MHz)	Waveform *	Level (Vpp)	Impedance (Ω)**	Note
5	Sine	1.5 – 5.3	100 k	AC Coupled
5	Square *	1.5 – 5.3	100 k	AC Coupled
10	Sine	1.5 – 5.3	100 k	AC Coupled
10	Square *	1.5 – 5.3	100 k	AC Coupled

Note (*) Square wave duty cycle range is 45 – 50%.
 (**) Impedance of the SLR 8000 Base Station/Repeater's frequency reference port.

7.2.10 Receiver RF

The Receiver RF port is a BNC (female) type connector. [Figure 7-11](#) depicts the Receiver RF connector.



Figure 7-11 Receiver RF Connector

7.2.11 Transmitter RF

The Transmitter RF port is an N-Type (female) type connector. [Figure 7-12](#) depicts the Transmitter RF connector.

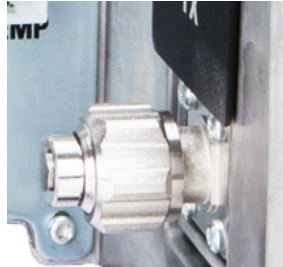


Figure 7-12 Transmitter RF Connector

7.2.12 Bonding Ground Connection

The base station/repeater Bonding Ground Connection is realized with two M6 x 1 x 3 mm screws (T30 Torx). [Figure 7-13](#) depicts the Bonding Ground Connection.



Figure 7-13 Bonding Ground Connection

7.2.13 Wireline 1 (WL1)

This is an RJ-45 connection that supports the wireline interface to the SLR 8000 Base Station/ Repeater, which includes configuration provisions for a balanced 2-wire or 4-wire operation (via CPS), configurable impedance settings (via CPS), and settable audio/ tone levels (via Tuner).

Additionally, the interface also supports electrically isolated E&M signaling, tone remote control, and DC remote control. See [Chapter 13: SLR 8000 Wireline](#) of this manual for additional details. [Figure 7-14](#) depicts the RJ-45 connector while [Table 7-9](#) lists the functional characteristics of the connector's pins.

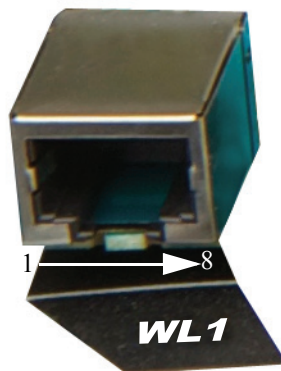


Figure 7-14 RJ-45 Connector (Wireline 1)

Table 7-9 Functional Characteristics of RJ-45 Connector (Wireline 1)

Location	Pin Assignment	Type	Signal Characteristics
1	Line 2+	Audio	2-wire Phone Line (differential) input/ output, or 4-wire Phone Line (differential) output; 600 Ω typical impedance (country specific)
2	Line 2-		
3	Aux In 1+	DC	Opto-Isolated In-Current flow to Activate*
4	Line 1-	Audio	4-wire Phone Line (differential) input; 600 Ω typical impedance (country specific)
5	Line 1+		
6	Aux In 1-	DC	Opto-Isolated In-Current flow to Activate*
7	Aux Out Relay 1 (N.O.)	DC	Form Relay A Closed When Active
8	Aux Out Relay 1 (N.O.)	DC	Form Relay A Closed When Active

7.2.14 Wireline 2 (WL2)

Not supported at this time.

This is an RJ-45 connection that supports the wireline interface to the SLR 8000 Base Station/ Repeater, which includes configuration provisions for a balanced 2-wire or 4-wire operation (via CPS), configurable impedance settings (via CPS), and settable audio/ tone levels (via Tuner).

Additionally, the interface also supports electrically isolated E&M signaling, tone remote control, and DC remote control. See [Chapter 13: SLR 8000 Wireline](#) of this manual for additional details.

[Figure 7-15](#) depicts the RJ-45 connector while [Table 7-10](#) lists the functional characteristics of the connector's pins.

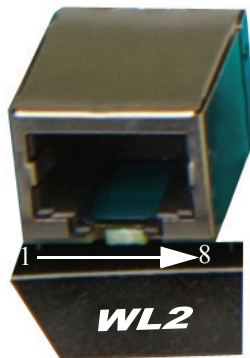


Figure 7-15 RJ-45 Connector (Wireline 2)

Table 7-10 Functional Characteristics of RJ-45 Connector (Wireline 2)

Location	Pin Assignment	Type	Signal Characteristics
1	Line 4+	Audio	2-wire Phone Line (differential) input/ output, or 4-wire Phone Line (differential) output; 600 Ω typical impedance (country specific)
2	Line 4-		
3	Aux In 2+	DC	Opto-Isolated In-Current flow to Activate*
4	Line 3-	Audio	4-wire Phone Line (differential) input; 600 Ω typical impedance (country specific)
5	Line 3+		
6	Aux In 2-	DC	Opto-Isolated In-Current flow to Activate*
7	Aux Out Relay 2 (N.O.)	DC	Form Relay A Closed When Active
8	Aux Out Relay 2 (N.O.)	DC	Form Relay A Closed When Active

7.2.15 GPIO 1

Not supported at this time.

This is an RJ-45 connection that provides four additional GPIO connections to the SLR 8000 Base Station/Repeater. [Figure 7-16](#) depicts the RJ-45 connector while [Table 7-11](#) lists the functional characteristics of the connector's pins.

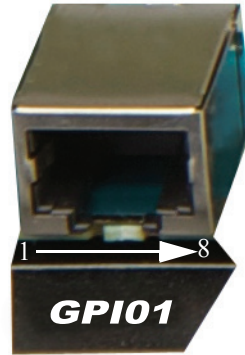


Figure 7-16 RJ-45 Connector (GPIO 1)

Table 7-11 Functional Characteristics of RJ-45 Connector (GPIO1)

Location	Pin Assignment	Type	Signal Characteristics
1	Ground		
2	Aux GPIO 1	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
3	Ground		
4	Aux GPIO 2	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
5	Ground		
6	Aux GPIO 3	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
7	Ground		
8	Aux GPIO 4	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC

7.2.16 GPIO 2

Not supported at this time.

This is an RJ-45 connection that provides four additional GPIO connections to the SLR 8000 Base Station/Repeater. [Figure 7-17](#) depicts the RJ-45 connector while [Table 7-12](#) lists the functional characteristics of the connector's pins.

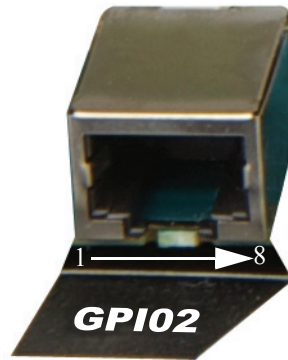


Figure 7-17 RJ-45 Connector (GPIO 2)

Table 7-12 Functional Characteristics of RJ-45 Connector (GPIO 2)

Location	Pin Assignment	Type	Signal Characteristics
1	Ground		
2	Aux GPIO 5	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
3	Ground		
4	Aux GPIO 6	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
5	Ground		
6	Aux GPIO 7	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
7	Ground		
8	Aux GPIO 8	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC

7.2.17 GPIO 3

Not supported at this time.

This is an RJ-45 connection that provides four additional GPIO connections to the SLR 8000 Base Station/Repeater. [Figure 7-18](#) depicts the RJ-45 connector while [Table 7-13](#) lists the functional characteristics of the connector's pins.

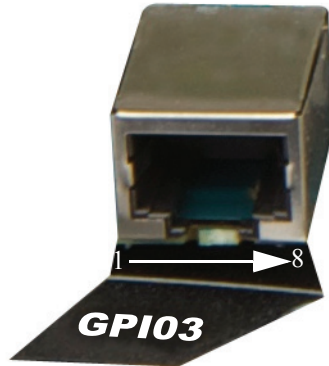


Figure 7-18 RJ-45 Connector (GPIO 3)

Table 7-13 Functional Characteristics of RJ-45 Connector (GPIO 3)

Location	Pin Assignment	Type	Signal Characteristics
1	Ground		
2	Aux GPIO 9	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
3	Ground		
4	Aux GPIO 10	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
5	Ground		
6	Aux GPIO 11	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC
7	Ground		
8	Aux GPIO 12	Digital	Output Logic Low: 0.5 VDC max Output Logic High: Open Collector with 10k pull-up to 5V Input Logic Low: 0 – 0.8 VDC Input Logic High: 3.0 – 14 VDC

7.2.18 RF Antenna Relay

When installed, the optional RF Antenna Relay presents an additional three N-Type (female) connectors to the back panel. [Figure 7-19](#) depicts the additional three connectors of the RF Antenna Relay option.

When installed, the RF Antenna Relay's Tx connection is cabled to the "Transmitter RF" connector (see [Section 7.2.11](#)) or to the optional External Dual Circulator Tray (see [Chapter 14](#)) with the RF Antenna's Rx connection is cabled to the "Receive RF" connector (see [Section 7.2.10](#)). The RF Antenna Relay's ANT connection is then interfaced to the antenna and/ or greater radio frequency distribution system.

See [Chapter 14](#) for more details regarding the RF Antenna Relay as well as other RF peripheral options.



Figure 7-19 RF Antenna Relay Connectors

7.2.19 P-TEMP

The P-TEMP connector is a MOLEX 43020-0200 panel mount plug and accepts interface to MOLEX 43025-0200 receptacles. The P-TEMP interface provides for temperature sensing of the optional External Dual Circulator Tray. [Figure 7-20](#) depicts the P-TEMP connector.



Figure 7-20 P-TEMP Connector

Notes

Chapter 8 SLR 8000 Test Equipment And Service Aids

8.1 Recommended Test Equipment

The list of equipment contained in [Table 8-1](#) includes most of the standard test equipment required for servicing Motorola SLR 8000 Base Station/Repeaters.

Table 8-1 Recommended Test Equipment

Equipment	Example	Application
Service Monitor	Aeroflex 3920 Digital Radio Test Set or equivalent*	Frequency/ deviation meter, signal generator, oscilloscope, RF power meter for wide-range troubleshooting and alignment.
Digital RMS Multimeter	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage measurements

Note (*) Equivalency can be established with “all-in-one” service monitors and/ or the individual functional components of a service monitor (e.g. RF Signal Generator, RF Spectrum Analyzer, RF Deviation Meter, RF Power Meter, and oscilloscope).

8.2 Service Aids

[Section A.1.8 on page A-3](#) lists the service aids recommended for working on the SLR 8000 Base Station/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.

Notes

Chapter 9 SLR 8000 Performance Check or Testing

9.1 General

The SLR 8000 Base Station/Repeater meets published specifications through the 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 equipment manufacturer's recommended calibration schedule.

Note Although these base station/repeaters function in digital and analog modes, all testing is done in analog mode. Digital Base Station/Repeater tests can be performed using an Aeroflex 3900 Series Service Monitor, if the DMR Digital Base Station/Repeater Test Option is purchased. This auto testing could be performed in lieu of the Manual testing described below.

9.2 Transmitter Testing



Caution

The base station/repeater needs to be taken out of service in order to carry out performance testing procedures. Unless the base station/repeater is already out of service, it is recommended to perform the procedures during off-peak hours in order to minimize disruption of service to the system subscribers.

9.2.1 Introduction

While most module faults can be detected by running the base station/repeater diagnostics, the following procedure provides a more traditional method of troubleshooting the transmitter circuitry.

This procedure allows the service technician to make minor adjustments and verify proper operation of the base station/repeater transmit circuitry, including:

- Exciter Section of Modem Module
- Power Amplifier Module
- Power Supply Module

In general, the transmitter circuitry is exercised by injecting and measuring signals using a Service Monitor (or equivalent). Incorrect measurement values indicate a faulty module(s); measurement values within the acceptable range verify proper operation of the above listed modules and circuitry.

9.2.2 Test Equipment

The following test equipment are required to perform the procedure:

- Aeroflex 3920 Digital Radio Test Set (or equivalent)
- Microphone (GMMN4063_)
- Power Meter and Sensor
- Station Rear Accessory Test Cable
- Dummy Load (50 Ω , base station/repeater wattage or higher)

9.2.3 Verifying Transmitter Circuitry Procedure

1. Connect and set up test equipment as shown in [Figure 9-1](#).
2. Apply input power (AC or DC) to the base station/repeater. The power supply, modem and PA fans should run a few seconds to confirm fan operation.
3. Press the PTT switch of the microphone and observe the PA Keyed LED indicator on the Base Station/Repeater Front Panel.
 - If PA Keyed fails to light, suspect the following:
 - Faulty Power Amplifier Module
 - Faulty Modem Module
 - Loose or bad Exciter-to-PA RF cable
 - Loose or bad PA-to-antenna RF output cable
 - Improperly terminated PA RF output cable
 - Faulty Power Supply Module
4. Measure output power by pressing the PTT button and observing reading on an in-line wattmeter.
 - If PA output is not at proper power (as set for particular site), adjust the output power as described in the CPS online help.
5. If PA output power is proper, set up the Service Monitor for spectrum analyzer display. Press the PTT button and observe the display. The display should show a single frequency carrier:
 - If the display shows multiple carriers evenly spaced about the carrier, suspect a faulty Exciter module or PA module.
 - If the display shows a solid carrier but it is off frequency, suspect the following:
 - Faulty Modem Module
 - Faulty external 5/10 MHz reference source (if used)
 - If the display shows a single carrier moving erratically, suspect a faulty Modem Module.
6. If display is proper, set up Aeroflex 3900 Series Communications System Analyzer to display modulation. Using the microphone, push the PTT button and speak into the microphone. Verify that the display shows an audio signal.
 - If the proper display is not obtained, suspect faulty SCM or Exciter Module
7. Set the Aeroflex 3900 Series Communications System Analyzer for GEN/ MON MTR. Press the PTT button and speak loudly into the microphone to cause maximum deviation. Display should read:
 - 4.60 kHz maximum for a 25 kHz system
 - 3.68 kHz maximum for a 20 kHz system
 - 2.30 kHz maximum for a 12.5 kHz system
 - If the proper display is not obtained, suspect faulty SCM or Exciter Module.
8. This completes the Verifying Transmitter Circuitry test procedure. If all displays and measurements are correct, the transmitter circuitry may be considered to be operating properly.

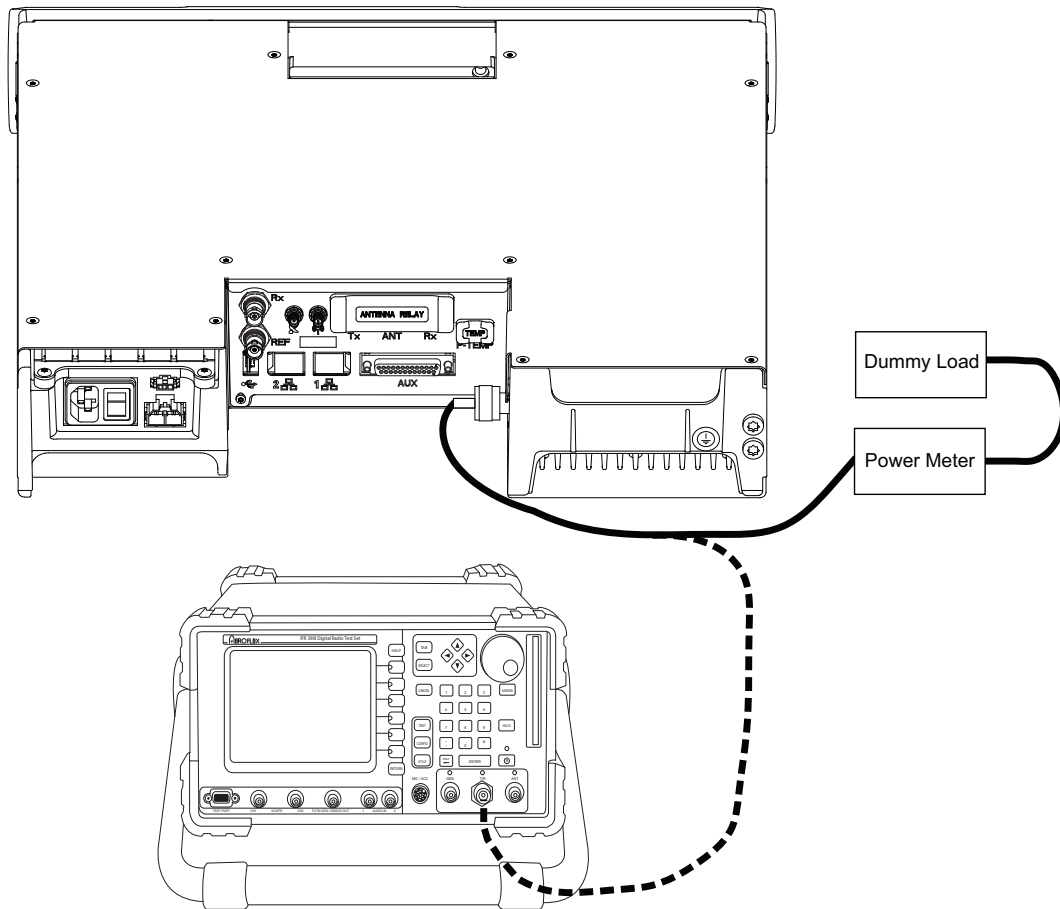


Figure 9-1 Backside - Test Equipment Setup for Verifying Transmitter Circuitry

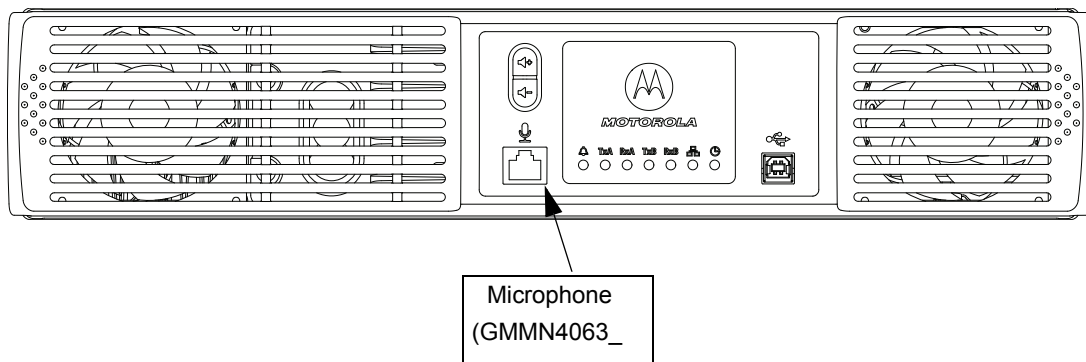


Figure 9-2 Frontside - Test Equipment Setup for Verifying Transmitter Circuitry

9.3 Receiver Testing



Caution

Performing this procedure requires that the base station/repeater be taken out of service. It is recommended that, unless the repeater is already out of service, this procedure be performed during off-peak hours so as to minimize the disruption of service to the system subscribers.



Caution

If the base station/repeater operates as a base station/repeater, the transmit output from the base station/repeater must be connected to a dummy load to prevent over-the-air broadcast during Receiver testing.

9.3.1 Introduction

While most module faults can be detected by running the base station/repeater diagnostics, the following procedure provides a more traditional method of troubleshooting the Receiver circuitry.

This procedure allows the service technician to make minor adjustments and verify proper operation of the base station/repeater receive circuitry on the Modem Module.

In general, the Receiver circuitry is exercised by injecting and measuring signals using a Service Monitor (or equivalent). Incorrect measurement values indicate a faulty module(s); measurement values within the acceptable range verify proper operation of the receiver circuitry on the Modem Module.

9.3.2 Required Test Equipment

The following test equipment are required to perform the procedure:

- Aeroflex 3920 Digital Radio Test Set (or equivalent)
- Station Rear Accessory Test Cable
- Dummy Load (50 Ω , base station/repeater wattage or higher) required for base station/repeaters only

9.3.3 Verifying Receiver Circuitry Procedure

1. Connect equipment as shown in [Figure 9-3](#).
2. Set the Service Monitor to generate a 1.0 μV (-107 dBm) FM signal at the Receiver frequency, modulated by a 1 kHz tone at 3 kHz deviation for 25 /30 kHz channel spacing, or 1.5 kHz deviation for 12.5 kHz channel spacing. The 1 kHz tone should be audible through the Front Panel speaker. If no audio is heard, suspect the following:
 - Faulty Modem Module
 - Faulty antenna-to-Receiver preselector RF cable (for the base station/repeater with optional internal preselector)
 - Faulty Service Monitor-to-station RF cable
 - Faulty Antenna Relay cable (If installed)
 - Faulty or mistuned Preselector cable (If installed)
 - Rear Panel to Test Box cable unplugged
 - Faulty rear panel to Test Box Cable
 - Front Panel speaker is at “minimum” or muted setting
 - Faulty Front Panel
 - Internal modem to Front Panel cable faulty or disconnected
 - Internal Front Panel to speaker cable disconnected
3. If Audio is heard (the audio volume can be adjusted via the front panel volume buttons), look at the Oscilloscope window on the Aeroflex 3920 (or a separate O-Scope) and verify that the Audio level Sine Wave measures between 0.75 to 1.5 Vpp. If not, connect to Tuner and increase the RX Audio level until this is achieved. If the level cannot be obtained, suspect a faulty Modem.
4. Move the BNC cable from the Scope CH 1 input to the Audio 1 input.
5. Change System Monitor injection signal level to the noted levels in [Table 1-3](#).
6. Measure the Receiver 12 dB SINAD sensitivity.
 - If the SINAD level is less than 12 dB, suspect faulty Modem.
7. This completes the Verifying Receiver Circuitry test procedure. If all displays and measurements are correct, the Receiver circuitry may be considered to be operating properly. Remove test equipment, restore the base station/repeater to normal service, and (if applicable) return to the troubleshooting flow chart to resume troubleshooting sequence.

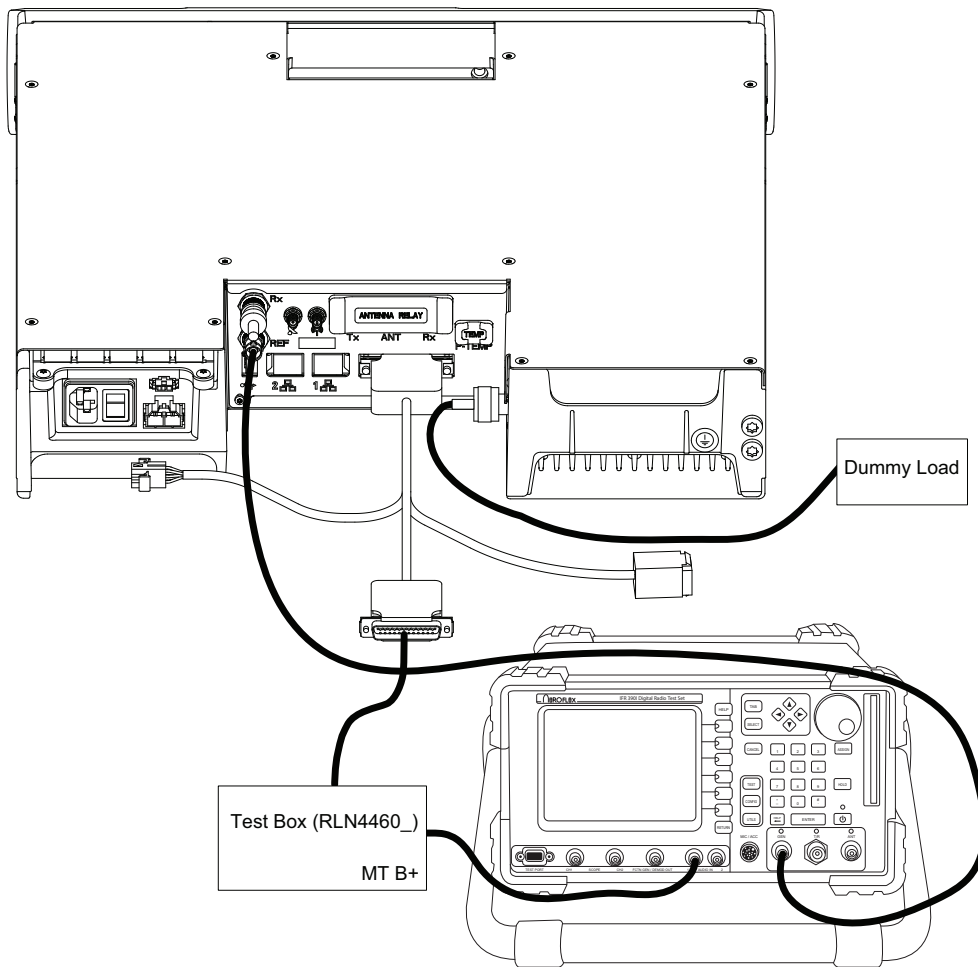


Figure 9-3 Backside - Test Equipment Setup for Verifying Receiver Circuitry

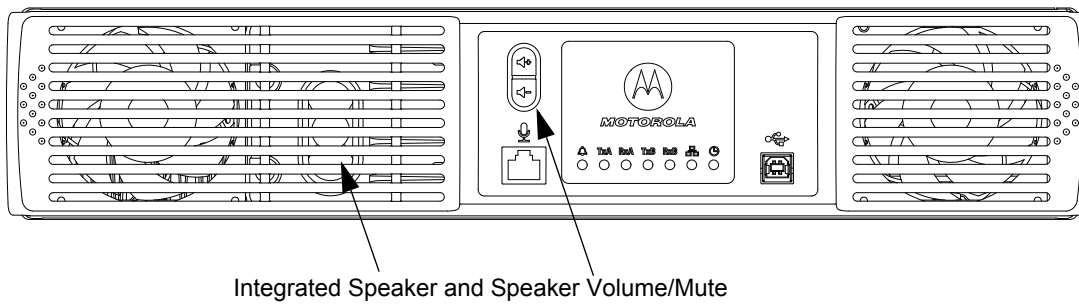


Figure 9-4 Frontside - Test Equipment Setup for Verifying Receiver Circuitry

Chapter 10 SLR 8000 Programming and Tuning


10.1 Introduction

This chapter provides an overview of the MOTOTRBO Customer Programming Software (CPS) and the MOTOTRBO Tuner application for use on Windows 7™, Windows 8™, or Windows 8.1™. These two MOTOTRBO applications are used for the configuration and alignment of the SLR 8000 Base Station/Repeater.

10.2 Customer Programming Software Setup

The Customer Programming Software setup, shown in [Figure 10-1](#) is used to program the base station/repeater. See [Figure 10-2](#) and [Figure 10.3](#) for the actual connectors on the front and rear panels of the base station/repeater.

Note See appropriate program on-line help files for the programming procedures.



Caution Computer USB ports can be sensitive to Electronic Discharge. Employ proper ESD practices (wrist strap, grounding, etc.) and do not touch exposed contacts on cables when connected to a computer.

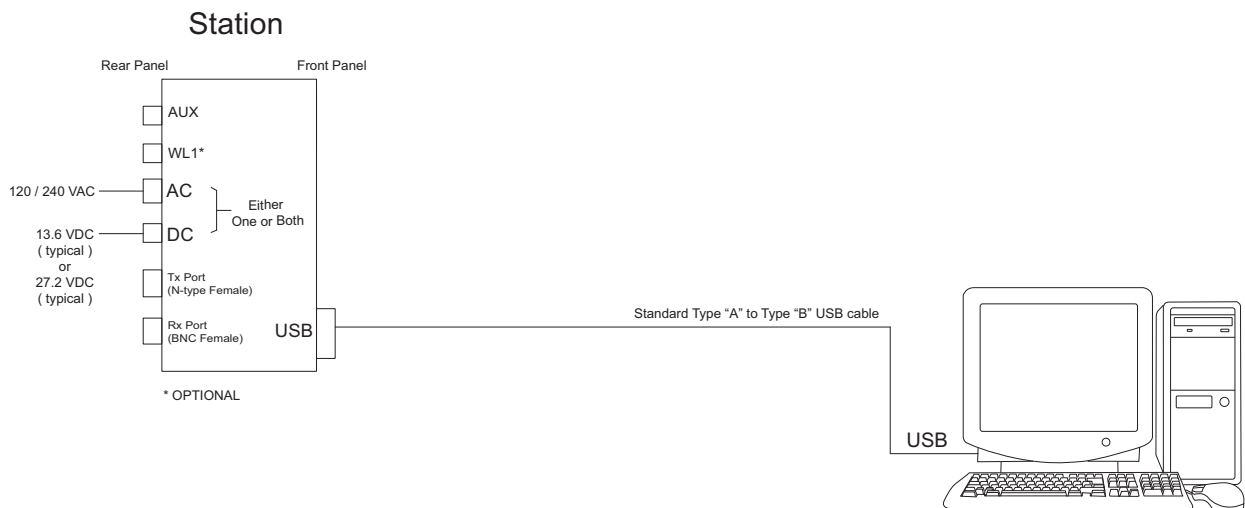


Figure 10-1 Customer Programming Software Setup

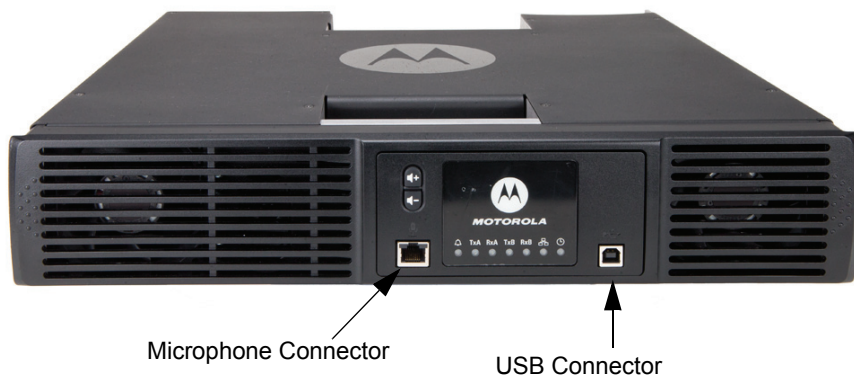


Figure 10-2 Front view of SLR 8000 Base Station/Repeater

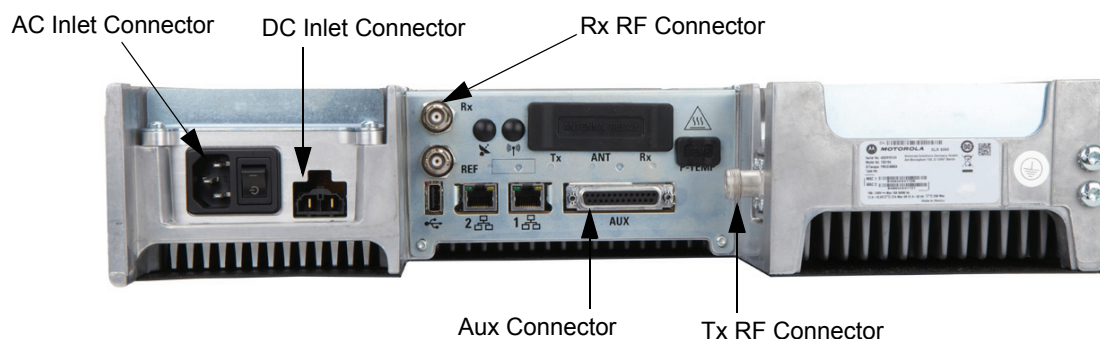


Figure 10-3 Rear view of SLR 8000 Base Station/Repeater

10.3 Reference Oscillator Alignment

This feature is used to adjust the reference oscillator of the base station/repeater. This alignment process should be done as maintenance schedules and regulations require or if the Modem FRU has been replaced in the base station/repeater.

10.3.1 Tuning Procedure

1. Connect the base station/repeater's transmitter antenna port to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Click the "Read" button in the tuner to begin reading the base station/repeater's tuning softpot values.
4. Select "Ref Oscillator" under the TX menu in the tree view (See [Figure 10-4](#)).

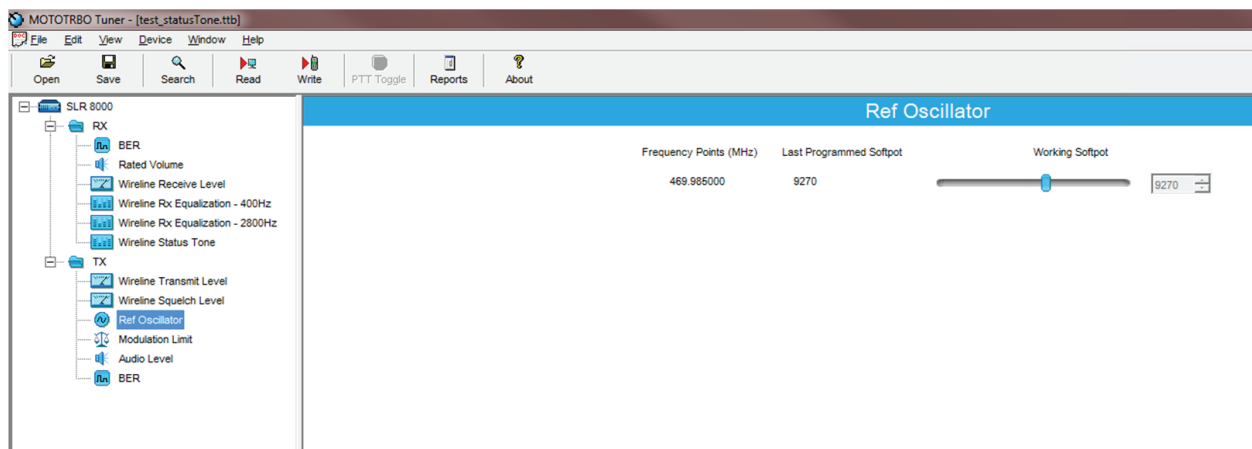


Figure 10-4 Tx Menu Tree (Ref. Oscillator)

5. Configure the current operating frequency into the Communications Analyzer.
6. Click the “PTT Toggle” button to key up the base station/repeater.
7. Adjust the working softpot value until the frequency is within the performance specifications (+/- 40 Hz for UHF and VHF) from the frequency point.
8. Click the “PTT Toggle” button to de-key the base station/repeater.
9. Click the “Write” button to save the tuned softpot value into the base station/repeater codeplug.

10.4 Base Station/Repeater Tuning Setup

A personal computer (PC), Windows™ operating system, and the MOTOTRBO Tuner application are required to align the base station/repeater. To perform the tuning procedures, the base station/repeater must be connected to the PC and test equipment setup as shown in Figure 10-5.

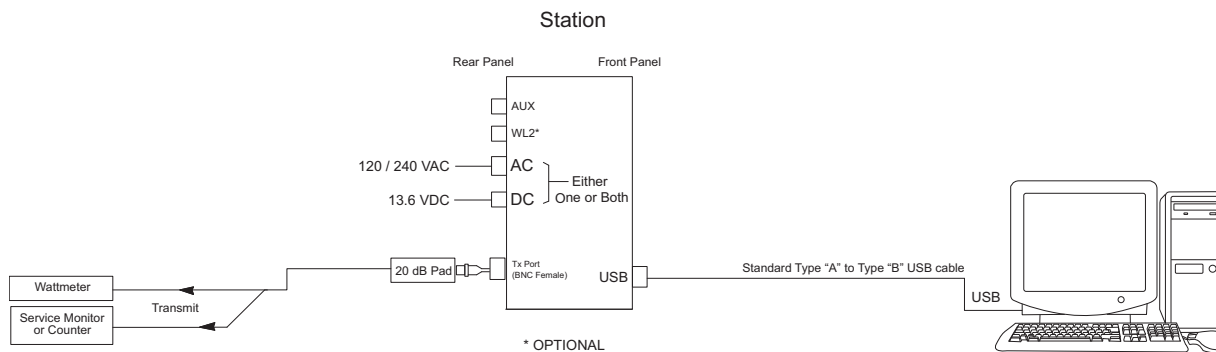


Figure 10-5 SLR 8000 Base Station/Repeater Tuning Equipment Setup

10.5 Rx Audio Level Set

The procedure outlined in this section is used to set the receive output audio level from the base station/repeater for a given RF deviation of the received RF signal. Perform this procedure any time the Rx audio level needs adjustment.

10.5.1 Tuning Procedure

1. Connect the base station/repeater's receiver antenna port to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Launch the Tuner application and click the "Read" button to read the softpot values.
4. Select "Rx Rated Volume" under the Rx menu in the tree view (See [Figure 10-6](#)).

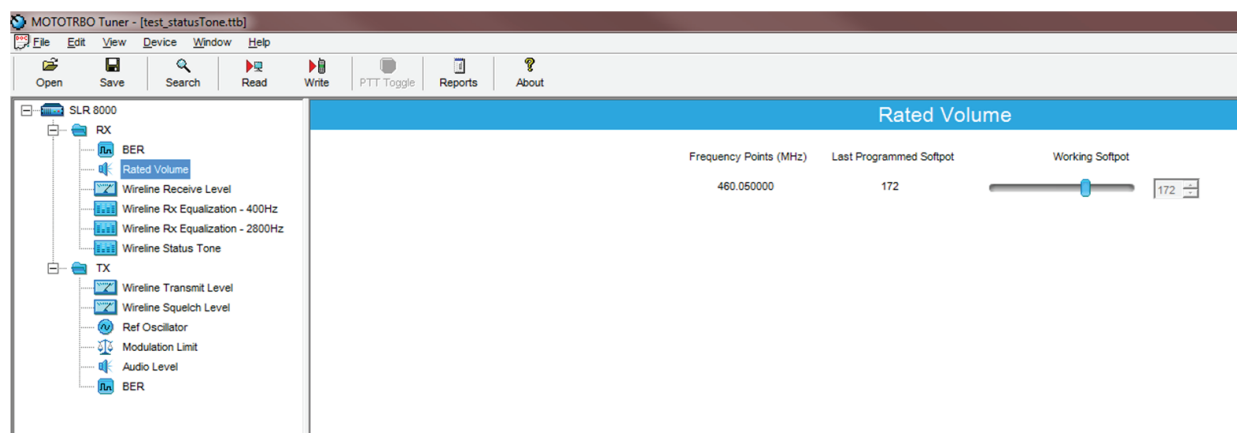


Figure 10-6 Rx Menu tree (Rx Rated Volume)

5. Set the Communication Analyzer to output a -47 dBm RF signal modulated with a 1 kHz tone at 60% of full deviation on the tuning frequency. The tuning frequency is the value displayed on the Tuner GUI under the heading of "Frequency Points".

Note The Tuner aligns this parameter in a 12.5 kHz channel spacing, so 60% is 1.5 kHz of deviation. If the CPS is set for 25 kHz operation, the base station/repeater will automatically scale the deviation by a factor of two when it is outside the Tuner environment.

Note Programmed TPL and DPL squelch requirements are automatically disabled for the tuning frequency while in the Tuner environment.

6. Adjust the softpot value until the desired receive audio level is achieved at pin #7 (in reference to ground) on the Aux connector. Ground connections provided by the Aux connector are pins: 9, 16, 17, 18, and 19.

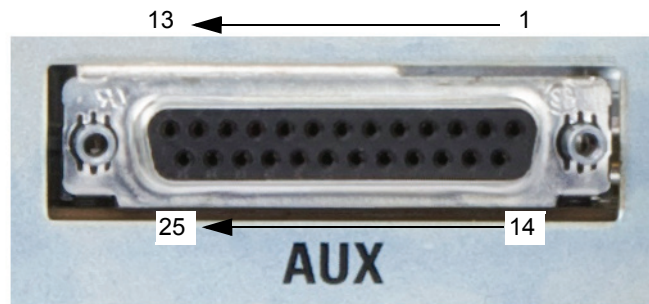


Figure 10-7 Auxiliary Connector

Note Optimally, it is recommended to load pin #7 with application loading used during normal operation of the base station/repeater.

7. Click “Write” to save the new tuned softpot value into the base station/repeater’s codeplug.

10.6 Tx Audio Level Set

The procedure outlined in this section is used to allow adjustment of the transmitter audio level the base station/repeater is expecting at its Aux connector. Adjusting this level set has the effect of increasing or decreasing RF signal deviation for a given transmit audio level. Perform this procedure any time the transmitter audio level needs adjustment.

10.6.1 Tuning Procedure

1. Connect the base station/repeater’s transmitter antenna port to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Apply a 1 kHz signal at the desired input level to pin #1 or #22 (in reference to ground) on the Aux connector. Ground connections provided by the Aux connector are pins: 9, 16, 17, 18, and 19. See [Figure 10-7](#).

Note Optimally, it is recommended to load pin #1 or #22 with the application source impedance used during normal operation of the base station/repeater.

4. Launch the Tuner application and click the “Read” button to read the softpot values.

5. Select “Tx Audio Level” under the Tx menu in the tree view (See [Figure 10-8](#)).

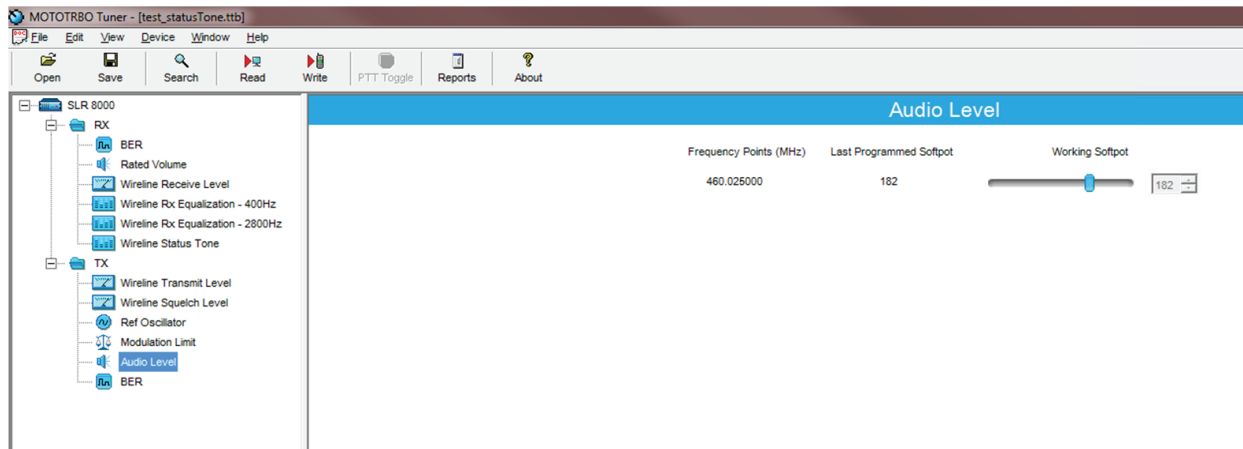


Figure 10-8 Tx Menu Tree (Tx Audio Level)

6. Enter the tuning frequency into the Communication Analyzer (the value displayed on the Tuner GUI under the heading of “Frequency Points”).
7. Click the “PTT Toggle” button within the Tuner environment to key up the base station/repeater.
8. Adjust the softpot value until 60% of the rated system deviation (RSD) is achieved.

Note The Tuner aligns this parameter in a 12.5 kHz channel spacing, so 60% is 1.5 kHz of deviation. If the CPS is set for 25 kHz operation, the base station/repeater will automatically scale the deviation by a factor of two when it is outside the Tuner environment.

9. Click the “PTT Toggle” button within the Tuner environment to de-key the base station/repeater.
10. Click “Write” to save the new tuned softpot value into the base station/repeater’s codeplug.

10.7 Modulation Limit Alignment

This feature is to set the modulation limit of the SLR 8000 Base Station/Repeater.

Note A modulation limit alignment is not needed if the base station/repeater is used in repeat mode. This is always the case when the base station/repeater is in digital mode.

10.7.1 Tuning Procedure (with no Tx Data and no PL)

Note If data or PL signaling is applied to Pin 13 of the J7 connector, proceed to [Section 10.7.3](#).

1. Connect the base station/repeater’s antenna port to the attenuation pad, if necessary, before connecting to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Apply a 1 kHz signal at 1.2 Vrms to Pin 1 of the J7 backplane connector.
 - Signal ground is Pin 9 of the J7 backplane connector.
4. Launch the Tuner application and click the “Read” button to read the softpot values.
5. Select “Modulation Limit” under the Tx menu in the tree view (See [Figure 10-9](#)).

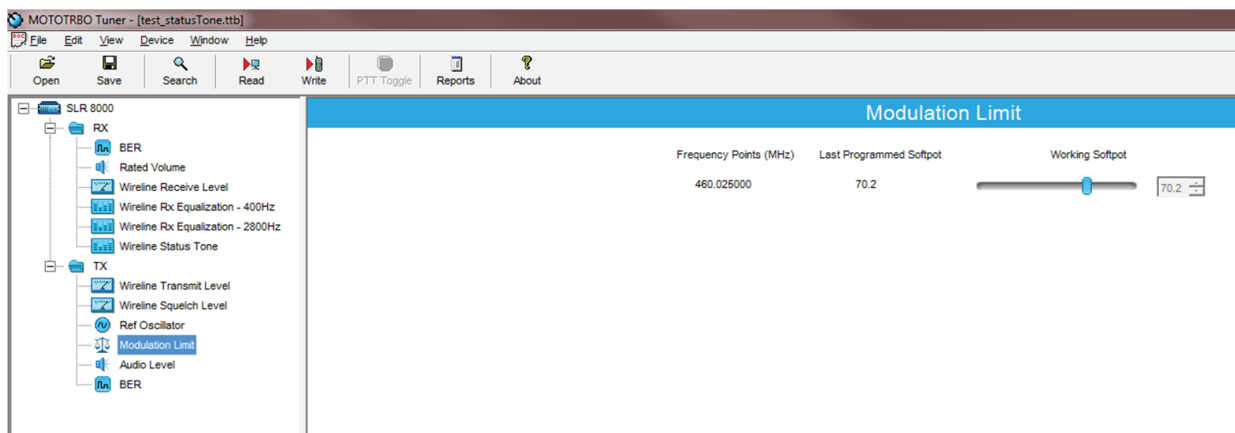


Figure 10-9 Tx Menu tree (Tuning Procedure with no Tx data)

6. Enter the tuning frequency into the Communication Analyzer (the value displayed on the Tuner GUI).
7. Click the “PTT Toggle” button within the Tuner environment to key up the base station/ repeater.
8. Adjust the softpot value until the maximum deviation is 92% of the rated system deviation (RSD). This will be tested in a 12.5 kHz channel spacing, so 92% of 2.5 kHz is 2.3 kHz.

Note Set the modulation limit to 92% so that any additional deviation incurred by the transmitter VCOs over temperature is compensated for.

Channel Spacing (kHz)	RSD (kHz)	92% of RSD (kHz)	Tolerance (Hz)
12.5	2.5	2.3	+0/ -50

9. Click the “PTT Toggle” button within the Tuner environment to de-key the base station/repeater.
10. Click “Write” to save the new tuned softpot value into the base station/repeater’s codeplug.

10.7.2 Verification (with no Tx Data and no PL)

1. Connect the base station/repeater’s antenna port to the attenuation pad, if necessary, before connecting to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Via CPS, program the base station/repeater with any frequency within the specified range of the base station/repeater under test, and set the base station/repeater for low power and disable the repeat path.
4. Apply a 1 kHz signal at 1.2 Vrms to Pin 1 of the Aux connector.
 - Signal ground is Pin 9 of the Aux connector.
5. Key up the base station/repeater and measure the deviation
 - Key the base station/repeater by grounding Pin 2 of the Aux connector.

Note CPS must have Pin 2 configured as an active low with the PTT function.

6. De-key the base station/repeater.

The deviation shall meet the limits shown in the table below.

Channel Spacing (kHz)	Relative Standard Deviation (RSD) (kHz)	92% of RS (kHz)	Tolerance (Hz)
12.5	2.5	2.3	+0/ -50
20.0	4.0	3.68	+0/ -80
25.0	5.0	4.6	+0/ -100

- Note**
- The base station/repeater will be factory-tuned in accordance to the above procedure and specification.
 - Verification is performed outside of the Tuner application, i.e. in normal mode.

10.7.3 Tuning Procedure (with Tx Data or PL)

1. Connect the base station/repeater's antenna port to the attenuation pad, if necessary, before connecting to the Communication Analyzer.
2. Turn on the base station/repeater using an AC or DC source.
3. Click the "Read" button on the Tuner application to read the base station/repeater's softpot values.
4. Select "Modulation Limit" under the Tx menu in the tree view.
5. Enter the tuning frequency into the Communication Analyzer (the value displayed by the Tuner application).
6. Click the "PTT Toggle" button within the Tuner environment to key up the base station/repeater.
7. Apply a 1 kHz signal at 1.2Vrms to Pin 22 of the J7 backplane connector.
 - Signal ground is Pin 9 of the J7 backplane connector.
 - If the manufacturer of the third party controller specifies that the Tx Audio is not to be pre-emphasized, use Pin 1 instead of Pin 22.
8. Adjust the Modulation Limit softpot to a value that limits the maximum deviation to "X"% RSD, where "X" is equal to "92% RSD" minus "Tx Data's % RSD".

E.g. If Tx Data deviation is equal to 17%,
 $X = 92\% - 17\% = 75\%$ as the maximum deviation limit.

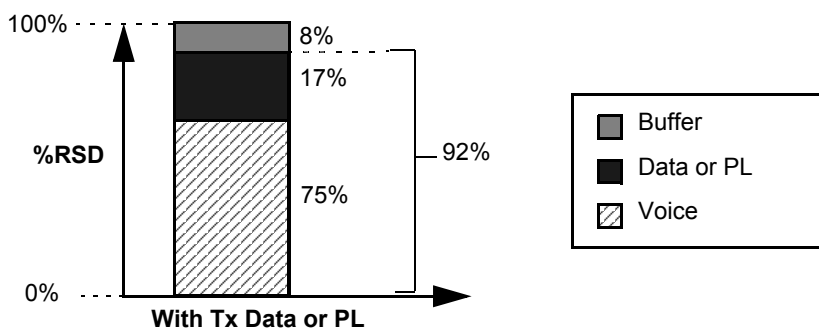


Figure 10-10 Example of maximum deviation limit calculation

9. Click the "PTT Toggle" button within the Tuner environment to de-key the base station/repeater.
10. Click "Write" to save the newly tuned softpot value into the base station/repeater's codeplug.
11. Alignment is complete.

Note See Figure 3-3 for details regarding the audio and data flow.

Note Set the modulation limit to 92% to compensate for any additional deviation incurred by the transmitter VCOs over temperature.

Note The Tuner application always aligns the Modulation Limit parameter in a 12.5 kHz channel spacing regardless of the CPS setting, so calculate the tuning % RSD accordingly. If the CPS is set for 25 kHz operation, the base station/repeater will automatically scale the deviation by a factor of two when outside of the Tuner environment.

10.7.4 Verification (with Tx Data or PL)

See [Section 10.7.2](#) with the following exceptions:

- The same Tx data signal level determined (obtained from Step 8 in [Section 10.7.3](#)), is applied to Pin 13 during the validation process.
- Pin 22 may be used instead of Pin 1, depending on the recommendation by the manufacturer of the third party controller.

10.8 Tuning Setup (Wireline)

10.8.1 Wireline Receive Level Tuning

The procedure outlined in this section is used to set the output level on the Wireline/Aux board's Rx path for a given RF signal deviation on the received signal. Perform this procedure during initial Wireline installation or any time the Rx audio level needs adjustment.

10.8.1.1 Tuning Procedure

1. Connect the radio's receiver antenna port to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Launch the Tuner application and click the "Read" button to read the softpot values.
4. Select "Wireline Receive Level" under the Rx menu in the tree view (See [Figure 10-11](#)).

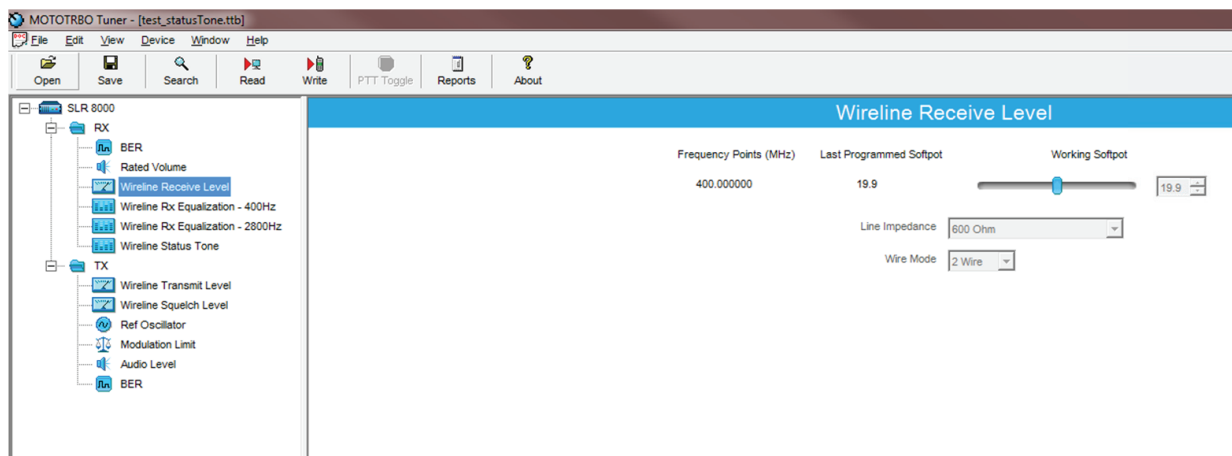


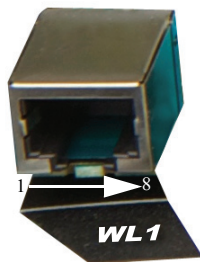
Figure 10-11 Rx Menu tree (Wireline Receive Level)

- Set the Communication Analyzer to output a -47 dBm RF signal modulated with a 1 kHz tone at 60% of full deviation on the tuning frequency. The tuning frequency is the value displayed on the Tuner GUI under the heading of "Frequency Points".

Note The Tuner aligns this parameter in a 12.5 kHz channel spacing, so 60% is 1.5 kHz of deviation. If the CPS is set for 25 kHz operation, the base station/repeater will automatically scale the deviation by a factor of two when it is outside the Tuner environment.

Note Programmed TPL and DPL squelch requirements are automatically disabled for the tuning frequency while in the Tuner environment.

- Adjust the softpot value until the desired receive audio level is achieved (-30 dBm to +7 dBm) across line two of the WL1 Wireline/Aux backplane connector terminals.



Location	Pin Assignment	Operation
1	Line 2+	2-wire or 4-wire
2	Line 2-	2-wire or 4-wire

Note It is imperative that the load the Wireline/Aux board is driving, matches that of the Wireline/Aux board's source impedance setting noted in the Tuner environment. Optimally, it is recommended to use the actual load which is used during normal operation of the radio.

- Click "Write" to save the new tuned softpot value into the radio's codeplug.

10.8.2 Wireline Rx Equalization – 2800 Hz Tuning

The Rx Equalization feature allows the frequency response adjustment of the Rx Audio relative to a specified rated system deviation, to compensate (equalize) for the response of the wireline backhaul network itself. This section outlines the procedure for high frequency adjustment. Perform this procedure only after setting the Wireline Receive Level. See [Section 10.8.1](#).

The Rx Equalizer is adjusted relative to the response at 1 kHz. Note the 1 kHz response observed when performing the tuning procedure for Wireline Receive Level. Equalizer adjustments are approximate. Typical adjustments range from 0 dB to approximately +6 dB.

10.8.2.1 Tuning Procedure

1. Connect the radio's receiver antenna port to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Launch the Tuner application and click the "Read" button to read the softpot values.
4. Select "Wireline Rx Equalization – 2800 Hz" under the Rx menu in the tree view (See [Figure 10-12](#)).

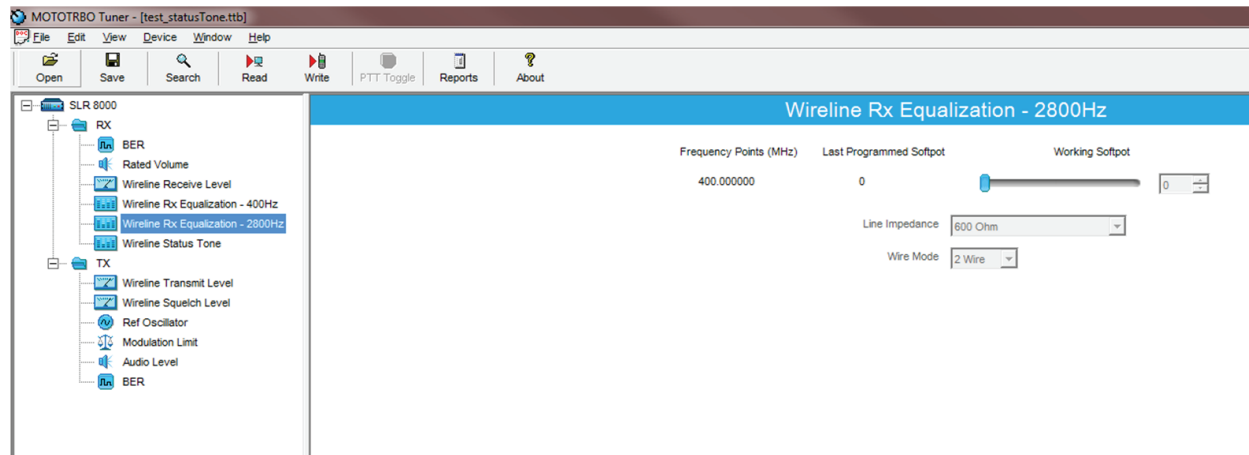


Figure 10-12 Rx Menu tree (Wireline Rx Equalization – 2800 Hz)

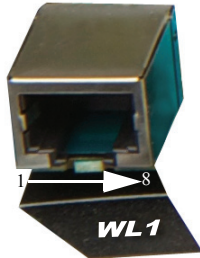
5. Set the Communication Analyzer to output a -47 dBm RF signal modulated with a 2800 Hz tone at 60% of full deviation on the tuning frequency. The tuning frequency is the value displayed on the Tuner GUI under the heading of "Frequency Points".

Note The Tuner aligns this parameter in a 12.5 kHz channel spacing, so 60% is 1.5 kHz of deviation. If the CPS is set for 25 kHz operation, the base station/repeater will automatically scale the deviation by a factor of two when it is outside the Tuner environment.

Note The emphasis setting of the Communication Analyzer must be turned off for this alignment procedure.

Note Programmed TPL and DPL squelch requirements are automatically disabled for the tuning frequency while in the Tuner environment.

- Adjust the softpot value until the best equalization is achieved across line two of the WL1 Wireline/Aux backplane connector terminals. Best equalization is achieved when the far side of the Wireline cable measures a flat response across the upper region of the audio spectrum. Compare the response at 2800 Hz with the response measured at 1000 Hz. The values should be approximately equal.



Location	Pin Assignment	Operation
1	Line 2+	2-wire or 4-wire
2	Line 2-	2-wire or 4-wire

Note It is imperative that the load the Wireline/Aux board is driving, matches that of the Wireline/Aux board's source impedance setting noted in the Tuner environment. Optimally, it is recommended to use the actual load which is used during normal operation of the radio.

- Click "Write" to save the new tuned softpot value into the radio's codeplug.

10.8.3 Wireline Rx Equalization – 400 Hz Tuning

The Rx Equalization feature allows the frequency response adjustment of the Rx Audio relative to a specified rated system deviation, to compensate (equalize) for the response of the Wireline backhaul network itself. This section outlines the procedure for low frequency adjustment. Perform this procedure only after setting the Wireline Receive Level. See [Section 10.8.1](#).

The Rx Equalizer is adjusted relative to the response at 1 kHz. Note the 1 kHz response observed when performing the tuning procedure for Wireline Receive Level. Equalizer adjustments are approximate. Typical adjustments range from 0 dB to approximately +6 dB.

10.8.3.1 Tuning Procedure

1. Connect the radio's receiver antenna port to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Launch the Tuner application and click the "Read" button to read the softpot values.
4. Select "Wireline Rx Equalization – 400 Hz" under the Rx menu in the tree view (See [Figure 10-13](#)).

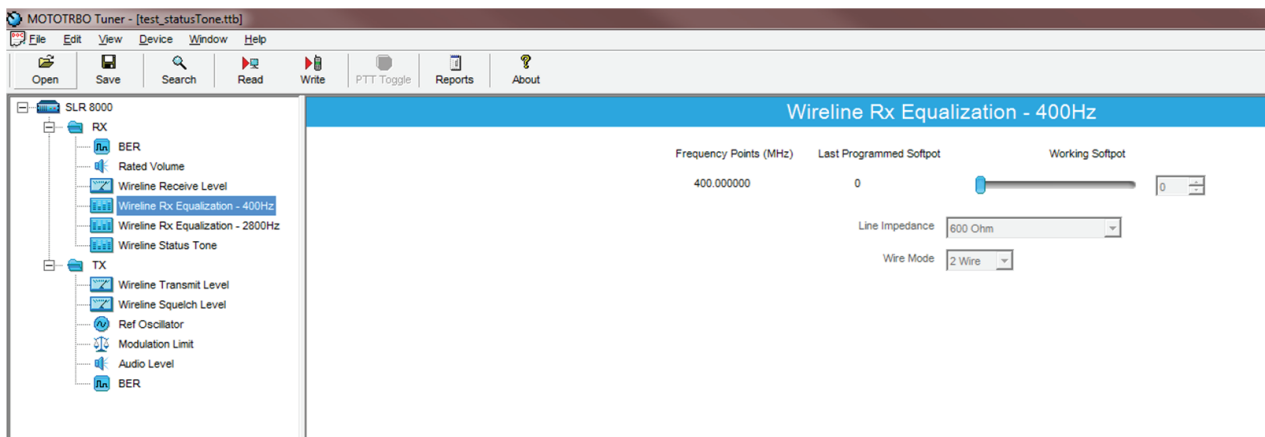


Figure 10-13 Rx Menu tree (Wireline Rx Equalization – 400 Hz)

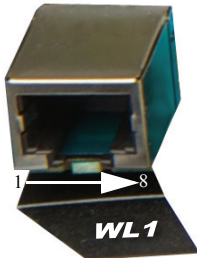
5. Set the Communication Analyzer to output a -47 dBm RF signal modulated with a 400 Hz tone at 60% of full deviation on the tuning frequency. The tuning frequency is the value displayed on the Tuner GUI under the heading of "Frequency Points".

Note The Tuner aligns this parameter in a 12.5 kHz channel spacing, so 60% is 1.5 kHz of deviation. If the CPS is set for 25 kHz operation, the base station/repeater will automatically scale the deviation by a factor of two when it is outside the Tuner environment.

Note The emphasis setting of the Communication Analyzer must be turned off for this alignment procedure.

Note Programmed TPL and DPL squelch requirements are automatically disabled for the tuning frequency while in the Tuner environment.

- Adjust the softpot value until the best equalization is achieved across line two of the WL1 Wireline/Aux backplane connector terminals. Best equalization is achieved when the far side of the Wireline cable measures a flat response across the lower region of the audio spectrum. Compare the response at 400Hz with the response measured at 1000 Hz. The values should be approximately equal.



Location	Pin Assignment	Operation
1	Line 2+	2-wire or 4-wire
2	Line 2-	2-wire or 4-wire

Note It is imperative that the load the Wireline/Aux board is driving, matches that of the Wireline/Aux board's source impedance setting noted in the Tuner environment. Optimally, it is recommended to use the actual load which is used during normal operation of the radio.

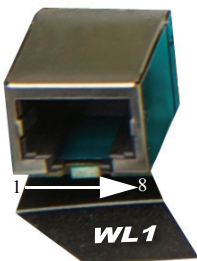
- Click "Write" to save the new tuned softpot value into the radio's codeplug.

10.8.4 Wireline Transmit Level Tuning

The procedure outlined in this section is used to adjust the level the Wireline is expecting on the Tx pair of the WL1 Wireline/Aux connector. Adjusting the expected level has the effect of increasing or decreasing RF signal deviation for a given Wireline Tx audio level. Perform this procedure during initial Wireline installation or any time the Tx audio level needs adjustment.

10.8.4.1 Tuning Procedure

- Connect the radio's transmitter antenna port to the Communication Analyzer.
- Power the base station/repeater from either an AC or DC source.
- Apply a 1 kHz signal at the desired input level (-36 dBm to +4 dBm) to the WL1 Wireline/Aux backplane connector terminals. This signal is known as "Test Tone" and corresponds with the level of average voice. Optimally, it is recommended to use the actual source which is used during normal operation of the radio to provide the signal.



Location	Pin Assignment	Operation
1	Line 2+	2-wire
2	Line 2-	2-wire
4	Line 1-	4-wire
5	Line 1+	4-wire

Note Most Motorola dispatch consoles can generate a 1 kHz tone at the correct level by using the "Alert Tone" feature. Consult the appropriate console manual for more information.

Note If the Wire Mode is set for 2 Wire operation, then inject the signal into the line two terminals of connector WL1. Otherwise, inject the signal into the line one terminals of WL1.

- Launch the Tuner application and click the "Read" button to read the softpot values.

5. Select “Wireline Transmit Level” under the Tx menu in the tree view (See [Figure 10-14](#)).

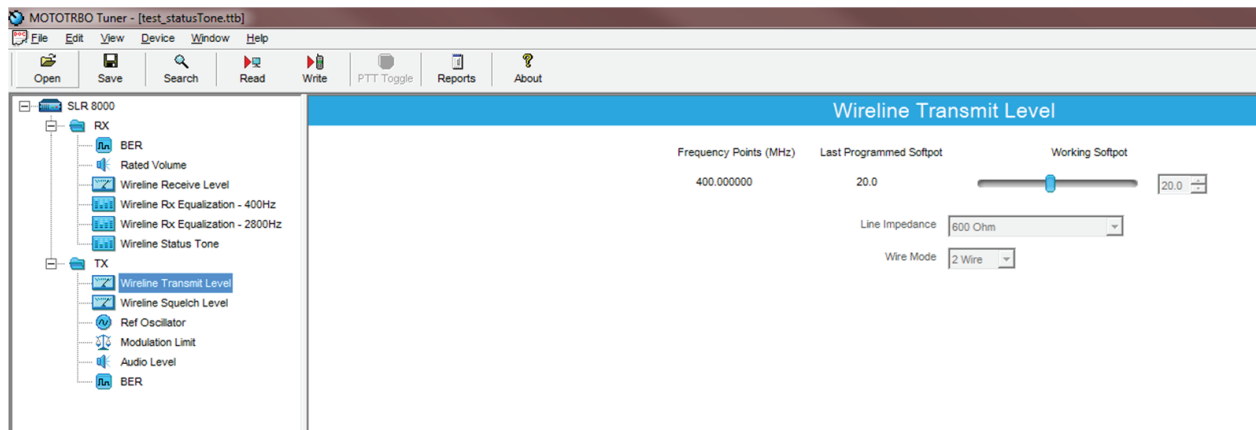


Figure 10-14 Tx Menu tree (Wireline Transmit Level)

6. Enter the tuning frequency into the Communication Analyzer (the value displayed on the Tuner GUI under the heading of “Frequency Points”).
7. Click the “PTT Toggle” button within the Tuner environment to key up the radio.

Note If enabled, the Wireline’s Automatic Level Control (ALC) and Wireline Squelch Hysteresis features are automatically turned off when the radio is keyed up from the “PTT Toggle” button within the Tuner environment. The features are automatically re-enabled when the radio is de-keyed by pressing the “PTT Toggle” button or when leaving the Tuner environment.

8. Adjust the softpot value until 60% of the rated system deviation (RSD) is achieved.

Note The Tuner aligns this parameter in a 12.5 kHz channel spacing, so 60% is 1.5 kHz of deviation. If the CPS is set for 25 kHz operation, the base station/repeater will automatically scale the deviation by a factor of two when it is outside the Tuner environment.

9. Click the “PTT Toggle” button within the Tuner environment to de-key the radio.
10. Click “Write” to save the new tuned softpot value into the radio’s codeplug.

10.8.5 Wireline Squelch Level Tuning

The Wireline Squelch feature is used to mute Wireline Tx audio when the audio level falls below a designated threshold. The procedure in this section is used to set the nominal squelch threshold. An additional hysteresis value can be added to the nominal squelch threshold by adjusting the “Squelch Hysteresis” setting in the Wireline configuration options of the CPS tool.

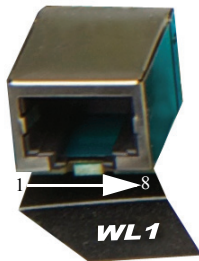
Note This calibration procedure should be performed after adjusting the Wireline Transmit Level. See [Section 10.8.4](#).

The Wireline Squelch level is adjusted relative to the expected audio level for High Level Guard Tone. This is true regardless of the Remote Control method selected. The expected level of High Level Guard Tone is 6 dB above the “Test Tone” level used during the Wireline Transmit Level tuning procedure of [Section 10.8.4](#).

Note It is possible to set the Wireline Squelch threshold higher than the level of average voice. Setting the Squelch threshold too high can result in unintended audio drop-outs or no audio at all.

10.8.5.1 Tuning Procedure

1. Connect the radio's transmitter antenna port to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Apply a 1 kHz signal, at the desired squelch threshold, to the WL1 Wireline/Aux backplane connector terminals. Optimally, it is recommended to use the actual source which is used during normal operation of the radio to provide the signal.



Location	Pin Assignment	Operation
1	Line 2+	2-wire
2	Line 2-	2-wire
4	Line 1-	4-wire
5	Line 1+	4-wire

Note If the Wire Mode is set for 2 Wire operation, then inject the signal into the line two terminals of connector WL1. Otherwise, inject the signal into the line one terminals of WL1. In addition, the Wire Mode used must be the same configuration as that was used in the Wireline Transmit Level alignment in [Section 10.8.4](#).

4. Launch the Tuner application and click the “Read” button to read the softpot values.

5. Select “Wireline Squelch Level” under the Tx menu in the tree view (See [Figure 10-15](#)).

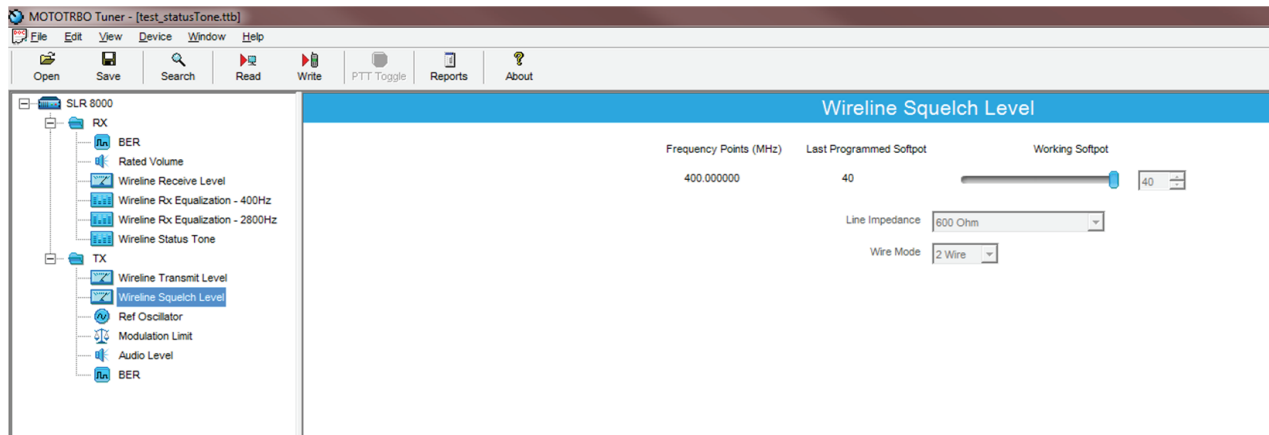


Figure 10-15 Tx Menu tree (Wireline Squelch Level)

6. Enter the tuning frequency into the Communication Analyzer (the value displayed on the Tuner GUI under the heading of “Frequency Points”).
7. Click the backplane “PTT Toggle” button within the Tuner environment to key up the radio.

Note If enabled, the Wireline’s Automatic Level Control (ALC) and Wireline Squelch Hysteresis features are automatically turned off when the radio is keyed up from the “PTT Toggle” button within the Tuner environment. The features are automatically re-enabled when the radio is de-keyed by pressing the “PTT Toggle” button or when leaving the Tuner environment.

Note The Wireline’s Automatic Level Control (ALC) alignment procedure can result in a difference between the Wireline Squelch Threshold set during this procedure and the actual value observed in normal operation. This difference can be eliminated or minimized, by carefully following the Wireline Transmit Level tuning procedure found in [Section 10.8.4](#) to obtain an accurate alignment.

8. Adjust the softpot value until the Communication Analyzer indicates that the deviation has dropped out (< 100 Hz of deviation).
9. Click the “PTT Toggle” button within the Tuner environment to de-key the radio.
10. Click “Write” to save the new tuned softpot value into the radio’s codeplug.

10.8.6 Wireline Status Tone Level Tuning (Analog Voting)

The procedure outlined in this section is used to set the status tone output level on the Wireline/Aux board's Rx path. Perform this procedure during initial Wireline/Aux board installation or anytime the Wireline receive audio level needs adjustment.

Note This calibration procedure should be performed after adjusting the Wireline Receive Level. See [Section 10.8.1](#).

10.8.6.1 Tuning Procedure

1. Connect the radio's receiver antenna port to the Communication Analyzer.
2. Power the base station/repeater from either an AC or DC source.
3. Launch the Tuner application and click the "Read" button to read the softpot values.
4. Select "Wireline Status Tone Level" under the Rx menu in the tree view (See [Figure 10-16](#))

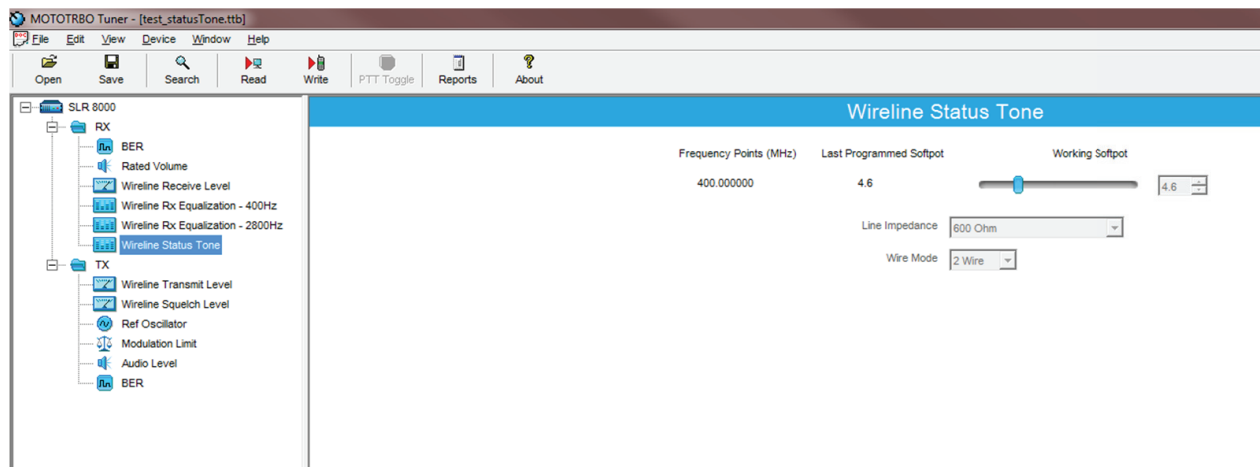


Figure 10-16 Rx Menu Tree (Wireline Status Tone Level)

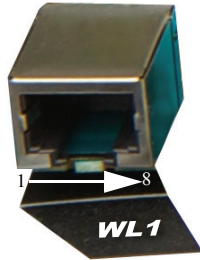
5. Set the Communication Analyzer to output a -47 dBm RF signal modulated with a 1 kHz tone at 100% of full deviation on the tuning frequency. The tuning frequency is the value displayed on the Tuner GUI under the heading of "Frequency Points".

Note The Tuner aligns this parameter in a 12.5 kHz channel spacing, so 100% is 2.5 kHz of deviation. If the CPS is set for 25 kHz operation, the base station/repeater will automatically scale the deviation by a factor of two when it is outside the Tuner environment.

Note Programmed TPL and DPL squelch requirements are automatically disabled for the tuning frequency while in the Tuner environment.

6. Note the audio level that is yielded from [step 5](#) and then remove the RF signal that was delivered to the base station/repeater in [step 5](#). The status tone level will now be generated with the absence of the RF carrier.

7. Relative to the audio level noted in [step 6](#), adjust the softpot value until the desired status tone level is achieved (0 to 20 dB below 100 % RSD) across line two of the WL1 Wireline/Aux backplane connector terminals.



Location	Pin Assignment	Operation
1	Line 2+	2-wire or 4-wire
2	Line 2-	2-wire or 4-wire

Note It is imperative that the load the Wireline/Aux board is driving, matches that of the Wireline/Aux board's source impedance setting noted in the Tuner environment. Optimally, it is recommended to use the actual load which is used during normal operation of the radio.

8. Click "Write" to save the new tuned softpot value into the radio's codeplug.

Chapter 11 SLR 8000 Maintenance and Disassembly/Reassembly

11.1 Introduction

This chapter provides details about the following:

- Routine maintenance
- Preventive maintenance (inspection and cleaning)
- Safe handling of CMOS and LDMOS devices
- Disassembly and reassembly of the base station/repeater

11.2 Routine Maintenance

Note It is recommended that the base station/repeater is cleaned with a soft dry cloth while in service.

The base station/repeater and ancillary equipment have been designed with state-of-the-art technology and operate under software control, thus requiring minimal routine maintenance. Virtually all base station/repeater operating parameters are monitored and self-corrected by the Modem and the firmware it runs, which makes adjustments and tuning virtually unnecessary.

Provided that the equipment is installed in an area which meets the specified environmental requirements, the only routine maintenance task required is the calibration of the base station/repeater reference oscillator circuit.

11.3 Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

11.3.1 Inspection

Check that the external surfaces of the base station/repeater are clean, and that all external controls and connections are in order. It is not recommended to inspect the interior electronic circuitry.

11.3.2 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 base station/repeater. External surfaces include the top cover and base station/repeater enclosure.

Periodically clean smudges and grime from exterior enclosure. Use a soft, non-abrasive cloth moistened in a 0.5% solution of mild dishwashing detergent 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 base station/repeater is disassembled for service or repair.

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 base station/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 base station/repeater enclosure.

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

11.4 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 stations, 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 base station/repeater without first referring to the following CAUTION statement.



Caution

This base station/repeater contains static-sensitive devices. Do not open the base station/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 can be ordered using the 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.

11.5 Disassembly of Optional Equipment

11.5.1 External Circulator Tray Disassembly/Reassembly

Note For the correct procedure in handling static-sensitive parts, see [Section 11.4](#).

1. Wear an electrostatic discharge (ESD) strap and connect its cable to a verified good ground. This strap must be worn throughout this procedure to prevent ESD damage to any components.
2. Turn off the DC breaker, and/or pull the AC source power cord from the back of the base station/repeater.
3. Remove the filter tray from the rack, as follows:
 - a. Label and disconnect the RF input, RF output, and ground cables from the tray.
 - b. Disconnect the Circulator Load temperature cable at the inline connector (which disconnects it from the cable leading to the RF Peripherals port on the base station/repeater backplane interface board).

Note Skip Step 3(b) for the UHF band.

- c. Using a Torque Driver T30 bit, remove the two screws which secure the tray to the rack.
 - d. Slide the tray out from the front of the rack.
4. If an individual External Dual Circulator module is replaced, perform the steps below. Otherwise, proceed to [Step 5](#).
 - a. Label and disconnect the RF input and RF output cables from the External Dual Circulator module.
 - b. Unscrew the connector that secures the Circulator Load to the External Dual Circulator module.
 - c. Remove the screws that secure the circulator baseplate to the tray.
 - d. Remove the circulator module including the circulator load module that extends beyond the baseplate.
 - e. Place the new External Dual Circulator module in the tray in the same location and orientation as the module which will be replaced.
 - f. Secure the new External Dual Circulator module baseplate to the tray using the screws previously removed.
 - g. Connect the RF input and RF output cables to the new External Dual Circulator module.
 - h. Connect the Circulator Load to the External Dual Circulator module.
5. If an individual Circulator Load is replaced, perform the steps below. Otherwise, proceed to [Step 6](#).
 - a. Unscrew the connector that secures the Circulator Load to the External Dual Circulator module.
 - b. Remove the Circulator Load module.
 - c. Place the new Circulator Load module on the tray in the same position and orientation as the module which will be removed.
 - d. Secure the new Circulator Load to the External Dual Circulator module by tightening the connector.

- e. Connect the Circulator load cable to the RF Peripherals port on the base station/repeater backplane interface board.

Note Skip Step 5(e) for the UHF band.

6. If an individual Low Pass/Harmonic Filter module is replaced, perform the steps below. Otherwise, proceed to [Step 7](#).
 - a. Label and disconnect the RF input and RF output cables from the Low Pass/Harmonic Filter module.
 - b. Pull up firmly to release the Low Pass Filter module from the two semi-circular clips holding it in place.
 - c. Insert the new Low Pass Filter module into the semi-circular clips using the same orientation as the module which will be replaced.
 - d. Connect the RF input and RF output cables to the new Low Pass/Harmonic Filter module.
7. If the entire tray including all of its modules are replaced, install the replacement tray in the rack.
8. Turn on the DC breaker, and/or connect the AC source power cord to the back of the base station/repeater.
9. Verify that the base station/repeater is operating properly using Customer Programming Software (CPS).




Caution

Shock Hazard. The SLR 8000 Base Station/Repeater contains voltages which can cause damage to the base station/repeater or other equipment if a short circuit occurred. Turn off the DC breaker, and/or pull the AC source power cord from the back of the base station/repeater when servicing this component in the base station/repeater.

11.6 Disassembly

11.6.1 Disassembly – General

Station modules suspected of being faulty must be replaced with known good modules to restore the base station/repeater to proper operation. The following are typical procedures to remove each of the base station/repeater modules.

	Power cord (and battery backup power, if used) and all external cables must be disconnected before opening up base station/repeater.
Caution	

1. Label each removed cable as required to ensure it is properly reconnected.
2. Take the proper grounding precautions as stated in [Section 11.4 on page 11-2](#).
3. When disassembling base station/repeater, retain all screws for reuse.

The following tools are required for disassembling and reassembling the base station/repeater:

- Torque Drivers (T10, T15, T20 and T30).
- Hex Nut Drivers (8 mm, 16 mm, 3/4 inch)
- Needle Nose Pliers (optional)
- Torque Gauge capable of measuring torque up to 20 lb-in within +/- 1 lb-in

If a unit requires more complete testing or service than is customarily performed at the basic level, send the base station/repeater or FRU to a Motorola Service Center.

The following disassembly procedures should be performed only if necessary.

11.6.2 Disassembly – Detailed

11.6.2.1 Cosmetic Cover Disassembly

1. Remove the ten screws securing the bottom cover with a T10 Torx driver.

2. Detach the bottom cover.

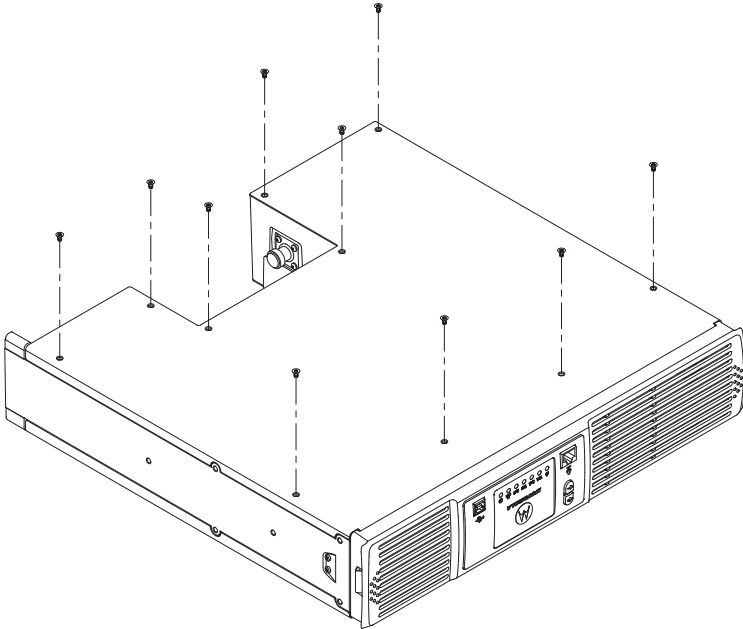


Figure 11-1 Removing Bottom Cover from Base Station/Repeater

3. Remove the screw securing the top cover with a T15 Torx driver. See [Figure 11-2](#).
4. Remove the remaining ten screws securing the top cover with a T10 Torx driver.
5. Detach the top cover.

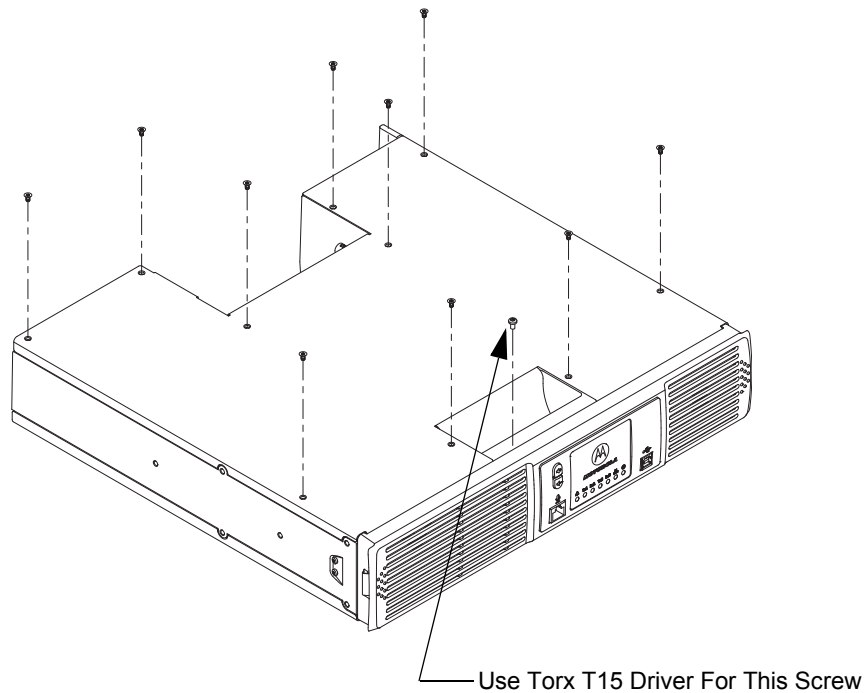


Figure 11-2 Removing Top Cover from Base Station/Repeater

11.6.2.2 Front Bezel Disassembly

1. Place one hand on each side flange of the front bezel.
2. Pull front bezel away from the base station/repeater to disengage from the locking clips.

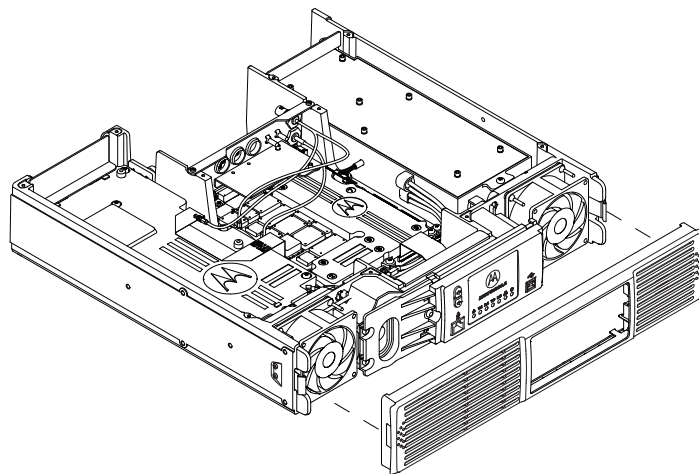


Figure 11-3 Removing Front Bezel from Base Station/Repeater

11.6.2.3 Faceplate Disassembly

1. Disengage the flex cable from the Modem that connects to the faceplate.

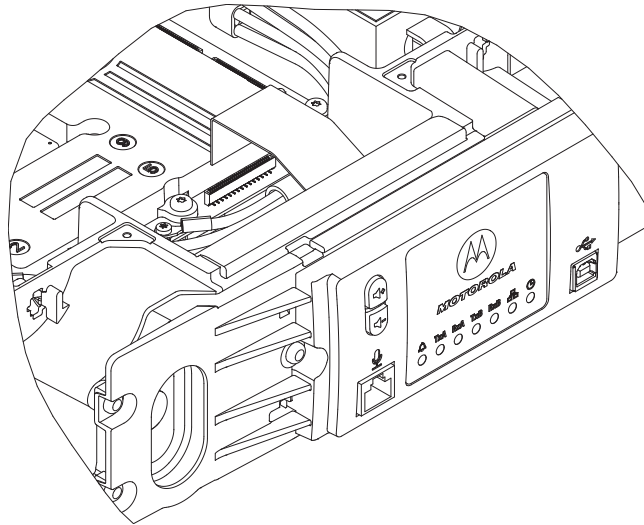


Figure 11-4 Disconnecting Flex Cable from Modem

2. Remove the four screws securing the faceplate to the repeater frame with a T20 Torx driver. Remove the faceplate assembly from the unit. Do not attempt to remove the thermal pad from the frame.

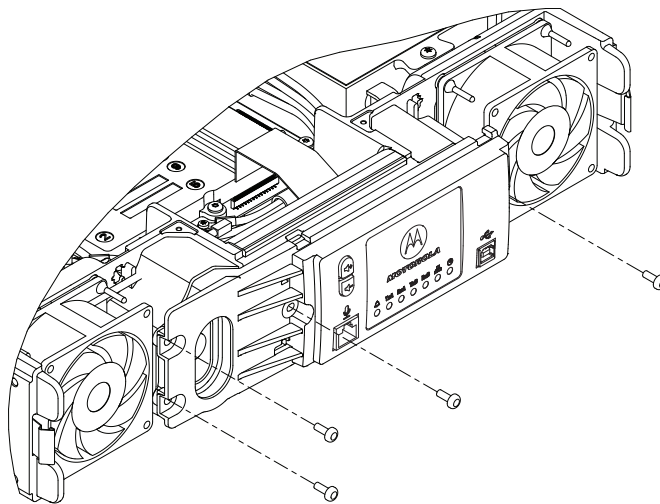


Figure 11-5 Removing Faceplate from Base Station/Repeater Frame

11.6.2.4 Faceplate Disassembly– Detailed

1. Disconnect the speaker cable from the connector on the PCB. Pull the speaker boot assembly out of the faceplate.
2. Remove the six screws securing the PCB to the faceplate with a T10 Torx driver and remove the PCB from the faceplate.
3. Pull the keypad out of the faceplate.

11.6.2.5 Fan Module Disassembly

Note If replacing the fans only, it is not necessary to remove the base station/repeater from the rack or remove either of the covers. However, please ensure that the power cord and all external cables are disconnected per [Section 11.6.1](#) and the front bezel is removed per [Section 11.6.2.2](#).

1. Disengage the cable from the Power Amplifier fan and its connection.
2. Disengage the cable from the Power Supply fan and its connection.
3. Disengage the latch on the fan clip by putting a flathead screwdriver through the gaps in the fan blades. See [Figure 11-6](#).

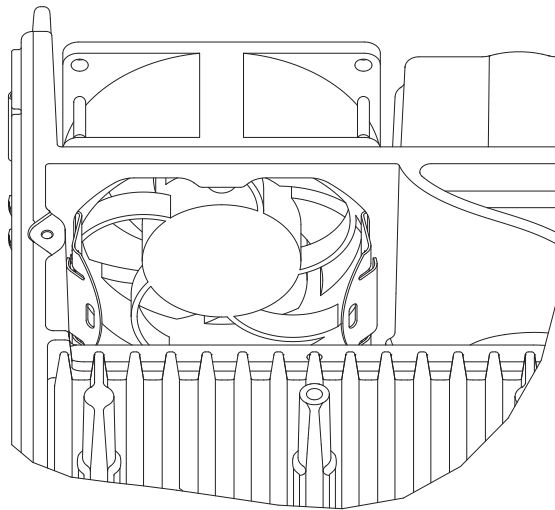


Figure 11-6 Disengaging Latch on Fan Clip

11.6.2.6 Bezel Clip Disassembly

1. Remove the two screws from each of the two bezel clips with a T10 Torx driver.

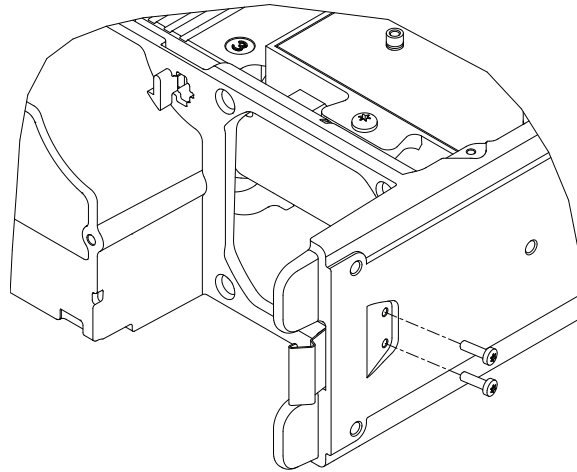


Figure 11-7 Removing Screws from Bezel Clip

11.6.2.7 Cable Disassembly

Note When disengaging flexible cables, pull parallel to the insertion direction of the cable to avoid damaging the cables.

1. Remove the flex cable that connects the Power Amplifier module to the Modem module by pulling out of the connectors.
2. Remove the RF cable that connects the Power Amplifier module to the Modem module.
3. Disconnect the RX Input cable from the Modem.
4. Disconnect the RX Reference cable from the Modem.
5. Disconnect the 15-pin connector from the Modem.
6. Disconnect the Chassis ID cable from the Modem.

Note DO NOT attempt to remove the Chassis ID flex from the chassis. DAMAGE will occur.

7. Unscrew the power lug from the Power Amplifier module with a T10 Torx driver.
8. Unscrew the ground lug from the Power Amplifier module with a T10 Torx driver.
9. Unscrew the power lug from the Modem with a T10 Torx driver.
10. Unscrew the ground lug from the Modem with a T10 Torx driver.
11. Disengage the fan jumper cable near the Power Amplifier module from the chassis.
12. Disengage the fan jumper cable near the Power Supply module from the chassis.

13. Remove the screw for each of the cable clamps securing the cables from the Power Supply module with a T20 Torx driver. Remove the cable clamps.

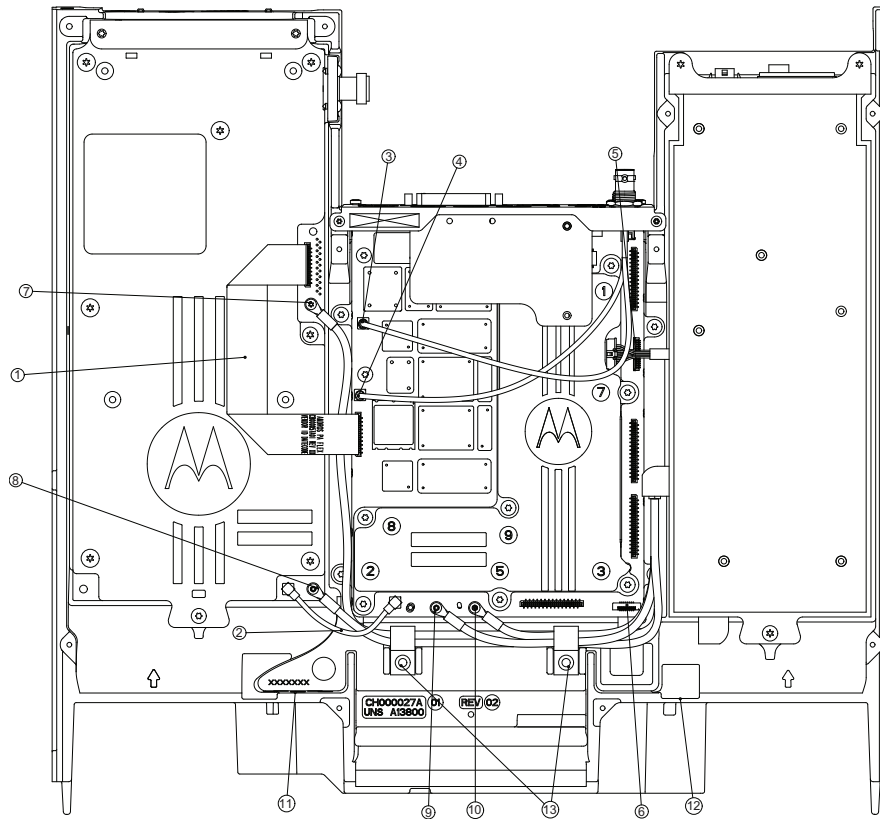


Figure 11-8 Removing Cables

11.6.2.8 Power Supply Module Disassembly

Note Ensure all connections from Power Supply to various parts of the repeater have been detached.

1. Remove the three screws securing the Power Supply module to the base station/repeater frame with a T20 Torx driver.
2. Remove the Power Supply module and back plate from the base station/repeater.

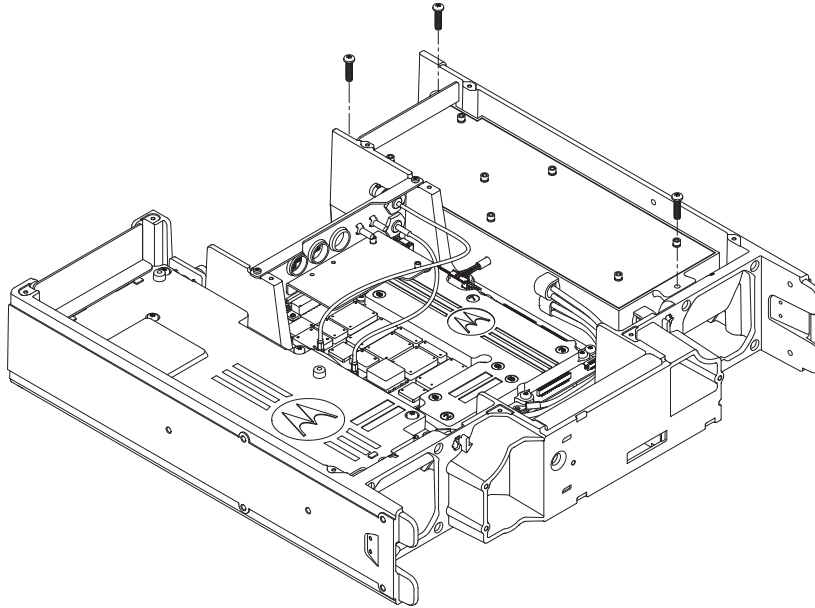


Figure 11-9 Removing Power Supply Module

11.6.2.9 Modem Module Disassembly

Note Ensure all connections from Power Supply to various parts of the repeater have been detached.

1. Remove the four screws securing the Modem module to the base station/repeater frame with a T20 Torx driver. See [Figure 11-10](#).
2. Remove the Modem module and Modem Gasket seal from the base station/repeater.

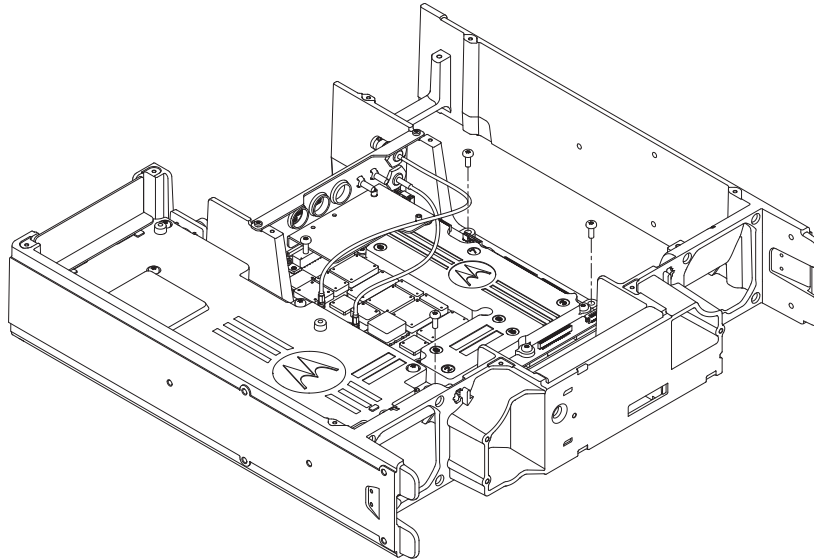


Figure 11-10 Removing Modem Module

11.6.2.10 Power Amplifier Disassembly

Note Ensure all connections from Power Supply to various parts of the repeater have been detached.

1. Remove the three screws securing the Power Amplifier module to the base station/repeater frame with a T20 Torx driver. See [Figure 11-11](#).
2. Remove the Power Amplifier module and back plate from the base station/repeater.

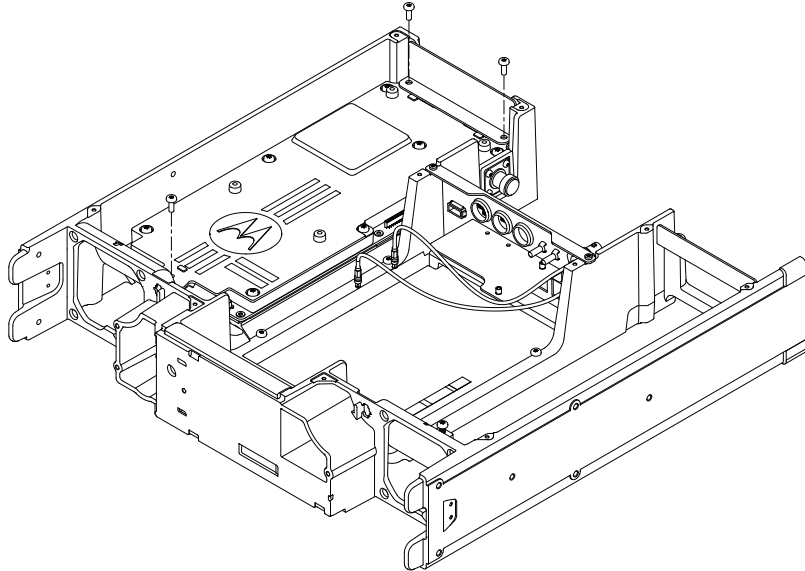


Figure 11-11 Removing Power Amplifier

11.6.2.11 Back Panel Disassembly

1. Using a 16 mm hex nut driver, remove the two nuts securing the RX and Reference BNC cables to the back panel.
2. Remove the two corresponding lock washers and both cables.
3. Using a T10 Torx driver, remove the four screws securing the back panel to the base station/repeater frame.
4. Remove the back panel from the base station/repeater.

11.7 Reassembly

11.7.1 Reassembly – Detailed

11.7.1.1 Bottom Cover Installation

1. Instal the ten flathead M3 x 6 mm screws each (PN: 0310913B41) to 10 lb-in using a T10 Torx driver in the locations as shown in [Figure 11-12](#) to secure the bottom cover to the base station/repeater chassis.

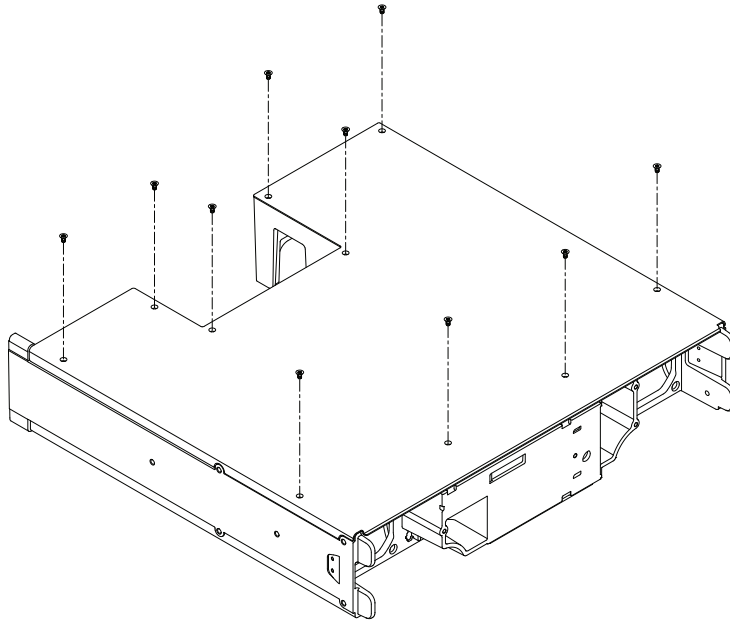


Figure 11-12 Securing Bottom Cover to Base Station/Repeater

11.7.1.2 Power Amplifier Module Installation

a. For base station/repeater without Preselector Module:

1. Connect the Power Amplifier to Modem flex cable (PN: CB000057A01) into the connector on the Power Amplifier module. See [Figure 11-13](#) for orientation.
2. Place the Power Amplifier module (PN: PMTE4000_) into the chassis using the grip points at the ends to lower into place.
3. Place the Power Amplifier back panel (PN: EN000020A01) into place at the rear of the base station/repeater. See [Figure 11-13](#) for reference.
4. Using a T20 Torx driver, install two M4 x 16 mm screws (PN: 0371274L02) through the back panel clearance holes into the mounting points on the Power Amplifier module to 15 lb-in.
5. Install a third M4 x 16 mm screw (PN: 0371274L02) at the mounting location at the other end of the module to 15 lb-in.

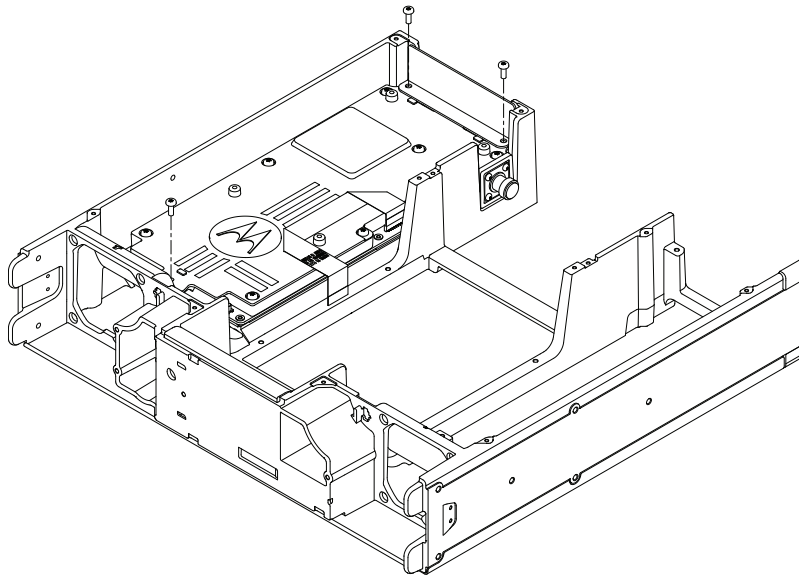


Figure 11-13 Installing the Power Amplifier Module

b. OPTIONAL - For base station/repeater with Preselector Module:

1. Connect the Power Amplifier to Modem flex cable (PN: CB000057A01) into the connector on the Power Amplifier module. See [Figure 11-14](#) for orientation.
2. Place the Power Amplifier module (PN: PMTE4000_) into the chassis using the grip points at the ends to lower into place.
3. Using a T20 Torx driver, install two M4 x 16 mm screws (PN: 0371274L02) through the back panel clearance holes into the mounting points on the Power Amplifier module to 15 lb-in.
4. Install a third M4 x 16 mm screw (PN: 0371274L02) at the mounting location at the other end of the module to 15 lb-in.
5. Place the Preselector Module onto place on top of the Power Amplifier Module. See [Figure 11-14](#) for reference.

- Using a T20 Torx driver, install four screws (PN: 0310909A59) into place to 15 lb-in.

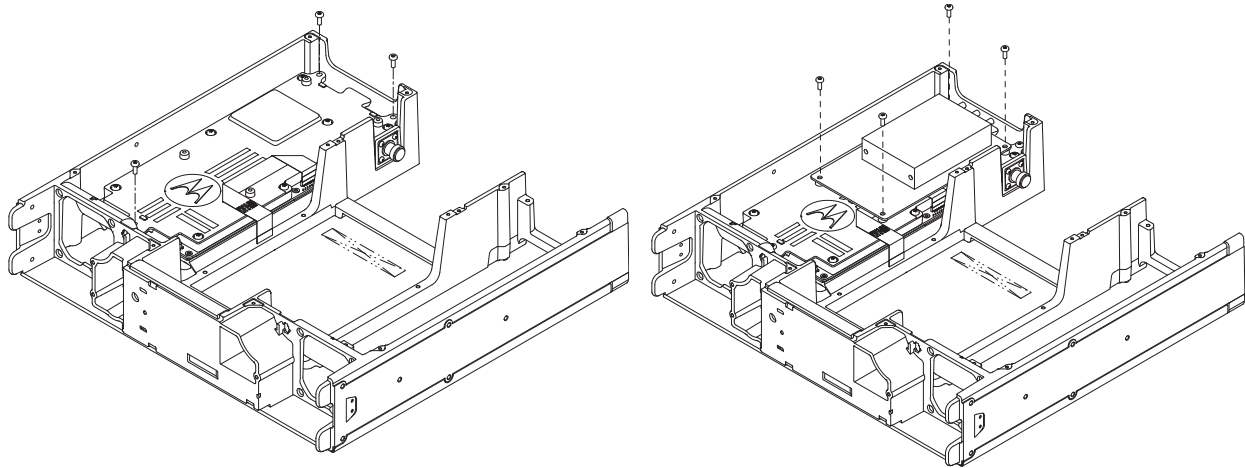


Figure 11-14 Installing the Power Amplifier Module and Preselector Module

11.7.1.3 Modem Module Installation

- Secure the Modem Gasket seal (PN: SL000100A01) onto the chassis.

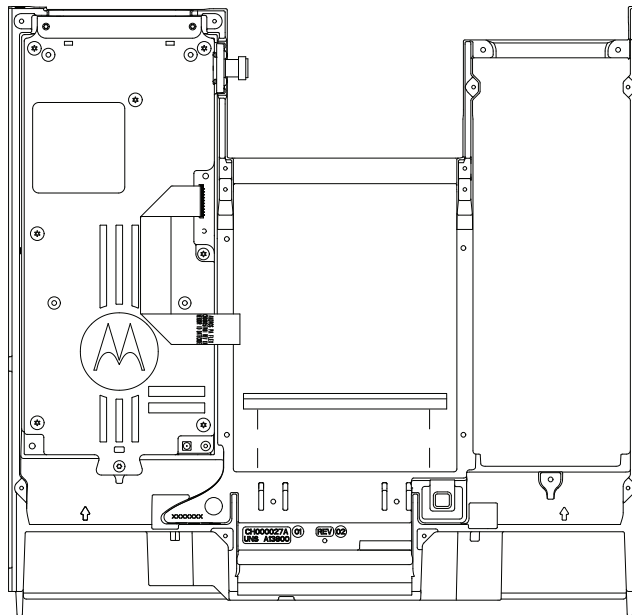
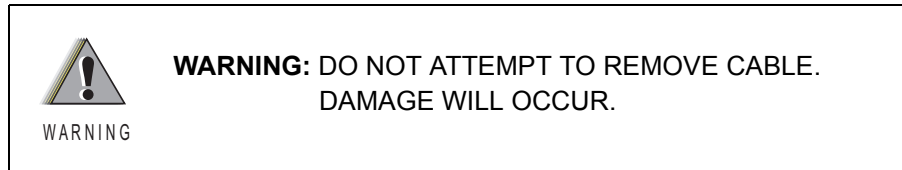


Figure 11-15 Securing Modem Gasket Seal

2. Lift the Chassis ID cable out of the way.



3. Place the Modem (PN: PMTE4032_) onto the chassis.
4. Using a T20 Torx driver, install the four M4 x 16 mm screws (PN: 0371274L02) and tighten to 15 lb-in.

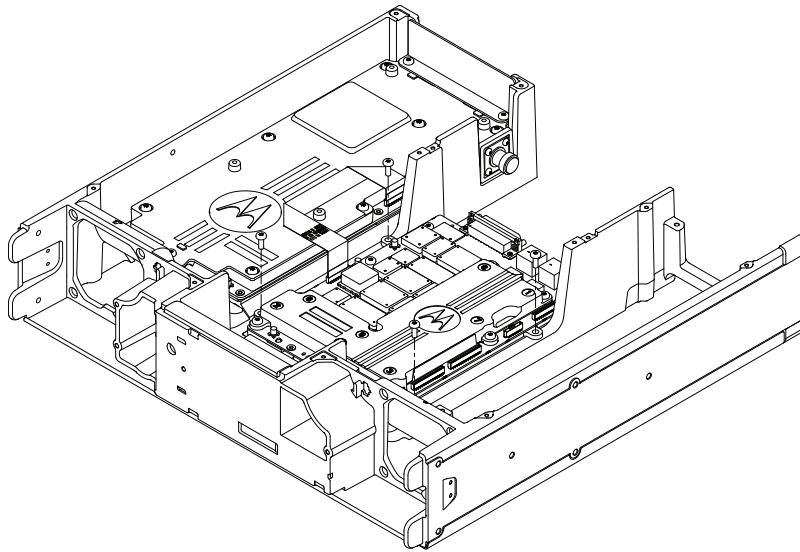


Figure 11-16 Securing Modem to Base Station/Repeater Chassis

11.7.1.4 Power Supply Installation

a. For base station/repeater without Wireline Card:

1. Place the Power Supply module (PN: PMPN4053_) into the chassis.
2. Place the Power Supply back panel (PN: EN000035A01) into place at the rear of the base station/repeater. See [Figure 11-17](#) for reference.
3. Using a T20 Torx driver, install two M4 x 16 mm screws (PN: 0371274L02) through the back panel clearance holes into the mounting points on the Power Supply module to 15 lb-in.

4. Install a third M4 x 16 mm screw (PN: 0371274L02) at the mounting location at the other end of the module to 15 lb-in.

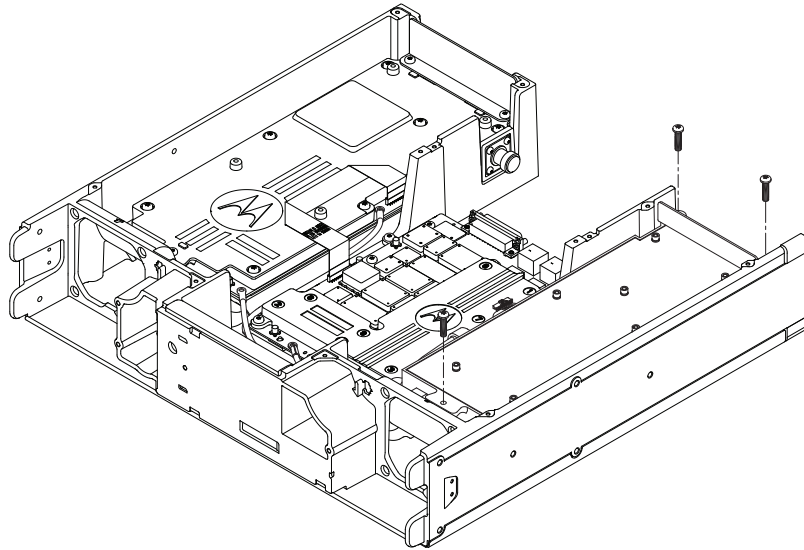


Figure 11-17 Securing Power Supply to Base Station/Repeater Chassis

b. OPTIONAL - For base station/repeater with Wireline Card

1. Place the Power Supply module (PN: PMPN4053_) into the chassis.
2. Using a T20 Torx driver, install two M4 x 16 mm screws (PN: 0371274L02) through the back panel clearance holes into the mounting points on the Power Supply module to 15 lb-in.
3. Install a third M4 x 16 mm screw (PN: 0371274L02) at the mounting location at the other end of the module to 15 lb-in.
4. Place the Wireline card onto the Power Supply Module and using a T15 Torx driver, install seven M3.5 screws (PN: 0310909A45) into place as shown in [Figure 11-18](#).

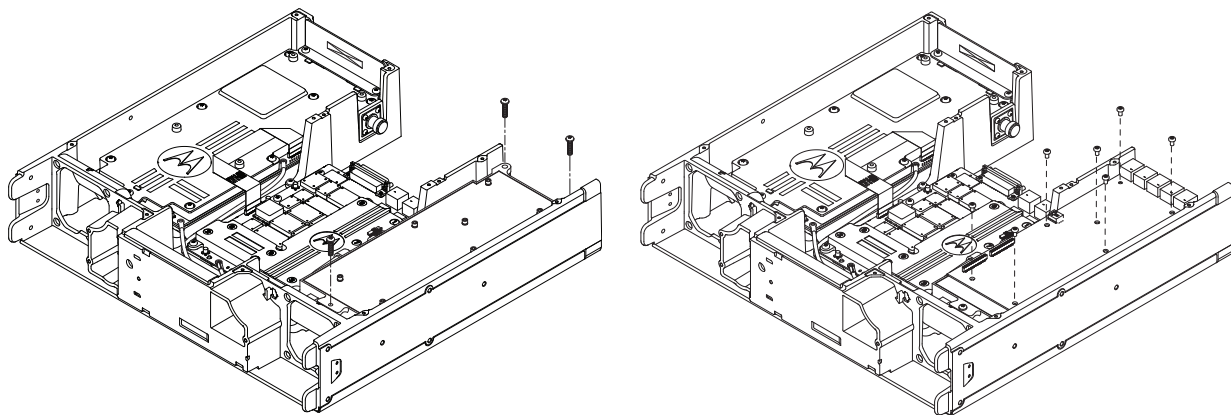


Figure 11-18 Securing Power Supply with Wireline Card to Base Station/Repeater Chassis

11.7.1.5 Back Panel Installation

1. Place the back panel (PN: EN000019A01) onto chassis.
2. Hold the top corners to ensure the back panel seats flat.
3. Using a T10 Torx driver, install four M3 x 6 mm screws (PN: 0310907A18) to 10 lb-in. See [Figure 11-19](#).

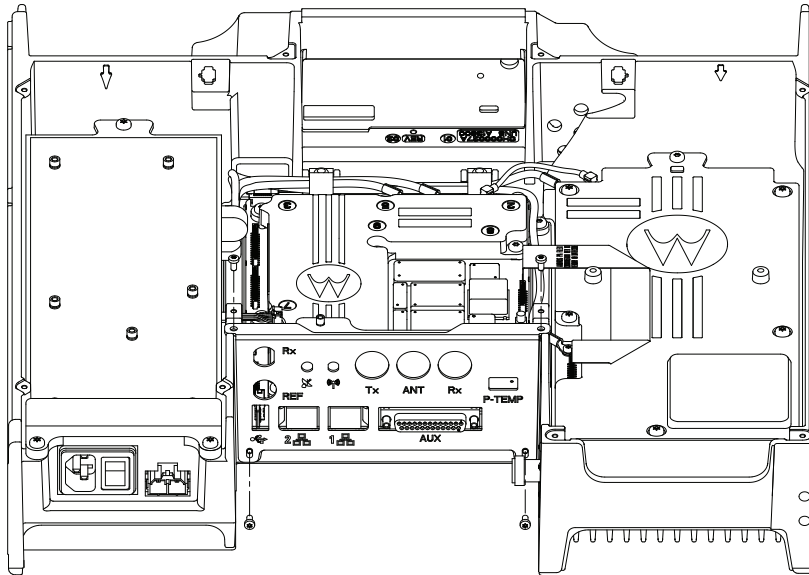


Figure 11-19 Securing Back Panel to Base Station/Repeater

11.7.1.6 OPTIONAL - Antenna Relay Installation

For base station/repeater with Antenna Relay Module

1. Place the Antenna Relay module onto the back panel as shown in [Figure 11-20](#).
2. Using a T10 Torx driver, install two M3 screws (PN: 0310909A54) into place.

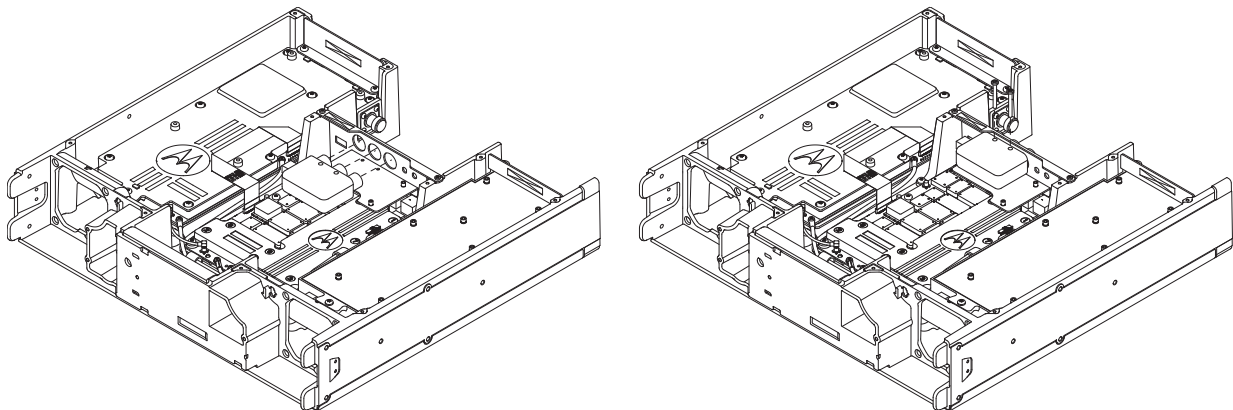


Figure 11-20 Securing Antenna Relay Module

11.7.1.7 Receive Cable Installation

1. Assemble the BNC to MCX coax cables (PNs: CB000058A01 and CB000164A01) into the corresponding holes in the back panel.
2. Install the washer and nuts. Using a 16 mm hex nut driver, tighten to 15 lb-in.

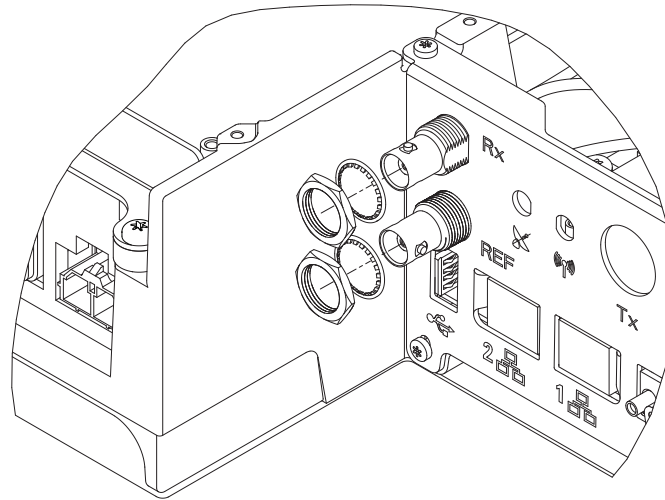


Figure 11-21 Installing RX Cables

11.7.1.8 Faceplate Installation

1. Install the Front Panel to Modem Flex cable (PN: 84007002001) into the connector on the Faceplate assembly.
2. Ensure the cable is fully seated and installed straight.

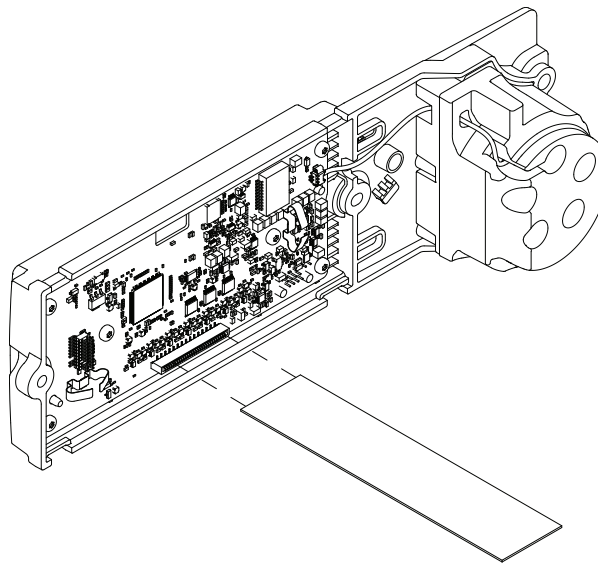


Figure 11-22 Installing Front Panel to Modem Flex Cable

3. Place the Faceplate (Kit Number: PMLN6822_) onto the front of the base station/repeater using the alignment pins to guide into place.

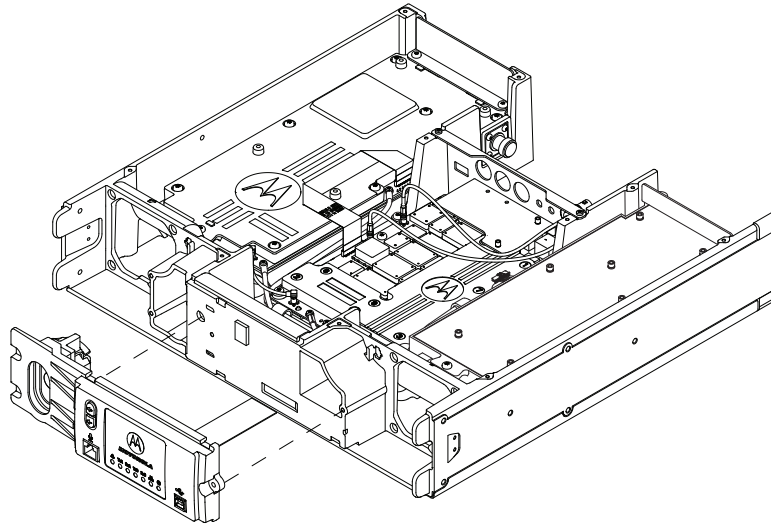


Figure 11-23 Aligning Faceplate to Front of Base Station/Repeater

4. Using a T20 Torx driver, install the four M4 x 10 mm screws (PN: 0310909A61) to 15 lb-in in the order shown in [Figure 11-24](#).

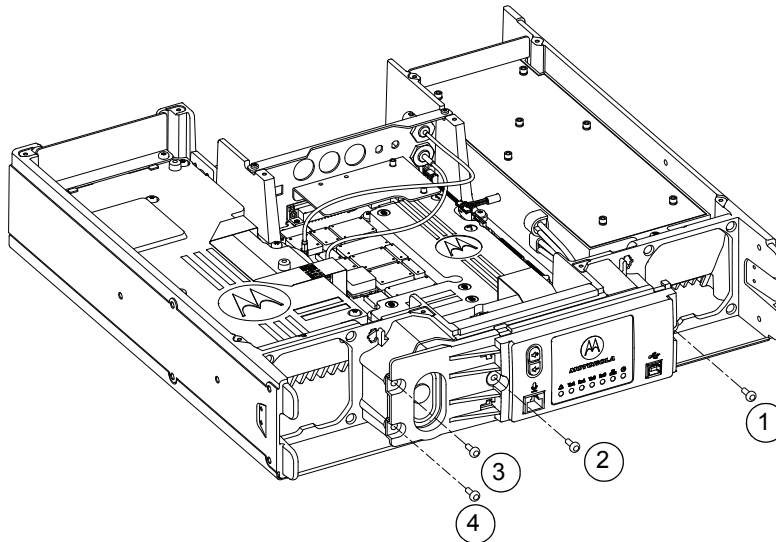
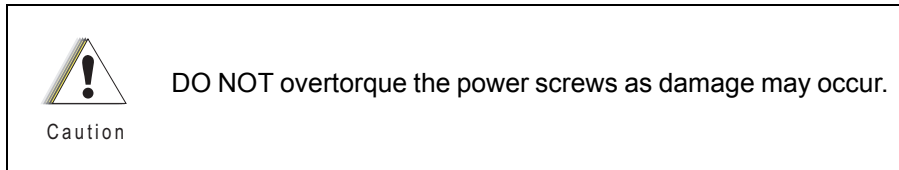
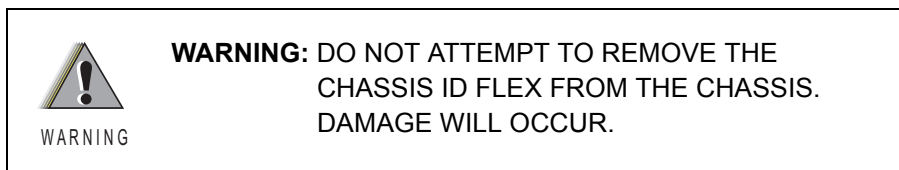


Figure 11-24 Securing Faceplate to Base Station/Repeater

11.7.1.9 Cable Installation



1. Install the two power screws from the Power Supply Module into the Power Amplifier board at location 1 in [Figure 11-25](#). Tighten to 6.5 lb-in using a T10 Torx driver.
2. Install the two power screws from the Power Supply Module into the Modem board at location 2 in [Figure 11-25](#). Tighten to 6.5 lb-in using a T10 Torx driver.
3. Snap the Power Amplifier Fan cable connector into the chassis at location 3 in [Figure 11-25](#).
4. Snap the Power Supply cable connector into the chassis at location 4 in [Figure 11-25](#).
5. Place the Power Amplifier, Modem and Power Amplifier Fan cables into the cable clamp (PN: 42009306002) and using a M4 x 10 mm screw (PN: 0310909A61) drive clamp into location 5 in [Figure 11-25](#). Tighten to 15 lb-in using a T20 Torx driver.
6. Place the Power Amplifier and Power Amplifier Fan cables into the cable clamp (PN: 42009306002) and using a M4 x 10 mm screw (PN: 0310909A61) drive clamp into location 6 in [Figure 11-25](#). Tighten to 15 lb-in using a T20 Torx driver.
7. Connect the Front Panel to Modem flex into the Modem at location 7 in [Figure 11-25](#).
8. Connect the Chassis ID flex to the Modem at location 8 in [Figure 11-25](#).



9. Connect the signal cable from the Power Supply to the Modem at location 9 in [Figure 11-25](#).
10. Connect the Power Amplifier to Modem coax cable (PN: CB000419A01) to the Power Amplifier board and Modem board in location 11 in [Figure 11-25](#).
11. Connect the Rx input coax cable to location 12 on the Modem in [Figure 11-25](#).
12. Connect the Rx reference coax cable to location 12 on the Modem in [Figure 11-25](#).

13. Snap the Fan cable connectors into the chassis in locations 13.

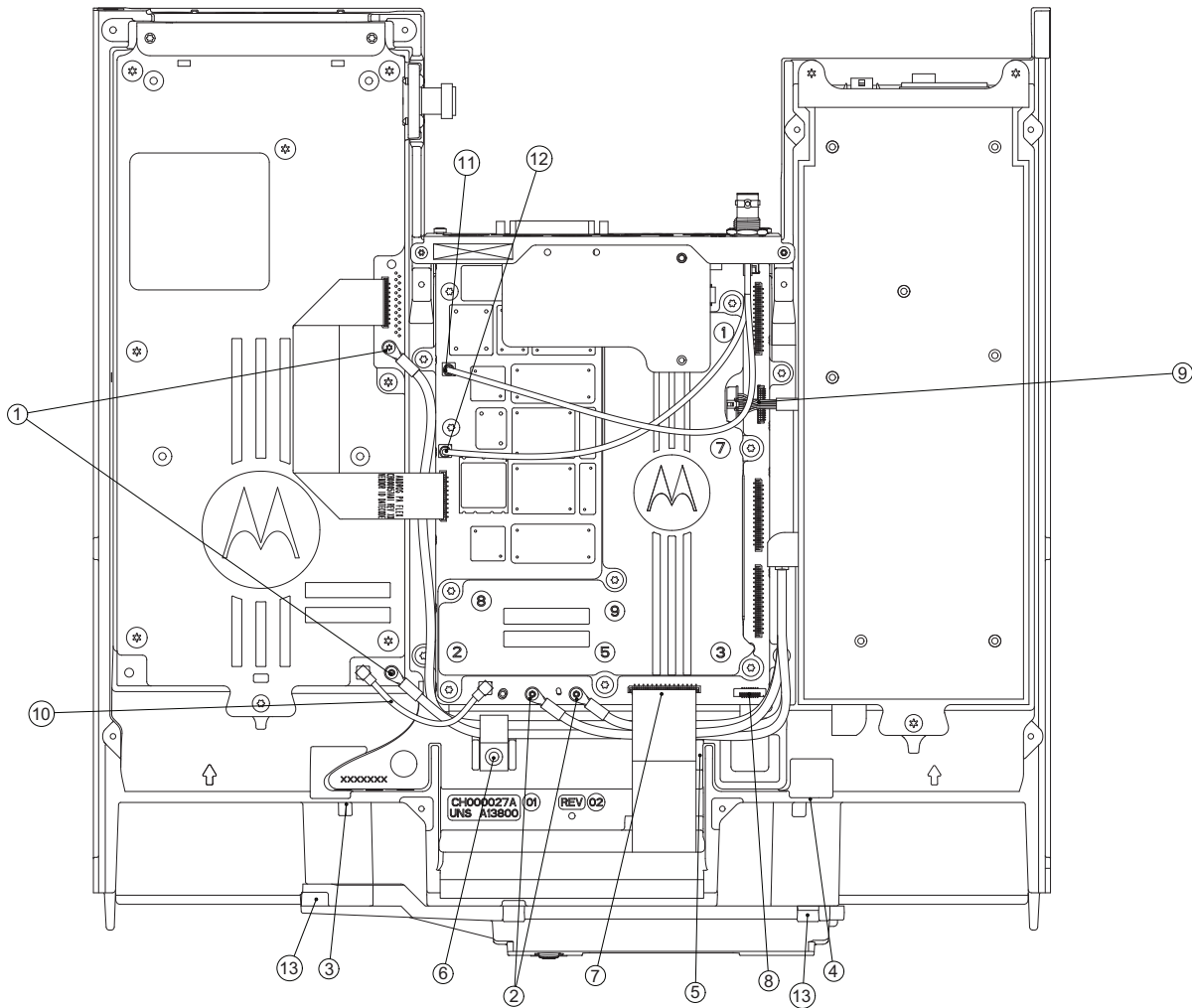


Figure 11-25 Cable Installation

OPTIONAL - Option Cable Installation

14. If using Wireline Card, install the two flex cables (PN: CB000057A03) from the Modem to the Wireline Card in locations shown in [Figure 11-26](#).
15. If using Preselector Module, connect the Rx input cable into the location on the Preselector as shown in [Figure 11-26](#).

Use the cable (PN: CB000059A01) which is included, to connect from the Preselector to the Modem as shown in [Figure 11-26](#).

16. If using Antenna Relay, connect the cable (PN: CB000062A01) from the Wireline Card to the Antenna Relay as shown in [Figure 11-26](#). Snap the remaining connector on cable CB000062A01 into the back panel location.

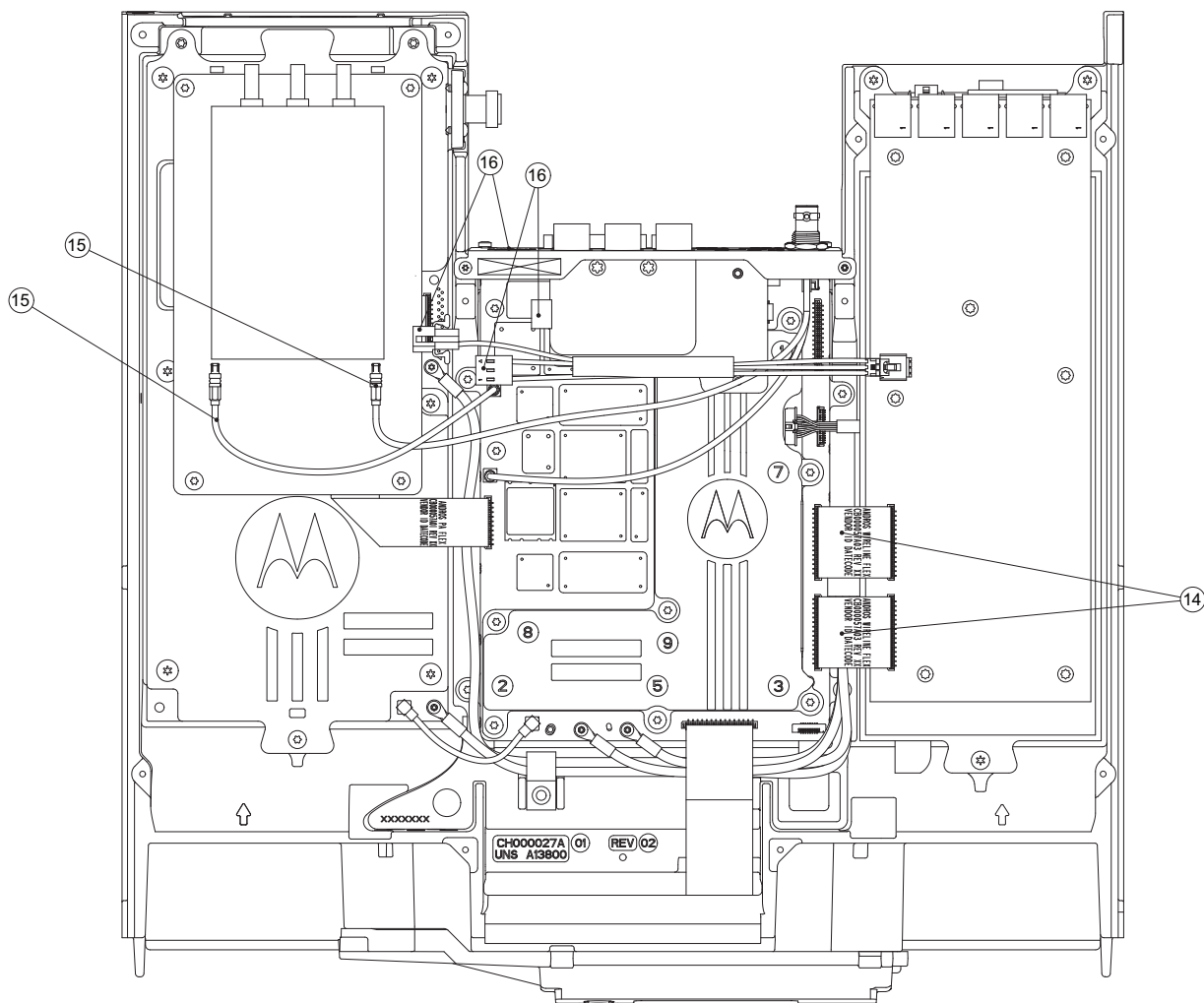


Figure 11-26 Option Cable Installation

11.7.1.10 Bezel Clip Installation

1. Place the Bezel clip (PN: BR000050A01) in the location and orientation as shown in [Figure 11-27](#).
2. Install two M3 x 10 mm screws (PN: 0310907A20) through the chassis into the clip nut and tighten to 10 lb-in using a T10 Torx driver.
3. Repeat the process for the second Bezel clip on the opposite side of the base station/ repeater.

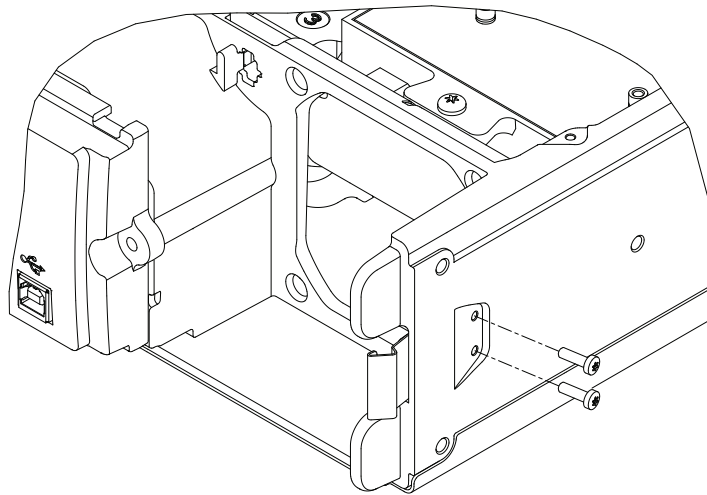


Figure 11-27 Installing Bezel Clip

11.7.1.11 Fan Installation

1. For each of the two fan clips (PN: BR000141A01) pull the four rubber isolators (PN: HW000743A01) through the fan clips to position as shown in [Figure 11-28](#).
2. Once all four rubber isolators are pulled through the fan clips, pull the rubber isolators through the fans (PN: MR121971A02), orienting the fans such that the wires are in line with the printed text “wires” on the fan clip.
3. Ensure the blowing direction is correct. See [Figure 11-28](#).

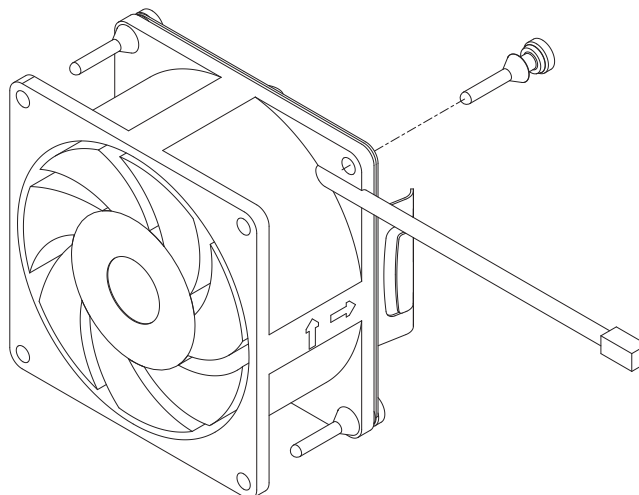


Figure 11-28 Securing and Positioning the Rubber Isolators

4. Orient the fan on the left as shown in [Figure 11-29](#) and push into place until a click is heard and the fan clip is secured into the base station/repeater.
5. Orient the fan on the right 180 degrees counterclockwise such that the cable is facing the left and the vertical arrow is pointing downwards. Push the fan into place until a click is heard and the fan clip is secured into the base station/repeater.
6. Connect the fan cable to the jumper cable that is mounted into the chassis.

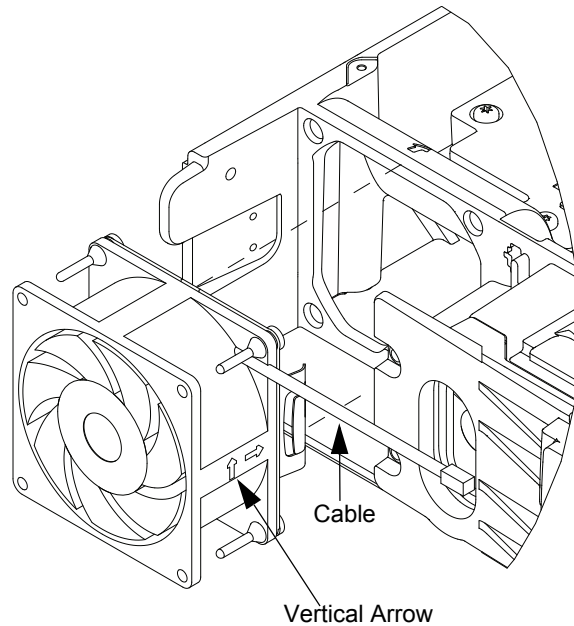


Figure 11-29 Installing Fan

11.7.1.12 Option Plug Installation

1. For models without the Expansion Board, install two Expansion Board plugs (PN: 3287533V01) into the holes as shown in [Figure 11-30](#).

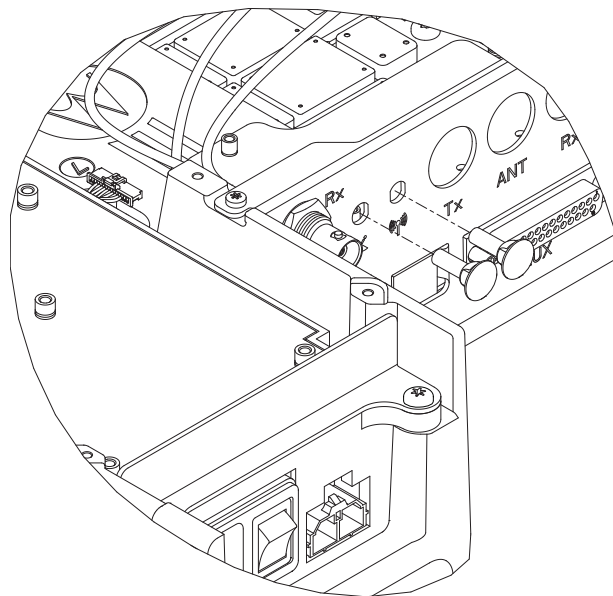


Figure 11-30 Installing Expansion Board Plugs

2. For models without the Antenna Relay, install the Antenna Relay plug and Brown Wire plug onto the back panel of the base station/repeater. See [Figure 11-31](#).

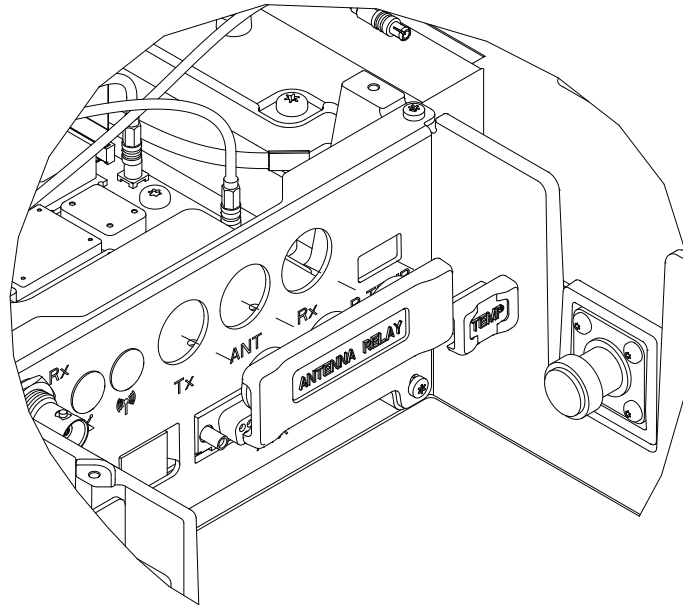


Figure 11-31 Installing Antenna Relay and Brown Wire Plugs

11.7.1.13 Top Cover Installation

1. Install one M3.5 x 6 mm screw (PN: 0310909A45) into the location indicated in [Figure 11-32](#).
2. Tighten to 10 lb-in using a T15 Torx driver.
3. Install ten flathead M3 x 6 mm screws (PN: 0310913B41).
4. Tighten to 10 lb-in using a T10 Torx driver.

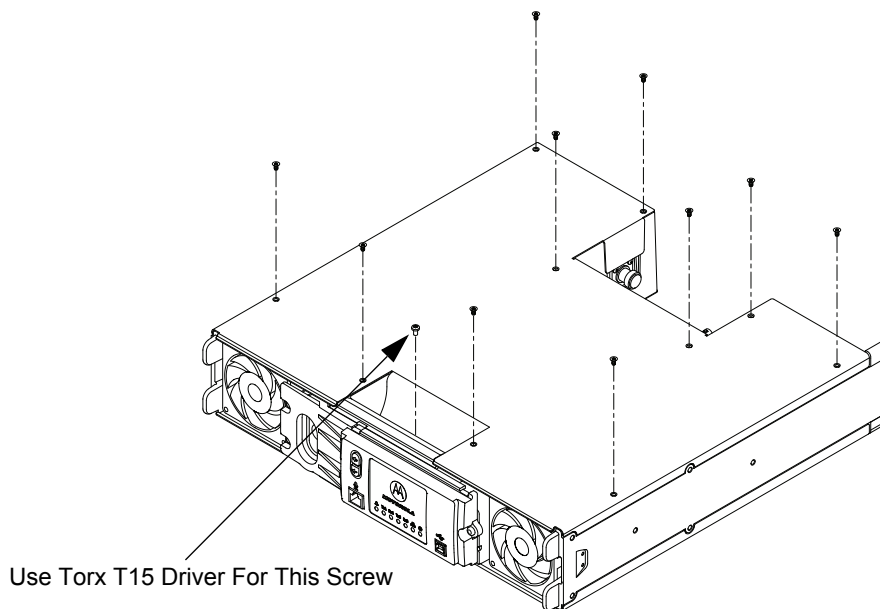


Figure 11-32 Installing Top Cover

11.7.1.14 Front Bezel Installation

1. Orient the Front Bezel (PN: EN000018A01) as shown in [Figure 11-33](#).
2. Press onto bezel clips.
3. Bezel will snap into place and secured.

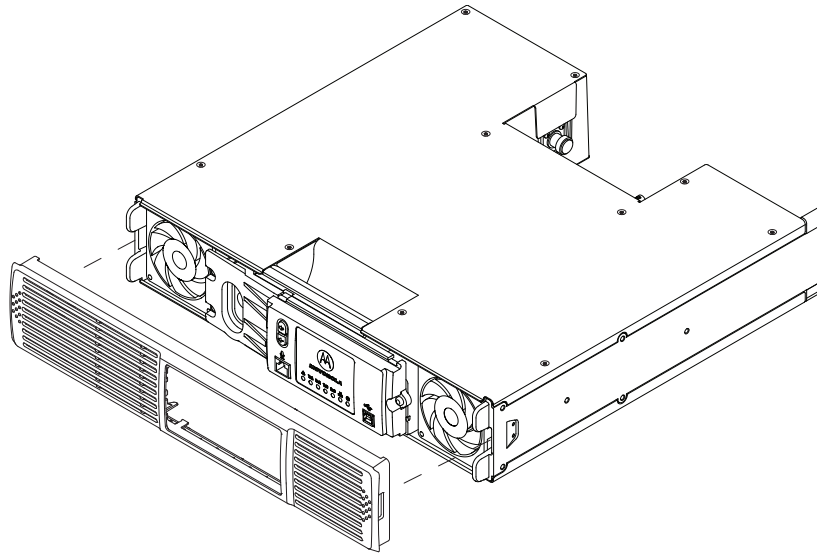


Figure 11-33 Securing Front Bezel

11.8 Exploded Mechanical View

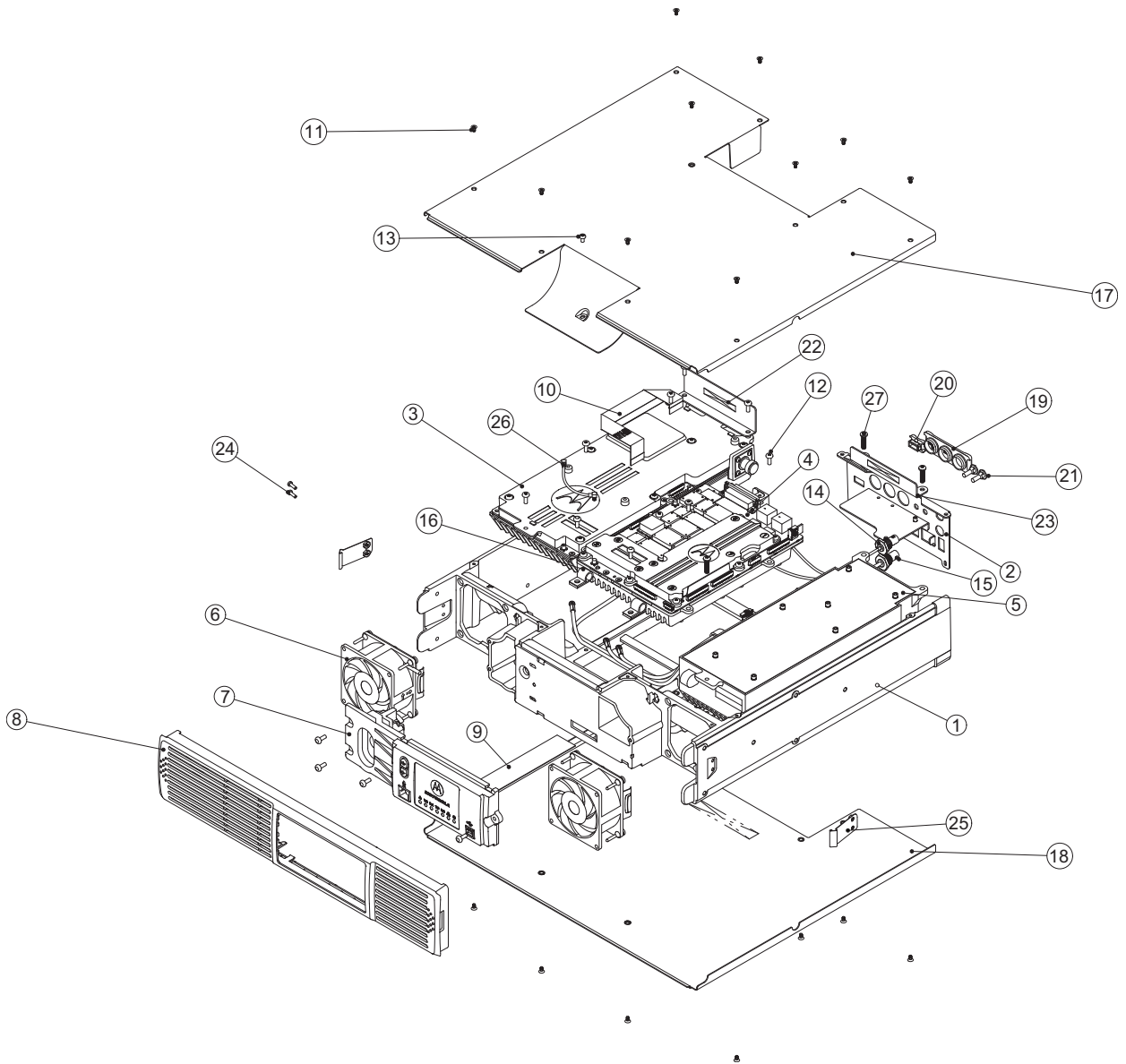


Figure 11-34 SLR 8000 Assembly Exploded View

11.9 Parts List

Table 11-1 SLR 8000 Exploded View Parts List

Item No.	Description	Part Number	Quantity
1	Base Frame	PMHN4355_	1
2	Back Plate	EN000019A01	1
3	PA FRU	See Table 11-2	1
4	Modem FRU	See Table 11-2	1
5	PSU FRU	PMPN4053_	1
6	Fan Assembly	PMLN7450_	2
7	Front Panel	PMLN6822_	1
8	Front Bezel	EN000018A01	1
9	Front Panel Flex	84007002001	1
10	PA Flex	CB000057A01	1
11	M3 Screw	0310913B41	20
12	M4 x 10 mm Screw	0310909A61	6
13	M3.5 Screw	0310909A45	1
14	Rx Cable	CB000058A01	1
15	Rx Reference Cable	CB000164A01	1
16	Cable Clamp	42009306002	2
17	Top Cover	HN000168A01	1
18	Bottom Cover	HN000168A02	1
19	Antenna Relay Plug	SL000203A01	1
20	P-Temp Plug	SL000204A01	1
21	Rubber Plug	3287533V01	2
22	PA Back Plate	EN000020A01	1
23	PS Back Plate	EN000035A01	1
24	M3 Clip Screws	0310907A20	4
25	Chassis Clip	BR000050A01	2
26	RF Cable Transmit	CB000419A01	1
27	M4 x 16 mm Screw	0371274L02	10

Table 11-2 FRU Part Number by Band

Part Number	Description
PMTE4000_S	UHF Band 1 Power Amplifier Module
WAEE4534_	UHF Band 1 Modem Module
PMTD1360_S	VHF Power Amplifier Module
WAED4538_	VHF Modem Module

11.10 Torque Charts

Table 11-3 lists the various torque values. Torque all screws to the recommended value when assembling the base station/repeater.

Table 11-3 Torque Specifications for Nuts and Screws

Driver Type	Torque Set Point (± 1) lb-in
Torx T10	10
Torx T15	10
Torx T20	15
Torx T30	20
3/4 Inch Hex Nut Driver	20
8 mm Hex Nut Driver	10
16 mm Hex Nut Driver	15

Notes

Chapter 12 SLR 8000 Installation

12.1 Pre-Installation Considerations

Proper installation ensures the best possible performance and reliability of the base station/repeater. Pre-installation planning is required. This includes considering the mounting location of the equipment in relation to input power, antennas, and system interfaces. Also to be considered are site environment conditions, the particular mounting method (several available), and required tools and equipment.

It is highly recommended that to read the following before installing this type of equipment for the first time:

- this entire installation section before beginning the actual installation, and
- the Motorola Quality Standard Fixed Network Equipment Installation manual, R56, specifically refer to the information on ground connection for lightning protection.

12.1.1 Installation Overview

The following information is an overview for installing the base station/repeater and ancillary equipment. Step-by-step procedures for each of the major installation tasks are then provided beginning in [Section 12.2: "Mechanical Installation" on page 12-8](#).

- Plan the installation, paying particular attention to environmental conditions at the site, ventilation requirements, and grounding and lightning protection.
- Unpack and inspect the equipment.
- Mechanically install the equipment at the site.
- Make necessary electrical and cabling connections, including the following:
 - AC input cabling
 - Coaxial cables to transmit and receive antennas
 - System cables
- Perform a post-installation function checkout test of the equipment to verify proper installation. Proceed to the Optimization procedures to customize the base station/repeater parameters per customer specifications (e.g., operating frequency, PL, codes, etc.)

12.1.2 Site Environmental Conditions



Caution

If the base station/repeater is to be installed in an environment which is unusually dusty or dirty (and so does not meet the air quality requirements), the air used to cool the base station/repeater modules must be treated using appropriate filtering devices. Dust or dirt accumulating on the internal circuit boards and modules is not easily removed, and can cause such malfunctions as overheating and intermittent electrical connections.

The base station/repeater may be installed in a suitable, restricted access, indoor enclosure in any location suitable for electronic communications equipment, provided that the environmental conditions do not exceed the equipment specifications for temperature, humidity and air quality.

These are:

- Operating Temperature Range

-30 °C (-22 °F) to +60 °C (+140 °F)

This is the temperature measured in close proximity to the base station/repeater. For example, if the base station/repeater is mounted in a cabinet, the temperature within the cabinet is measured.

- Humidity

Base station/repeater to be kept at or below RH of 95%, non-condensing at 50 °C (122 °F).

- Air Quality

For equipment operating in an area with airborne contaminants, the airborne particulates level must not exceed 90 µg/m³

12.1.3 Equipment Ventilation

The base station/repeaters are equipped with cooling fans that are used to provide forced convection cooling. When planning the installation, observe the following ventilation guidelines:

- Mounting the SLR 8000 Base Station/Repeater in a Cabinet

Cabinets must be equipped with ventilation slots or openings in the front (for air entry) and back (for air to exit). If several base station/repeaters are installed in a single cabinet, be sure ventilation openings align with each base station/repeater to allow for adequate cooling.

All cabinets must have at least 15 cm (6 in) of open space between the air vents and any wall or other cabinets. This allows adequate air flow.

When multiple cabinets (each equipped with several base station/repeaters) are installed in an enclosed area, make sure the temperature within each cabinet does not exceed the recommended/ maximum operating temperature of +60 °C (+140 °F). It may be necessary to have air-conditioning or other climate-control equipment installed to satisfy the environmental requirements.

- Mounting the SLR 8000 Base Station/Repeater in a Rack

Multiple SLR 8000 Base Station/Repeaters can be mounted in an open rack without degradation of specification.

12.1.4 AC and DC Input Power Requirements

12.1.4.1 AC Input Power Requirements

The base station/repeater is equipped with a switching power supply, and this assembly operates from 85 – 264 VAC at 47 – 63 Hz AC input power. A standard 3-prong line cord is supplied to connect the power supply to the AC source.

It is recommended that a standard 3-wire grounded electrical outlet be used as the AC source.



The AC socket outlet must be installed near the equipment and must be easily accessible.

The outlet must be connected to an AC source capable of supplying a maximum of 500 VA. For a nominal 110/ 120 VAC input, the AC source must be capable of continuously supplying 5 A (minimum). Per R56, the minimum ampacity of the circuit (and protective breaker) feeding the base station/repeater should be no less than 15A. For a nominal 220/ 240 VAC input, the ampacity requirements can be halved.

- Requirement for European Union (EU) Countries

Beginning January 1, 2001, input harmonic current specifications were changed for most electronic telecommunication equipment installed in EU countries. Accordingly, the SLR 8000 Base Station/Repeater is compliant with the resulting necessary power factor correction.

12.1.4.2 DC Input Power Requirements

Refer to [Table 1-3 on page 1-7](#).

12.1.4.3 Ground Connection

The base station/repeater is equipped with two ground screws located on the back panel of the base station/repeater. [Figure 7-1a on page 7-1](#) shows the location of the grounding screws. Connect the ground screw to the site ground point using a double lug connector. The size of the wire used for this connection must be 8 AWG minimum.



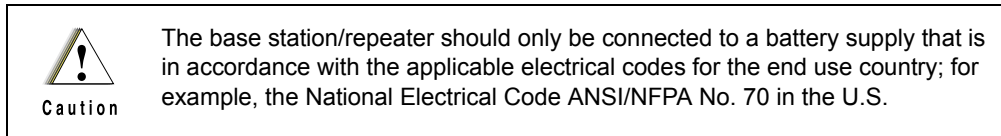
Refer to Motorola Quality Standards Fixed Network Equipment Installation Manual R56, for complete information regarding lightning protection.



The base station/repeater should only be connected to a battery supply that is in accordance with the applicable electrical codes for the end use country; for example, the National Electrical Code ANSI/ NFPA No. 70 in the U.S.

12.1.4.4 Battery Connection

Battery backup interface offers the capability of connecting to battery backup power in the event of an AC power line failure. The battery backup system is connected to the base station/repeater through the DC inlet connector on the rear panel of the base station/repeater. See [Figure 7-1a on page 7-1](#) for the location of the DC inlet connector.



12.1.4.5 RF Antenna Connections

The transmit and receive antenna RF connections are made using two separate connectors. Coax cables from the receive and transmit antennas must be connected to their respective connectors.

12.1.4.6 System Cable Connections

System connections are made through the Aux and/or Ethernet connectors located on the back panel of the base station/repeater.

12.1.5 Equipment Mounting Methods

The base station/repeater may be mounted in a rack or cabinet.

Base station/repeater can be mounted:

- In a floor-mount cabinet. Each floor-mount cabinet has front and rear vented doors and has the capacity to hold a minimum of a single base station/repeater (see thermal limitations described under Equipment Ventilation), and required ancillary equipment. The larger cabinets provide additional room for supplementary peripheral equipment.
- In a rack. Open frame racks accept multiple base station/repeaters and ancillary equipment; EIA 48.3 cm (19 inch) rack configuration.

12.1.5.1 Floor-Mounted Cabinet

The front, side and top views for all available floor-mount cabinets are shown in [Figure 12-1](#) on [page 12-5](#). See [Table 12-1](#) for the cabinet models and associated description.

Table 12-1 Cabinet Models

Model	Description
DDN2188A	30 inch (76.2 cm) indoor Cabinet
DDN2189A	46 inch (116.84 cm) indoor Cabinet

Refer to [Section 12.1.3: "Equipment Ventilation"](#) on [page 12-2](#) for recommended ventilation clearances.



WARNING

Ensure that the cabinet is securely anchored to the floor, thereby avoiding possible equipment tipping and personal injury. Refer to [Section 12.1.5.1: "Floor-Mounted Cabinet"](#) for details on proper cabinet installation.

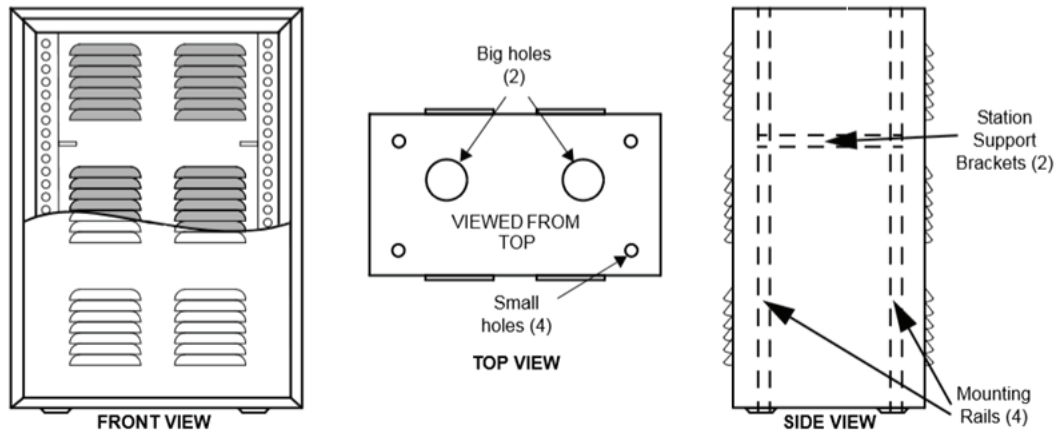


Figure 12-1 Floor Mount Cabinet

12.1.5.2 Modular Racks

See [Table 12-2](#) for the rack models and associated description.

Table 12-2 Rack Models

Model	Description
DDN2192A	30 inch (76.2 cm) Modular Rack (16 RK U)
DDN2193A	45 inch (114.3 cm) Modular Rack (24 RK U)
DDN2194A	52 inch (132.08 cm) Modular Rack (27 RK U)

The side, top and bottom views for all available modular racks are shown in [Figure 12-2](#). The top and bottom plates are identical and all dimensions and clearances are common to all racks.

Recommended clearance front and rear is 91.44 cm (36 in) minimum for servicing access. Refer to [Section 12.1.3: "Equipment Ventilation" on page 12-2](#) for recommended ventilation clearances.

Rack Mount Hardware is included with each rack model. This allows proper installation of the SLR 8000 Base Station/Repeater within the racks center of gravity.

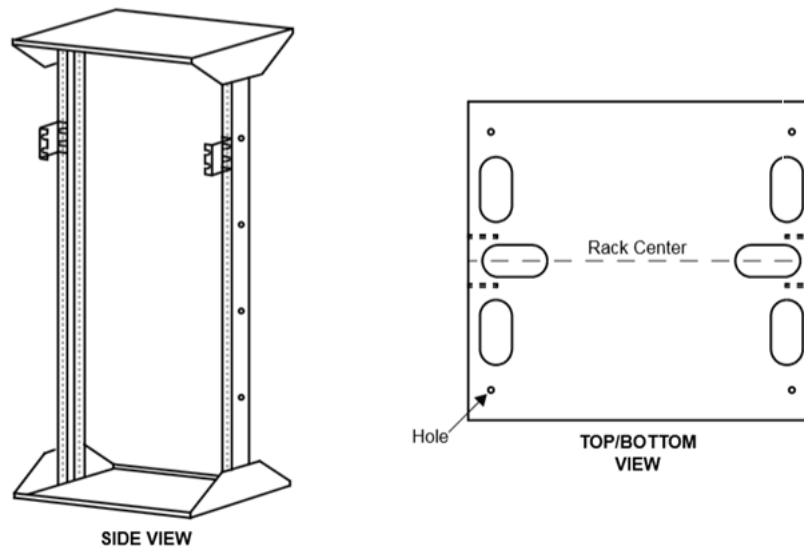


Figure 12-2 Modular Rack

12.1.6 Recommended Tools and Equipment

In addition to the typical compliment of hand tools, the following tools and equipment are recommended for proper installation of the base station/repeater equipment.

- Tarpaulin or plastic drop cloth or cover surrounding equipment while drilling concrete anchor holes (for installations where cabinet or rack is being anchored to concrete).
- Vacuum cleaner for removing concrete dust caused by drilling.

12.1.7 Equipment Unpacking and Inspection

12.1.7.1 Unpacking

Remove base station /epeater from cardboard box. Remove foam corners and remove base station/repeater from antistatic bag. Keep foam corners and antistatic bag for future shipping of base station/repeater.

12.1.7.2 Initial Inspection

- After removing the base station/repeater from the packaging, set on the surface for inspection. Top and bottom cosmetic covers should be free of damage. Front housing should have no obvious scuffs or marks.
- Back Panel connectors should be free of damage. Connectors should not be bent with regard to the back panel. Threads on RF connectors should be free of debris and undamaged.
- Remove protective liner from lens on LED display.
- Thoroughly inspect the equipment as soon as possible after delivery. If any part of the equipment has been damaged in transit, immediately report the extent of the damage to the transportation company and to Motorola.
- When a base station/repeater is delivered from Motorola, it arrives in suitable packing materials. If the unpacked equipment is damaged, return it to Motorola in its original packaging.



Equipment should be handled in its original packaging until it is delivered to its final destination. If the equipment is damaged while being moved without the original packaging, the warranty claim is not valid.

12.2 Mechanical Installation

12.2.1 Equipment Unpacking and Inspection

Remove base station/repeater from cardboard box. Remove foam corners and remove base station/repeater from antistatic bag.

Note Antistatic plastic bags and foam corners should be kept for future shipping/transporting of base station/repeater.

Thoroughly inspect the equipment as soon as possible after delivery. If any part of the equipment has been damaged in transit, immediately report the extent of the damage to the transportation company and to Motorola.

When a base station/repeater is delivered from Motorola, it arrives in suitable packing materials. If the unpacked equipment is damaged, return it to Motorola in its original packaging.



WARNING

Equipment should be handled in its original packaging until it is delivered to its final destination. If the equipment is damaged while being moved without the original packaging, the warranty claim is not valid.



WARNING

Improper handling of the base station/repeater may cause personal injury or damage to the base station/repeater. DO NOT pick up the base station/repeater by holding the Preselector (if so equipped). Use the integrated handle on the top of the front bezel of the base station/ repeater, or the Power Supply and Power Amplifier casings when picking up the base station/repeater.

12.2.2 Mounting Procedures

The base station/repeaters can be mounted in the selected cabinet or rack, and may be installed by following the procedures below.

12.2.2.1 Transferring Equipment from Shipping Container to Rack or Cabinet

As mentioned under Equipment Unpacking and Inspection, a base station/repeater can be shipped in a box. Upon delivery, the equipment must be removed from the container and transferred to a rack or cabinet.

Note Cabinets and racks must have mounting rails and hole spacing compatible with EIA Universal 48.3 cm (19 in) specifications. Cabinets must provide adequate ventilation (as detailed under Equipment Ventilation) and must meet the following criteria:

- 48.3 cm (19 in) deep
- 48.3 cm (19 in) wide
- 13.4 cm (5.25 in) high
- Two mounting rails 5 cm (2 in) from front of cabinet with front mounting holes 5.7 cm (2.25 in) apart (center to center).

Contact Motorola Customer Support for specific questions regarding mounting equipment in customer-supplied cabinets.

12.2.2.2 Installing Racks

In a typical installation, the rack is bolted to a concrete floor to provide stability.

The following procedure describes the steps necessary to bolt the rack to a concrete floor. Be sure to check with local authorities to verify that the following procedure conforms to local building codes and regulations before permanently installing the rack.

1. Carefully align the rack at the desired anchoring location.
2. Use the rack mounting foot as a template and mark the location of the six 19 mm (3/4 in) diameter mounting holes. All six anchoring positions must be used.
3. Move the rack aside, drill holes in the concrete floor, and install the mounting anchors (RAM RD-56 anchors recommended) per instructions provided with the anchors. Make sure that none of the anchors comes in contact with the reinforcing wire mesh buried in the concrete; the rack must be electrically isolated from any other equipment or materials at the site.
4. Align the rack with the installed anchors and lightly secure the rack to the floor using the proper mounting hardware. Do not tighten the mounting hardware at this time.
5. Check the vertical plumb of the rack. Also check that the top is level. Use shims (flat washers or flat aluminum plates) as necessary under the rack mounting foot to achieve vertical plumb and horizontal level.
6. Tightly secure the rack to the floor anchors making sure that it remains vertically plumb and horizontally level.
7. Assemble the two mounting brackets to each side of the base station/repeater either in the front or middle of the base station/repeater depending on whether rack is made for front mount or mid-mount using three supplied screws for each bracket.

8. Hold base station/repeater in the desired rack location. Line up mounting bracket holes with mounting locations on rack rail and assemble both brackets to the mounting rail on the rack using 10-32 screws.



Caution

Cement dust from concrete flooring is harmful to electronic equipment and wiring. Make sure that the rack and any collocated equipment are protected prior to drilling holes in the concrete floor. Use a tarpaulin, cloth, or plastic sheeting to cover exposed equipment. (The rack should be already covered with an antistatic bag; do not remove the bag at this time.) Use a vacuum while drilling the holes to minimize the spread of concrete dust. Carefully clean up any accumulated dust and debris from the anchor installation before uncovering the equipment.

12.2.2.3 Installing Cabinets

Each cabinet bottom is pre-drilled with four (4) mounting holes to allow attachment to the site floor. If installing on a concrete floor, use the cabinet as a template, mark the hole locations, and follow the procedures above for anchoring equipment racks. If installing on a wooden floor, use lag bolts and washers (customer supplied) to secure the cabinet to the floor.

12.3 Post Installation Checklist

After the MOTOTRBO Repeater has been mechanically installed and all electrical connections have been made, power may now be applied and the repeater checked for proper operation.

12.3.1 Applying Power

Turn ON the circuit breaker controlling the AC outlet that is supplying power to the repeater Power Supply Module.

12.3.2 Verifying Proper Operation

Operation of the repeater can be verified by:

- Observing the state of the 7 LEDs located on the front panel, and
- Exercising radio operation.



Caution

Some repeater components can become extremely hot during operation. Turn OFF all power to the repeater and wait until sufficiently cool before touching the repeater.



Symbol indicates areas of the product that pose potential burn hazards.

12.3.3 Front Panel LEDs

After turning ON the repeater power (or after a repeater reset), the 7 LEDs on the repeater front panel:

- Light for approximately one second to indicate that they are functional, then
- Go off for one second, then
- Indicate the operational status of the repeater.

12.3.4 Copying the Repeater Codeplug Data to a Computer

Backup the repeater's codeplug data by using the Customer Programming Software (CPS) on a computer.

12.4 Installing Base Station/Repeater Hardware Options

12.4.1 General Bonding and Grounding Requirements

Cabinets and racks used to mount the base station/repeater and optional equipment include a rack grounding bar with the capacity to terminate numerous ground wires. Equipment added to the cabinet or rack should be attached to the grounding bar using solid or stranded 6 AWG copper wires. See the Motorola R56 manual Standards and Guidelines for Communication Sites for more information on proper bonding and grounding at a site.

12.4.2 General Cabling Requirements

Diagrams for cabling are typically included in the system-specific configuration documentation provided by Motorola. Also see the Motorola R56 manual Standards and Guidelines for Communication Sites for cabling standards.

Chapter 13 SLR 8000 Wireline

13.1 Description

The Wireline Interface Board is described in this section. A general description, identification of inputs and outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level.

13.1.1 General Description

The SLR 8000 Wireline board is used to connect an analog audio source and sink (such as a console) to the SLR 8000 Base Station/Repeater. The Wireline board supports Tone Remote Control and DC Remote Control, E&M Control, and analog voting modes. For remote control operation (2-wire or 4-wire), the Wireline board allows for channel selection and PTT signaling for use with compatible voting systems, which includes Spectra-TAC and Digi-TAC comparators.

Included on the Wireline board are the following functional circuits.

- WL CODEC
- DC Control Decoder
- Surge Protection
- Impedance Matching Network
- GPIO Signaling
- Antenna Relay Control
- External Circulator Temperature A/D

With few exceptions, the Wireline options are configured and aligned via the CPS and Tuner software configuration tools, just as the other base station/repeater options are. The exceptions are DC Remote and E&M type configurations, which are accomplished via jumper sets on the Wireline board itself.

13.1.2 Input and Output Connections

Figure 13-1 shows the location of the Wireline board jumpers and all input and output external connections.

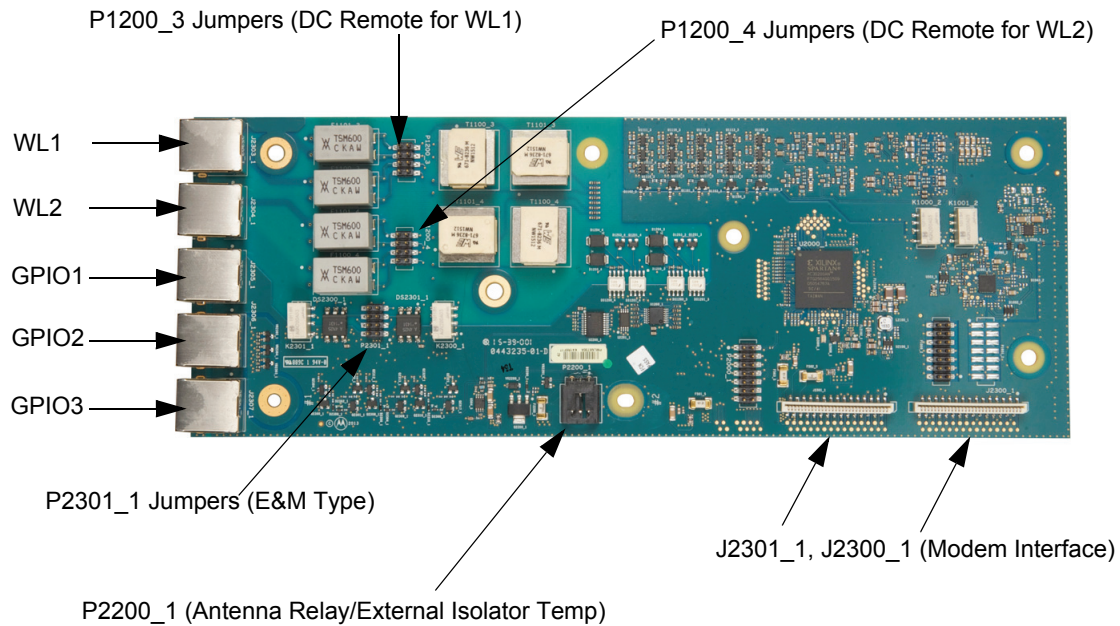


Figure 13-1 Wireline Board Jumpers and Input/Output Connections

Note WL1, WL2, GPIO1, GPIO2, and GPIO3 pin out information is in Chapter 7.

13.2 Specifications

Table 13-1 shows the specifications of the SLR 8000 Wireline board.

Table 13-1 Specifications of Wireline Board

Parameter	Specification
Wireline Transmit Level	+10 to -30 dBm
Wireline Receive Level	+7 to -30 dBm
Return Loss	> 20 dB
Distortion Introduced	< 0.5%

13.3 Board Configuration

There are only two options on the Wireline board that must be configured through jumpers. All other configuration settings are modified using the Customer Programming Software (CPS).

13.3.1 DC Remote Jumper Configuration

When operating the Wireline board in DC Remote Control mode, the jumpers on header P1200_3 must be set. These jumpers route DC Control currents from the correct Wireline pair to the DC Remote Decoder.

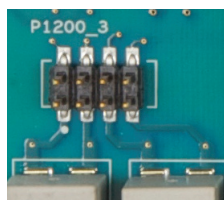
Note For maximum audio performance, the jumpers should be removed when operating in Tone Remote Control or no remote control mode.

Table 13-2 shows the jumper configuration while shows the location of jumpers on the P1200_3 connector for the Wireline Interface Board.

Table 13-2 Wireline Board Jumper Settings

Header P1200_3	
No DC Remote	No jumpers installed
2-Wire DC Remote	Jumper pins: 1 to 2, 3 to 4
4-Wire DC Remote	Jumper pins: 5 to 6, 7 to 8

Note Do not simultaneously enable 2-Wire and 4-Wire DC Remote



Jumpers

Top (from left to right):

2, 4, 6, 8

Bottom (from left to right):

1, 3, 5, 7

Figure 13-2 Location of Jumpers on the P1200_3 Connector

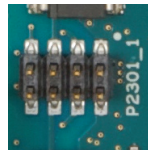
13.3.2 E&M Jumper Configuration

When operating the SLR 8000 in an E&M configuration via the Wireline board, there are two modes to choose from. The E&M mode is selected via the jumper settings on header P2301_1. These jumpers select whether Wireline board's PTT and COR functions are electrically isolated or non-isolated.

Table 13-3 shows the jumper configuration while Figure 13-3 shows the location of jumpers on the P2301_1 connector for the Wireline Interface Board.

Table 13-3 Wireline Board Jumper Settings

Header P2301_1	
Isolated	No jumpers installed
Non-Isolated	Jumper pins: 1 to 3, 2 to 4, 5 to 7, 6 to 8



Jumpers

Top (from left to right):

7, 5, 3, 1

Bottom (from left to right):

8, 6, 4, 2

Figure 13-3 Location of Jumpers on the P2301_1 Connector

PTT Function:

In isolation mode, a minimum source current of 5 mA (20 mA maximum) is required to assert the PTT function. The current source is to be applied to pin 3, the positive terminal, and pin 6, the negative terminal, of the WL1 connector.

When in non-isolation mode, shorting pin 3 to pin 6 of the WL1 connector will assert the PTT function.

COR Function:

Pins 7 and 8 of the WL1 connector are internally connected to the N.O. contact pair of a relay residing on the Wireline board. When a qualified receiver carrier is present, pins 7 and 8 will indicate this condition by being shorted together via the internal relay contacts. The COR operation is the same regardless of the state of the P2301_1 jumper set.

The maximum current through pins 7 and 8 should be limited to 150 mA with potentials no greater than 60 VDC.

13.3.3 CPS Configuration

This section describes how to set up the Wireline board using the Customer Programming Software (CPS) tool. Ensure that the Wireline board is properly installed in the base station/repeater and that the CPS software is configured for “Expert View” before proceeding.

Configure the settings in CPS to match the appropriate table. Under the “Accessories” menu, select the “De & Pre” option under “Analog Accessory Emphasis”. For “Audio type”, select the “Rx & Tx Filtered Squelch” option. Lastly, set the Audio Priority. See [Figure 13-4](#).

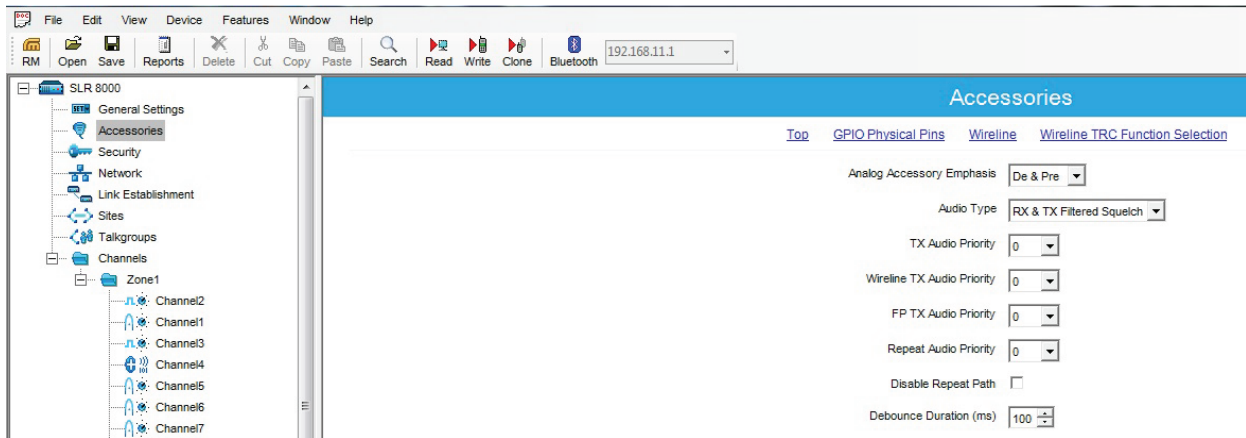


Figure 13-4 Wireline Audio Configuration in CPS

13.3.3.1 Choosing a Remote Control Mode

The first step in configuring the Wireline board in CPS is to choose a remote control mode. Under the “Accessories” menu, select the appropriate mode from the “Remote Control Mode” option in the CPS Wireline Configuration menu. For Tone Remote Control, choose TRC. For DC Remote Control, choose DC. If PTT is generated by a device other than the Wireline board (commonly known as Local PTT), choose “None”. See screenshot below.

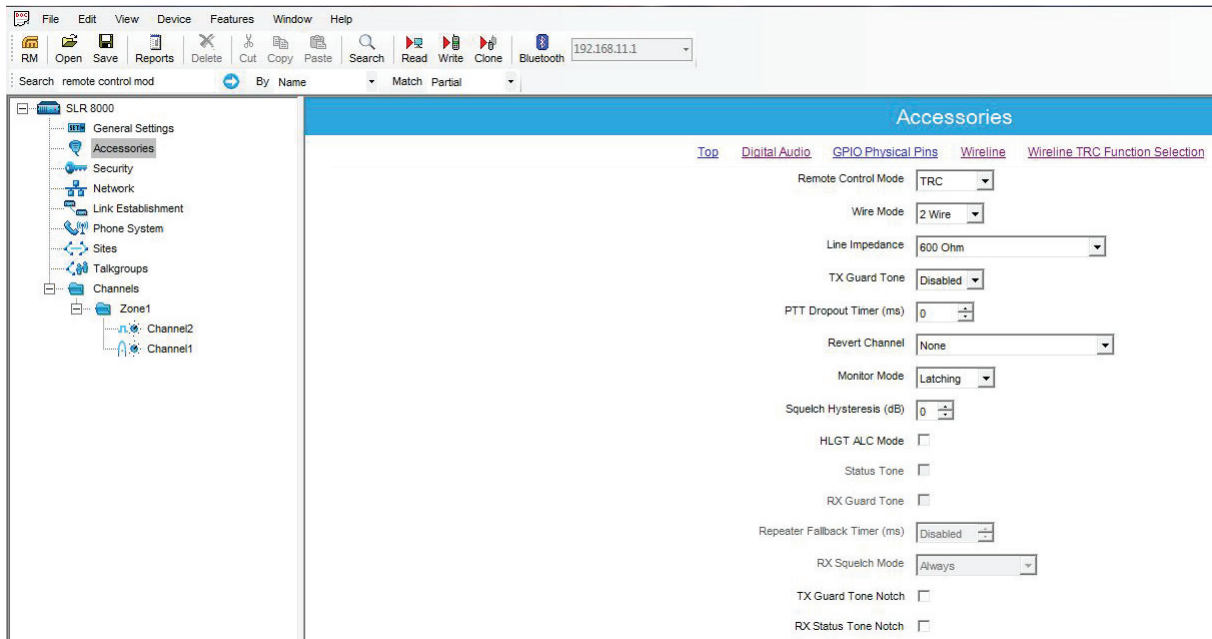


Figure 13-5 Setting Remote Control Mode

Then set the Wire Mode for 2-Wire or 4-Wire. See screenshot directly below.

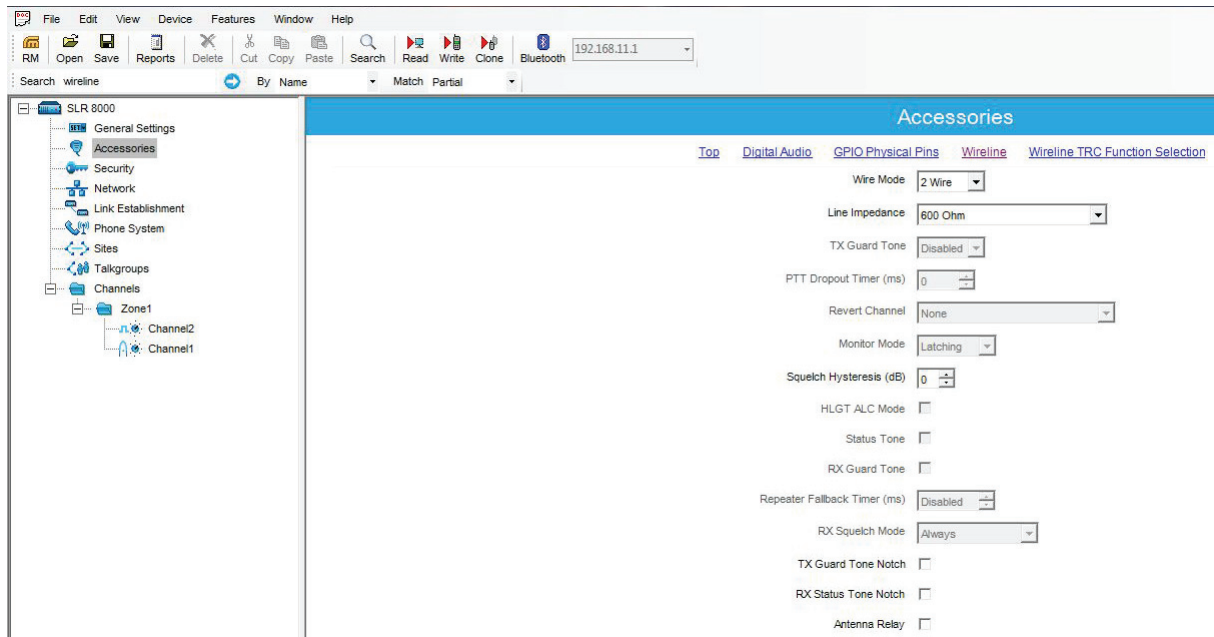


Figure 13-6 Setting 2-Wire/4-Wire Mode

If TRC is chosen as the remote type, the TRC function tones must be mapped to their desired function. See screen shot directly below.

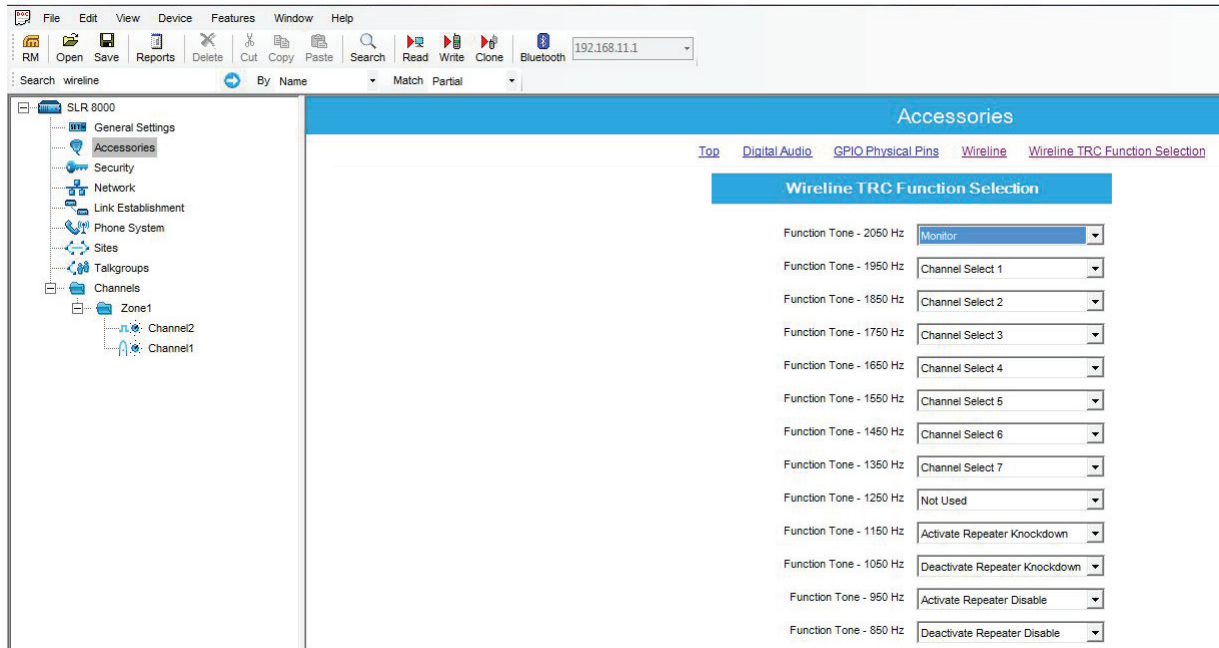


Figure 13-7 Setting Wireline TRC Functions

13.3.3.2 Other Wireline Configuration Options

All remaining wireline options can be set as desired, with their respective functions explained in the CPS Help Pane.

13.4 Tone Remote Control

A tone sequence must meet specific requirements for timing, amplitude, and frequency to be considered valid. The timing requirements for a tone sequence are defined in [Figure 13-8](#). All tone sequences must include a minimum of 120 mS of High Level Guard Tone (HLGT) and 40 mS of function tone, that is Function tone is required (even on single frequency systems).

Low Level Guard Tone (LLGT) is not required. This allows the console to change frequencies or manipulate alternate CPS defined GPIO functions without keying up the base station/repeater. When Low Level Guard Tone is present (at the end of a tone sequence), the base station/repeater will key up and remain transmitting for as long as LLGT is present.

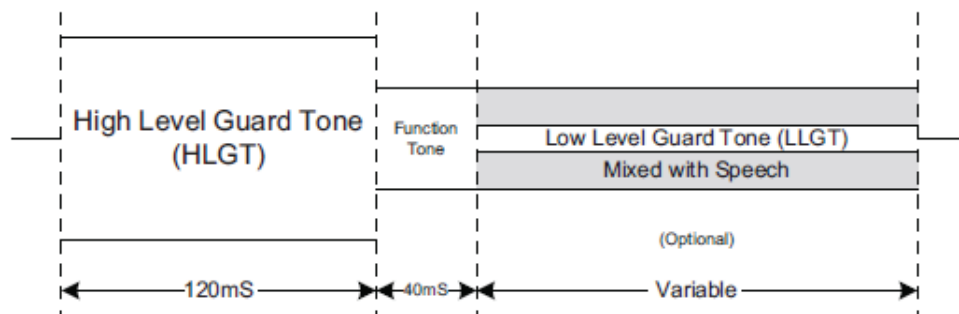


Figure 13-8 Timing Requirements for a Valid Tone Remote Control Sequence

Note All tones must be within +/- 10 Hz of the nominal expected frequency for guaranteed detection.

The required amplitude for HLG T in absolute terms is determined by the Wireline Tx Level alignment process. See Chapter 10. HLG T is expected to be 6 dB above the Test Tone level used in the alignment process. Function Tone is expected to be 4 dB below the Test Tone Level and LLG T is expected to be 24 dB below the Test Tone level. See Figure 13-9.

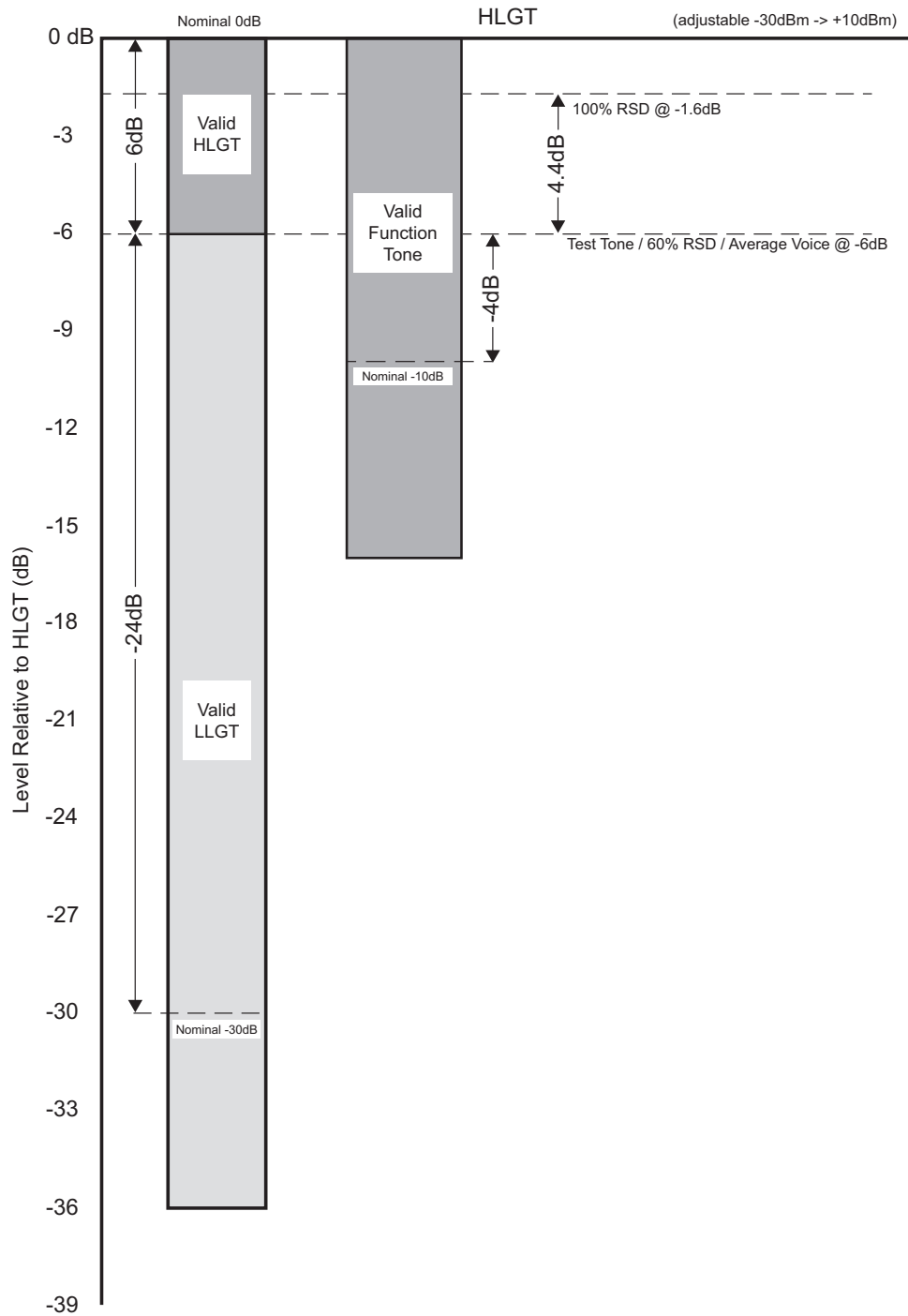


Figure 13-9 Valid Amplitudes for Tone Remote Control Signaling

13.5 DC Remote Control

The signaling plan for DC Remote Control is shown in [Table 13-4](#) for console configuration. Ensure that the DC Remote Control routing jumper are properly configured. See [Section 13.3.1](#). If the base station/repeater does not key up on the expected frequency, reverse the polarity of the wires on the Tx pair of the J6 connector on the back of the base station/repeater.

Table 13-4 DC Remote Function Definition

DC Current (mA)	Function
-2.5 (+/- 20%)	Monitor
-5.5 (+/- 20%)	Channel 3
-12 (+/- 20%)	Channel 4
2.5 (+/- 20%)	Channel 5
5.5 (+/- 20%)	Channel 1
12.5 (+/- 20%)	Channel 2

13.6 Voting

[Figure 13-10](#) displays the relative levels of Rx Guard Tone and a nominally set Status Tone relative to that of Test Tone at 100% RSD. It should be noted that the Guard Tone level is not individually adjustable. In other words, the level of Rx Guard Tone is always at the same level as that of Test Tone.

While Status Tone is nominally set 13 dB below the Test Tone level for Motorola comparators, the Status Tone level can be adjusted via the Tuner application. See [Chapter 10](#).

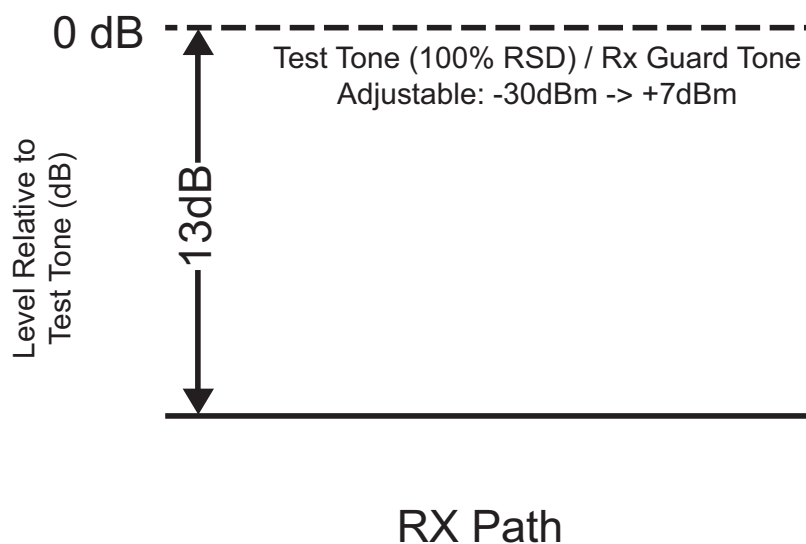


Figure 13-10 Rx Guard Tone and Status Tone Levels

Notes

Chapter 14 SLR 8000 Radio Frequency Distribution System (RFDS) Equipment

14.1 Description

The Radio Frequency Distribution System (RFDS) equipment included in your system depends on what options were purchased from Motorola. The following lists some examples of the RFDS equipment available for your system.

14.1.1 General Description

14.1.1.1 Base Station/Repeater Preselectors

The preselector rejects unwanted signals including the transmitter signals from overloading the Receiver. The filter is usually not required when using a Receiver multi-coupler system. This filter can be retuned in the field.

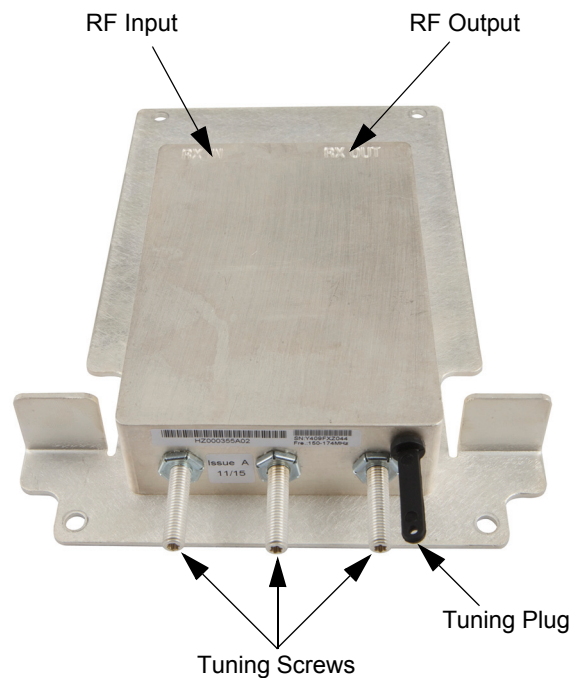


Figure 14-1 Base Station/Repeater Preselector (UHF version shown)

14.1.1.2 Duplexer

This optional filter provides the capability to use a single antenna for both transmitter and Receiver. Only one transmitter and Receiver can be combined.

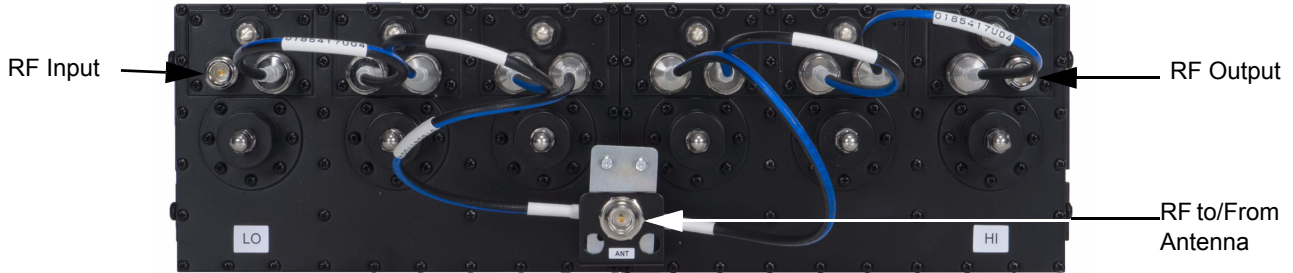


Figure 14-2 Duplexer (UHF version shown)

Note A Preselector is required when a base station/repeater Duplexer is ordered.

14.1.1.3 External Dual Circulator Tray

An option for the SLR 8000 Base Station/Repeater is an External Dual Circulator module which isolates the base station/repeater from the antenna, thus reducing the transmitter generated intermodulation. The circulator load dissipates reflected power. It includes a cable that connects to the RF Peripherals port on the base station/repeater backplane interface board to provide temperature monitoring in identifying antenna problems.

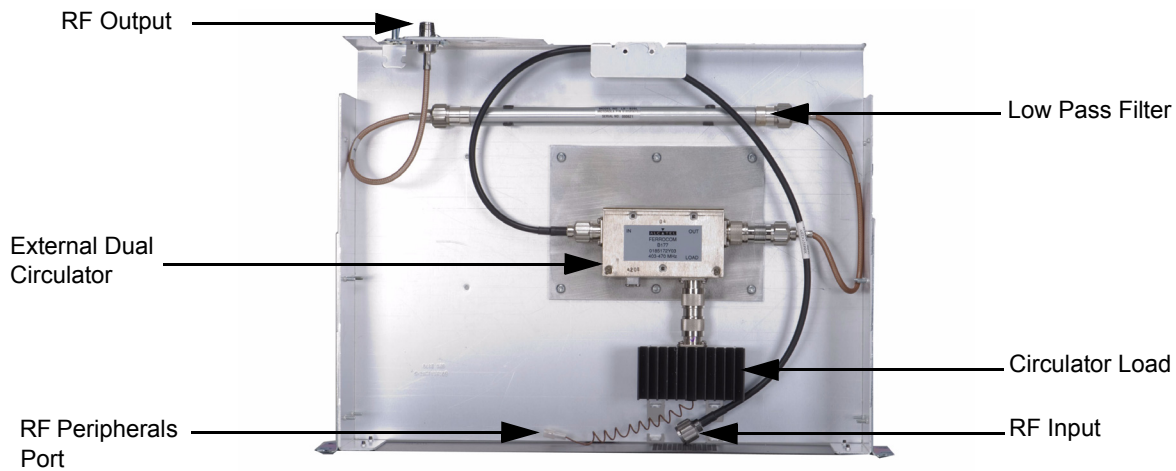


Figure 14-3 External Dual Circulator Tray (UHF version shown)

14.1.1.4 Antenna Relay

The Antenna Relay module allows a single antenna to be used for both transmit and receive functions (Base station/Simplex mode only). The Antenna Relay is controlled by a signal from the Modem Module (via the wireline board) to connect the antenna to either the PA (transmit) when activated/energized or Receiver Module (receive) when deactivated/de-energized. The Antenna Relay module is mounted on a flange provided on the back panel of the station.

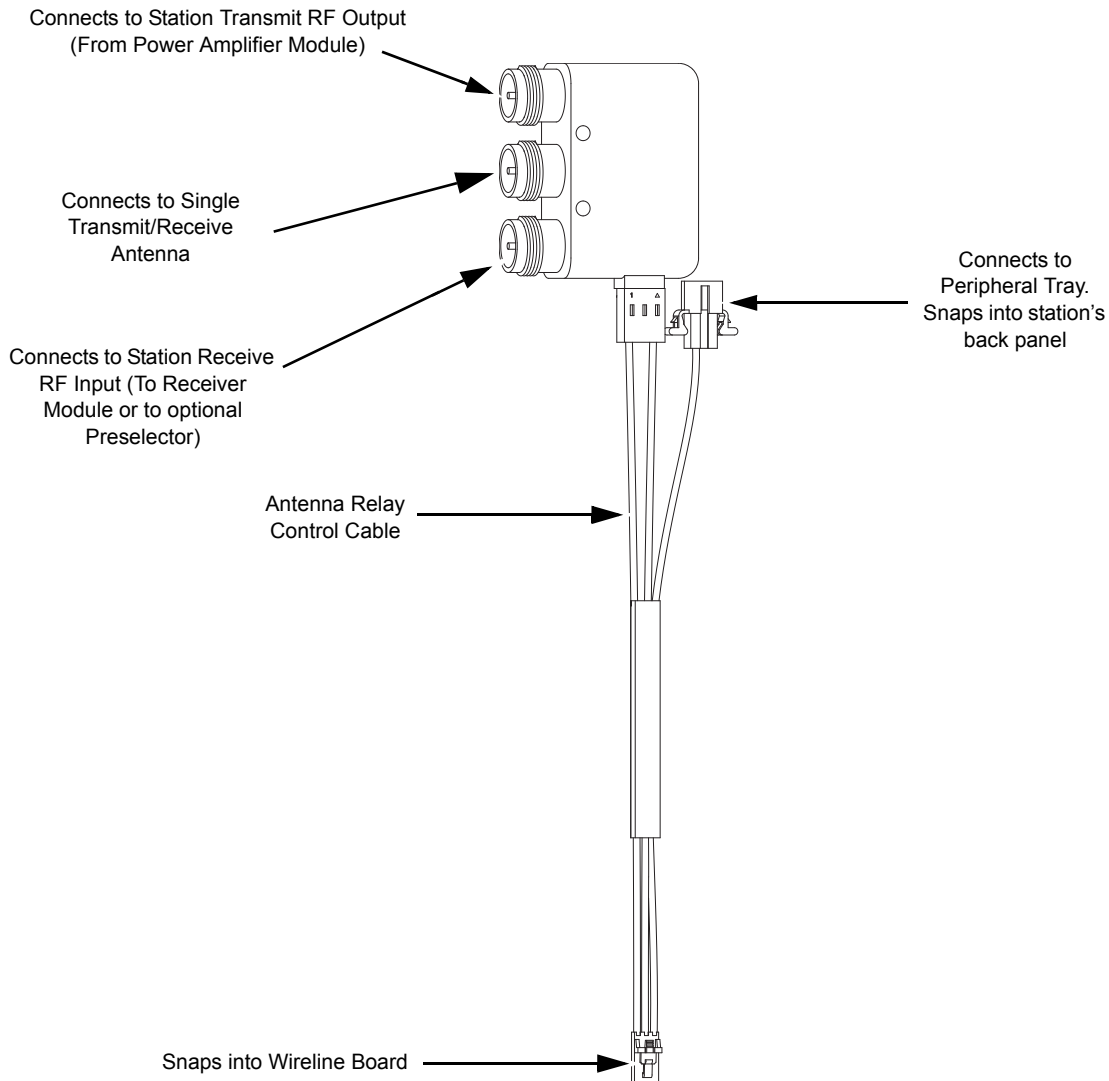


Figure 14-4 Typical Antenna Relay Module – Inputs/Outputs

- Note**
- Antenna Relay functionality is provided in analog mode only.
 - To enable functionality of the Antenna Relay, the “Antenna Relay” function box must be checked within the “Accessories” field in the CPS.
 - The Wireline Board is required for Antenna Relay operation.

14.2 Specifications

14.2.1 Base Station/Repeater Preselectors

Table 14-1 shows the spec limits for the the VHF frequency band and Table 14-2 for the UHF frequency band for the Preselector.

Table 14-1 SLR 8000 Base Station/Repeater Preselector Filter Specifications (VHF)

Parameter	Preselector Spec Limit (VHF)	Typical
Tuning Range	136 MHz–154 MHz 150 MHz–174 MHz	–
Bandwidth	4 MHz	–
Insertion Loss	1.2 dB	1 dB
VSWR max.(RL min.)	1.5:1 (14 dB RL)	–
Rejection <108 MHz	24 dB	–
Rejection @ fo +20.4 MHz	31 dB	–
Input Connector	MCX	–
Output Connector	MCX	–

Table 14-2 SLR 8000 Base Station/Repeater Preselector Filter Specifications (UHF)

Parameter	Preselector Spec Limit (UHF)	Typical
Tuning Range	350 MHz–470 MHz	–
Bandwidth	4 MHz	–
Insertion Loss	1.2 dB	1 dB
VSWR max. (RL min.)	1.3:1 (17.5 dB RL)	1.5:1
Rejection <300 MHz	18 dB	–
Rejection @ fo +52.8 MHz	20 dB	–
Input Connector	MCX	–
Output Connector	MCX	–

Note See [Appendix A](#) for the model number.

14.2.2 Duplexer

Table 14-3 shows the spec limit for Duplexer for VHF frequency band and Table 14-4 for UHF frequency band.

Table 14-3 SLR 8000 Duplexer Specifications (VHF)

Parameter	Duplexer Spec Limit	Typical	Notes
Frequency range	136 MHz–146 MHz, 144 MHz–160 MHz, 158 MHz–174 MHz	–	–
Insertion loss Tx	1.3 dB	0.7 dB	–
Insertion loss Rx	1.3 dB	0.5 dB	–
VSWR max.	1.5:1	1.2:1	–
Rx isolation	75 dB	80 dB	–
Tx isolation	75 dB	77 dB	–
Antenna Connector	N female	–	–
Rx/Tx Output Connector	N female	–	Reduced performance down to 1 MHz spacing
Minimum Rx-Tx Frequency Spacing	1.5 MHz	–	–

Table 14-4 SLR 8000 Duplexer Specifications (UHF)

Parameter	Duplexer Spec Limit	Typical	Notes
Frequency range	403 MHz–435 MHz, 435 MHz–470 MHz,	–	–
Insertion loss Tx	1.3 dB	1.1 dB	–
Insertion loss Rx	1.3 dB	1.1 dB	–
VSWR max.	1.3:1	1.2:1	–
Rx isolation <470 MHz >470 MHz	100 dB 100 dB	–	R/T 5 MHz R/T 3 MHz
Tx isolation <470 MHz >470 MHz	100 dB 100 dB	–	R/T 5 MHz R/T 3 MHz
Antenna Connector	N female	–	–
Rx/Tx Output Connector	N female	–	–

14.2.3 External Dual Circulator Tray

Table 14-5 shows the spec limit for External Dual Circulator Tray for VHF frequency band and Table 14-6 for UHF frequency band.

Table 14-5 SLR 8000 External Dual Circulator Specifications (VHF)

Parameter	External Dual Circulator Spec Limit	Typical
Operating Frequency Range	136–146 MHz, 144–160 MHz, 158–174 MHz	–
Insertion Loss	1.6 dB	0.7 dB
Input Return Loss	18 dB	25 dB
Reverse Isolation	40 dB	50 dB
Power (continuous)	200 W	–
Harmonic Attenuation <1 GHz	50 dB	–
Input Connector	RF cable with N male	–
Output Connector	N female	–

Table 14-6 SLR 8000 External Dual Circulator Specifications (UHF)

Parameter	External Dual Circulator Spec Limit	Typical
Operating Frequency Range	403–435 MHz, 435–470 MHz,	–
Insertion Loss	1.6 dB	1.2 dB
Input Return Loss	18 dB	24 dB
Reverse Isolation	40 dB	50 dB
Power (continuous)	200 W	–
Harmonic Attenuation <10 GHz	70 dB (Typical: 80 dB)	–
Input Connector	RF cable with N male	–
Output Connector	N female	–

Note See [Appendix A](#) for the model number.

14.2.4 Antenna Relay

Table 14-7 shows the spec limit for Antenna Relay.

Table 14-7 SLR 8000 Antenna Relay Specifications

Parameter	Antenna Relay Spec Limit
Operating Frequency	DC to 4 GHz @ 20°C
Maximum Input Power	500 W @ 1 GHz
Coil Specifications: Pull-in voltage Drop-out voltage Resistance	10.0 VDC minimum 2.0 VDC maximum 100 Ω \pm 10% @ 20°C
Contact Specifications: Type Actuation Pull-in time Drop-out time (Includes remake of NC contact)	SPDT Fail-safe (Break before make) 20 ms maximum @ 20°C 20 ms maximum @ 20°C
Insertion Loss	0.3 dB maximum
Isolation	70 dB minimum
VSWR Maximum	1.3:1
Temperature Range	-30°C to +80°C
Terminations	Female N-Type
Input and Output Impedance	50 Ω

Note See [Appendix A](#) for the model number.



Caution

Set the “Antenna Relay Delay Timer” minimally to 50 ms in the Customer Programming Software (CPS) to ensure that the Antenna Relay is physically in proper position during transmitter key-up. Damage to the antenna relay will result if a value less than 50 ms is entered into the CPS.

14.3 Field Tuning Procedures

14.3.1 Base Station/Repeater Preselectors

Depending on the configuration, the base station/repeater may have an Internal Preselector assembly with the always present integrated preselector. The optional Internal Preselector assembly is a 3-pole bandpass filter equipped with tuning slugs to adjust the passband corresponding to the operating frequency (s) of the base station/repeater. For the integrated preselector, circuitry in the Receiver Module provides a varactor-tuned bandpass filter which adapts to the required frequency range.

The internal preselector must be retuned if the preselector assembly or Receiver Module are replaced in the field, or if the base station/repeater operating frequency (s) are modified. The integrated varactor-tuned preselector is factory-tuned to cover the relevant frequency band in its entirety. The integrated preselector does not require field tuning even if the Receiver Module is replaced.

14.3.1.1 Internal Preselector Tuning Procedure (Preferred Method)

14.3.1.1.1 Test Equipment

The following test equipment is required to properly tune the preselector assembly.

Table 14-8 Test Equipment

No.	Item	Type
1	Network Analyzer	Keysight E5062A/E5071B/E5071C / or equivalent
2	Tuning Cable	N-type
3	Torx Driver	T10 bit
4	Two Adaptors	N-MCX

14.3.1.1.2 Equipment Setup

For the **350 – 470 MHz** preselector,

1. **Initial frequency setup:** Press the START key, input 310 MHz, then press the STOP key and input 620 MHz.
2. **Marker setup:** Enter the four (4) marker frequencies shown below into the NWA memory.

Table 14-9 Marker Setup for 350 – 470 MHz

Mark No.	Frequency
Mark 1	433 MHz
Mark 2	437 MHz
Mark 3	466 MHz
Mark 4	470 MHz

3. **Output level setup:** Select MENU, press POWER and input 10 dBm.
4. **Sweep points setup:** Select MENU, press NUMBER OF POINTS soft key, and input 401.
5. **Display mode setup:** Select DISPLAY, press ALLOCATE CHANNELS soft key, then select "X1", next return DISPLAY page and press NUMBER OF TRACES and select 2; finally return DISPLAY page again and press ALLOCATE traces and select "X2".
6. **S-parameter plot setup:** Select S12 (S21), press SCALE REF key, then select REFERENCE POSITION soft key, and input 10/DIV, next press REFERENCE VALUE and input 0.
7. **Set S11 (S22) plot as return loss:** Press FORMAT key, select LOG MAG soft key, then select SCALE REF, press SCALE/DIV and input 1/DIV, and turn to REFERENCE VALUE soft key and input -18.

14.3.1.1.3 Tuning Connections

With a properly calibrated Network Analyzer (NWA), proceed to “Unit connection.”

1. Unit Connection

- a. If necessary, disconnect and remove the 350 – 470 MHz band preselector assembly from the base station/repeater.
- b. Connect the 350 – 470 MHz band preselector to the NWA via the adaptors and cables shown in [Figure 14-5](#).

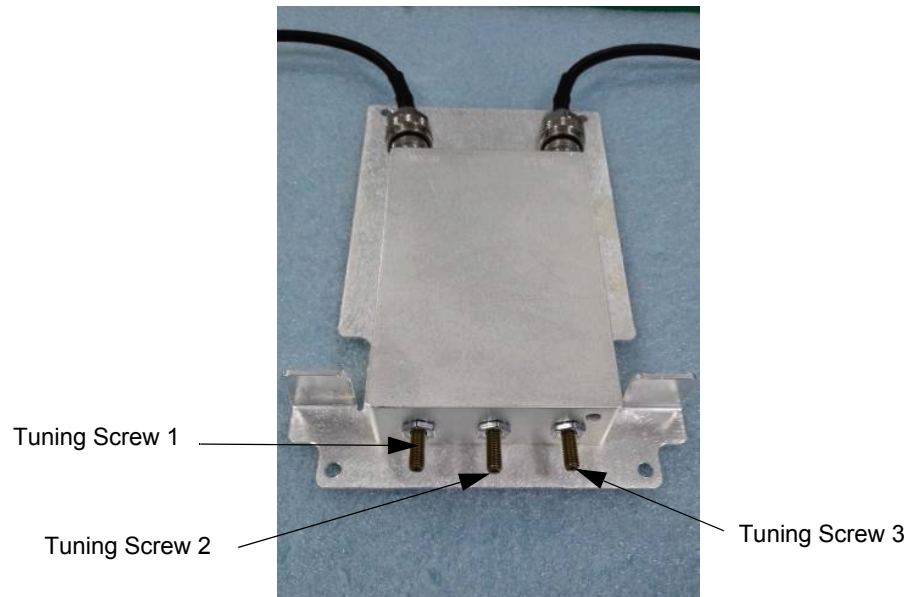


Figure 14-5 Connecting Preselector to the NWA

2. Unit Tuning - An example exercise illustrating a re-tuning to a center frequency of 470 MHz.
 - a. Initial Curve

The preselector, if already tuned, should look similar for a given center frequency to that of the NWA display shown in [Figure 14-6](#). The example below happens to be tuned to 435 MHz.

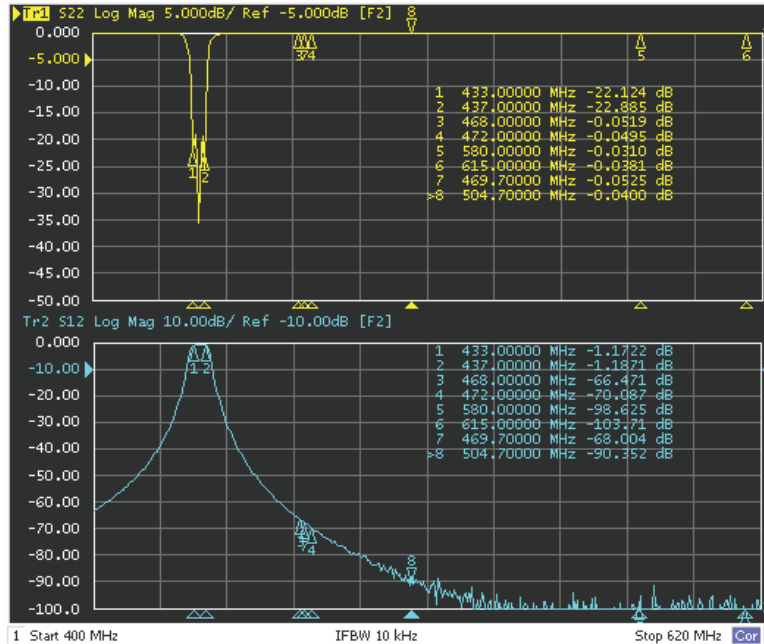


Figure 14-6 Initial Curve (Start 400 MHz, Stop 620 MHz)

To expand and thus better display the curve, readjust the STOP band value to a lower value (such as 505 MHz as shown in [Figure 14-7](#)).

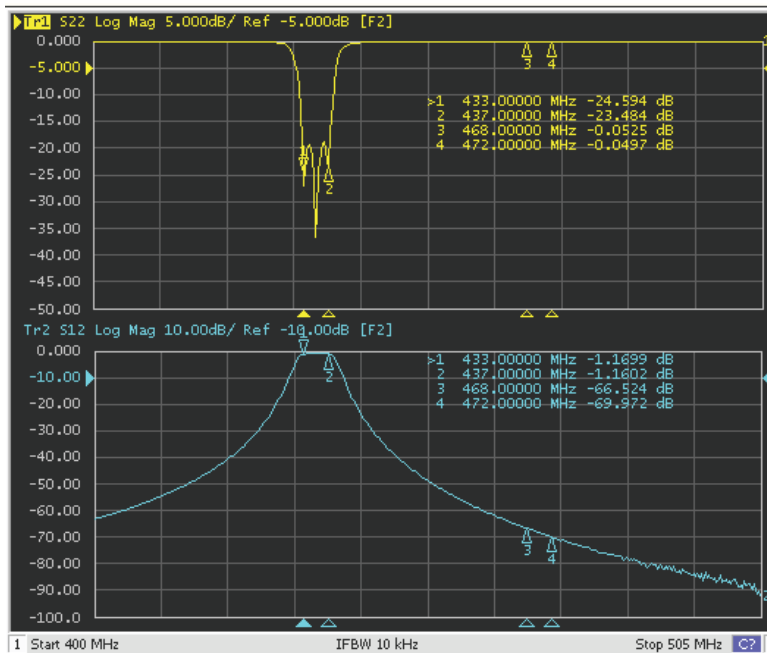


Figure 14-7 Initial Curve (Start 400 MHz, Stop 505 MHz)

b. Rough Tuning

- i. Adjustment of the tuning screws changes the position of the frequency peaks on the displayed curves. As an example note that when screw 1 is adjusted counterclockwise, the resonance peak moves to the right and if turned clockwise, the peak moves to the left as indicated by the yellow arrow in [Figure 14-8](#).

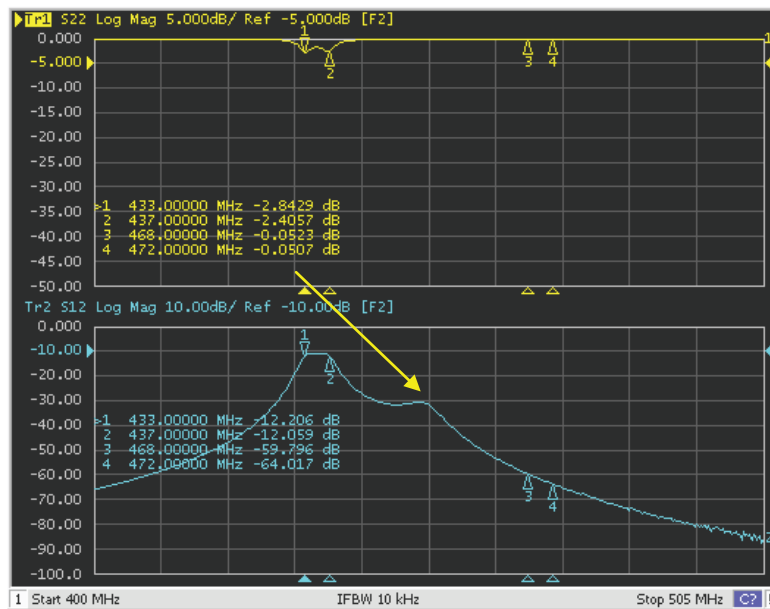


Figure 14-8 Passband Tuning of Tuning Screw 1

- ii. Continue adjust tuning screw 1 until the peak moves into the 466 – 470 MHz range (the area between Marker 3 and Marker 4). See [Figure 14-9](#).

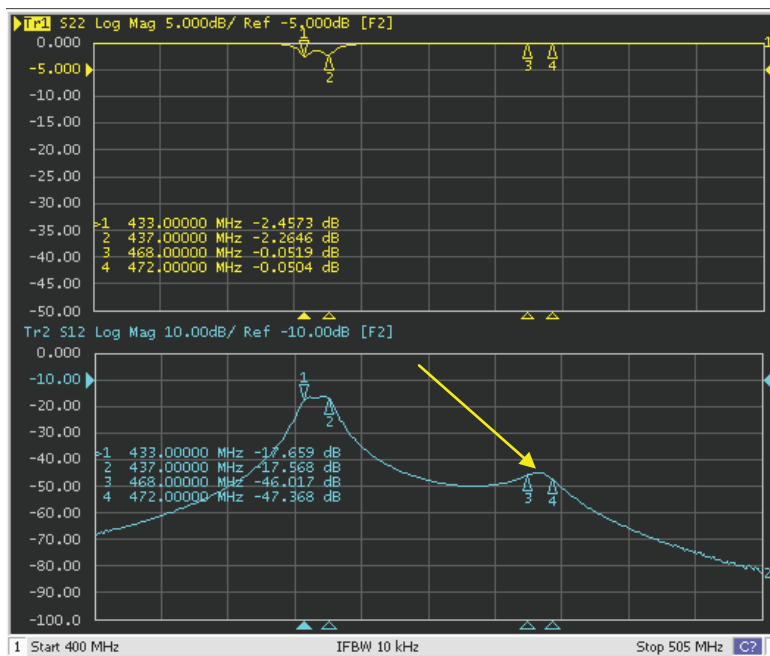


Figure 14-9 Passband Tuning of Tuning Screw 1 to the New Passband

- iii. Adjust tuning screw 2 until the peak moves into the 466 – 470 MHz range (the area between Marker 3 and Marker 4). See Figure 14-10 and Figure 14-11.

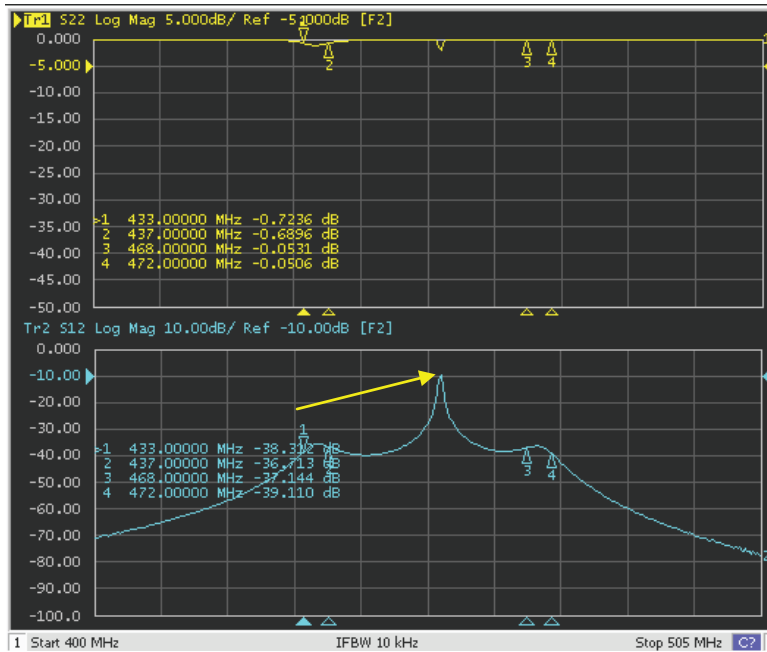


Figure 14-10 Passband Tuning of Tuning Screw 2

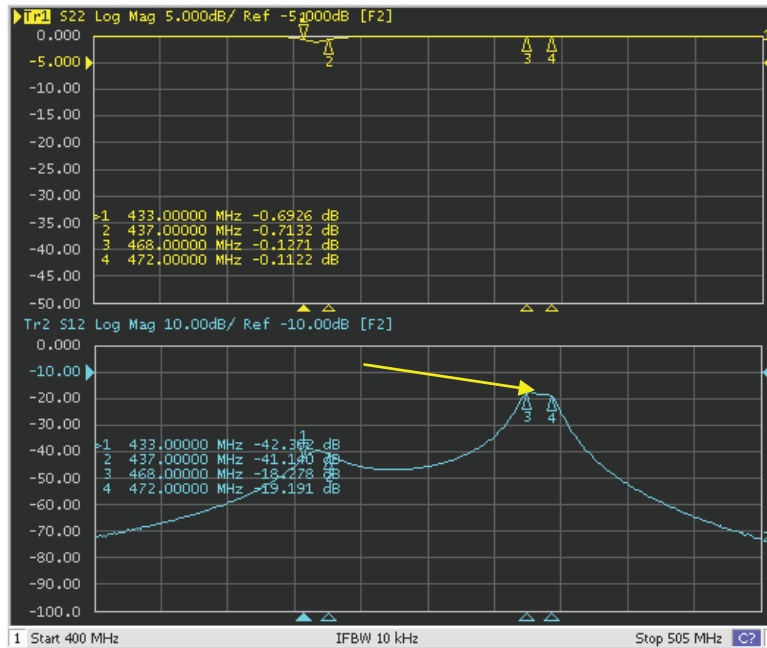


Figure 14-11 Passband Tuning of Tuning Screw 2 to the New Passband

- iv. In a similar process as tuning with screws 1 and 2, tune screw 3 until the peak adjusted by it moves into the passband area between Marker 3 and Marker 4. See [Figure 14-12](#).

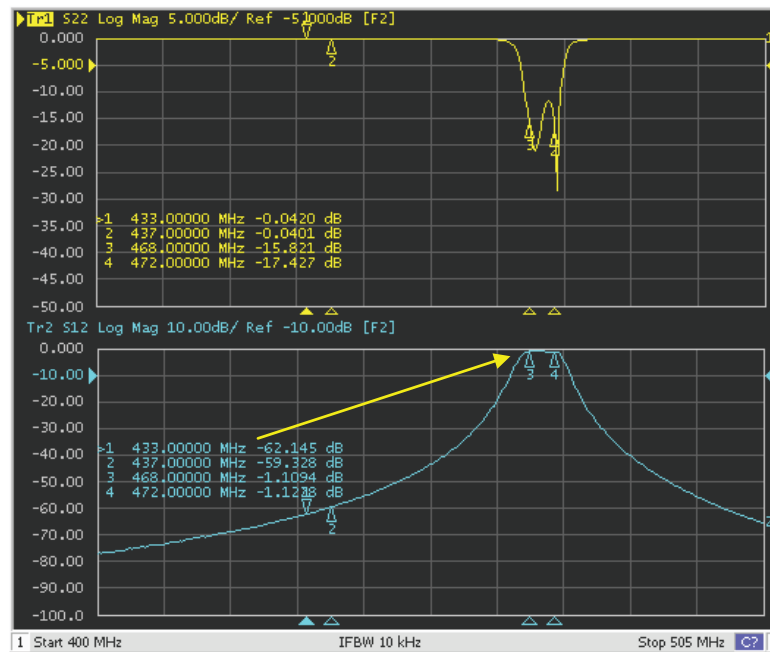


Figure 14-12 Passband Tuning of Tuning Screw 3 to the New Passband

c. Fine Tuning

- i. The 350 – 470 MHz band preselector is now roughly tuned to the required passband. See [Figure 14-13](#). The preselector performance will now be fine-tuned to specification-required frequencies and levels.

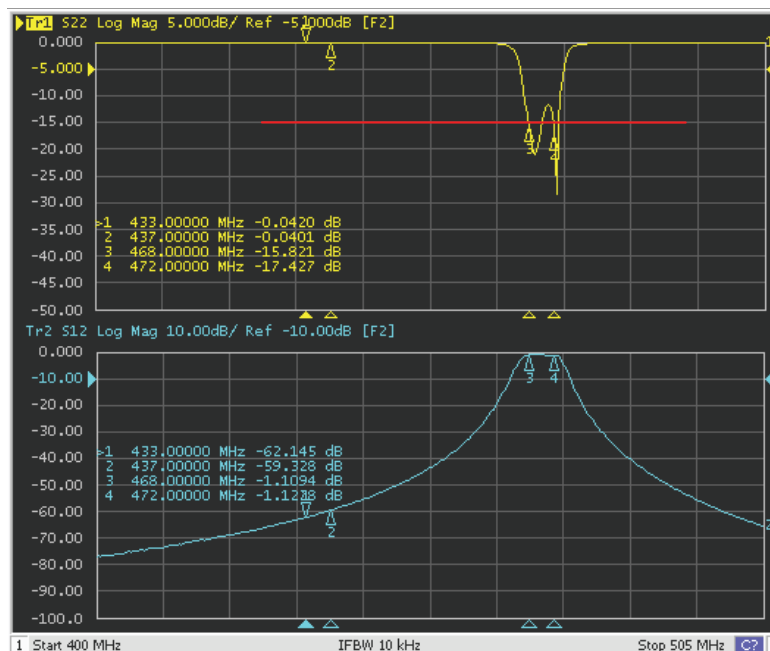


Figure 14-13 Passband and Return Loss after Rough Tuning

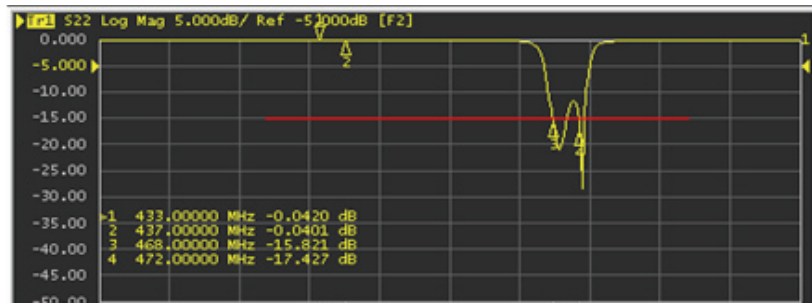


Figure 14-14 Return Loss

- ii. In this process, make only small (less than 10°) adjustments. Working with each of the tuning screws 2, 3, or 4 (one at a time), make slight adjustments in either direction while observing the return loss curve. For example, turning one of the screws clockwise may result in worse return loss such as shown in Figure 14-15 or better as shown in Figure 14-16.

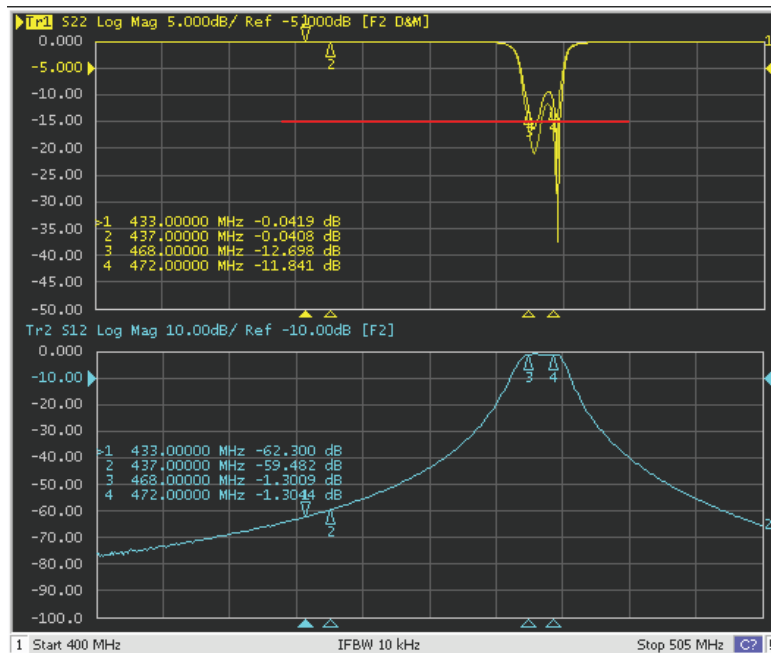


Figure 14-15 Turn Screw Clockwise

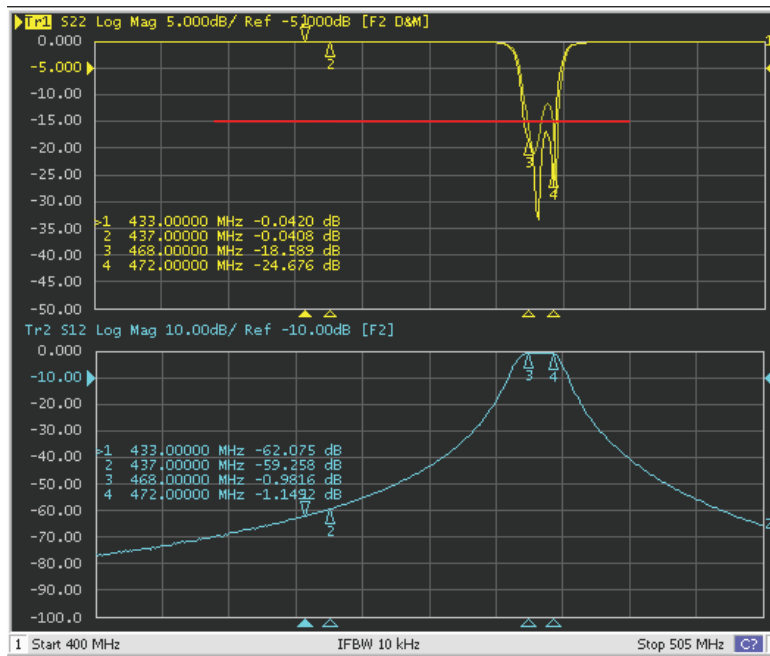


Figure 14-16 Turn Screw Counterclockwise

- iii. Continue this process of adjusting each of the screws one at a time by small rotations until the optimized return loss performance is provided as shown in Figure 14-17 where all of the pass band return loss curve is well below the red limit line.

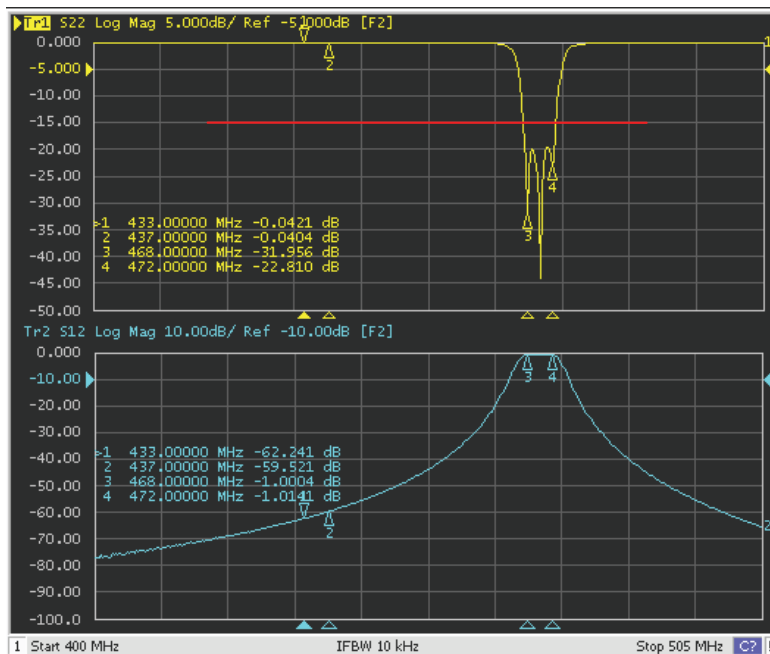


Figure 14-17 Result after Fine Tuning

3. Final Inspection
 - a. Inspect the final performance curves and parameter plot against the following specification limits in Table 14-2.
 - Insertion Loss
 - VSWR (RL)
 - Rejection < 300 MHz
 - Rejection @ $f_0 + 52.8$ MHz
 - b. Tighten the tuning nuts to approximately 1.36 Nm (12 lb-in), so the screws are secure. Make very slight adjustments at any of the screws to compensate for change tightening that screw causes.
4. Reassembly
 - a. Mount the preselector assembly in the station, and reconnect the previously-removed cabling.

- Note**
- All instruments should be properly calibrated before operation.
 - All joints between cavity and instrument should be checked. Loose connections can greatly impact the tuning results.
 - Rejection meets specification requirements after passband and return loss are tuned, and it is needless to check one by one. However, the passband shall be tuned to the center frequency. In other words, insertion loss of two side frequencies of pass band is approximate.
 - Lock the tension nut with proper torque force: 1.2 Nm ~ 1.3 Nm. Excessive torque will lead to excessively tight locking (hard to tune) and inadequate to loose locking (tuning screw falling off).
 - The methodology and procedure for the VHF preselector is similar to that of the UHF preselector described above.

14.3.1.2 Internal Preselector Tuning Procedure (Alternate Method)

While less precise than the preferred method previously described, this method allows one to retune the preselector without removing the station's cover nor removing the station from its mounting in a cabinet or rack. While less accurate, this method still allows minimum specified performance to be achieved.

14.3.1.2.1 Test Equipment

The following test equipment is required to properly tune the preselector assembly.

Table 14-10 Test Equipment

No.	Item	Type
1	Network Analyzer	Keysight E5062A/E5071B/E5071C / or equivalent
2	Tuning Cable	N-type
3	Tuning Probe	Motorola part number 3082059X02
4	Torx Driver	T10 bit
5	Adaptor	N-BNC

14.3.1.2.2 Equipment Setup

For the **350 – 470 MHz** preselector,

1. **Initial frequency setup:** Press the START key, input 310 MHz, then press the STOP key and input 620 MHz.
2. **Marker setup:** Enter the four (4) marker frequencies shown below into the NWA memory.

Table 14-11 Marker Setup for 350 – 470 MHz

Mark No.	Frequency
Mark 1	433 MHz
Mark 2	437 MHz
Mark 3	466 MHz
Mark 4	470 MHz

3. **Output level setup:** Select MENU, press POWER and input 10 dBm.
4. **Sweep points setup:** Select MENU, press NUMBER OF POINTS soft key, and input 401.
5. **Display mode setup:** Select DISPLAY, press ALLOCATE CHANNELS soft key, then select "X1", next return DISPLAY page and press NUMBER OF TRACES and select 2; finally return DISPLAY page again and press ALLOCATE traces and select "X2".
6. **S-parameter plot setup:** Select S12 (S21), press SCALE REF key, then select REFERENCE POSITION soft key, and input 10/DIV, next press REFERENCE VALUE and input 0.
7. **Set S11 (S22) plot as return loss:** Press FORMAT key, select LOG MAG soft key, then select SCALE REF, press SCALE/DIV and input 1/DIV, and turn to REFERENCE VALUE soft key and input -18.

14.3.1.2.3 Tuning Connections

With a properly calibrated Network Analyzer (NWA), proceed to “Unit connection.”

1. Unit Connection
 - a. Remove the protective probe cavity plug from the rear of the preselector.
 - b. Connect the 350 – 470 MHz band preselector to the NWA via the adaptors and cables shown in [Figure 14-18](#).

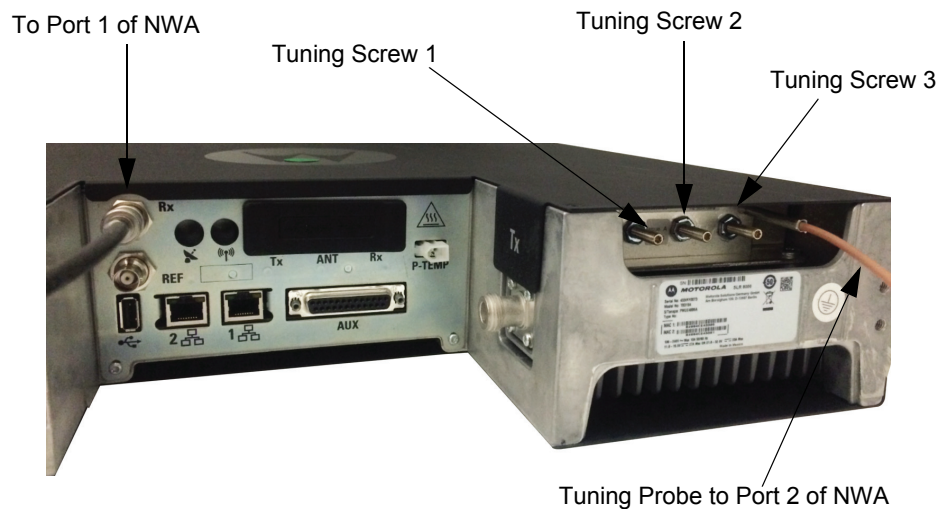


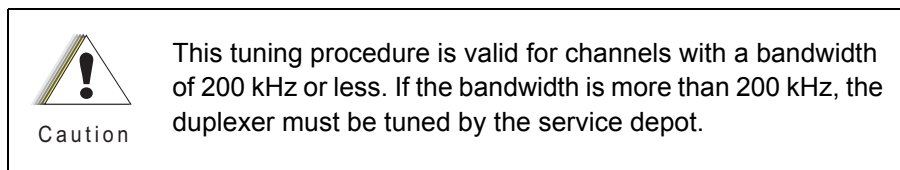
Figure 14-18 Connecting Preselector to the NWA

2. Unit Tuning
 - a. The procedure is identical to that described in the preferred method. The exception is that one will not be able to see the absolute insertion loss of the preselector assembly. The approximate insertion loss using the tuning probe in the alternate method is as follows:
 - VHF 50 dB +/- 10 dB
 - UHF 30 dB +/- 10 dBAs such, insertion loss will be relative, with return loss still yielding an absolute measurement. With this method, tune for a return loss greater than 18 dB across the 4 MHz passband of interest.
 - b. Reinstall the preselector’s protective probe cavity plug.

14.3.2 Duplexer

Duplexer modules shipped with stations are tuned at the factory. If a duplexer must be replaced in the field, the unit must be installed and tuned specifically to the transmit and receive frequency pair for the particular base station/repeater.

The duplexer module is comprised of three low-pass/high-notch cavities and three high-pass/low-notch cavities. Each set of three cavities provides bandpass filtering for either the transmit RF signal or the receive RF signal. In general, the duplexer must be tuned so that the transmit cavity set passes the transmit signal and rejects the receive signal and, at the same time, the receive cavity set must be tuned to pass the receive signal and reject the transmit signal.



Tuning is performed by injecting RF signals and making tuning adjustments (using the tuning pass and notch and trimmer screws) while monitoring for maximum or minimum readings on the RF millivoltmeter. Field tuning the duplexer module requires the following general adjustments:

- Tune high-pass/low-notch cavities for maximum pass and reject response
- Tune low-pass/high-notch cavities for maximum pass and reject response
- Check high-pass/low-notch and low-pass/high-notch cavities for insertion loss

Check high-pass/low-notch and low-pass/high-notch cavities for isolation

14.3.2.1 Duplexer Tuning Procedure (with basic instruments)

14.3.2.1.1 Test Equipment

The following test equipment are required to properly tune the duplexer module:

- Aeroflex 3900 Series Communications System Analyzer (or equivalent)
- RF Millivoltmeter (Boonton 92E or equivalent)
- RF Signal Generator (HP8565B or equivalent)
- 50 Ω N-type terminator
- Tuning tool; 4 mm x 10.1 cm (5/32" x 4") screwdriver
- N-to-N bullet connector (UG29A/U or equivalent)
- 11 mm (7/16") Nutdriver
- 11 mm (7/16") Open End Wrench
- N-to-BNC Adapter (UG349A/U)
- N-to-N Connector (UG57B/U)

14.3.2.1.2 Setting Up for Tuning Duplexer

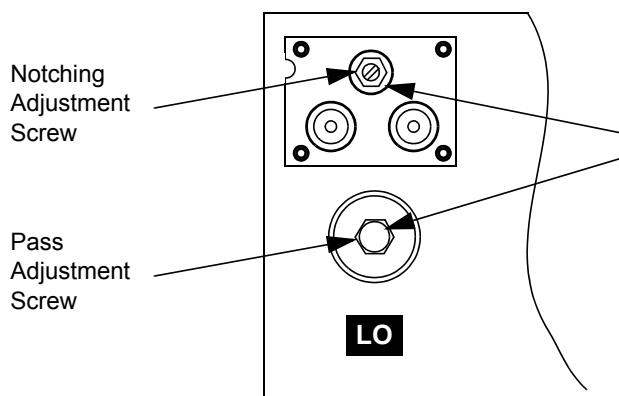
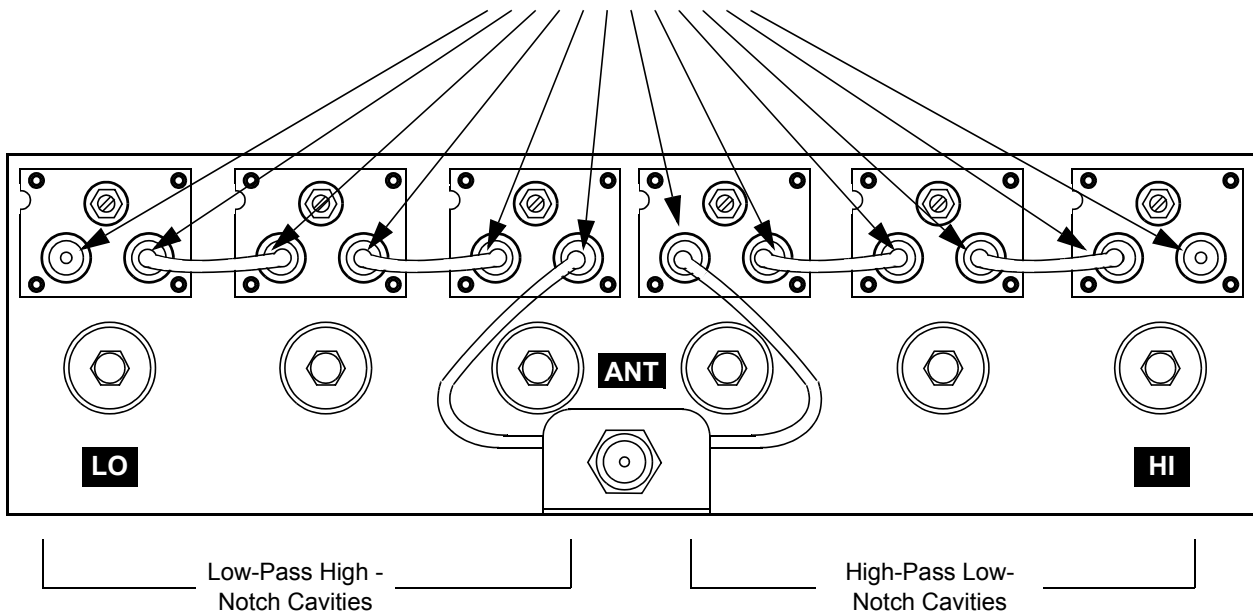
Perform the preliminary tasks shown in [Figure 14-19](#) to prepare the duplexer module for tuning.



Caution

Each Duplexer cable is unique and **must** be returned to the original position when removed. Use tape to label each end of each cable to ensure it is correctly replaced.

1. Disconnect twelve N-type connectors and remove six cables from cavities.



2. For each of the 6 cavities, use open-end wrench to loosen locknuts (2 per cavity).

Figure 14-19 Preliminary Tasks Prior to Tuning Duplexer

14.3.2.1.3 Duplexer Tuning Procedure

The duplexer field tuning procedures are provided in [Figure 14-20](#) to [Figure 14-23](#). The procedures are most easily performed with the duplexer module removed from the base station/repeater rack or cabinet. Be sure to take note of the transmit and receive frequencies for the particular base station/repeater before beginning.

If the duplexer module is tuned according to instructions and does not meet specifications for return loss, insertion loss, and/or isolation, return the duplexer for repair.

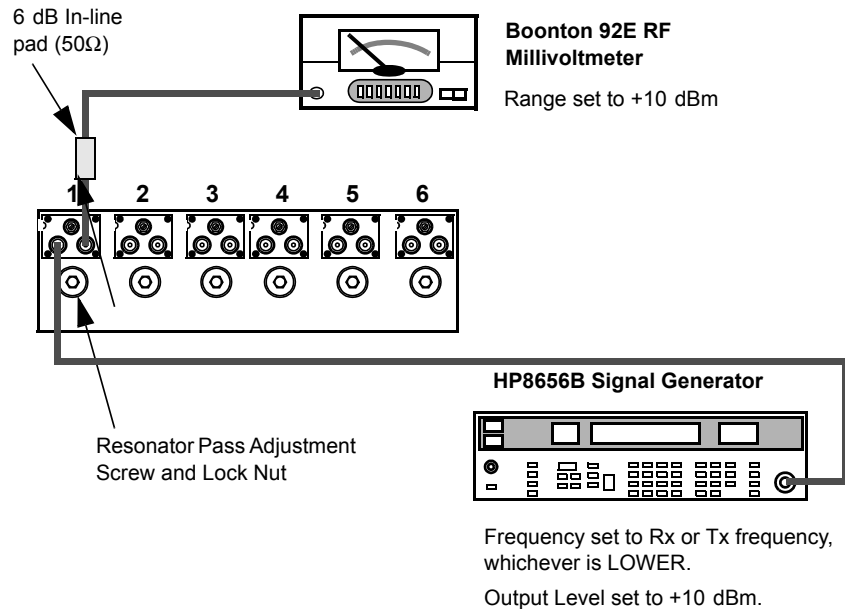
The notch (reject) frequency will maintain its spacing to the pass frequency when the pass adjustment of a cavity is moved several MHz. For example, a system operating at 455 MHz and 460 MHz, which is moved to 460 MHz and 465 MHz will require a minimum of readjustment if the pass adjustment is made first. It is therefore recommended that the pass adjustments be made first and that the procedures provided in [Figure 14-20](#) to [Figure 14-23](#) are followed.

1. To Start

Remove cables from the duplexer, noting and label the position of each cable. Each cable is unique and must be returned to the original position when tuning is complete.

2. Tuning Low Pass Resonators

1. Set up test equipment as shown, connecting to cavity no.1.
2. Use nut driver to adjust pass adjustment screw for cavity no.1 to obtain a peak reading on the millivoltmeter.
3. Use open end wrench and tighten lock nut carefully, making sure pass adjustment screw does not shift position.
4. Repeat steps 1–3 for cavities no.2 and no.3.



3. Tuning High Pass Resonators

1. Set up test equipment as shown, connecting to cavity no.4.
2. Use nut driver to adjust pass adjustment screw for cavity no.4 to obtain a **PEAK** reading on the millivoltmeter.
3. Use open end wrench and tighten lock nut carefully, making sure pass adjustment screw does not shift position.
4. Repeat steps 1–3 for cavities no.5 and no.6.

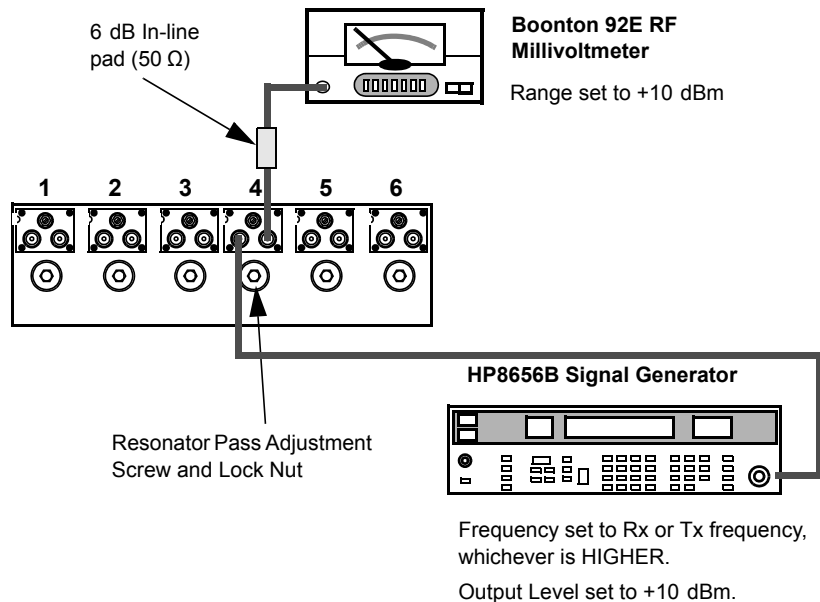
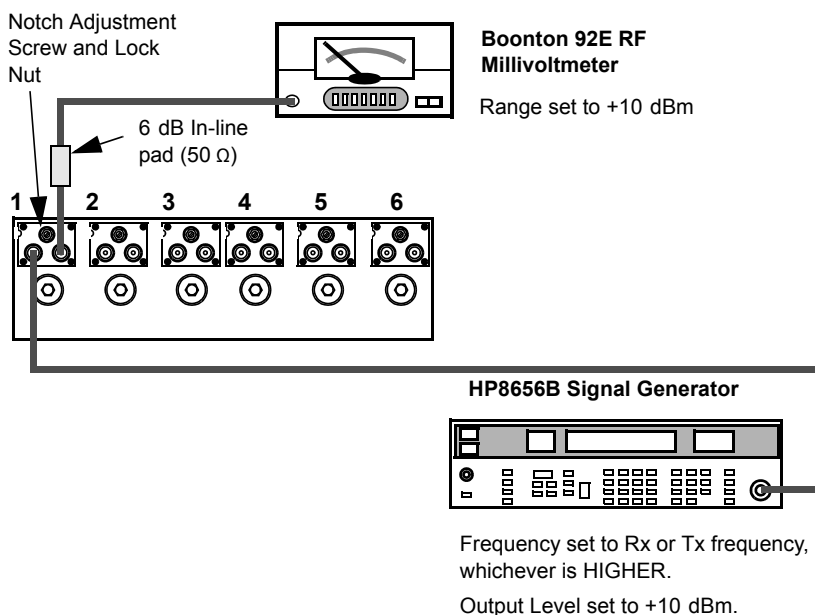


Figure 14-20 UHF Duplexer Field Tuning Procedure

4. Tuning High Notch Loop Assemblies

1. Set up test equipment as shown, connecting to cavity no.1.
2. Use screwdriver to adjust notch adjustment screw for cavity no.1 to obtain a minimum reading on the millivoltmeter. (Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Use open end wrench and tighten lock nut carefully, making sure notch adjustment screw does not shift position.
4. Repeat steps 1–3 for cavities no.2 and no.3.



5. Tuning Low Notch Loop Assemblies

1. Set up test equipment as shown, connecting to cavity no.4.
2. Use screwdriver to adjust notch adjustment screw for cavity no.4 to obtain a minimum reading on the millivoltmeter. (Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Use open end wrench and tighten lock nut carefully, making sure notch adjustment screw does not shift position.
4. Repeat steps 1–3 for cavities no.5 and no.6.
5. Reconnect the cables on the duplexer. Make sure that the cables are returned to their original position on the Duplexer.

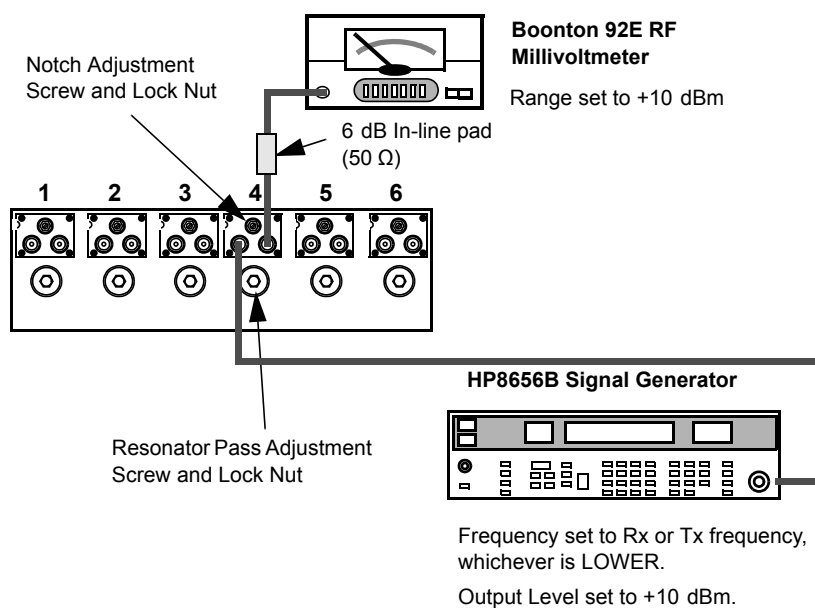
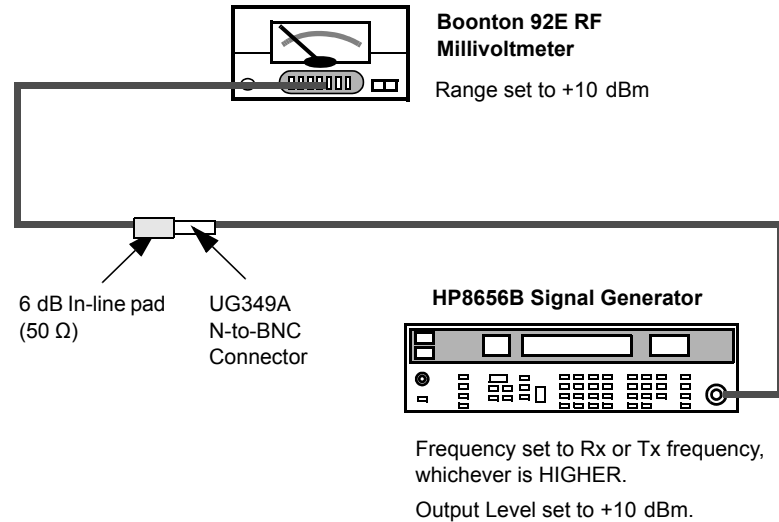


Figure 14-21 UHF Duplexer Field Tuning Procedure (continued)

6. Verifying Insertion Loss

1. Connect test equipment as shown.
2. Observe and note the level in dBm as shown on the millivoltmeter.



3. Connect the duplexer cables and test equipment to the duplexer as shown.
4. Observe and note the level in dBm as shown on the millivoltmeter.
5. Subtract the absolute number noted in Step 2 from the number noted in Step 4. The difference should be less than 1.3 dB to meet specification for Insertion Loss.
6. Repeat Steps 1–5 for Low- Pass/ High Notch cavities with the following exceptions:
 - a. Set Frequency Generator for Rx or Tx frequency, whichever is LOWER
 - b. Connect Signal Generator to Low Pass duplexer input (cavity no.1)
 - c. Connect terminator to cavity no.6.

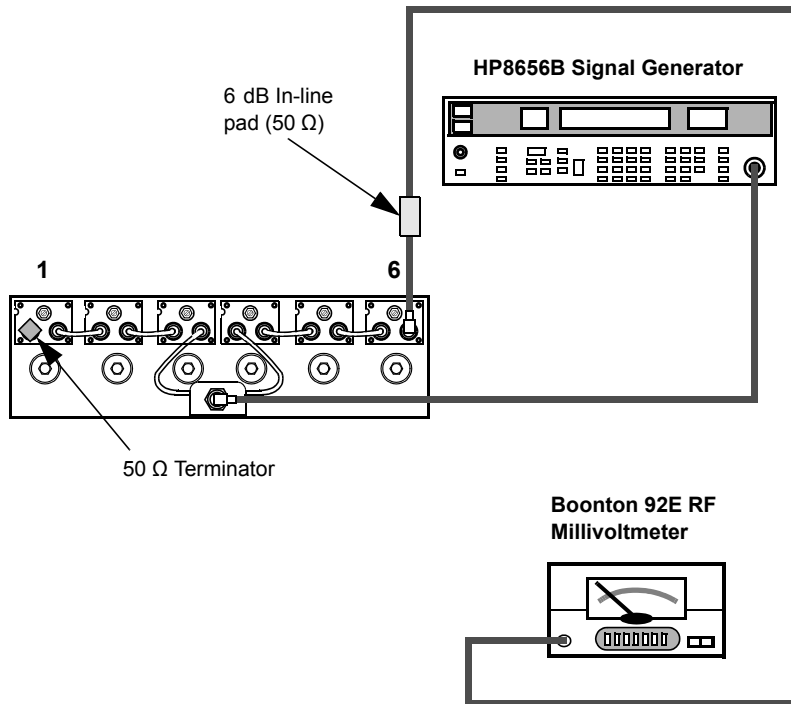


Figure 14-22 UHF Duplexer Field Tuning Procedure (continued)

8. Post-Tuning Checks

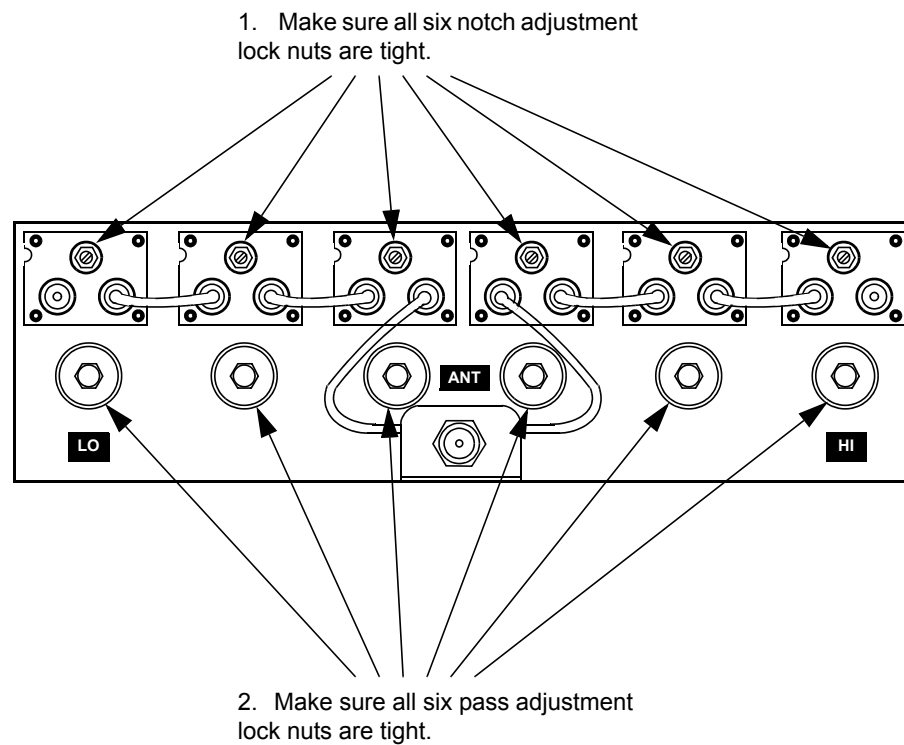


Figure 14-24 UHF Duplexer Field Tuning Procedure (continued)

This completes the Duplexer Tuning Procedure (with basic instruments). To obtain a more precise calibration, see [Section 14.3.2.2](#) to perform the Duplexer Tuning Procedure (with advanced instruments).

14.3.2.2 Duplexer Tuning Procedure (with advanced instruments)

14.3.2.2.1 Initial Settings

1. Power up the Network Analyzer (NWA), HP 8753C or equivalent. Based on whether it is VHF (U01, U02, U03) or UHF (U04, U05), the NWA has to be calibrated to the appropriate frequency sub-bands. See [Table 14-12](#).

Table 14-12 Frequency Range (U01, U02, U03, U04, U05)

	Frequency
U01	136–146 MHz
U02	144–160 MHz
U03	158–174 MHz
U04	403–435 MHz
U05	435–470 MHz

2. If the unit to be tuned is one of the VHF sub-bands, unscrew all the tuning screw caps (two each for the LO side cavities, and one each for the HI side cavities). Use a torque wrench to loosen the screws by the side of the tuning rods.
3. Adjust the NWA START frequency, STOP frequency, SPAN etc., based on the LO and HI frequencies which has to be tuned on the unit. Set the NWA source power to 10 dBm.

14.3.2.2.2 Tuning the LO side

Note Please note that the duplexer tuning procedures from [Section 14.3.2.2.2](#) to [Section 14.3.2.2.4](#) are applicable to UHF and VHF bands although the test frequencies represented in the figures below are for VHF bands.



Caution

Each Duplexer cable is unique and **must** be returned to the original position when removed. Use tape to label each end of each cable to ensure it is correctly replaced.

1. **For UHF units:** Connect the two N-type test cables hooked up on ports 1 and 2 of the NWA to the two N type female connectors of LO side Cavity 1. Set up markers on the NWA-Marker 1 (m1) to LO frequency on CH1 (S11–Reflection) and Marker 2 (m2) to HI frequency on CH2 (S21–Transmission).
For VHF units: Connect the two N-type NWA test cables hooked up on the ports 1, 2 to a T and connect it to LO Cavity 1. Set up markers on the NWA-Marker 1 (m1) to LO Frequency on CH1 (S11–Reflection) and Marker 2 (m2) to HI Frequency on CH2 (S21–Transmission).

Initial NWA display may be similar to [Figure 14-25](#). Here the unit that is being tuned is a VHF unit, and the LO freq: 144 MHz, HI freq: 145.5 MHz.

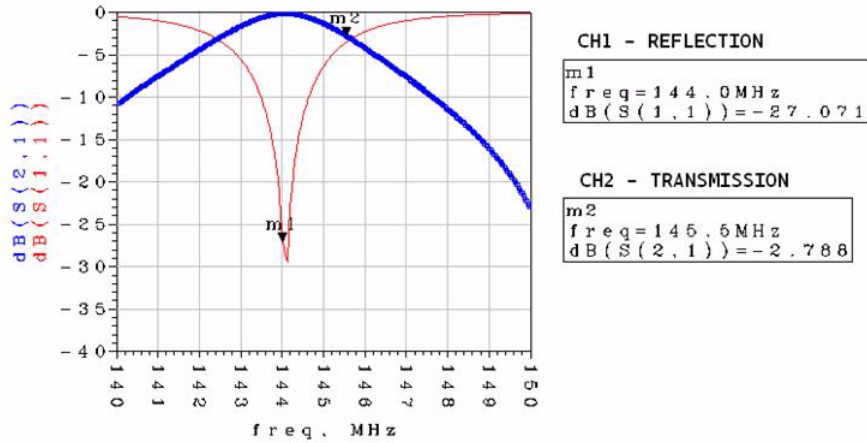


Figure 14-25 Untuned LO SIDE-Cavity 1

- Turn the notch screw until Marker 1 falls in the dip of the CH1 curve as shown in Figure 14-26. Lightly tighten the locknut in place to prevent further movement.

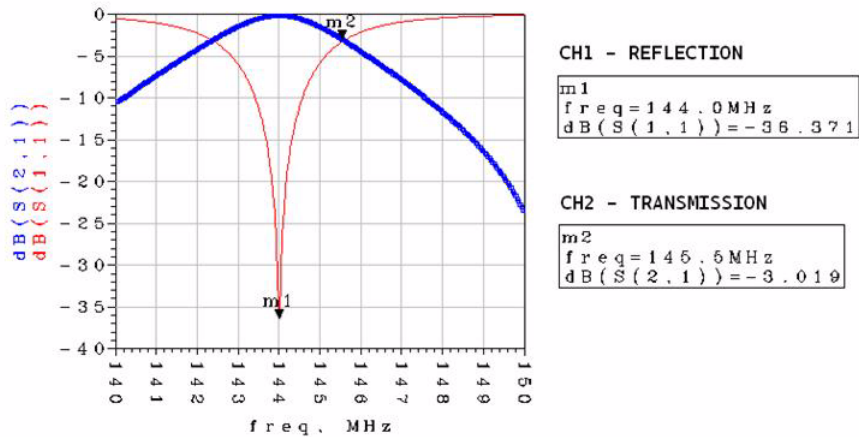


Figure 14-26 Tuned CH1 - LO SIDE-Cavity 1

- Turn the pass screw until Marker 2 falls in the dip of the CH2 curve as shown in Figure 14-27. Lightly tighten the locknut in place to prevent further movement.

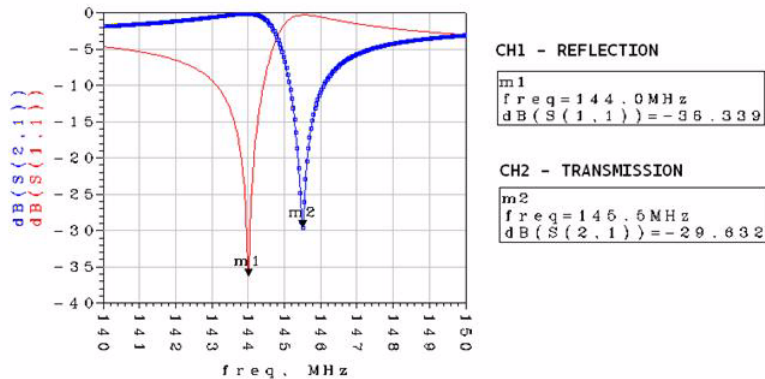


Figure 14-27 Tuned CH1, CH2 - LO SIDE-Cavity 1

- Do not change the settings on the network analyzer, just repeat Step 1, 2, and 3 for the other LO cavities 2 and 3 on the left.

14.3.2.2.3 Tuning the HI side

- For UHF units:** Connect the two N-type test cables hooked up on the ports 1,2 of the NWA to the two N type female connectors of HI cavity 4. Set up markers on the NWA-Marker 1 to HI Frequency on CH2 (S21–Transmission) and Marker 2 to LO Frequency on CH1 (S22–Reflection).

For VHF units: Connect the two N-type NWA test cables hooked up on the ports 1, 2 to a T and connect it to HI cavity 4. Set up markers on the NWA-Marker 1 to HI Frequency on CH2 (S21–Transmission) and Marker 2 to LO Frequency on CH1 (S22–Reflection).

Initial NWA display may be similar to [Figure 14-28](#). Here the unit that is being tuned is a VHF unit and the LO freq: 144 MHz, HI freq: 145.5 MHz.

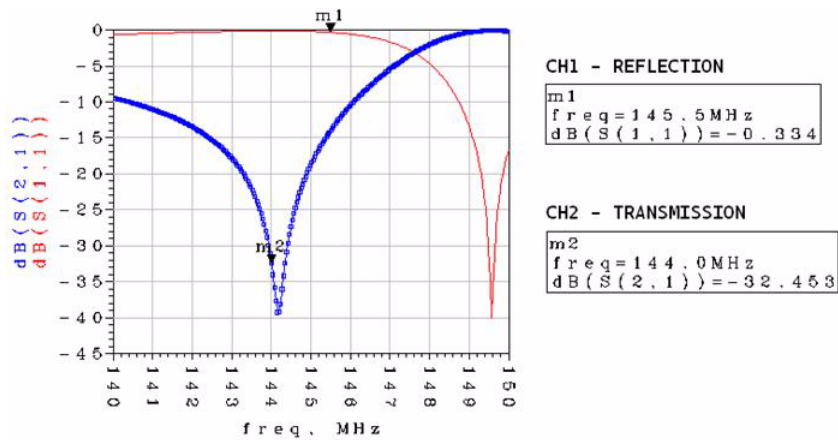


Figure 14-28 Untuned HI SIDE-Cavity 4

- Turn the notch screw until Marker 1 falls in the dip of the CH1 curve as shown in [Figure 14-29](#). Lightly tighten the locknut in place to prevent further movement.

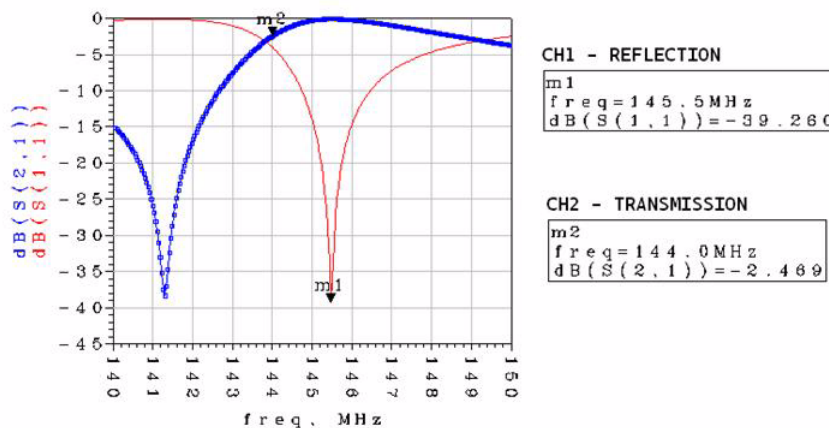


Figure 14-29 Tuned CH1 - HI SIDE-Cavity 4

3. Turn the pass screw until Marker 2 falls in the dip of the CH2 curve as shown in [Figure 14-30](#). Lightly tighten the locknut in place to prevent further movement.

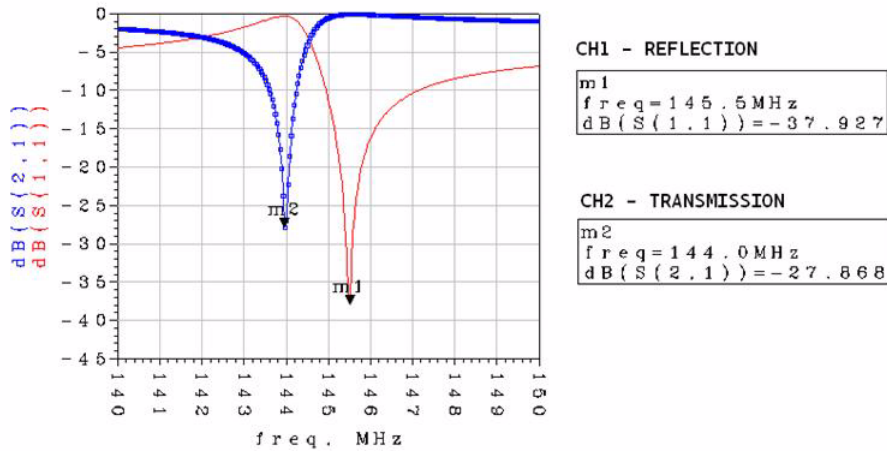


Figure 14-30 Tuned CH1, CH2 - HI SIDE-Cavity 4

Do not change the settings on the network analyzer, just repeat Step 5, 6, and 7 for the other HI cavities 5 and 6 on the right.

14.3.2.2.4 Fine Tuning the Duplexer

1. When all 6 cavities have been tuned separately, connect the Port 1 NWA cable to the N connector of the LO side input cavity (cavity 1) and the Port 2 of NWA to the duplexer Antenna port (ANT) respectively.
 - a. Connect ports 1 and 2 of the NWA to the LO input side (far left) and ANT, respectively. The desired response on the NWA for m1 (return loss), m2 (insertion loss), and m3 (noise suppression) is as shown in [Figure 14-31](#).

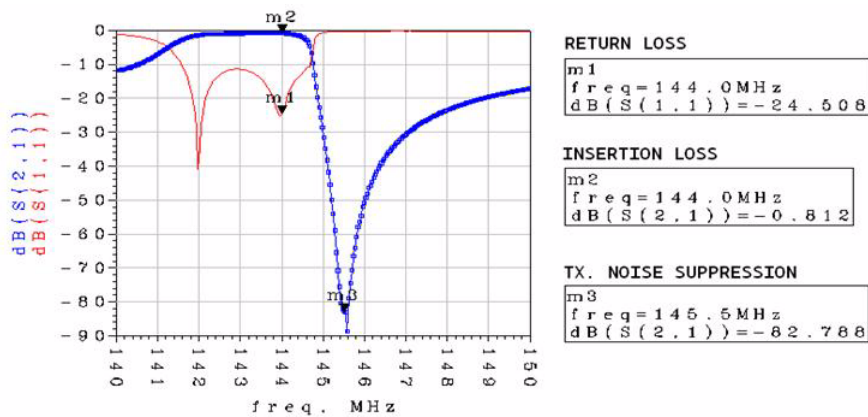


Figure 14-31 LO Side Response Curves

- b. Now connect ports 1 and 2 of the NWA to the ANT and the HI input side (far right), respectively. The desired response on the NWA for the m1 (return loss), m2 (insertion loss), and the m3 (noise suppression) markers is as shown in [Figure 14-32](#).

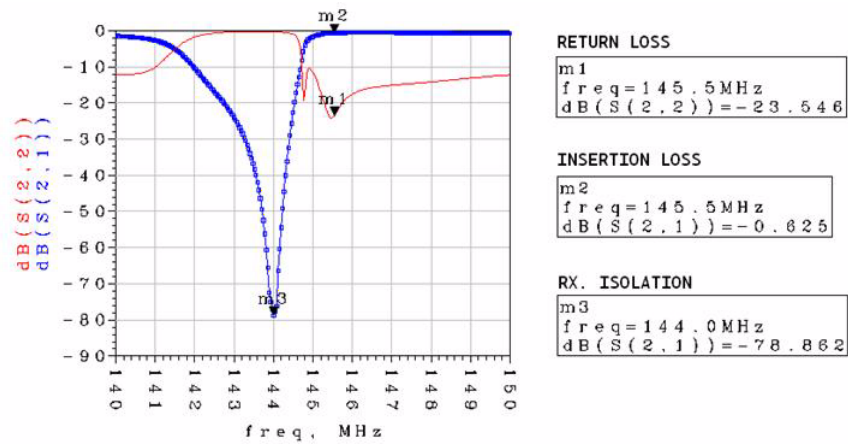


Figure 14-32 HI Side Response Curves

2. If all the specification limits are met with some margin, stop tuning the unit any further. With caution, fine tuning of the tuning notch and pass, and tuning screws can be done to improve the performance further in cases where the response seems to be marginal. This is more significant in cases where the T/R spacing is 1.5 MHz or lower. For the sample shown, fine tuning was done to improve the performance slightly, as shown by comparing Figure 14-31 to Figure 14-33 and Figure 14-32 to Figure 14-34.

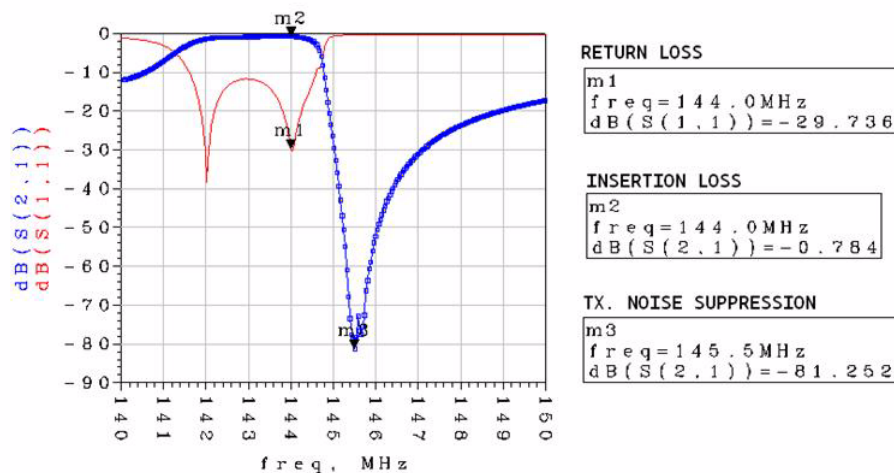


Figure 14-33 After Fine Tuning—LO Side Response Curves

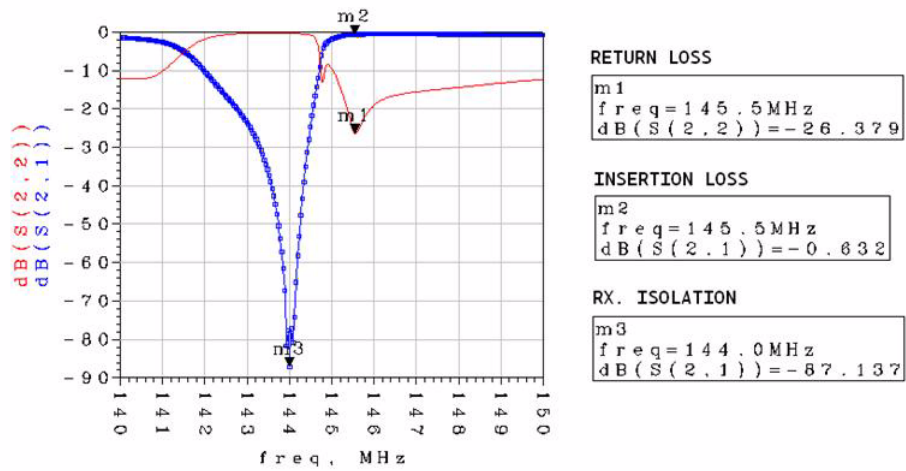


Figure 14-34 After Fine Tuning—HI Side Response Curves

3. See Figure 14-35 for the post-tuning checks.

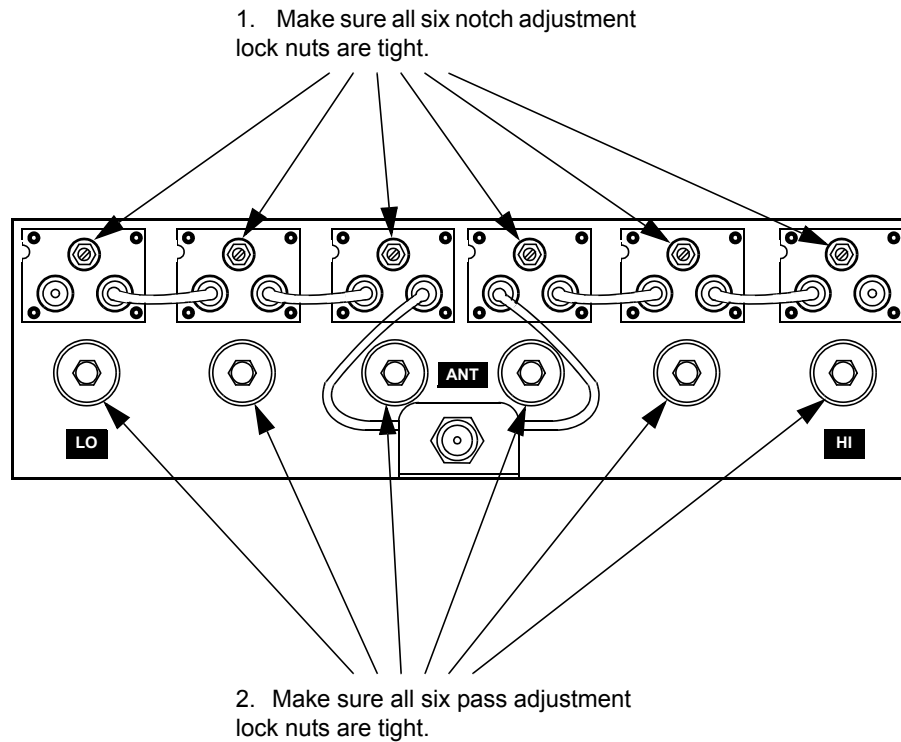


Figure 14-35 UHF Duplexer Field Tuning Procedure (continued)

This completes the Duplexer Tuning Procedure (with advanced instruments).

Appendix A Accessories

A.1 Introduction

Motorola provides the following approved accessories to improve the productivity of the SLR 8000 Base Station/Repeater.

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

A.1.1 Cables

Part No.	Description
3087791G04	Power Cord, Euro
3087791G07	Power Cord, UK
3087791G10	Power Cord, Australia/NZ
PMKN4167_	Battery Charger Cable
CB000057A03	Wireline to Modem Flex Cable
CB000059A01	Preselector Rx Output Cable
CB000062A01	Antenna Relay Power Cable
CB000063A01	Rear Panel to Circulator Tray Cable (load temp alarm)
3013942M07	Antenna Relay Tx Cable
3013943E08	Antenna Relay Rx Cable

A.1.2 Documentation

Part No.	Description
6880309T12	MOTOTRBO System Planner
MN002732A01	Capacity Max System Planner
6801200069	Hi-Power Repeater Safety Leaflet
9880384V83	CDROM for R56 manual
PMLN7401_	SLR 8000 CDROM (BSIM)
GMLN4575_	MOTOTRBO Publication CD
GMVN5141_	MOTOTRBO Software DVD
GMVN5520_	MOTOTRBO RDAC Software CD

A.1.3 Duplexer

Part No.	Description
PMLE5152_	Duplexer Hardware Kit

A.1.4 Mounting

Part No.	Description
PMLN7478_S	Mounting Hardware Service Kit
BR000020A01	Mounting Ears
BR000050A01	Front Bezel Mounting Clip

A.1.5 Preselectors

Part No.	Description
PMLD4819_S	VHF Preselector, 136 – 154 MHz
PMLD4820_S	VHF Preselector, 150 – 174 MHz
PMLE5124_S	UHF Preselector, 350 – 470 MHz
N/A	Tuning Probe

A.1.6 Service Kits

Part No.	Description
WAED4538_	SLR 8000 Series VHF Modem Service Kit
WAEE4534_	SLR 8000 Series UHF1 Modem Service Kit
PMTD1360_S	SLR 8000 VHF PA Service Kit
PMTE4000_S	SLR 8000 UHF PA Service Kit
PMPN4053_S	SLR 8000 Power Supply Unit Service Kit
PMLN6822_S	SLR 8000 Front Panel Service Kit
PMHN4355_	Chassis Service Kit (contact Motorola Service Center for replacement)
PMLN7450_	SLR 8000 Fan Assembly Service Kit
PMLN6730_S	SLR 8000 Wireline Card Service Kit
PMLN7092_S	SLR 8000 Antenna Relay Service Kit
PMLD4836_	SLR 8000 VHF 136 – 146 MHz Circulator Service Kit
PMLD4837_	SLR 8000 VHF 144 – 160 MHz Circulator Service Kit
PMLD4838_	SLR 8000 VHF 158 – 174 MHz Circulator Service Kit
PMLE5153_	SLR 8000 UHF 403 – 470 MHz Circulator Service Kit
PMFD4000_	VHF Duplexer, 136 – 146 MHz
PMFD4001_	VHF Duplexer, 144 – 160 MHz
PMFD4002_	VHF Duplexer, 158 – 174 MHz
PMFE4000_	UHF Duplexer, 403 – 435 MHz
PMFE4001_	UHF Duplexer, 435 – 470 MHz

A.1.7 Service Parts

Part No.	Description
0185172Y03	UHF Circulator
0185172Y07	VHF Circulator 132 – 146 MHz
0185172Y06	VHF Circulator 144 – 160 MHz
0185172Y05	VHF Circulator 158 – 174 MHz
9185856Y01	UHF Low Pass Filter
9185856Y03	VHF Low Pass Filter
0185172Y10	RF Load

A.1.8 Service Tools

Part No.	Description
PMKN4166_	Test Cable (for test box and external speaker)
30009477001	USB A to USB B Cable (for programming)
RLN4460_	Test Box
N/A	Aeroflex 3900 Series Communications System Analyzer
N/A	Keysight E5062A/E5071B/E5071C Network Analyzer

A.1.9 Microphone

Part No.	Description
GMMN4063_	Microphone, RJ45

A.1.10 Miscellaneous

Part No.	Description
HW000190A01	Front Panel Thermal Pad
LB000303A01	Wireline I/O Label

Notes

Appendix B EMEA Regional Warranty, Service and Technical Support

B.1 Warranty and Service Support

Motorola offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/ repair or spare parts support out of warranty. Any "return for exchange" or "return for repair" by an authorized Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorized Motorola Dealer.

B.1.1 Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only.

In instances where the product is covered under a "return for replacement" or "return for repair" warranty, a check of the product should be performed prior to shipping the unit back to Motorola. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radio back to the appropriate Motorola warranty depot, please contact Customer Resources (Please see page B-2). All returns must be accompanied by a Warranty Claim Form, available from your Customer Services representative. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

B.1.2 After Warranty Period

After the Warranty period, Motorola continues to support its products in two ways.

1. Motorola's Managed Technical Services (MTS) offers a repair service to both end users and dealers at competitive prices.
2. MTS supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

B.2 European Radio Support Centre (ERSC)

European Repair and Service Centre:
Telephone: +49 30 6686 1555
Fax ERSC: +49 30 6686 1579
Email ERSC: ERSC@motorolasolutions.com

Please use these numbers for repair enquiries only.

B.3 Piece Parts

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 cancellations 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.

Orders for replacement parts, kits and assemblies should be placed directly on Motorola's local distribution/dealer organisation or via Motorola Online at: <https://emeaonline.motorolasolutions.com>

* 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).

B.4 Technical Support

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

Contact Details:

Email: essc@motorolasolutions.com

The Technical Support is available through the following service numbers:

Austria:	01206091087	Poland:	00 800 141 0252
Denmark:	043682114	Portugal:	0217616160
France:	0157323434	Russia:	810 800 228 41044/ 810 800 120 1011
Germany:	06950070204	Saudi Arabia:	800 844 5345
Israel:	180 931 5818	South Africa:	0800981900
Italy:	0291483230	Spain:	0912754787
Lithuania:	880 030 828	United Kingdom:	02030 277499
Netherlands:	0202061404	All other countries:	+44 2030 277499
Norway:	24159815		

B.5 Further Assistance From Motorola

You can also contact the Customer Help Desk through the following web address.
<http://www.motorolasolutions.com>


Appendix C SLR 8000 Third Party Controllers

C.1 Overview

The SLR 8000 Base Station/Repeater is capable of interfacing to a number of third party controllers via the four-wire and GPIO/GPI interface afforded by the back panel AUX connector. This section covers the connections and signal levels between the third party controllers and the base station/repeater, as well as the audio path configuration needed via CPS. Note that this section is not a substitute for a more comprehensive instruction detailed in the vendor's manuals of their respective third party controllers.

The third party controllers supported by SLR 8000 Base Station/Repeater are as follows:

- Community Repeater Panel (Zetron Model 38-Max)
- Phone Patch (Zetron Model 30)
- Tone Remote Adapter (Motorola Model L3276)
- LTR (Trident Model Raider and Marauder)
- Passport (Trident Model NTS) (see Note)



Caution Do not hot swap any of the third party controllers as this could (at a minimum) cause a malfunction with the base station/repeater.

Note The SLR 8000 Base Station/Repeater only support the third party controllers noted above when it is configured in analog mode. The screen capture below shows the CPS location to configure the SLR 8000 Base Station/Repeater for analog mode.

Note If the third party controllers are supplied power by the SLR 8000 Base Station/Repeater, then the SLR 8000 Base Station/Repeater needs to be in a powered off state when establishing (or removing) the connection to the SLR 8000 back panel connector.

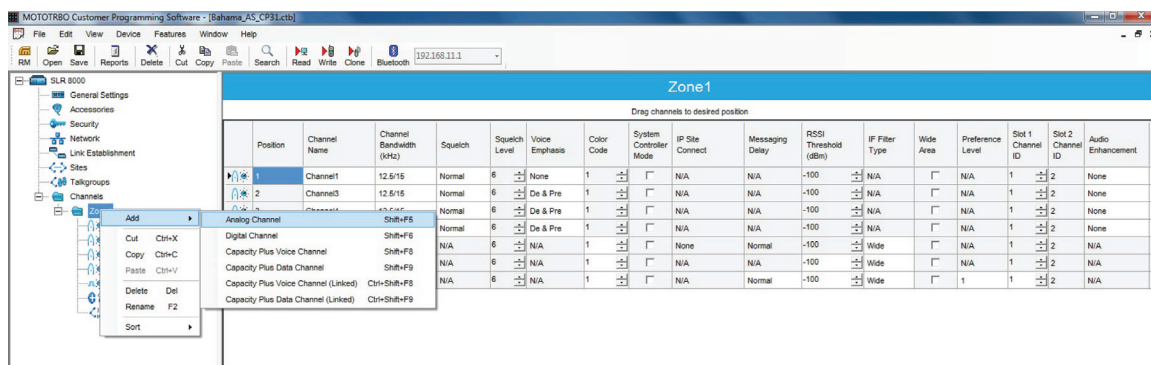


Figure C-1 CPS Settings to Configure SLR 8000 Base Station/Repeater for Analog Mode

C.2 Community Repeater Panel

C.2.1 Description

The SLR 8000 Base Station/Repeater is capable of Multi-Coded Squelch through the Zetron Model 38 Repeater Panel. The Model 38 Repeater Panel interconnects to the SLR 8000 Base Station/Repeater and provides 38 PL tones and 22 DPL tones standard.

See Zetron Model 38 Repeater Panel Instruction Manual (supplied with the panel) for panel specifications, operation, installation, alignment, programming, and repair information.



Figure C-2 Model Zetron 38 Repeater Panel

C.2.2 Compatibility

Zetron Model 38 Repeater Panel is compatible for all versions of SLR 8000 software and hardware.

C.2.3 Hardware Connections

The connections between the SLR 8000 Base Station/Repeater and the community repeater panel are facilitated with a multi-conductor cable connected between the SLR 8000 back panel AUX 25-Pin connector and that of the community repeater panel. The connection provides the following signals:

- Transmit Audio
- Receiver Audio
- Push-to-talk (PTT)
- Carrier Operated Relay (COR)
- 13.6 VDC nominal (See note)
- Ground

Note If this connection is used, the external equipment must draw less than 1A.

Signal connections are noted in [Figure C-1](#). The SLR 8000 connector and physical Pin locations are noted in the backplane interface board section of this manual. See Zetron Model 38 Repeater Panel manual for its connector and physical Pin locations. The part number for a pre-fabricated cable is noted in the SLR 8000 ordering guide.

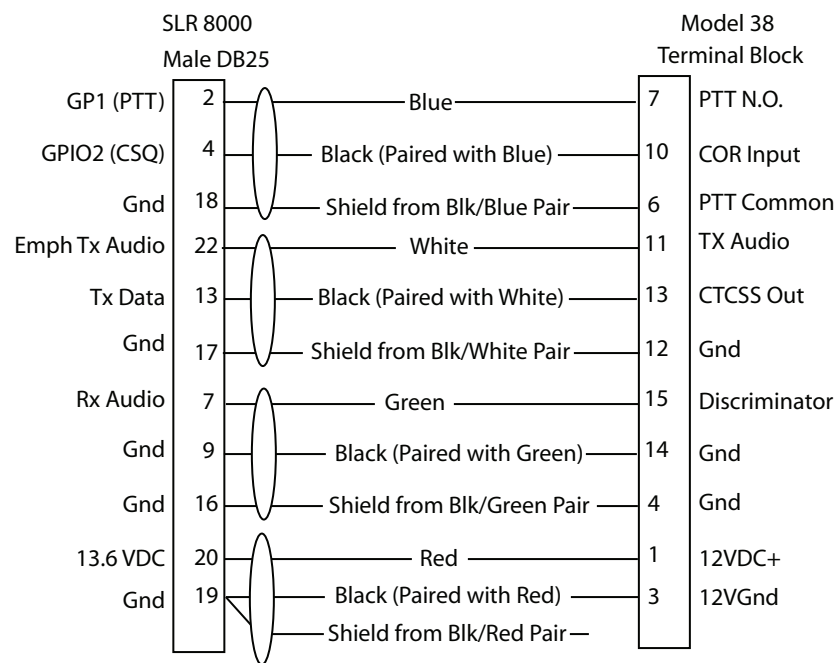


Figure C-3 Signal Connections between SLR 8000 Base Station/Repeater and Community Repeater Panel

C.2.4 CPS Configuration

The SLR 8000 Base Station/Repeater will need to be configured via the CPS application as shown in [Figure C-4](#) and [Figure C-5](#). More specifically, the affected parameters are as follows:

- Audio Type
 - Flat Unsquelled
- Disable Repeat Path
 - Checked
- GPIO Pin number 2, 11
 - Ext PTT
 - Active Low
- GPIO Pin number 4
 - Carrier Squelch (CSQ) Detect
 - Active High
- Squelch Type (Rx)
 - CSQ
- Squelch Type (Tx)
 - CSQ

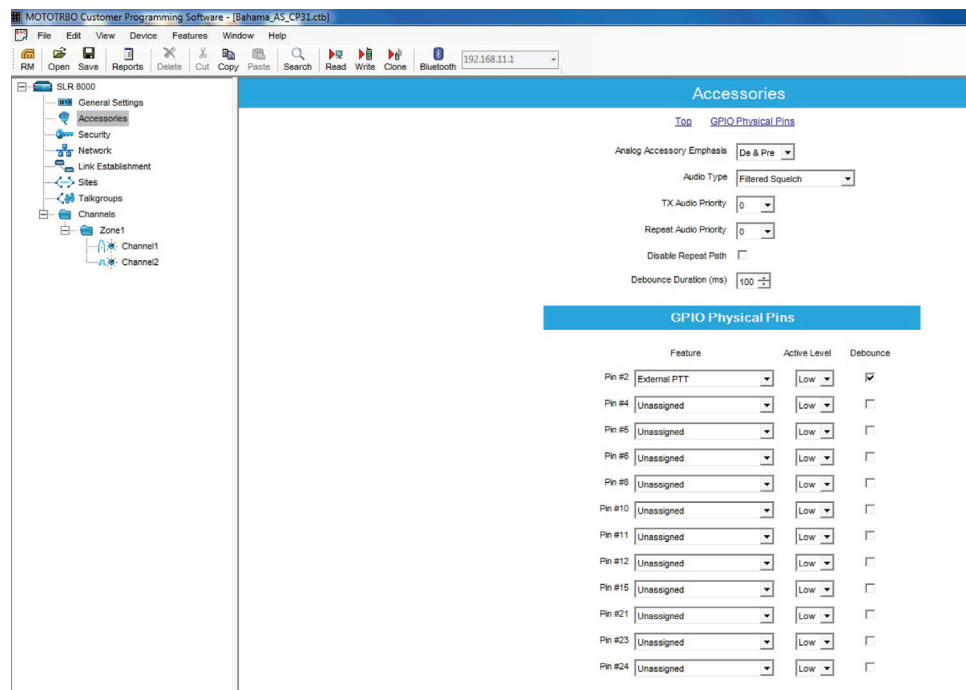


Figure C-4 CPS Configuration for Community Repeater Panel (1 of 2)

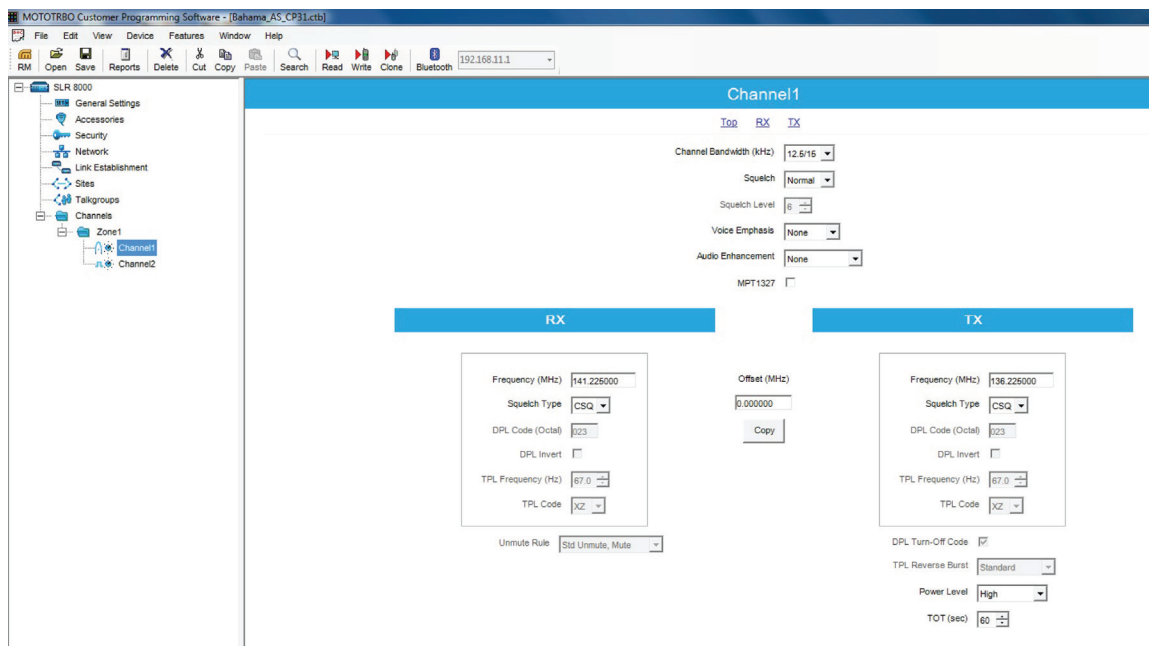


Figure C-5 CPS Configuration for Community Repeater Panel (2 of 2)

C.2.5 Community Repeater Panel Settings

The input and output levels should be adjusted per the community repeater panel's instructions. The summary below gives a brief overview of the high level characteristics and community repeater panel settings for configuration with the SLR 8000 Base Station/Repeater.

C.2.5.1 Discriminator

The SLR 8000 Base Station/Repeater's Receiver audio will yield 330mV rms into 50 kΩ with an RF input signal deviating at 60% RSD. With the community repeater panel's own loading impedance, the "Discriminator" signal delivered to the community repeater panel is at a high enough drive level to leave the community repeater panel's "Rx Audio Gain High/Low" switch in the factory default position (back panel Switch 1).

Note Under the System Programming, turn on the DCS Rx data.

C.2.5.2 Tx Audio

The SLR 8000 Base Station/Repeater's transmitter will yield 60% RSD with 80mV rms into the Emph Tx Audio port. The "Tx Audio" signal delivered by the community repeater panel is at a high enough drive level to leave the community repeater panel's "Tx Audio Gain High/Low" switch in the factory default position (back panel Switch 4).

Note Under the System Programming, turn on the DCS Tx data.

C.2.5.3 Continuous Tone-Controlled Squelch Systems (CTCSS) Out

The SLR 8000 Base Station/Repeater's transmitter will yield 60% RSD with 80mV rms into the Tx Data port. The "CTCSS" signal delivered by the community repeater panel is at a high enough drive level to leave the community repeater panel's "Encode gain high/low" switch in the factory default position (back panel Switch 3).

C.2.5.4 Tx Audio Pre-Emphasis

Set the “Encode flat/ De-emphasized” switch to the Up position on the community repeater panel.

C.2.5.5 Carrier Operated Relay (COR)

For use with the SLR 8000 Base Station/Repeater, configure the specified back panel switches on the community repeater panel as follows:

- Switch 6 “COR source internal/external” (set to the Down position)
- Switch 7 “COR polarity positive/negative” (set to the Up position)
- Switch 8 “COR pull-up on/off” (set to the Up position)

C.3 Phone Patch

C.3.1 Description

The SLR 8000 Base Station/Repeater is capable of multi-mode telephone interconnect through the Zetron Model 30 Phone Patch. The Zetron Model 30 Phone Patch interconnects to the SLR 8000 Base Station/Repeater and allow users to initiate and receive land line telephone calls via the subscriber radios. When properly configured, subscribers can initiate and answer telephone calls. Via selective signaling, calls from land line users can be directed to any subscriber or to a specific user. Additionally, access control is also afforded by the Zetron Model 30 Phone Patch.

See Zetron Phone Patch Manual (supplied with the phone patch) for specifications, operation, installation, alignment, programming, and repair information.



Figure C-6 Zetron Model 30 Phone Patch

C.3.2 Compatibility

Zetron Model 30 Phone Patch is compatible for all versions of SLR 8000 Software and Hardware.

C.3.3 Hardware Connections

The connections between the SLR 8000 Base Station/Repeater and the phone patch are facilitated with a multi-conductor cable connected between the J7 SLR 8000 back panel Aux 25-Pin connector and that of the phone patch. The connection provides for the following signals:

- Transmit Audio
- Receiver Audio
- PTT
- COR
- 13.6 VDC Nominal (see Note)
- Ground

Note If this connection is used, the external equipment must draw less than 1A.

Signal connections are noted in [Figure C-2](#). The SLR 8000 Base Station/Repeater connector and physical Pin locations are noted in the backplane interface board section of this manual. See Zetron Model 30 manual for its connector and physical Pin locations. The part number for a pre-fabricated cable is noted in the SLR 8000 ordering guide.

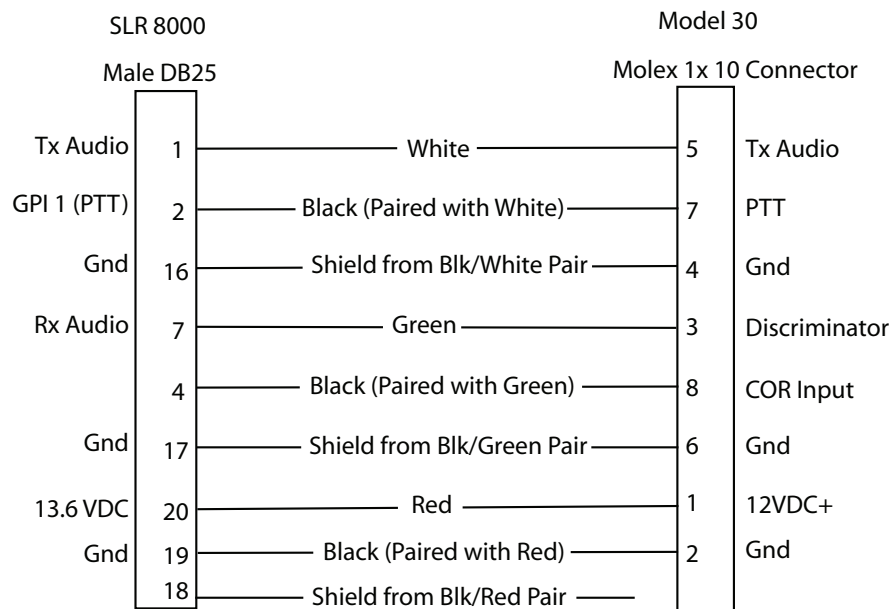


Figure C-7 Signal Connections between SLR 8000 Base Station/Repeater and Zetron Model 30 Phone Patch (Analog Phone Patch Cable & Digital Phone Patch Cable)

C.3.4 CPS Configuration

The SLR 8000 Base Station/Repeater will need to be configured via the CPS application as shown in [Figure C-4](#) and [Figure C-5](#). More specifically, the affected parameters are as follows:

- Audio Type
 - Filtered Squelch
- Analog Accessory Emphasis
 - De & Pre
- Disable Repeat Path
 - Un-Checked
- Tx Audio Priority
 - 0
- GPIO Pin number 2, 11
 - Ext PTT
 - Active Low
- GPIO Pin number 4
 - PL/Talkgroup Detect
 - Active Low
- Squelch Type (Rx)
 - TPL
- Squelch Type (Tx)
 - TPL

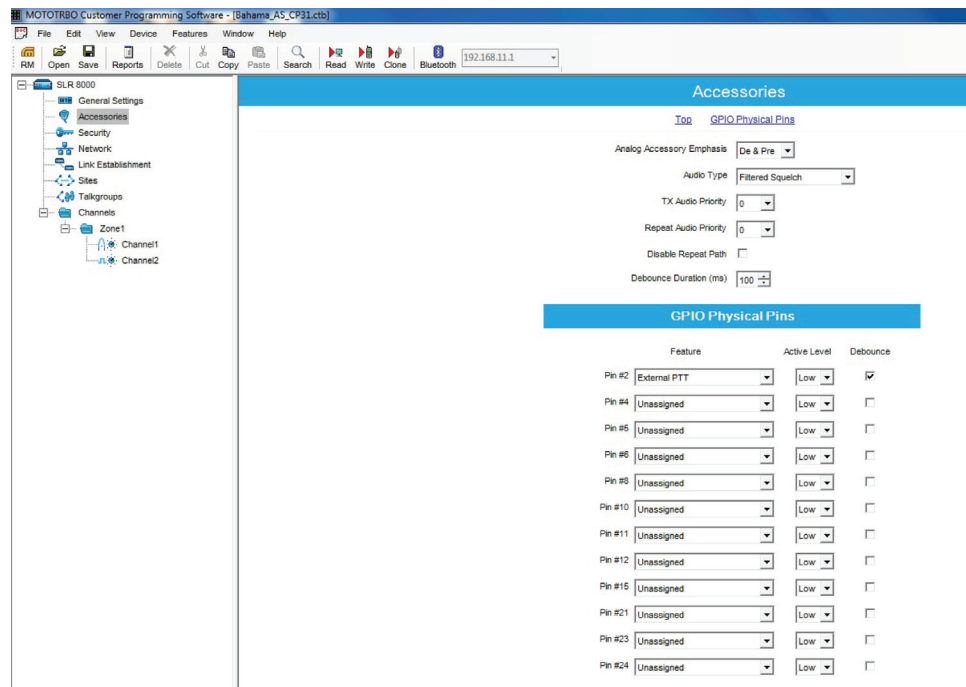


Figure C-8 CPS Configuration for Phone Patch (1 of 2)

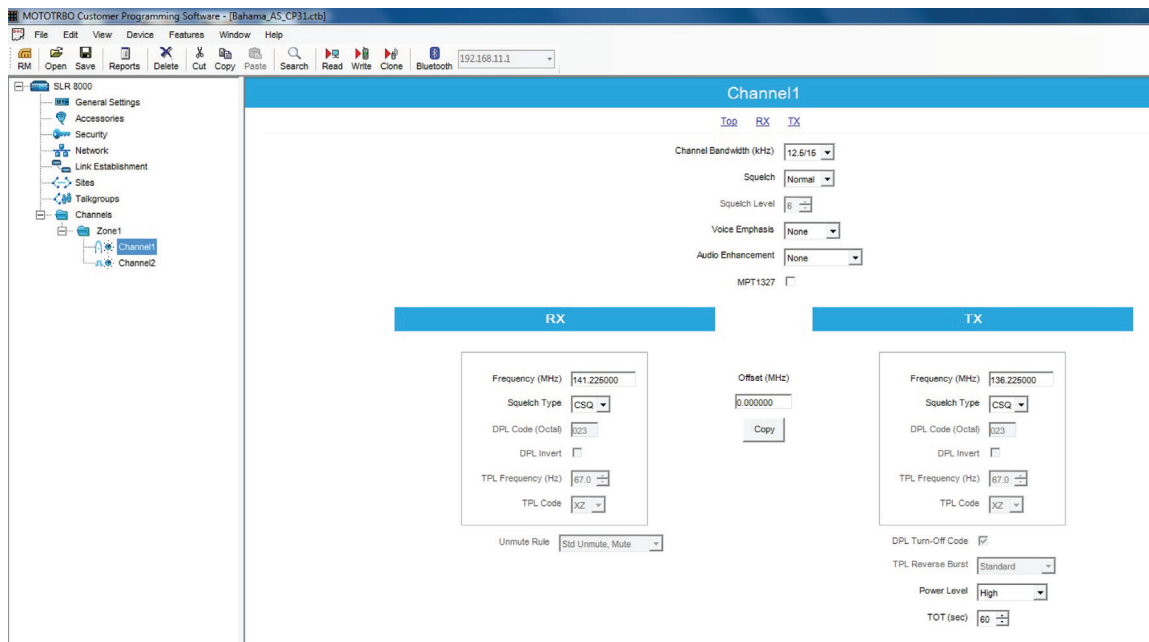


Figure C-9 CPS Configuration for Phone Patch (2 of 2)

C.3.5 Phone Patch Level Settings

The input and output levels should be adjusted per the phone patch's instructions. The summary below gives a brief overview of the high level characteristics and phone patch settings for configuration with the SLR 8000.

C.3.5.1 Disc

The SLR 8000 Base Station/Repeater's Receiver audio will yield 330mV rms into 50 kΩ with an RF input signal deviating at 60% RSD. With the phone patch's own loading impedance, the "Disc" signal delivered to the phone patch is at a high enough drive level to leave jumper JP1 in the factory default position (position A).

C.3.5.2 Tx Audio

The SLR 8000 Base Station/Repeater's transmitter will yield 60% RSD with 80mV rms into the Tx Audio port. The "Tx Aud" signal delivered by the phone patch is at a high enough drive level to leave jumper JP3 in the factory default position (position B).

C.3.5.3 CTCSS/ DCS DECODE INPUT/ COR

Set jumper JP6 to position A, to match the SLR 8000 active low indication of a PL/DPL detect.

Set jumper JP7 to position B, to external squelch indication.

Set jumper JP8 to position C, to match the SLR 8000 active low indication of a COR detect.

C.4 Tone Remote Adapter

C.4.1 Description

When a dispatch console or deskset sends out signals to a remote repeater, it does so over a Wireline. Two types of signals are sent:

- Audio signal
- Command signals (function tones) that are used to perform the remote control functions.

The SLR 8000 Base Station/Repeater is capable of decoding function tones, sent over a Wireline from a remote analog deskset or console, via the Motorola Tone Remote Adapter (Model L3276). When properly configured, the Tone Remote Adapter will perform the following functions in conjunction with the SLR 8000 Base Station/Repeater:

- Transmit and Receive Audio
- PTT
- Monitor
- Channel Select (up to 15 frequencies)
- Wildcard (e.g. Repeater Knockdown)

See Motorola Tone Remote Adapter Manual (supplied with the Tone Remote Adapter) for specifications, operation, installation, alignment, programming, alternate configurations, and repair information.

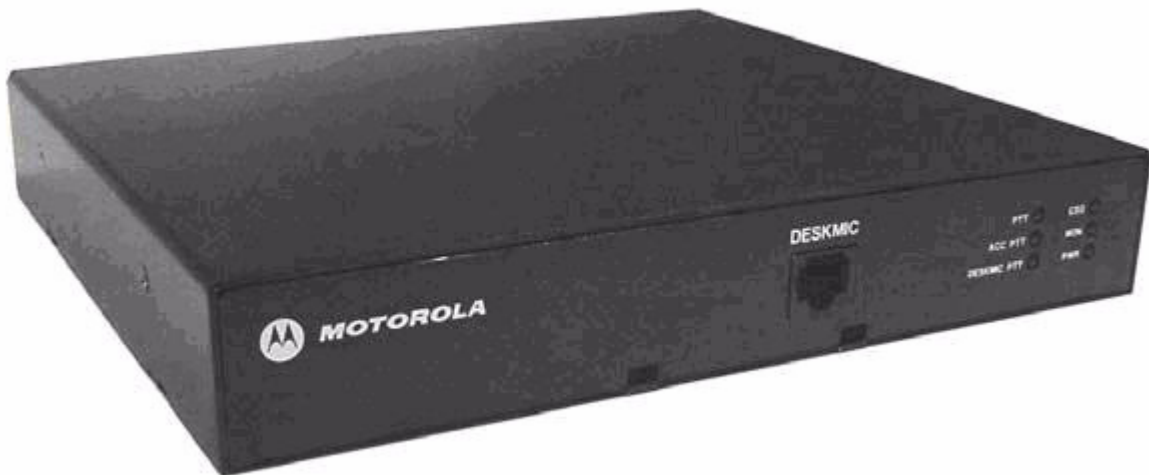


Figure C-10 Model L3276 Tone Remote Adapter

C.4.2 Compatibility

Model L3276 Tone Remote Adapter is compatible for all versions of SLR 8000 Software and Hardware.

C.4.3 Hardware Connections

The connections between the SLR 8000 Base Station/Repeater and the Tone Remote Adapter are facilitated with a multi-conductor cable connected between the J7 SLR 8000 back panel AUX 25-Pin connector and that of the Tone Remote Adapter. The connection provides for the following signals:

- Transmit Audio
- Receiver Audio
- PTT
- COR
- Monitor
- Channel Steering
- Wild Card (E.g. Repeater Knockdown)
- Ground

Signal connections are noted in [Figure C-3](#). SLR 8000 Base Station/Repeater connector and physical Pin locations are noted in the backplane interface board section of this manual. See Motorola L3276 25-Pin manual for its connector and physical Pin locations. The part number for a pre-fabricated cable is noted in the SLR 8000 ordering guide.

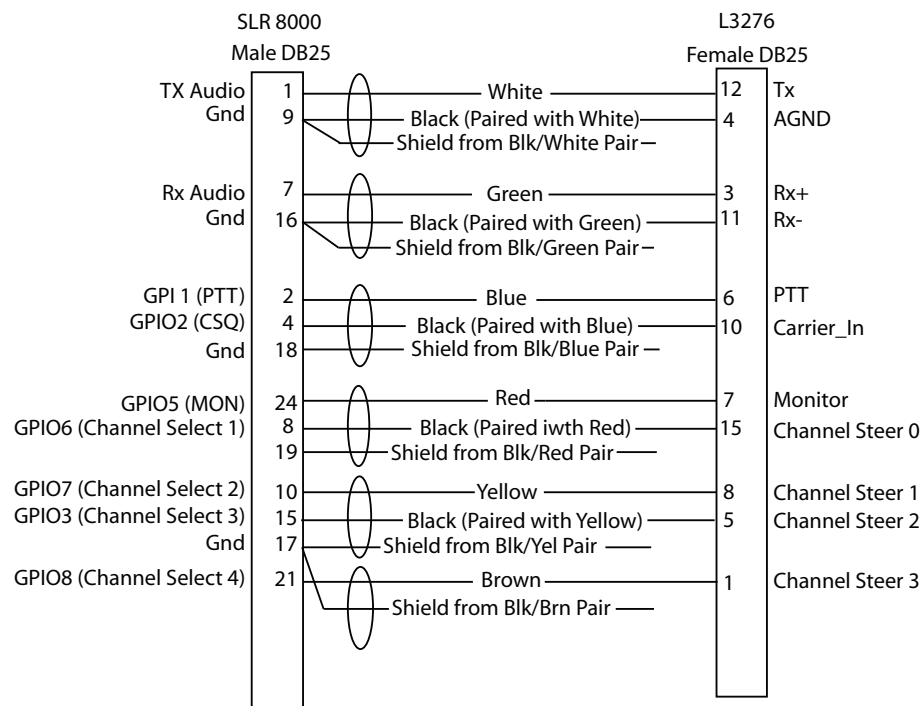


Figure C-11 Signal Connections between SLR 8000 Base Station/Repeater and Motorola L3276 25-Pin connector for a 15 Channel Remote Control

C.4.4 CPS Configuration (For a 15 Channel Remote Control)

The SLR 8000 Base Station/Repeater will need to be configured via the CPS application as shown in [Figure C-12](#). More specifically, the affected parameters are as follows:

- Audio Type
 - Filtered Squelch
- Analog Accessory Emphasis
 - De & Pre
- Disable Repeat Path
 - Un-Checked or Checked
- Tx Audio Priority
 - Set to 0 for console priority
- GPIO Pin number 2, 11
 - Ext PTT
 - Active Low
- GPIO Pin number 4
 - CSQ Detect or PL/ Talk group Detect
 - Active Low
- GPIO Pin number 24
 - Monitor
 - Active Low
- GPIO Pin number 8, 25
 - Channel Select 1
 - Active Low
- GPIO Pin number 10, 12
 - Channel Select 2
 - Active Low
- GPIO Pin number 15
 - Channel Select 3
 - Active Low
- GPIO Pin number 21
 - Channel Select 4
 - Active Low

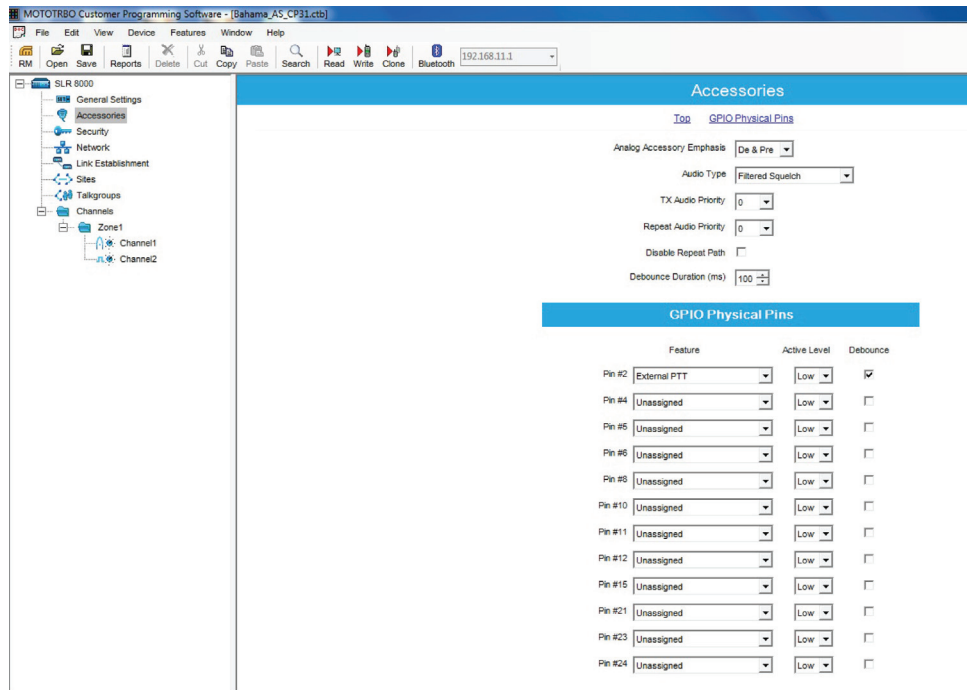


Figure C-12 CPS Configuration for L3276 Tone Remote Adapter (For a 15 Channel Remote Control)

Note The above configuration is considered typical. The L3276 Remote Tone Adapter provides alternate configurations that are supported by SLR 8000 Base Station/Repeater as well. See L3276 Remote Tone Adapter Manual for additional details.

C.4.5 Tone Remote Adapter settings

The input and output levels should be adjusted per the Tone Remote Adapter's instructions. The summary below gives a brief overview of the high level characteristics and typical Tone Remote Adapter settings for configuration with the SLR 8000 Base Station/Repeater.

C.4.5.1 Radio Rx

The SLR 8000 Base Station/Repeater's Receiver audio will yield 330mV rms into 50 kΩ with an RF input signal deviating at 60% RSD. With the Remote Tone Adapter's own loading impedance, the "Radio Rx" signal delivered to the phone patch is at a high enough drive level to leave jumper S10 in the factory default position (position is "out").

C.4.5.2 Radio Tx

The SLR 8000 Base Station/Repeater's transmitter will yield 60% RSD with 80mV rms into the Tx Audio port. The "Radio Tx" signal delivered by the Remote Tone Adapter is at a high enough drive level to leave jumper S9 in the factory default position (position A).

C.4.5.3 Channel Steering

Leave jumper S7 in position B (factory default) to match the SLR 8000 Base Station/Repeater's active low setting for the Channel Steering 1, Channel Steering 2, Channel Steering 3, and Channel Steering 4 GPIO signaling.

C.4.5.4 Monitoring

Leave jumper S8 in the "IN" position (factory default) to match the SLR 8000 active low setting for the Monitor GPIO signaling.

C.4.5.5 PTT

Leave jumper S5 in the "IN" position (factory default) to match the SLR 8000 active low setting for the PTT GPIO signaling.

C.4.5.6 Wildcard 1 (optional)

Leave jumper S6 in position A (factory default) to match the SLR 8000 active low setting for the Repeater Disabled GPIO signaling.

C.5 Trunking Controllers

C.5.1 Description

The SLR 8000 Base Station/Repeater is capable of supporting LTR trunking operations with the Trident's Marauder and Raider controllers. Additionally, the SLR 8000 Base Station/Repeater also supports Passport trunking as well with Trident's NTS controller.

See respective Trident Instruction Manuals (supplied with the controllers) for specifications, operation, installation, alignment, programming, and repair information.



Figure C-13 Model Trident's Marauder



Figure C-14 Model Trident's Raider

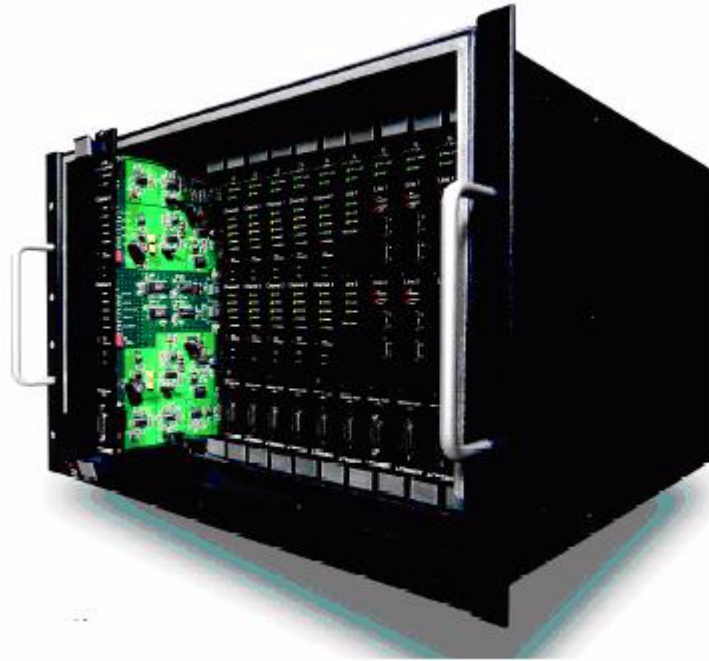


Figure C-15 Model Trident's NTS

C.5.2 Compatibility

Trident Model Raider, Marauder and NTS are compatible for all versions of SLR 8000 Software and Hardware.

C.5.3 Hardware Connections

The connections between the SLR 8000 Base Station/Repeater and the trunking controllers are facilitated with a multi-conductor cable connected between the J7 SLR 8000 back panel AUX 25-Pin connector and that of the connector on the trunking controller. The connection provides for the following signals:

- Transmit Audio
- Transmit Data
- Receiver Audio
- PTT
- 13.6 VDC (see Note)
- Ground

Note If this connection is used, the external equipment must draw less than 1A. This connection is not supported for the NTS controller.

Signal connections are noted in [Figure C-4](#). The SLR 8000 Base Station/Repeater connector and physical Pin locations are noted in the backplane interface board section of this manual. See the Trident manuals for their respective connector and physical Pin locations. The part number for a pre-fabricated cable is provided in the respective Trident manuals.

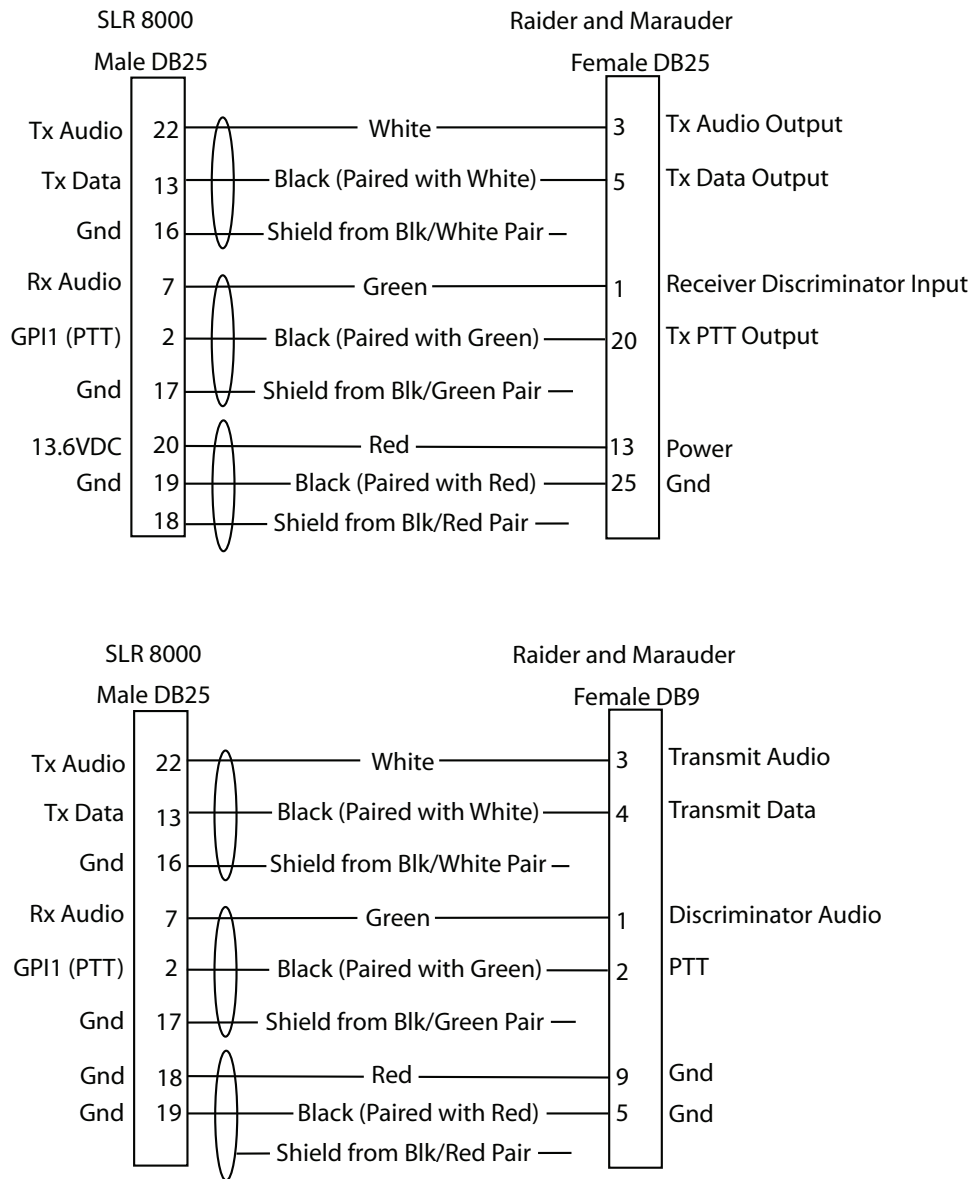


Figure C-16 Signal connections between SLR 8000 Base Station/Repeater, Trident Model Raider, Marauder and NTS

C.5.4 CPS Configuration

The SLR 8000 will need to be configured via the CPS application as shown in the figures below. More specifically, the affected parameters are as follows:

- Audio Type
 - Flat Unsquelched
- Disable Repeat Path
 - Checked
- GPIO Pin number 2
 - Ext PTT
 - Active Low

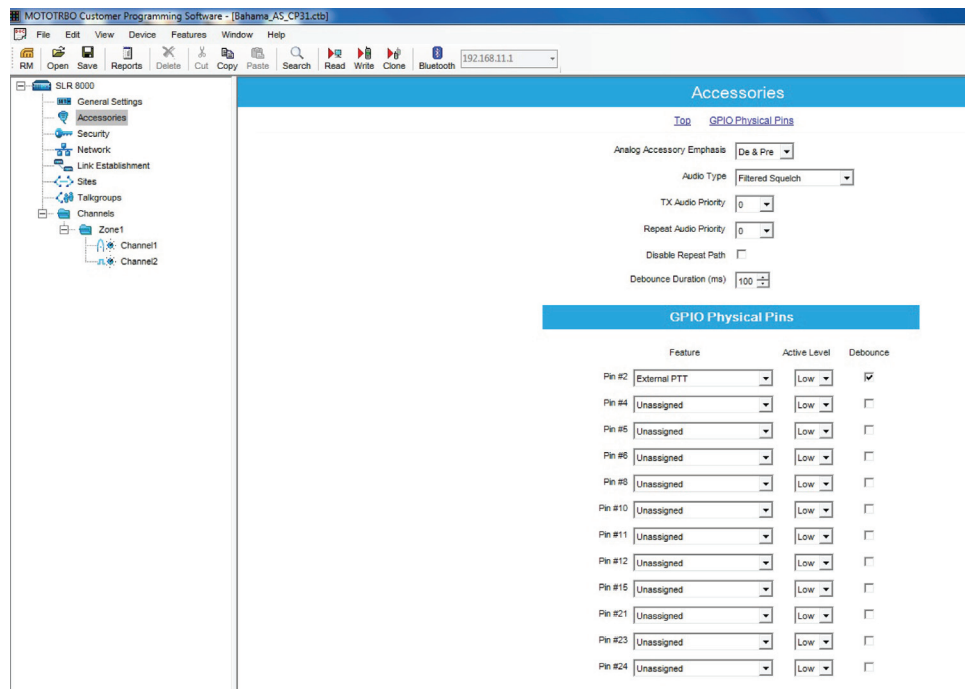


Figure C-17 CPS Configuration for Trident Model Raider, Marauder and NTS

C.5.5 Trunking Controller Settings

The input and output levels should be adjusted per the trunking controller's instructions. The summary below gives a brief overview of the high level characteristics and trunking controller settings for configuration with the SLR 8000 Base Station/Repeater.

C.5.5.1 Discriminator

The SLR 8000 Base Station/Repeater's Receiver audio will yield 330 mV rms into 50 k Ω with an RF input signal deviating at 60% RSD. With the trunking controllers own loading impedance, the "Discriminator" signal delivered to the trunking controller will need to be boosted by setting the following jumpers in the noted position:

- Marauder and Raider
 - W22: OUT position
 - W30: IN position

C.5.5.2 Tx Audio

The SLR 8000 Base Station/Repeater's transmitter will yield 60% RSD with 80 mV rms into the Emph Tx Audio port. No range setting is provided in the trunking controller for the Tx Audio, rather the level is solely controlled by a singular potentiometer or soft-potentiometer.

C.5.5.3 Tx Data

The SLR 8000 Base Station/Repeater's transmitter will yield 60% RSD with 80 mV rms into the Tx Data port. No range setting is provided in the trunking controller for the Tx Data, rather the level is solely controlled by a singular potentiometer or soft-potentiometer.

- Marauder, Raider and NTS
 - Data needs to be inverted
 - NTS needs to be set for DSP operation (Channel card setting)

Note

Appendix D Audio Enhancement

D.1 Overview

The Hear Clear, Flutter Fighter, and Companding features improve analog audio quality in a multi-path fading environment. The Hear Clear (Companding and Flutter Fighter activated together) and Flutter Fighter features are only available in the 800 and 900 MHz bands, while the Companding feature is available for all bands.

D.1.1 Hear Clear feature with the third party controllers

The Hear Clear feature is only available to third party controllers without the data such as phone patch and Tone remote Adaptor.

Third Party Controller	Hear Clear Configuration for Third Party Box	Flutter Fighter
Community Repeater Panel	Not selectable	Selectable
Trident's Marauder controller	Not selectable	Selectable
Trident's Raider controller	Not selectable	Selectable
Phone Patch	Selectable	Selectable
Tone Remote Adaptor	Selectable	Selectable

D.1.2 Third party controller and the subscriber configuration for Hear Clear feature

The Hear Clear feature requires matching configuration between the SLR 8000 Base Station/ Repeater that supports third party controllers and the subscribers.

SLR 8000 with Phone Patch/ Tone Remote Adapter	Subscriber
Hear Clear	Hear Clear
Flutter Fighter	Flutter Fighter
None	None

D.1.3 Hear Clear feature configuration in repeater mode

The Hear Clear feature requires matching configurations between the subscribers.

Repeater mode		
Subscriber 1	Repeater	Subscriber 2
Hear Clear	Hear Clear	Hear Clear
Flutter Fighter	Hear Clear	Flutter Fighter
None	Hear Clear	None

D.1.4 Companding feature configuration between third party controllers and subscriber

The companding feature requires matching configuration between the third party controllers and the subscriber.

SLR 8000 with Phone Patch/ Tone Remote Adapter	Subscriber
Companding	Companding
None	None

D.1.5 Companding feature configuration between the repeater and subscribers

The companding feature requires matching configurations between the subscribers.

Repeater mode		
Subscriber 1	Repeater	Subscriber 2
Companding	Hear Clear	Companding
None	Hear Clear	None

Appendix E MOTOTRBO Base Station/Repeater – EME ASSESSMENT

Note The example given in this Appendix applies for a UHF band system. For different frequency bands, applicable band-specific parameters should be employed to carry out the computations yielding band-specific compliance boundaries.

E.1 Executive Summary

The Electromagnetic Energy (EME) compliance boundaries in a typical system configuration of the Motorola MOTOTRBO SLR 8000 Base Station/Repeater described in the following are derived.

Compliance is established with respect to the applicable limits defined in the ICNIRP guidelines [1], the United States regulations [2]-[3], and in the CENELEC Standards EN50384:2002 [5] and EN50385:2002 [6]. These standards and regulations apply to *occupational* and *general public* EME exposure.

The assessment was carried out using a computational method described in the CENELEC Standard EN50383:2010 [4], which is referenced by the EN50385:2002, and this report has been drafted in accordance with its requirements. Thus the assessment and report address the European Radio and Telecommunications Terminal Equipment (R&TTE) Directive requirements concerning EME exposure.

The following table provides the compliance distances for *general public* and *occupational-type* exposure, for the UHF frequency band, antenna, and parameters considered in this analysis, based on a typical system configuration:

Table E-1 EME Compliance Distances Based on Example UHF Evaluation

Compliance distances	Antenna front (Andrew mod. DB408)	Ground level (20 m below antenna)
General public exposure	6.9 m	Always compliant
Occupational-type exposure	2.15 m	Always compliant

E.2 Exposure Prediction Model

E.2.1 Exposure in Front of the Antenna

The cylindrical-wave model defined in Clause 8.3.4 of the EN50383:2010 standard is applied to determine the compliance boundaries for workers and general public for a typical system configuration of the MOTOTRBO SLR 8000 Base Station/Repeater.

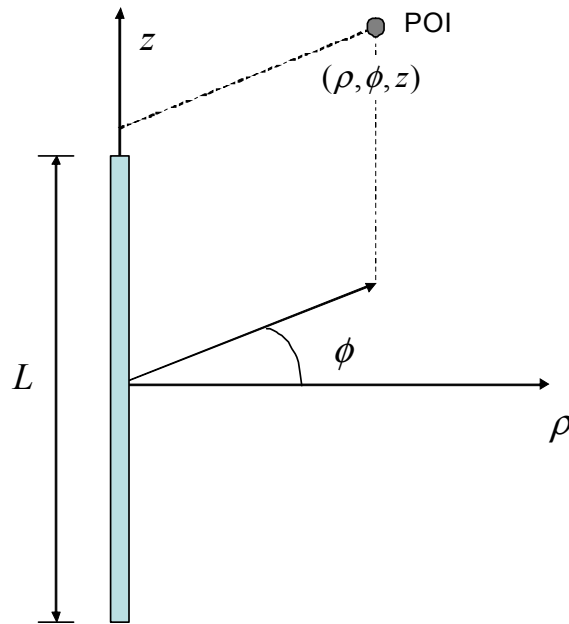


Figure E-1 Reference frame for the point of interest (POI) cylindrical co-ordinates

Per the reference frame in [Figure E-1](#), the cylindrical-wave model is applicable in the volume described in cylindrical co-ordinates (ρ, ϕ, z) for omni-directional array antennas as follows:

$$\hat{S}(r, \phi) = \frac{P}{\pi r L \cos^2 \gamma \sqrt{1 + \left(2 \frac{r}{r_0}\right)^2}}, \quad r_0 = \frac{1}{2} D_A L \cos^2 \gamma \quad (1)$$

where

P available power at the antenna port (W);

L physical antenna length (metres);

D_A peak antenna directivity (unit-less), assumed equal to the peak gain G_A ;

γ electrical down-tilt angle of the antenna main beam (radians), and

$$r = \frac{\rho}{\cos \gamma} \quad (2)$$

is the distance from the antenna center (metres). Spatial power density averaging may be required by some regulations. As the formula (1) predicts the peak power density, it represents a conservative estimate of the average power density. Thus there is no need to compute the latter.

E.2.2 Exposure at Ground Level

Several methods can be employed to determine the EME exposure at ground level. Such an assessment is not necessary if the mounting height of the antenna is larger than the compliance distance *in front* of the antenna, computed using the EN50383:2010 methodology outlined in [Section E.2.1](#). If this is not feasible, then the following approach can be employed.

At ground level exposure occurs in the antenna far-field. The antenna phase center is assumed to be the mounting height. The resulting predictive equation for the power density is:

$$S(d) = (2.56) \frac{P \cdot G(\theta)}{4\pi(H^2 + d^2)} \quad (3)$$

where $G(\theta)$ is the elevation gain pattern, which is approximated by the following expression:

$$G(\theta) = G_A \left| \frac{\sin\left(\frac{k_0 L}{2} \sin\theta\right)}{\frac{k_0 L}{2} \sin\theta} \right|^2 \quad (4)$$

where $k_0 = 2\pi/\lambda$ is the free-space wavenumber and L is the *effective* antenna length yielding the appropriate vertical beamwidth, while H is the antenna height above ground and d is the *point of interest* (POI) distance from the vertical antenna projection to ground (see [Figure E-2](#)). The multiplicative factor 2.56 is introduced to enforce near-perfect, in-phase ground reflection as recommended in [2]. In this case, spatial averaging is not carried out to make the EME exposure assessment more conservative.

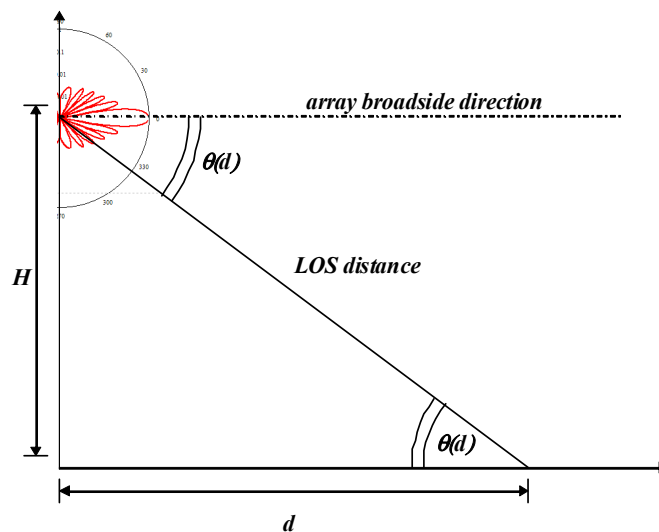


Figure E-2 Schematic of the ground-level exposure model adopted for the assessment

E.3 Typical System Configuration

The MOTOTRBO SLR 8000 Base Station/Repeater operates in different frequency ranges with different channels transmitting 100 W radio frequency (RF) power. The typical system configuration comprises an omnidirectional array antenna featuring 6–10 dBd gain, installed at or above 20 m from ground level, and fed by the SLR 8000 Base Station/Repeater through a combiner characterized by a typical 3 dB transmission loss, and a 30 m 7/8" coaxial cable characterized by a typical 2.7 dB/100m loss, resulting in a total 3.9 dB transmission loss. Based on these characteristics, the RF power at the antenna input is about 200 W.

Since shorter antennas provide a conservative EME exposure assessment from equation (1), when $r < r_0$, the parameters of a typical 6.6 dBd antennas are employed (it will have to be verified that the resulting compliance distances are indeed smaller than r_0). Such an antenna (e.g., Andrew DB408) would exhibit a typical elevation beamwidth of about 14 degrees.

E.4 Exposure Limits

Based on the SLR 8000 operating frequency range, the most conservative power density limits are those defined in the ICNIRP guidelines [1]. They are 10.1 W/m^2 for occupational exposure, and 2.02 W/m^2 for general public exposure. They will be used for the EME exposure assessment.

E.5 EME Exposure Evaluation

E.5.1 Exposure in Front of the Antenna

The assessment is based on the following characteristics of the Andrew DB408 antenna:

$$G_A = 10^{\frac{6.6+2.15}{10}} = 7.5 \quad P = 200 \text{ W} \quad \gamma = 0 \quad L = 2.7 \text{ m}$$

The parameter r_0 is thus $r_0 = 10.1 \text{ m}$. Upon inserting the power density limits established in [Section E.4](#) into formula (1), the following distances for occupational and general public exposure compliance are respectively determined:

$$r_{\text{occupational}} = 2.15 \text{ m}$$

and

$$r_{\text{general public}} = 6.9 \text{ m}$$

As both these distances are less than r_0 , the aforementioned choice ([Section E.3](#)) of considering the shorter, lower gain antenna to perform the assessment is deemed valid. Longer, higher gain antennas would yield shorter compliance distances, for the same input antenna power and operating frequency range.

E.5.2 Exposure at Ground Level

Since the antenna installation height above ground level in the typical system configuration (20 m) is larger than either of the compliance distances determined in [Section E.5.1](#), the EME exposure at ground level is always compliant with the exposure limits defined in the ICNIRP guidelines.

E.6 Compliance Boundary Description

Based on the analysis in [Section E.5](#), the compliance boundaries for *occupational* and *general public* exposure are defined as cylinders enclosing the antenna (see [Figure E-3](#)), extending 75 cm (one wavelength) above and below the physical antenna, with radii:

Occupational exposure:

$$\rho_{OCC} = 2.15 \text{ m}$$

General Public exposure:

$$\rho_{GP} = 6.9 \text{ m}$$

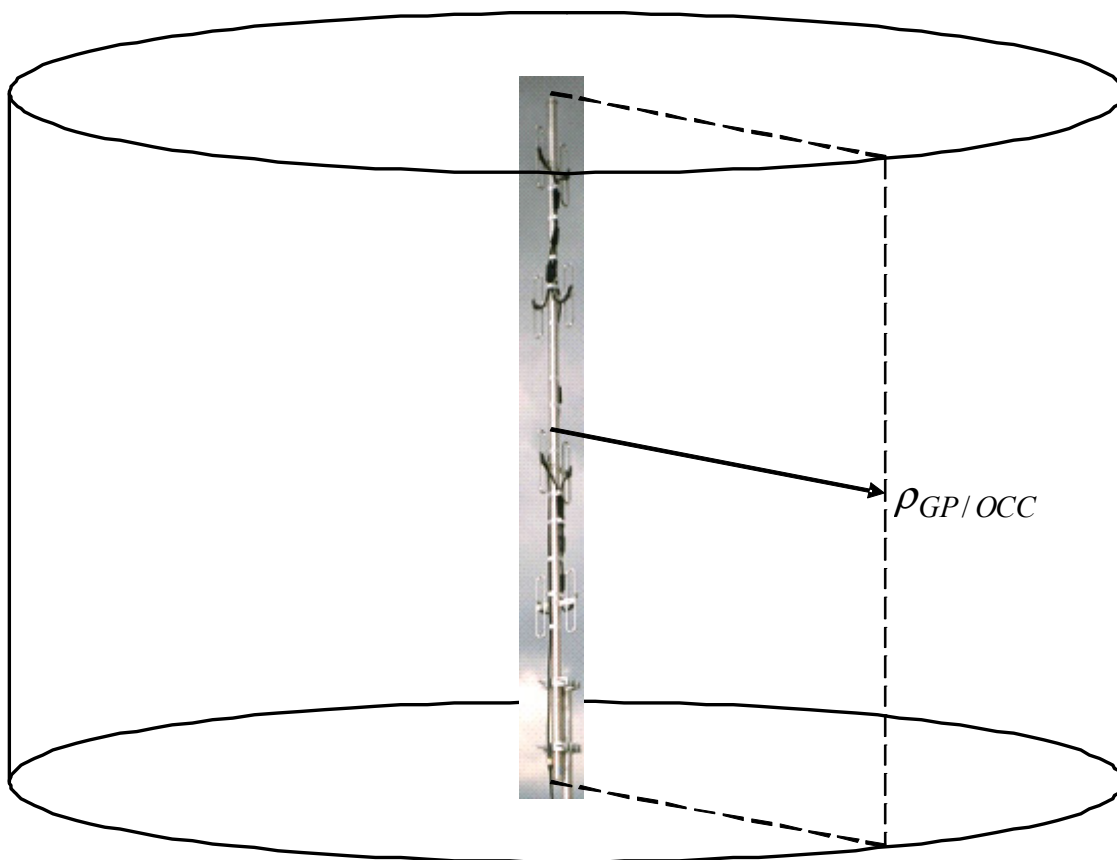


Figure E-3 Compliance boundary for general public (GP) and occupational (OCC) exposure

E.7 Product Put In Service

Some regulations require that additional exposure assessments be performed when putting the product in service, to account for antenna site-specific circumstances such as the environment (e.g. electromagnetic scatterers) and other antennas. In such cases, certain standards [7]–[10] may need to be considered to determine the most suitable compliance assessment methodology.

E.8 References

1. International Commission on Non-Ionizing Radiation Protection (ICNIRP), "Guideline for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields," Health Physics, vol. 74, no. 4, pp. 494-522, April 1998.
2. United States Federal Communication Commission, "Evaluating compliance with FCC guidelines for human exposure to radio frequency electromagnetic fields," OET Bulletin 65, Ed. 97-01, Section 2 (Prediction Methods), August 1997.
3. US Code of Federal Regulations, Title 47, Volume 1, Sec. 1.1310 Radio frequency radiation exposure limits (Revised as of October 1, 2003).
http://edocket.access.gpo.gov/cfr_2003/octqtr/47cfr1.1310.htm.
4. EN 50383:2010. Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz – 40 GHz). CENELEC (European Committee for Electrotechnical Standardization).
5. EN 50384:2002. Product standard to demonstrate the compliance of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz – 40 GHz). Occupational. CENELEC (European Committee for Electrotechnical Standardization).
6. EN 50385:2002. Product standard to demonstrate the compliance of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz – 40 GHz). General public. CENELEC (European Committee for Electrotechnical Standardization).
7. EN 50401:2006. Product standard to demonstrate the compliance of fixed equipment for radio transmission (110 MHz – 40 GHz) intended for use in wireless telecommunication networks with the basic restrictions or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service. CENELEC (European Committee for Electrotechnical Standardization).
8. EN 50400:2006. Basic standard to demonstrate the compliance of fixed equipment for radio transmission (110 MHz – 40 GHz) intended for use in wireless telecommunication networks with the basic restrictions or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service. CENELEC (European Committee for Electrotechnical Standardization).
9. EN 50492:2008. Basic standard for the in-situ measurement of electromagnetic field strength related to human exposure in the vicinity of base stations. CENELEC (European Committee for Electrotechnical Standardization).
10. IEC 62232:2011. Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure. IEC (International Electrotechnical Commission).

Glossary of Terms and Acronyms

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

Term	Definition
Alert tone	Audio signal produced by the station, providing feedback to the user.
Analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
ASIC	Application Specific Integrated Circuit
AUX	Auxiliary
Band	Frequencies allowed for a specific purpose.
CTCSS	Continuous Tone-Controlled Squelch Systems (PL)
Clear	Channel modulation type in which voice information is transmitted over the channel using analog modulation.
Conventional	Term used for standard non-trunked radio system (usually using TRC/DC console).
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.
DSP	Digital Signal Processor, microprocessor specifically designed to perform digital signal processing algorithms.
EIA	Electronic Industries Association
ESD	Electro Static Discharge
EU	European Union
FCC	Federal Communications Commission.
FM	Frequency Modulation
Frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
FRU	Field Replaceable Unit

Term	Definition
FSK	Frequency Shift Keying
GNSS	Global Navigation Satellite System
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
I/O	Input or Output
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.
LED	Light Emitting Diode: An electronic device that lights up when electricity is passed through it.
MDC	Motorola Data Communications. 1200 or 4800 baud data signalling scheme.
MHz	Megahertz: One million cycles per second. Used especially as a radio-frequency unit.
MISO	Master In, Slave Out.
MOSI	Master Out, Slave In.
PA	Power Amplifier that transmits final RF signal to transmit antenna
PC Board	Printed Circuit Board. Also referred to as a PCB.
PFC	Power Factor Correction
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
PTT	Push-to-talk; the switch located on the left side of the radio which, when pressed causes the radio to transmit.
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 retransmits received signals in order to improve communications range and coverage.
RF	Radio Frequency: The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).

Term	Definition
RSSI	Received Signal Strength Indicator; a dc voltage proportional to the received RF signal strength.
Rx	Receive.
SCM	Station Control Module; station controller.
SELV	Separated Extra Low Voltage
Signal	An electrically transmitted electromagnetic wave.
SINAD	Acronym for the ratio of signal plus noise plus distortion and noise plus distortion.
SLR	Refers to Digital Professional Repeater model names in the MOTOTRBO Professional Digital Two-Way Radio System.
Spectrum	Frequency range within which radiation has specific characteristics.
SPI	Serial Peripheral Interface (clock and data lines); simple synchronous serial interface for data transfer between processors and peripheral ICs.
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.
Trunking	Radio control system which permits efficient frequency utilization and enhanced control features.
Tx	Transmit.
UHF	Ultra High Frequency
USB	Universal Serial Bus: An external bus standard that supports data transfer rates of 12 Mbps.
VCO	Voltage-Controlled Oscillator; an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator.
VHF	Very High Frequency
VIP	Vehicle Interface Port.
VSWR	Voltage Standing Wave Ratio.
WLAN	Wireless Local Area Network

Notes



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