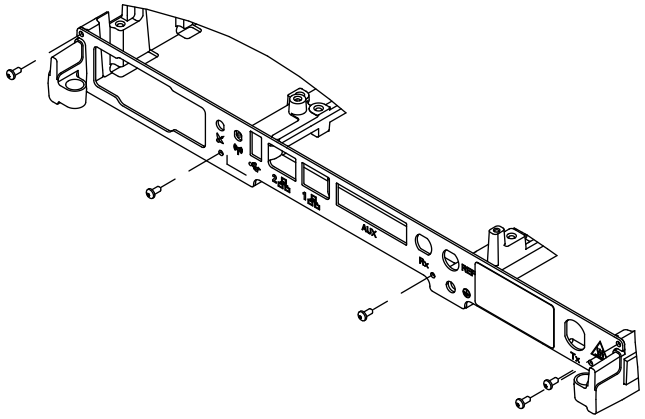
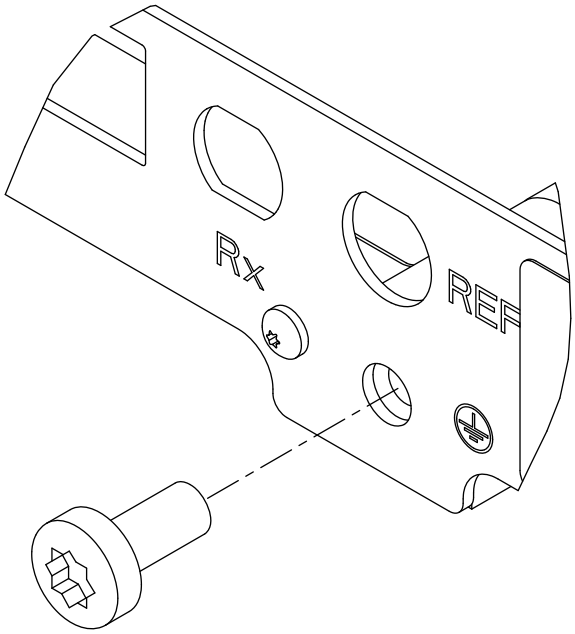
Figure 58: Installing M3 Screws



2 Using a T30 Torx driver, install a M6 x1x13 mm screw with captivated external tooth (PN: 00310909C91) to 20 in-lb (2.3 N-m).

Figure 59: Installing M6 Screw

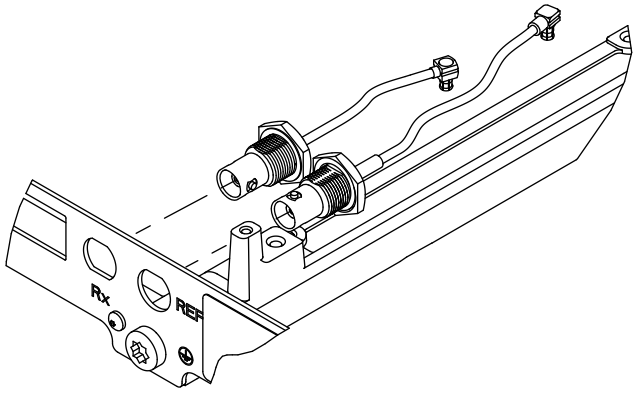


11.6.1.2 Input Cable Installation

Procedure:

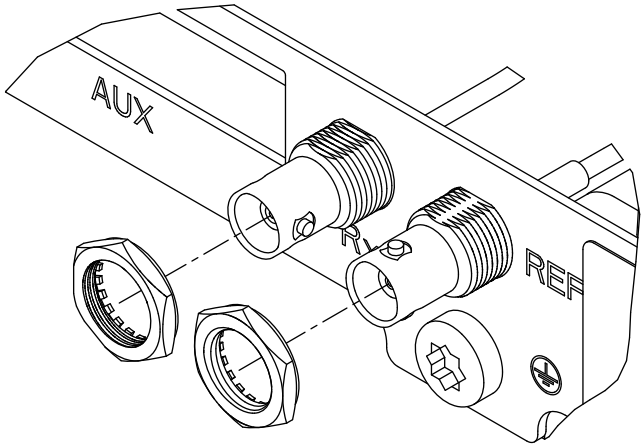
1 Insert the RX (PN: 30012083001) and Reference (PN: CB000024A01) cables into corresponding holes in back panel.

Figure 60: Installing Rx and Reference Cables



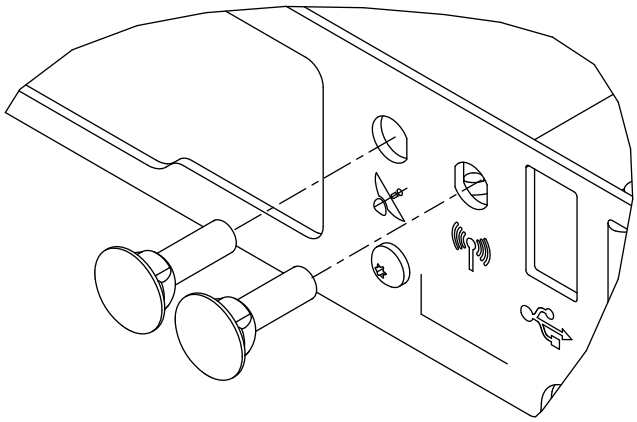
2 Assemble the corresponding lock washers onto the connectors. Using a 16 mm hex nut driver, tighten the 16 mm hex nuts to 15 in-lb (1.7 N-m) on both connectors.

Figure 61: Assembling Lock Washers onto Connectors



3 Insert two rubber plugs (PN 3287533V01) into the corresponding holes shown in Figure 62: Installing WLAN and GNSS Rubber Plugs on page 107.

Figure 62: Installing WLAN and GNSS Rubber Plugs

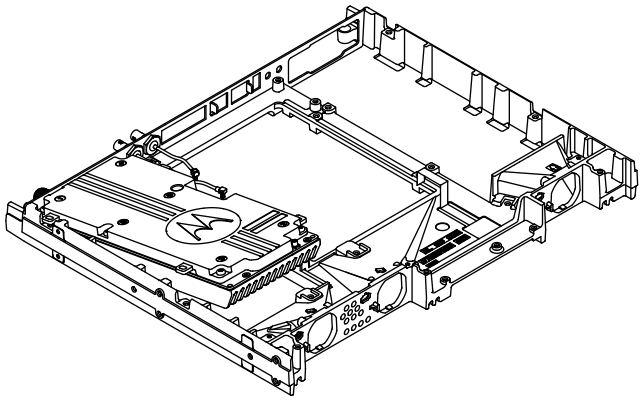


11.6.1.3
Power Amplifier Module Installation

Procedure:

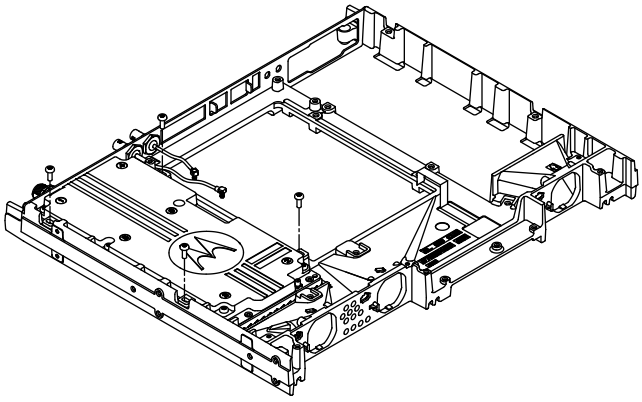
1. Insert the TX connector into the back panel.
2. Slide the Power Amplifier Module into the repeater chassis until it rests against the back panel.

   Figure 63: Installing Power Amplifier Module into Repeater



3. Lightly torque the four M4 x 0.7 x 10 mm screws (PN: 0310909A61) shown in Figure 64: Securing Power Amplifier Module to Repeater Chassis on page 108 with a T20 Torx driver so the screws are very lightly installed. Do not tighten down beyond initial seating.
4. Assemble the lock washer (PN: 04009303001) and 0.75 in. (19 mm) hex nut (PN: 02009277001) onto the TX connector of the Power Amplifier Module. Tighten the nut to 20 in-lb (2.3 N-m) with a 0.75 in. (19 mm) hex nut driver.
5. Tighten the four M4 x 0.7 x 10 mm screws (PN: 0310909A61) to 15 in-lb (1.7 N-m) with a T20 Torx driver to secure the Power Amplifier Module to the repeater chassis.

   Figure 64: Securing Power Amplifier Module to Repeater Chassis



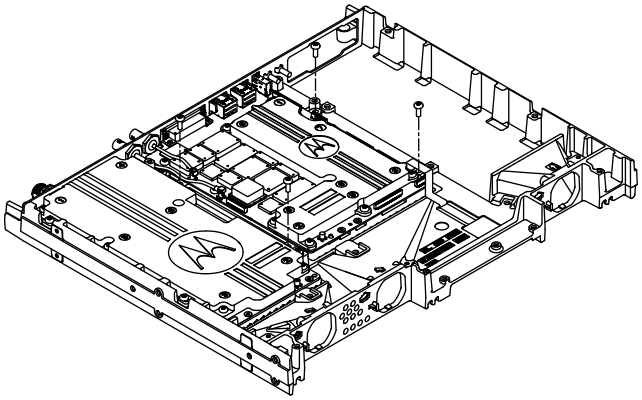
11.6.1.4
Modem Installation

Procedure:

1. Lift the RX and Reference (REF) cables and slide the Modem all the way to the back panel. Make sure the mounting ears on the Modem line up with the screw holes on the repeater chassis.

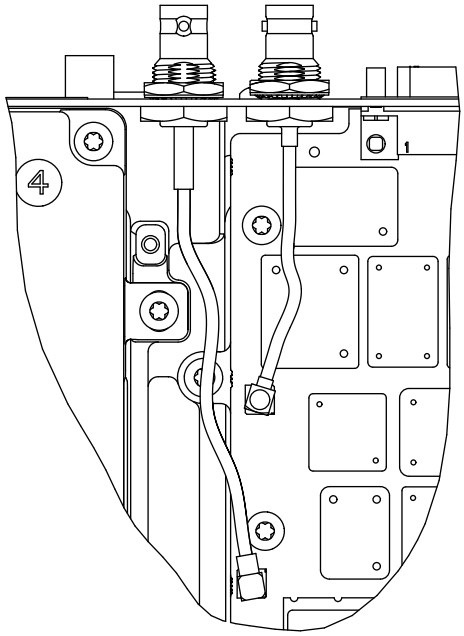
2 Tighten the four M4 x 0.7 x 10 mm screws (PN: 0310909A61) to 15 in-lb (1.7 N-m) using a T20 Torx driver to secure the Modem to the repeater chassis.

Figure 65: Securing Modem to Repeater Frame



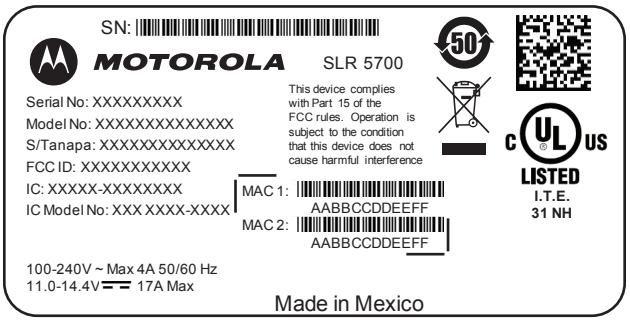
3 Secure the RX and REF cable connectors to the Modem.

Figure 66: Securing Rx and Reference Cable Connectors



4 If replacing Modem FRU from Service Kit in Service Parts on page 134, remove label PN LB000528A01 from kit package and place onto product label on back of repeater within the hash marks shown in Figure 67: Modem FRU Product Label on page 110.

Figure 67: Modem FRU Product Label



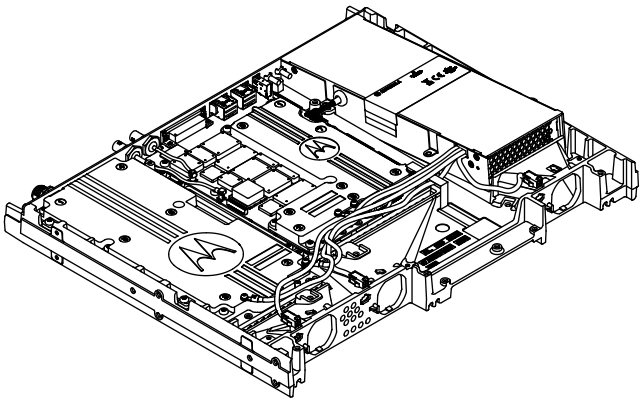
11.6.1.5

Power Supply Installation

Procedure:

1 Place the Power Supply Module into the repeater chassis until the back of the power supply rests against back panel.

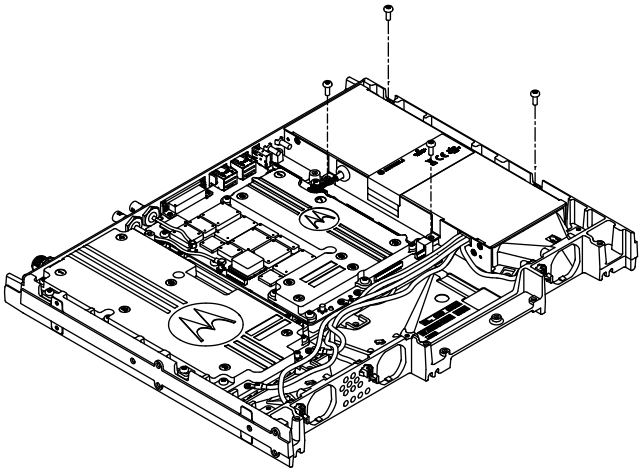
Figure 68: Installing Power Supply Module



2 Take the Chassis ID Module (PN: 84009669001) and insert chassis ID cable end into the 8 pin connector on the Modem. Route Chassis ID Module cable underneath power supply cables.

3 Tighten the four M4 x 0.7 x 10 mm screws (PN: 0310909A61) to 15 in-lb (1.7 N-m) using a T20 Torx driver to secure the Power Supply Module to the repeater chassis.

Figure 69: Installing M4 Screws



4 Snap the fan jumper cables into the chassis for the Power Supply, Modem, and Power Amplifier fans.

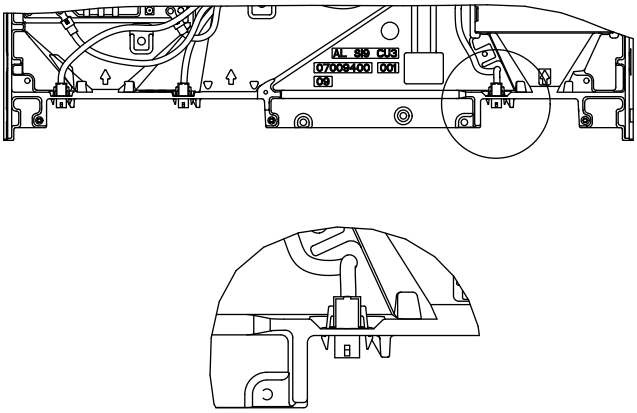


Figure 70: Snapping Fan Cable

11.6.1.6
Fan Installation

Procedure:

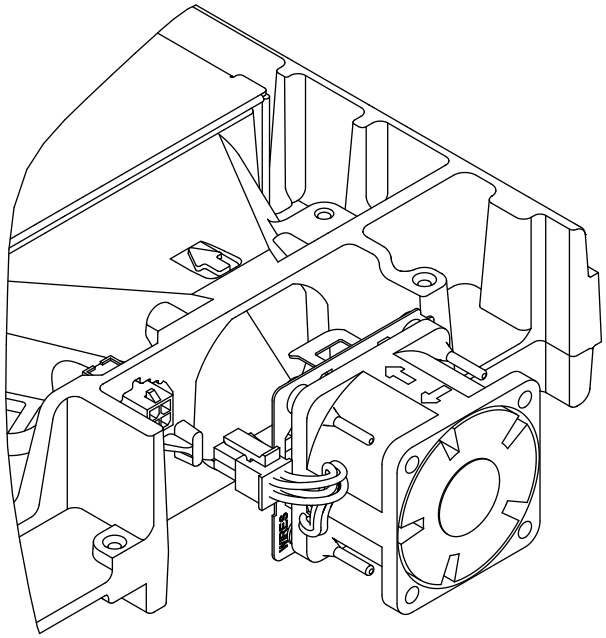
1 Orient the fan module so that the cables are out at the lower left. See Figure 71: Installing Fan on page 112.

2 Rest the bottom tab of the mounting bracket onto the main frame opening with proper orientation.

3 Push the fan assembly towards the main frame until both tabs are fully snapped and engaged. Two audible snaps should be heard.

4 Repeat the steps above for the remaining two fans.

Figure 71: Installing Fan



NOTICE: For each of the fans, look inside the fan shroud to ensure both the top and bottom fan mounting bracket tabs are fully engaged with the protrusions (teeth) of the base frame.

5 Connect the three fan cables to their corresponding jumper cables.

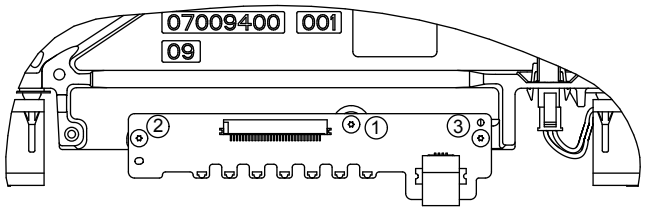
11.6.1.7
Front Panel Installation

Procedure:

1 Place the Front Panel (Kit Number: PMLN6490A) onto the corresponding bosses on the repeater frame.

2 Install the three M3 x 0.5 x 6 mm screws (PN: 0310907A18) to 10 in-lb (1.1 N-m) in the order shown in Figure 72: Installing Front Panel on page 112 using a T10 Torx driver.

Figure 72: Installing Front Panel



11.6.1.8
Cable Installation

Prerequisites:

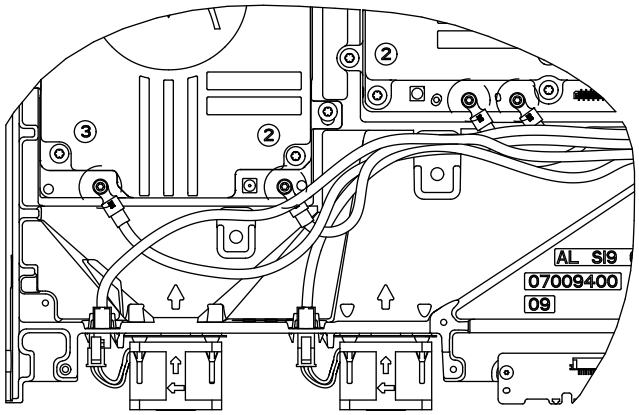
CAUTION: Do not over torque the power screws as damage may occur.

Procedure:

1. Install the two power screws from the Power Supply Module into the PA board to 6.5 in-lb (0.7 N-m) using a T10 Torx driver.
2. Install the two power screws from the Power Supply Module into the Modem board to 6.5 in-lb (0.7 N-m) using a T10 Torx driver.

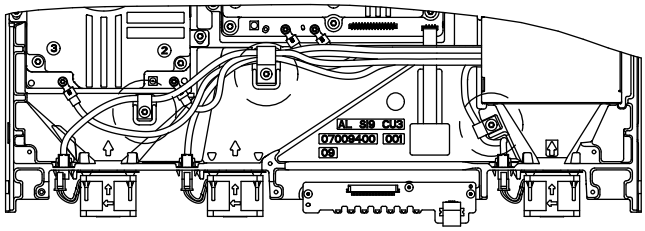
   CAUTION: Ensure that correct polarity of the modem power supply module is observed otherwise damage may occur.

   Figure 73: Installing Power Screws



3. Secure the "C3" cable from the Power Supply Module to the chassis in the pocket near the Power Supply Module using a cable clamp (PN: 42009306001) and a M4 x 0.7 x 10 mm screw (PN: 0310909A61) torque to 15 in-lb (1.7 N-m) using a T20 Torx driver.

   Figure 74: Securing Cables



4. Secure the "C2", "C4" and "C6" cables from the Power Supply Module to the chassis near the Modem using a cable clamp (PN: 42009306002) and a M4 x 0.7 x 10 mm screw (PN: 0310909A61) torque to 15 in-lb (1.7 N-m) using a T20 Torx driver.
5. Secure the "C6" cable from the Power Supply Module to the chassis near the PA Module using a cable clamp (PN: 42009306001) and a M4 x 0.7 x 10 mm screw (PN: 0310909A61) torque to 15 in-lb (1.7 N-m) using a T20 Torx driver.
6. Secure the connector of the "C5" cable between the Power Supply Module and the Modem to the corresponding Modem Connector.
7. Assemble the coaxial cable (PN: 30012084001) to the connectors on the Modem and PA Module

   NOTICE: When installing the flexible cables, directly insert the cable parallel to the connector to avoid damage to the connector. Do not assemble at angle.

8. Assemble the flex cable (PN: 30012085001) between the PA Module and the Modem. Install the PA Module side first.
9. Assemble the flex cable (PN: 84007002001) between the Modem and the Front Panel.

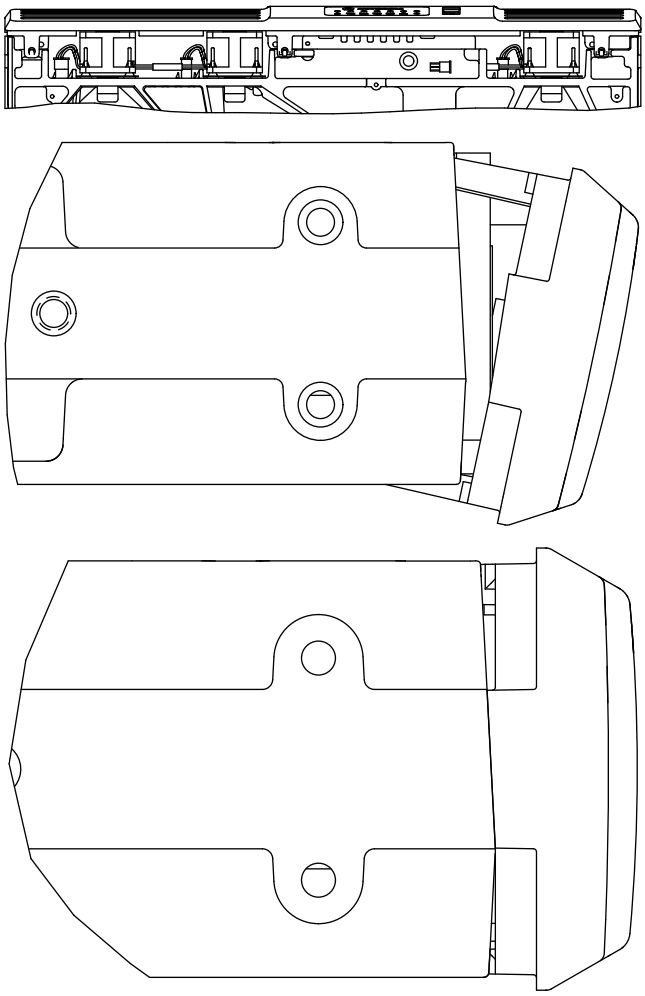
11.6.1.9

Front Housing Installation

Procedure:

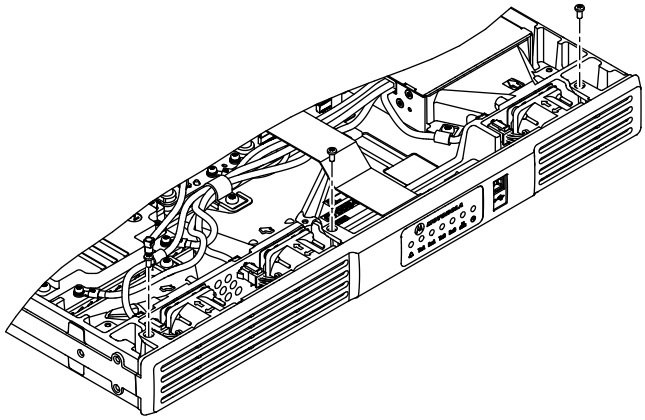
1 Line up the tabs on the Front Housing (PN: HN000198A01) to the pins on the repeater chassis and engage them. With all three tabs engaged, rotate the Front Housing into place.

Figure 75: Securing Front Housing



2 Install the three M3 x 0.5 x 6 mm screws (PN: 0310907D02) to 10 in-lb (1.1 N-m) using a T10 Torx driver.

Figure 76: Installing M3 Screws



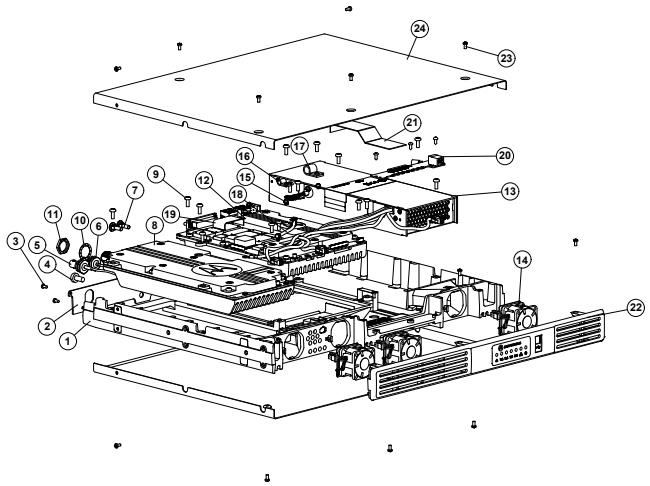
11.6.1.10
Protective Cover Installation

Procedure:

Install the six M3 x 0.5 x 6 mm screws each (PN: 0310907D02) to 12 in-lb (1.3 N-m) using a T10 Torx driver to secure the bottom and top cover (PN: 07009402001) to the repeater chassis.

11.7
Exploded Mechanical View

Figure 77: SLR 5000 Series Assembly Exploded View



11.8
Parts List

Table 37: SLR 5000 Series Exploded View Parts List

Item No.	Description	Part Number	Quantity
1	Chassis	See Service Parts on page 134.	1

Table continued…

Item No.	Description	Part Number	Quantity
2	Back Plate	64009331001	1
3	M3 Screw	0310907A18	8
4	M6 Screw, Ground	0310909C91	1
5	RF Cable, Rx	30012083001	1
6	RF Cable, Reference	CB000024A01	1
7	Rubber Plugs	3287533V01	2
8	PA, FRU	See Service Parts on page 134.	1
9	M4 Screw	0310909A61	15
10	Locking Washer	04009303001	1
11	Locking Nut	02009277001	1
12	Modem FRU	See Service Parts on page 134.	1
13	PSU FRU	See Service Parts on page 134.	1
14	Fan Assembly	See Service Parts on page 134.	3
15	M3 Screw, Insert	03009387001	4
16	Cable Clamp, Small	42009306001	2
17	Cable Clamp, Large	42009306002	1
18	RF Cable, Tx	30012084001	1
19	PA/ Modem FFC	30012085001	1
20	Front Panel Assembly	See Service Parts on page 134.	1
21	Front Panel FPC	84007002001	1
22	Front Housing Assembly	HN000198A01	1
23	M3 Screw, Black	0310907D02	15
24	Cover, Top/ Bottom	07009402001	2

11.9

Torque Charts

Table 38: Torque Specifications for Nuts and Screws on page 117 lists the various screws by description and torque values in different units of measure. Torque all screws to the recommended value when assembling the repeater.

Table 38: Torque Specifications for Nuts and Screws

Driver Type	Torque		
	N-m (± 0.1)	in-lb (± 1)	kg-cm (± 1.2)
Torx T10 (Front Housing/Panel)	1.1	10	11.5
Torx T10 (Protective Covers)	1.3	12	13.8
Torx T10 (Power Inserts)	0.7	6.5	7.5
Torx T20	1.7	15	17.3
Torx T30	2.3	20	23.0
¾ Inch (19 mm) Hex Nut Driver	2.3	20	23.0
16 mm Hex Nut Driver	1.7	15	17.3

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Chapter 12

SLR 5000 Series Installation

12.1 Pre-Installation Considerations

Proper installation ensures the best possible performance and reliability of the 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 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 Solutions Quality Standard Fixed Network Equipment Installation manual, R56 (which can be obtained by ordering CDROM 9880384V83), 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 repeater and ancillary equipment. Step-by-step procedures for each of the major installation tasks are then provided beginning in Mechanical Installation on page 127.

- 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 repeater parameters per customer specifications (such as operating frequency, PL, codes, and so on.)

12.1.2 Site Environmental Conditions

CAUTION: If the 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 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 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 repeater. For example, if the repeater is mounted in a cabinet, the temperature within the cabinet is measured.
- Humidity
  Repeater to be kept at or below RH of 95%, non-condensing at 50 °C (122 °F).
- Air Quality
  For equipment operating in an environmentally controlled environment with the repeater(s) rack mounted, the airborne particulates level must not exceed 25 µg/m³.

  For equipment operating in an area which is not environmentally controlled (repeater(s) cabinet mounted), the airborne particulates level must not exceed 90 µg/m³.

12.1.3
Equipment Ventilation

The SLR 5000 Series Repeaters are equipped with cooling fans that are used to provide forced convection cooling. When planning the installation, observe the following ventilation guidelines:

12.1.3.1
Mounting in a Cabinet

- Cabinets must be equipped with ventilation slots or openings in the front (for air entry) and back or side panels (for air to exit). If several repeaters are installed in a single cabinet, be sure ventilation openings surround each 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 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.

CAUTION:

- The mounting of only ONE REPEATER PER CABINET is recommended. More than one repeater per cabinet results in degradation of thermal specifications at high ambient temperatures.
- Appropriate precautions should be taken to ensure that repeater ambient temperature does not exceed +60 °C (+140 °F).
- If multiple repeaters are required, AND THERMAL SPECIFICATION DEGRADATION IS ACCEPTABLE, the following is recommended when no cabinet fans are used. Up to three repeaters can be mounted in a 76.2 cm (30 in.) or larger cabinet with two rack units of spacing between each repeater. This results in thermal specification performance of -30 °C (-22 °F) to +40 °C (+104 °F).

12.1.3.2
Mounting in a Rack

Multiple repeaters can be mounted in an open rack without degradation of specification.

12.1.4
AC and DC Input Power Requirements

This section describes the power requirements for the AC and DC inputs, as well as ground, battery, RF antenna, and system cable connections.

12.1.4.1
AC Input Power Requirements

The SLR 5000 Series Repeater is equipped with a switching power supply, and this assembly operates from 100–240 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.

Use a standard 3-wire grounded electrical outlet as the AC source.

CAUTION: 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 supply 5 A (minimum). Per R56, the minimum ampacity of the circuit (and protective breaker) feeding the repeater should be no less than 15 A. For a nominal 220/240 VAC input, the ampacity requirements can be halved.

12.1.4.2
DC Input Power Requirements

The DC source operates from 11 VDC to 14.4 VDC (17 A max). This DC source must be located in the same building as the repeater, and it must meet the requirements of a SELV circuit. The appropriate DC disconnects and current limiting devices must be chosen and implemented per R56.

12.1.4.3
Ground Connection

The repeater is equipped with a ground screw on the back panel of the repeater. Figure 81: Back Panel Connector Names and Locations on page 129 shows the location of the grounding screw. Connect the ground screw to the site ground point. The size of the wire used for this connection must be 8 AWG minimum.

CAUTION:
See the Motorola Solutions Quality Standards Fixed Network Equipment Installation Manual R56 (which can be obtained by ordering CDROM 9880384V83), for complete information regarding lightning protection.

The 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 repeater through the DC inlet connector on the rear panel of the repeater. See Figure 81: Back Panel Connector Names and Locations on page 129 for the location of the DC inlet connector.

CAUTION: The 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.

12.1.4.5
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. The position of these connectors is shown in Figure 81: Back Panel Connector Names and Locations on page 129, and their respective connector types are noted in Table 42: Connector Type and Primary Function on page 129.

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 repeater. The positions of the Aux and Ethernet connectors are shown in Figure 81: Back Panel Connector Names and Locations on page 129.

See Auxiliary (Aux) on page 75 for a description of the signaling that is supported by the Aux connector.

12.1.5
Equipment Mounting Methods

The SLR 5000 Series Repeater may be mounted in a rack or cabinet. The repeater may also be configured as a desk or wall mount unit.

The 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 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 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 78: Floor Mount Cabinet on page 123. See Table 39: Cabinet Models on page 122 for the cabinet models and associated description.

Table 39: Cabinet Models

Model	Description
THN6700	12 in. (30.48 cm) indoor cabinet
THN6701	30 in. (76.2 cm) indoor cabinet
THN6702	46 in. (116.84 cm) indoor cabinet

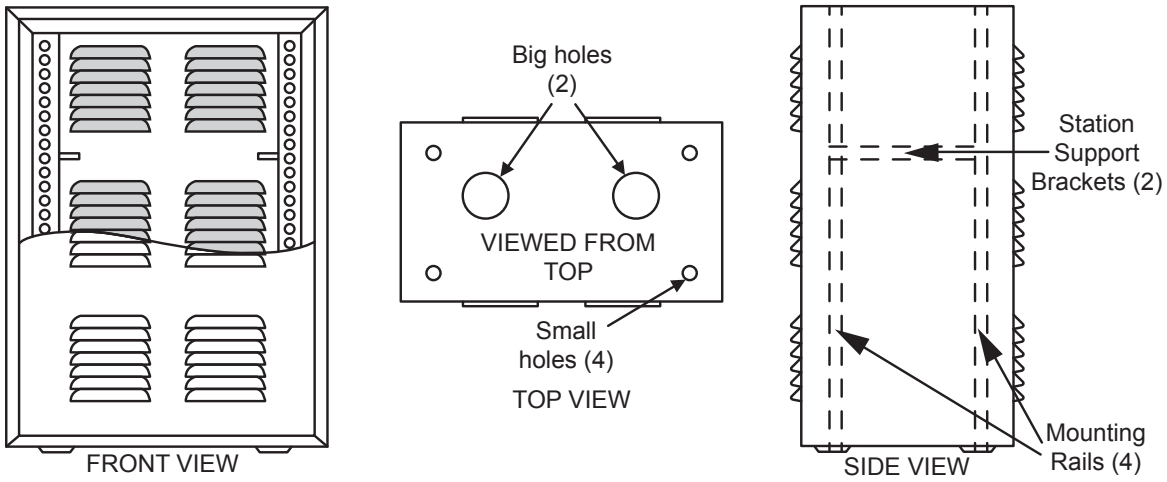
Refer to Equipment Ventilation on page 120 for recommended ventilation clearances. For improved access to the unit, tray slides are available as shown in Table 40: Cabinet Slide on page 123.

Table 40: Cabinet Slide

Model	Description
THN6788	Slides Motorola Solutions Cabinet

CAUTION: Ensure that the cabinet is securely anchored to the floor, thereby avoiding possible equipment tipping and personal injury.

Figure 78: Floor Mount Cabinet



12.1.5.2

Modular Racks

See Table 41: Rack Models on page 123 for the rack models and associated description.

Table 41: Rack Models

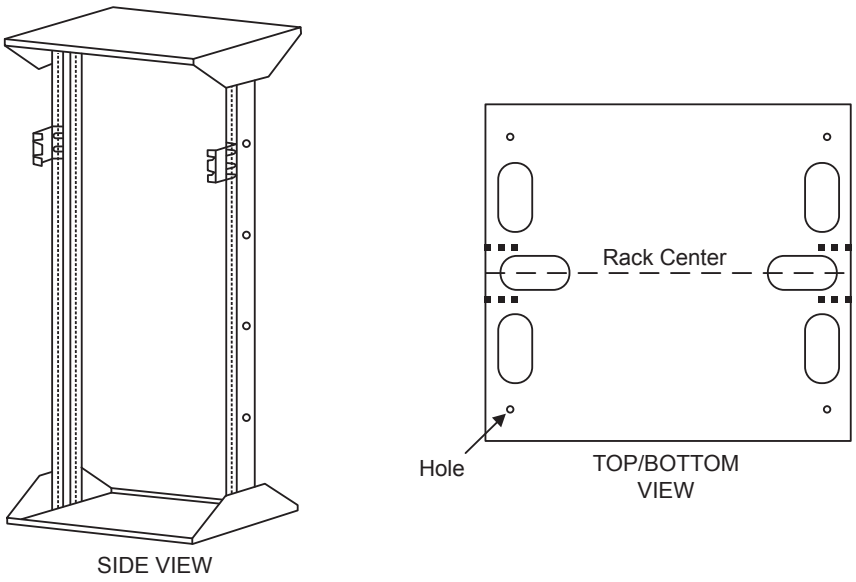
Model	Description
THN6752	30 in. (76.2 cm) Modular Rack (16 RK U)
THN6753	45 in. (114.3 cm) Modular Rack (24 RK U)
THN6754	52 in. (132.08 cm) Modular Rack (27 RK U)

The side, top and bottom views for all available modular racks are shown in Figure 79: Modular Rack on page 124. 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 Equipment Ventilation on page 120 for recommended ventilation clearances.

FRU kit PMLN6826 (Rack Mount Hardware) is included with each rack model. This allows proper installation of the SLR 5000 series repeater within the racks center of gravity.

Figure 79: Modular Rack



12.1.5.3
Desk Mount

The repeater can be set up for mounting onto a desk. See Desk Mount on page 128 for installation details.

12.1.6
Site Grounding and Lightning Protection

CAUTION: Proper site grounding and lightning protection are vitally important considerations. Failure to provide proper lightning protection may result in permanent damage to the radio equipment.

One of the most important considerations when designing a communications site is the ground and lightning protection system. While proper grounding techniques and lightning protection are closely related, the general category of site grounding may be divided into the following sections.

12.1.6.1
Electrical Ground

Ground wires carrying electrical current from circuitry or equipment at the site is included in the category of electrical ground. Examples include the AC or DC electrical power used to source equipment located at the site, and wires or cables connected to alarms or sensors located at the site.

12.1.6.2
RF Ground

This type of ground is related to the bypassing of unwanted radio frequency energy to earth ground. An example of RF grounding is the use of shielding to prevent or at least minimize the leakage of unwanted RF energy from communications equipment and cables.

12.1.6.3
Lightning Ground

Providing adequate lightning protection is critical to a safe reliable communications site. RF transmission cables, and AC and DC power lines must all be protected to prevent lightning energy from entering the site.

Comprehensive coverage of site grounding techniques and lightning protection is not within the scope of this instruction manual, but there are several excellent industry sources for rules and guidelines on grounding and lightning protection at communications sites.

NOTICE: Motorola Solutions recommends the following reference source:
Motorola Solutions Quality Standards Fixed Network Equipment Installation Manual R56: (which can be obtained by ordering CDROM 9880384V83).

12.1.6.4
Equipment Grounding

The SLR 5000 Series Repeater is equipped with a ground screw on the rear of the repeater power supply module. This screw is used to connect the repeater to the site grounding. All antenna cables, and AC and DC power cabling, should be properly grounded and lightning protected by following the rules and guidelines provided in the previous sections. Failure to provide proper lightning protection may result in permanent damage to the repeater.

12.1.7
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 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.

12.1.8
Equipment Unpacking and Inspection

This section describes ways to unpack and inspect the repeater equipment.

12.1.8.1
Unpack Equipment

Remove the repeater from the cardboard box. Remove the foam inserts and remove the repeater from the antistatic bag. Keep all packing components for future shipping of the repeater.

12.1.8.2
Initial Inspection

- After removing the repeater from the packaging, set on the surface for inspection. The top and bottom cosmetic covers should be free of damage. The 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 Solutions.
- When a repeater is delivered from Motorola Solutions, it arrives in suitable packing materials. If the unpacked equipment is damaged, return it to Motorola Solutions in its original packaging.

  CAUTION: 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.

  Improper handling of the repeater may cause personal injury or damage to the repeater.

12.2
Mechanical Installation

This section describes the equipment unpacking and inspection, as well as the mounting procedure for the repeater.

12.2.1
Mounting Procedures

The repeater can be mounted in the selected cabinet or rack, and may be installed by using the following information.

12.2.1.1
Transferring Equipment from Shipping Container to Rack or Cabinet

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

NOTICE: 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:
41.3 cm (16.25 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 Solutions Customer Support for specific questions regarding mounting equipment in customer-supplied cabinets.

12.2.1.2
Installing Racks

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

Prerequisites:
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.

Procedure:

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 (0.75 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 repeater either in the front or middle of the repeater depending on whether rack is made for front mount or mid-mount using three supplied screws for each bracket.

8 Hold the 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.

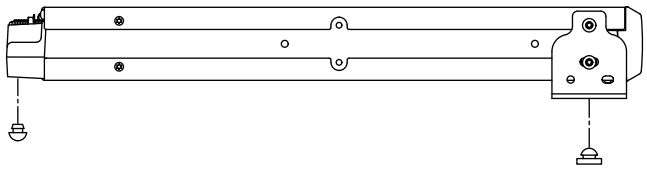
12.2.1.3
Cabinet Installation

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 in Installing Racks on page 127 for anchoring the equipment racks. If installing on a wooden floor, use lag bolts and washers (customer supplied) to secure the cabinet to the floor.

12.2.1.4
Desk Mount

To use the repeater as a desk mount, install mounting brackets (PN: 07009401001) at a 90 degree angle as shown in Figure 80: Desk Mount Installation on page 128 using two M4 screws (PN: 0310907A99) for each bracket using a
T20 Torx driver at 15 in-lb (1.7 N-m). Then push a rubber foot (PN: 75009498001) into each bracket as shown in Figure 80: Desk Mount Installation on page 128. Next push two rubber feet (PN: 75009502001) into the base frame also shown in Figure 80: Desk Mount Installation on page 128.

Figure 80: Desk Mount Installation



12.3
Electrical Connections

After the repeater equipment has been mechanically installed, electrical connections must be made.

This involves making the following connections to:

- power supply,
- antenna coax cables,
- system cables, and

- grounding.

Figure Figure 81: Back Panel Connector Names and Locations on page 129 shows the position of the repeaters external connectors located on the back panel of the repeater. Table 42: Connector Type and Primary Function on page 129 identifies the connector types as well as a given connector's primary function.

Figure 81: Back Panel Connector Names and Locations

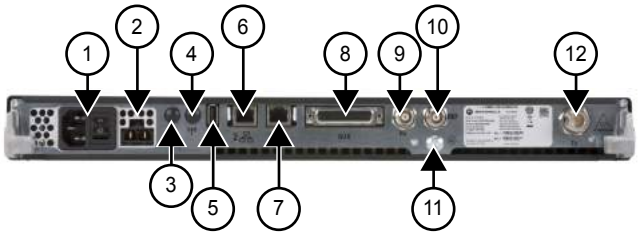


Table 42: Connector Type and Primary Function

Location	Connector Type	Function(s)
1	C14 (IEC 60320)	AC Power Inlet of Repeater Power Switch
2	Molex 42818-0212	DC Power Inlet and DC Charger Outlet
3	Option Dependent	Option Dependent 1
4	Option Dependent	Option Dependent 2
5	Type A Socket	USB
6	RJ-45 – Jack	Ethernet 2
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)

There is also a USB connection associated with maintenance and troubleshooting of the repeater. This connection is located on the front of the repeater. See Figure 82: Location of USB Connector on page 129.

Figure 82: Location of USB Connector

Table 43: Callout Legend

Label	Description
1	USB Service Port

12.3.1
Power Supply Connections

12.3.1.1
AC Input Power Connection

CAUTION:
Do not apply AC power to the repeater at this time. Make sure that the circuit breaker associated with the AC outlet is turned OFF.

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

Each repeater is shipped with an 2.5 m (8 ft) 3-conductor line cord. See Figure 81: Back Panel Connector Names and Locations on page 129 for AC power inlet connector. Insert the plug into an appropriate grounded outlet.

12.3.1.2
DC Input Power Connection/ DC Charger Connection

For DC operation, the DC source power is connected to the repeater through the DC power inlet connector shown in Figure 81: Back Panel Connector Names and Locations on page 129. The operation is also described in the “Battery Connection” section of this chapter. The DC source must be located in the same building as the repeater, and it must meet the requirements of an SELV circuit.

CAUTION: Ensure that the appropriate voltage is connected with a nominal 13.6 VDC (11 – 14.4 VDC).

12.3.1.3
Ground Connection

The repeater is equipped with a ground screw located on the back panel. Figure 81: Back Panel Connector Names and Locations on page 129 shows the location of the grounding screw. Connect the ground screw to the site ground point. The size of the wire used for this connection must be 8 AWG minimum.

CAUTION:
Refer to Motorola Solutions Quality Standards Fixed Network Equipment Installation Manual R56 (which can be obtained by ordering CDROM 9880384V83), for complete information regarding lightning protection.

The 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.

12.3.1.4
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 repeater through the DC inlet connector on the rear panel of the repeater. See Figure 81: Back Panel Connector Names and Locations on page 129 for the location of the DC inlet connector.

CAUTION: The 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.

12.3.1.5
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. The position of these connectors is shown in Figure 81: Back Panel Connector Names and Locations on page 129, and their respective connector types are noted in Table 42: Connector Type and Primary Function on page 129.

12.3.1.6
System Cable Connections

System connections are made through the Aux and/or Ethernet connectors located on the back panel of the repeater. The positions of the Aux and Ethernet connectors are shown in Figure 81: Back Panel Connector Names and Locations on page 129.

See Auxiliary (Aux) on page 75 for a description of the signaling that is supported by the Aux connector.

12.4
Post Installation Checklist

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

12.4.1
Apply Power

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

12.4.2
Verify Proper Operation

Operation of the repeater can be verified by:

- Observing the state of the seven 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.

12.4.3
Front Panel LEDs

After turning on the repeater power (or after a repeater reset), the seven 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.

12.4.4
Repeater Codeplug Data Backup

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

12.5
Installing Repeater Hardware Options

This section describes ways to install the hardware options of the repeater.

12.5.1
General Bonding and Grounding Requirements

Cabinets and racks used to mount the 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 Solutions R56 manual Standards and Guidelines for Communication Sites (which can be obtained by ordering CDROM 9880384V83) for more information on proper bonding and grounding at a site.

12.5.2
General Cabling Requirements

Diagrams for cabling are typically included in the system–specific configuration documentation provided by Motorola Solutions. Also see the Motorola Solutions R56 manual Standards and Guidelines for Communication Sites (which can be obtained by ordering CDROM 9880384V83) for cabling standards.

Appendix A: Accessories

Introduction

Motorola Solutions provides the following approved accessories to improve the productivity of the SLR 5000 Series Repeater.

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

Cables

Part No.	Description
3087791G01	Power Cable, US
PMKN4167_	Battery Charger Cable
0112004B04	N-Type Male to N-Type Male Connector
0112004U04	N-Type Male to BNC Male Connector

Documentation

Part No.	Description
6880309T12	MOTOTRBO System Planner
9880384V83	CDROM for R56 manual
DSPDCRSS5	Asia MOTOTRBO CPS Subscription
GMLN4575_	MOTOTRBO Publication CD
GMVN5141_	MOTOTRBO Software DVD
GMVN5520_	MOTOTRBO RDAC Software CD
PMVN4130_	MOTOTRBO CPS/AirTacer CD
PMVN4171_	MOTOTRBO RDAC APP

Duplexers

Part No.	Description
9175300H01	VHF Duplexer (RoHS) 132–146 MHz
9175300H02	VHF Duplexer (RoHS) 144–160 MHz
9175300H03	VHF Duplexer (RoHS) 158–174 MHz
9175300H05	UHF Duplexer (RoHS) 403–435 MHz
9175300H06	UHF Duplexer (RoHS) 435–470 MHz
9175300H07	UHF Duplexer (RoHS) 470–494 MHz
9175300H08	UHF Duplexer (RoHS) 494–512 MHz

Table continued…

Part No.	Description
DSCP10725 Tuned	UHF Duplexer Tuned 406–500 MHz
DSCP10725 Untuned	UHF Duplexer Untuned 406–500 MHz
HFD8188_	VHF Duplexer, 144–155 MHz
HFD8189_	VHF Duplexer, 155–162 MHz
HFD8190_	VHF Duplexer, 162–174 MHz
HFD8465_	VHF Duplexer, 150–160 MHz
HFE8400_	UHF Duplexer, 406–450 MHz
HFE8401_	UHF Duplexer, 470–495 MHz

Mounting

Part No.	Description
PMLN6826_	Mounting Hardware Kit
BR000031A01	Mounting Bracket (Long, Rack Mount Shipping only)
PMLE4548_	Rack Mount Duplexer/Filter Enclosure Kit (includes mounting screws)
PMLE5031_	Wall Mount Bracket Kit

Preselectors

Part No.	Description
HFD8461_	VHF Preselector, 144–160 MHz
HFD8462_	VHF Preselector, 160–174 MHz
HFD8463_	VHF Preselector, 136–144 MHz
HFD8458_	UHF Preselector, 406–440 MHz
HFE8459_	UHF Preselector, 440–474 MHz
HFE8460_	UHF Preselector, 474–512 MHz

Service Parts

Part No.	Description
PMTD4012_S	SLR 5000 Series VHF PA Service Kit
PMTD4013_S	SLR 5000 Series VHF Modem Service Kit
PMTE4022_S	SLR 5000 Series UHF R1 Modem Service Kit
PMTE4510_S	SLR 5000 Series UHF R2 Modem Service Kit
PMTE4023_S	SLR 5000 Series UHF R1 PA Service Kit
PMTE4500_S	SLR 5000 Series UHF R2 PA Service Kit

Table continued…

Part No.	Description
PMPN4026_S	SLR 5000 Series Power Supply Service Kit
PMLN6490_S	SLR 5000 Series Front Panel Board Service Kit
PMLN7244_	SLR 5000 Series Fan Assembly Service Kit

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
RVN5115_	Portable, Mobile and Repeater Customer Programming Software (CPS) Package
HSN1006_	Speaker, Amplified
GMMN4063_	Microphone, RJ45

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Appendix B: Replacement Parts Ordering

Replacement Parts Ordering

This section describes ways you can place your orders for the replacement parts.

Basic Ordering Information

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

Motorola Solutions Online

This section describes ways you can place your orders for the replacement parts.

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

To register for online access:

- Have your Motorola Solutions Customer number available.
- Go to https://businessonline.motorolasolutions.com and click on **Sign Up Now**.
- Complete the form and submit it.
- Or, call 1-800-422-4210 (for U.S. and Canada Service Centers only).

Contact your BDM to complete the set-up. Registration is completed within 24 to 48 hours.

Mail Orders

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

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

Telephone Orders

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

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

Fax Orders

Radio Products and Solutions Organization (see note)
(United States and Canada)
1-800-622-6210
1-847-576-3023 (United States and Canada)

USFGMD
(Federal Government Orders)
1-800-526-8641 (For Parts and Equipment Purchase Orders)

Parts Identification

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

NOTICE: 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).

Product Customer Service

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

Appendix C: Motorola Solutions Service Centers

Motorola Solutions Service Centers

This section lists the Motorola Solutions service centers for testing, troubleshooting, and service.

Servicing Information

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

Motorola Solutions Service Center

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

Motorola Solutions Federal Technical Center

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

Motorola Canadian Technical Logistics Center

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

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Appendix D: SLR 5000 Series Third-Party Controllers

Overview

The SLR 5000 Series 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 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 5000 Series Repeater are as follows:

- Community Repeater Panel (Zetron Model 38-Max)
- Phone Patch (Zetron Model 30)
- Tone Remote Adapter (Motorola Solutions 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 repeater.

NOTICE:
The SLR 5000 Series 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 5000 Series Repeater for analog mode.

If the third party controllers are supplied power by the SLR 5000 Series Repeater, then the SLR 5000 Series Repeater needs to be in a powered off state when establishing (or removing) the connection to the SLR 5000 Series back panel connector.

Figure 83: CPS Settings to Configure SLR 5000 Series Repeater for Analog Mode

Community Repeater Panel

The SLR 5000 Series Repeater is capable of Multi Coded Squelch through the Zetron Model 38 Repeater Panel. The Model 38 Repeater Panel interconnects to the 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 84: Model Zetron 38 Repeater Panel

Compatibility

Zetron Model 38 Repeater Panel is compatible for all versions of SLR 5000 Series Repeater software and hardware.

Hardware Connections

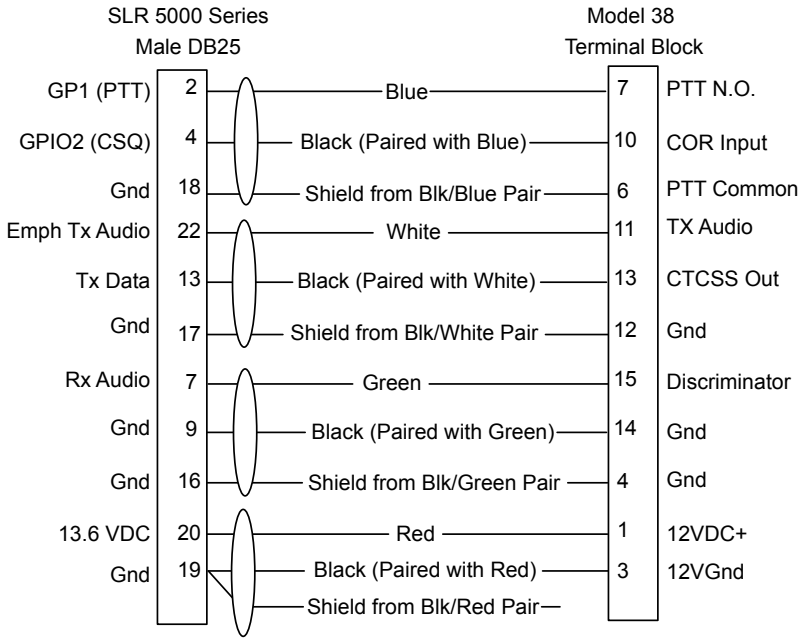
The connections between the SLR 5000 Series Repeater and the community repeater panel are facilitated with a multi-conductor cable connected between the SLR 5000 back panel AUX 25-Pin connector and that of the community repeater panel. The connection provides the following signals:

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

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

Signal connections are noted in Figure 83: CPS Settings to Configure SLR 5000 Series Repeater for Analog Mode on page 141. The SLR 5000 Series 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 5000 Series ordering guide.

Figure 85: Signal Connections between SLR 5000 Series Repeater and Community Repeater Panel



CPS Configuration

The SLR 5000 Series Repeater will need to be configured via the CPS application as shown in Figure 86: CPS Configuration for Community Repeater Panel (1 of 2) on page 143 and Figure 87: CPS

Configuration for Community Repeater Panel (2 of 2) on page 144. More specifically, the affected parameters are as follows:

- Audio Type
  - Flat Unsquelched
- 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 86: CPS Configuration for Community Repeater Panel (1 of 2)

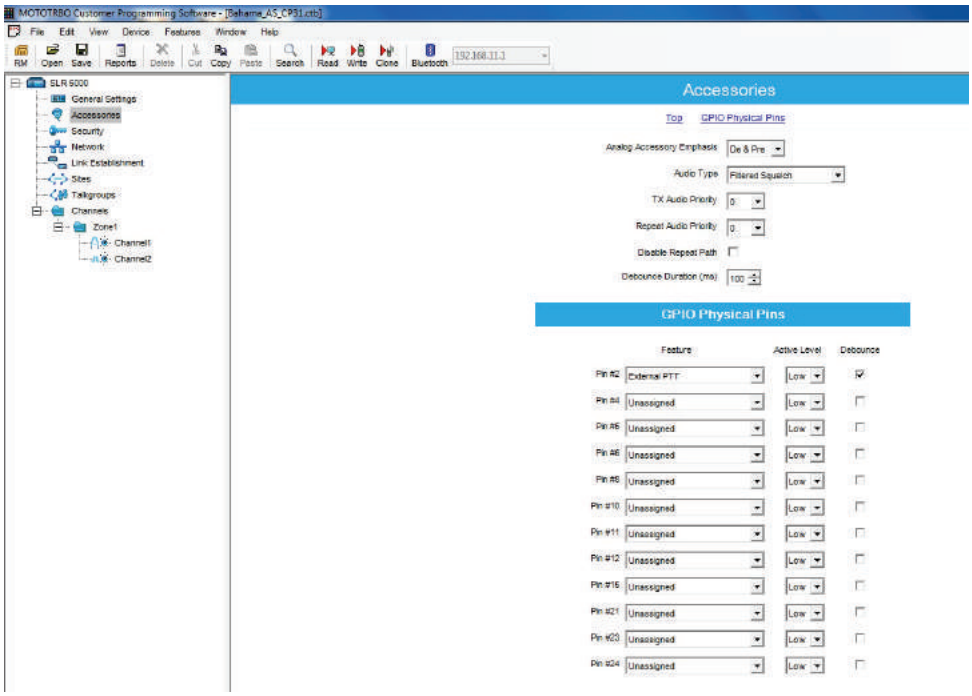
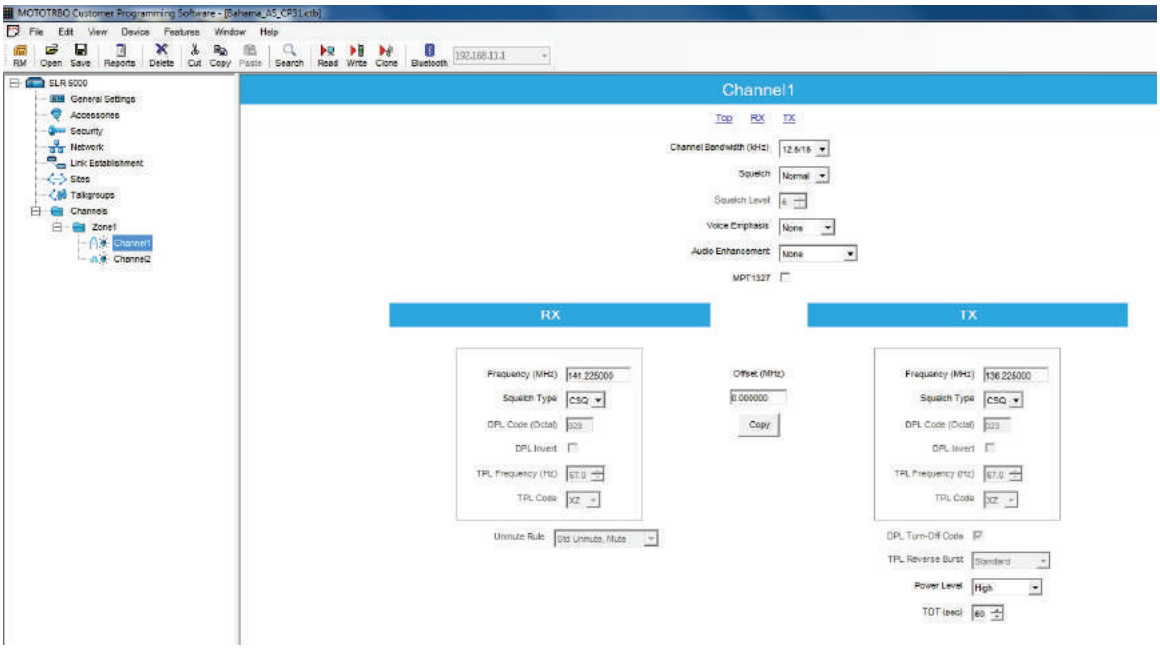


Figure 87: CPS Configuration for Community Repeater Panel (2 of 2)



Community Repeater Panel Settings

The input and output levels should be adjusted per the community repeater panel's instructions. The following sections give a brief overview of the high level characteristics and community repeater panel settings for configuration with the SLR 5000 Series Repeater.

Discriminator

The Receiver audio yields 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).

NOTICE: Under the System Programming, turn on the DCS Rx data.

Tx Audio

The transmitter yields 60% RSD with 80 mV 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).

NOTICE: Under the System Programming, turn on the DCS Tx data.

Continuous Tone-Controlled Squelch Systems (CTCSS) Out

The transmitter yields 60% RSD with 80 mV 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).

Tx Audio Pre-Emphasis

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

Carrier Operated Relay (COR)

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).

Phone Patch

The SLR 5000 Series Repeater is capable of multi-mode telephone interconnect through the Zetron Model 30 Phone Patch. The Zetron Model 30 Phone Patch interconnects to the repeater and allows users to initiate and receive land line telephone calls through the subscriber radios. When properly configured, subscribers can initiate and answer telephone calls. Through 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 88: Zetron Model 30 Phone Patch

Compatibility

Zetron Model 30 Phone Patch is compatible for all versions of SLR 5000 Series Repeater software and hardware.

Hardware Connections

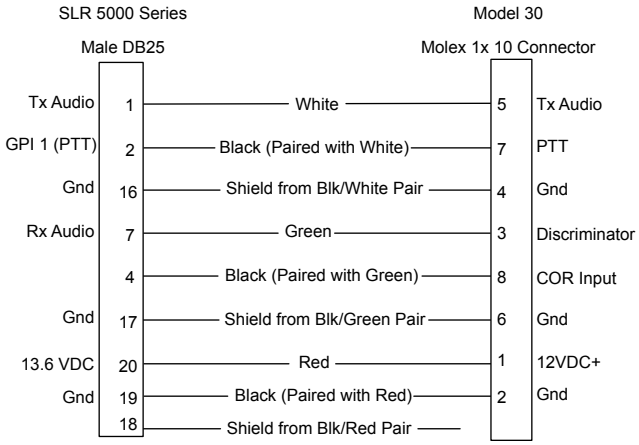
The connections between the SLR 5000 Series Repeater and the phone patch are facilitated with a multi-conductor cable connected between the J7 SLR 5000 Series back panel Aux 25-Pin connector and that of the phone patch. The connection provides for the following signals:

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

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

Signal connections are noted in Figure 1. The SLR 5000 Series 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 5000 Series ordering guide.

Figure 89: Signal Connections between SLR 5000 Series Repeater and Zetron Model 30 Phone Patch (Analog Phone Patch Cable & Digital Phone Patch Cable)



CPS Configuration

The SLR 5000 Series Repeater will need to be configured via the CPS application as shown in Figure 86: CPS Configuration for Community Repeater Panel (1 of 2) on page 143 and Figure 87: CPS Configuration for Community Repeater Panel (2 of 2) on page 144. 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 90: CPS Configuration for Phone Patch (1 of 2)

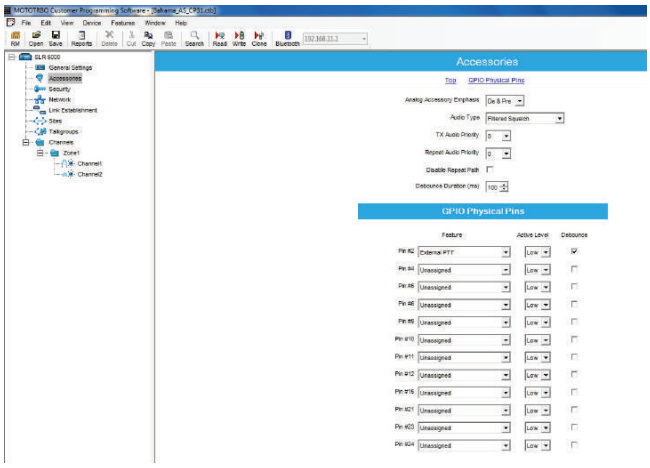
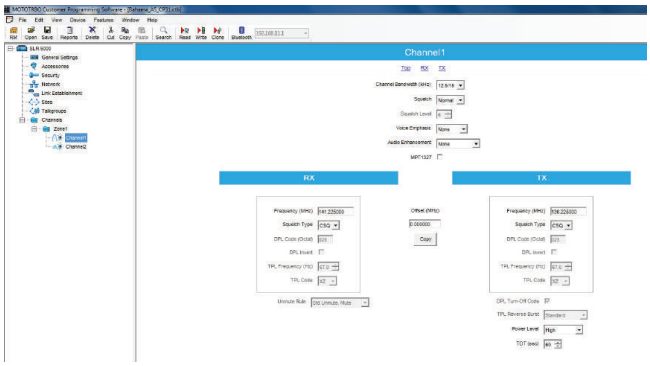


Figure 91: CPS Configuration for Phone Patch (2 of 2)



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 5000 Series Repeater.

Disc

The Receiver audio yields 330 mV 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).

Tx Audio

The transmitter yields 60% RSD with 80 mV 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).

CTCSS/ DCS DECODE INPUT/ COR

Set the jumpers on the phone patch as follows:

- Set jumper JP6 to position A, to match the SLR 5000 Series Repeater's 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 repeater's active low indication of a COR detect.

Tone Remote Adapter

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:

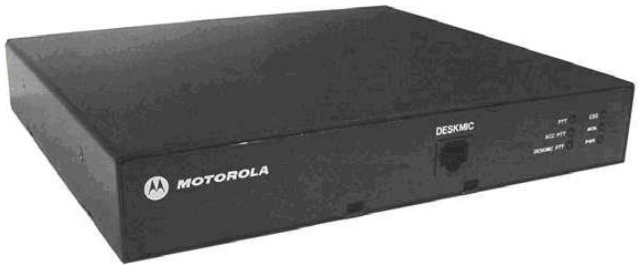
- Audio signal
- Command signals (function tones) that are used to perform the remote control functions.

The SLR 5000 Series Repeater is capable of decoding function tones, sent over a Wireline from a remote analog deskset or console, through the Motorola Solutions Tone Remote Adapter (Model L3276). When properly configured, the Tone Remote Adapter performs the following functions in conjunction with the repeater:

- Transmit and Receive Audio
- PTT
- Monitor
- Channel Select (up to 15 frequencies)
- Wildcard (such as, Repeater Knockdown)

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

Figure 92: Model L3276 Tone Remote Adapter



Compatibility

Model L3276 Tone Remote Adapter is compatible for all versions of SLR 5000 Series Repeater software and hardware.

Hardware Connections

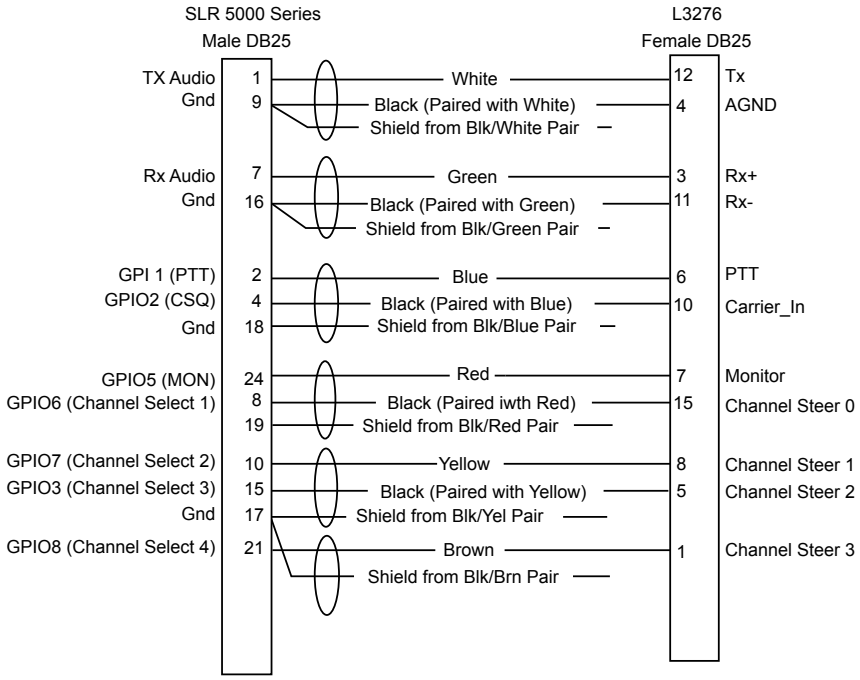
The connections between the SLR 5000 Series Repeater and the Tone Remote Adapter are facilitated with a multi-conductor cable connected between the J7 SLR 5000 Series back panel AUX 25-Pin connector and that of the Tone Remote Adapter. The connection provides for the following signals:

- Transmit Audio
- Receiver Audio
- PTT
- COR
- Monitor
- Channel Steering

- Wild Card (such as Repeater Knockdown)
- Ground

Signal connections are noted in Figure 85: Signal Connections between SLR 5000 Series Repeater and Community Repeater Panel on page 142. SLR 5000 Series Repeater connector and physical Pin locations are noted in the backplane interface board section of this manual. See Motorola Solutions L3276
25-Pin manual for its connector and physical Pin locations. The part number for a pre-fabricated cable is noted in the SLR 5000 Series ordering guide.

Figure 93: Signal Connections between SLR 5000 Series Repeater and Motorola Solutions L3276 25-Pin connector for a 15 Channel Remote Control



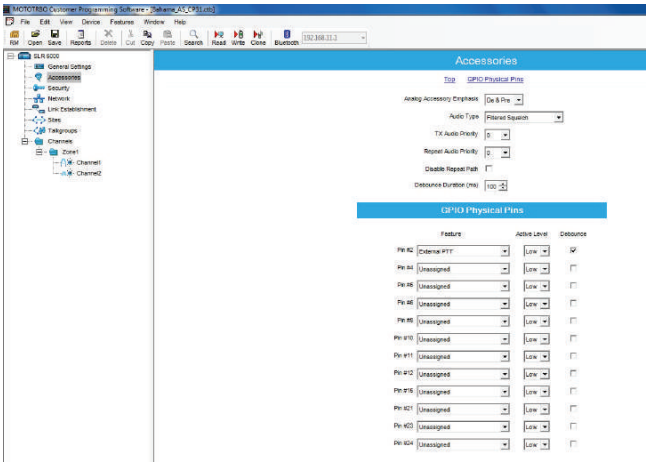
CPS Configuration (For a 15 Channel Remote Control)

The SLR 5000 Series Repeater will need to be configured via the CPS application as shown in Figure 94: CPS Configuration for L3276 Tone Remote Adapter
(For a 15 Channel Remote Control) on page 150. 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 94: CPS Configuration for L3276 Tone Remote Adapter (For a 15 Channel Remote Control)



NOTICE: The above configuration is considered typical. The L3276 Remote Tone Adapter provides alternate configurations that are supported by SLR 5000 Series Repeater as well. See L3276 Remote Tone Adapter Manual for additional details.

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 5000 Series Repeater.

Radio Rx

The Receiver audio yields 330 mV 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").

Radio Tx

The transmitter yields 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).

Channel Steering

Leave jumper S7 in position B (factory default) to match the active low setting for the Channel Steering 1, Channel Steering 2, Channel Steering 3, and Channel Steering 4 GPIO signaling.

Monitoring

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

PTT

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

Wildcard 1 (optional)

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

Trunking Controllers

The SLR 5000 Series Repeater is capable of supporting LTR trunking operations with the Trident's Marauder and Raider controllers. Additionally, the 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 95: Model Trident's Marauder

Figure 96: Model Trident's Raider

Figure 97: Model Trident's NTS

Compatibility

Trident Model Raider, Marauder and NTS are compatible for all versions of SLR 5000 Series Repeater software and hardware.

Hardware Connections

The connections between the SLR 5000 Series Repeater and the trunking controllers are facilitated with a multi-conductor cable connected between the J7 SLR 5000 Series back panel AUX 25-Pin connector and that of the connector on the trunking controller. The connection provides for the following signals:

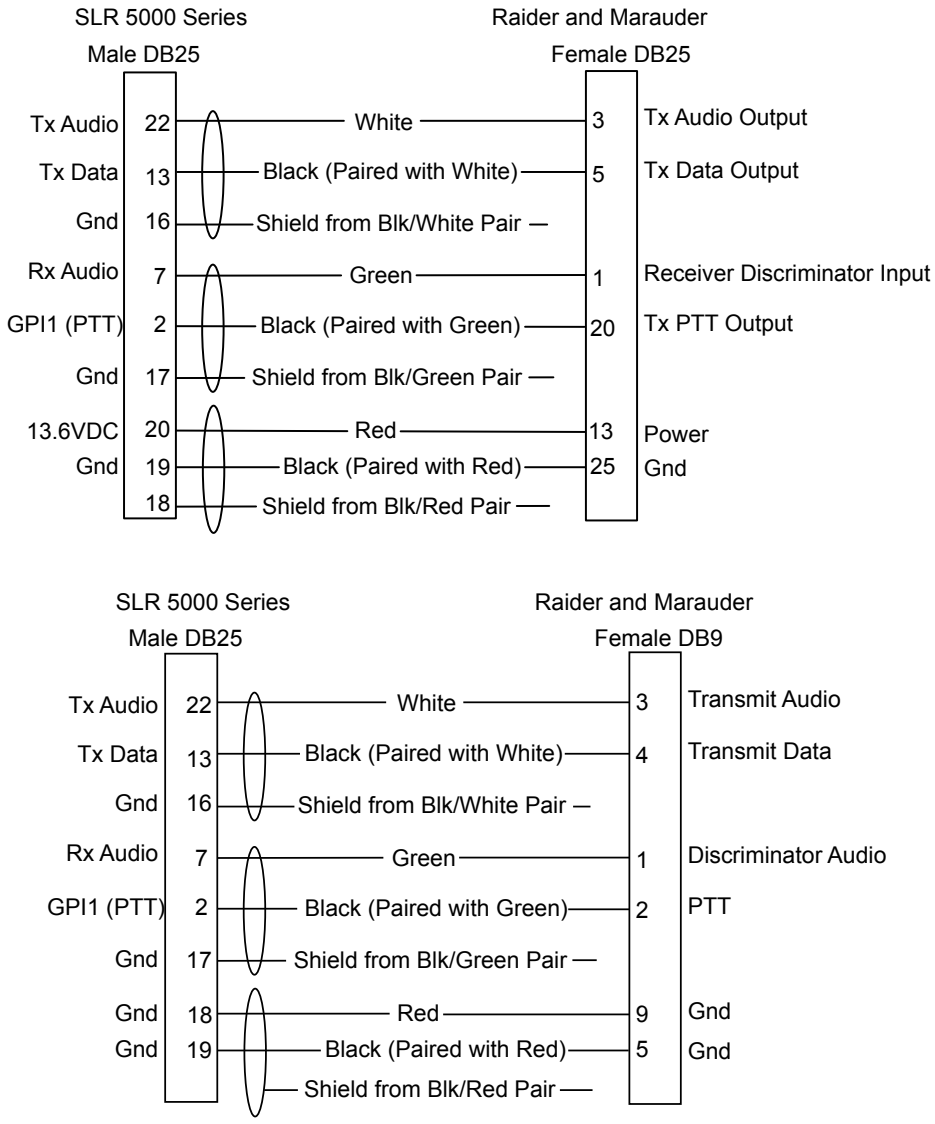
- Transmit Audio
- Transmit Data
- Receiver Audio
- PTT
- 13.6 VDC (see Note)
- Ground

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

Signal connections are noted in Figure 86: CPS Configuration for Community Repeater Panel (1 of 2) on page 143. The SLR 5000 Series 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 98: Signal connections between SLR 5000 Series Repeater, Trident Model Raider, Marauder, and NTS

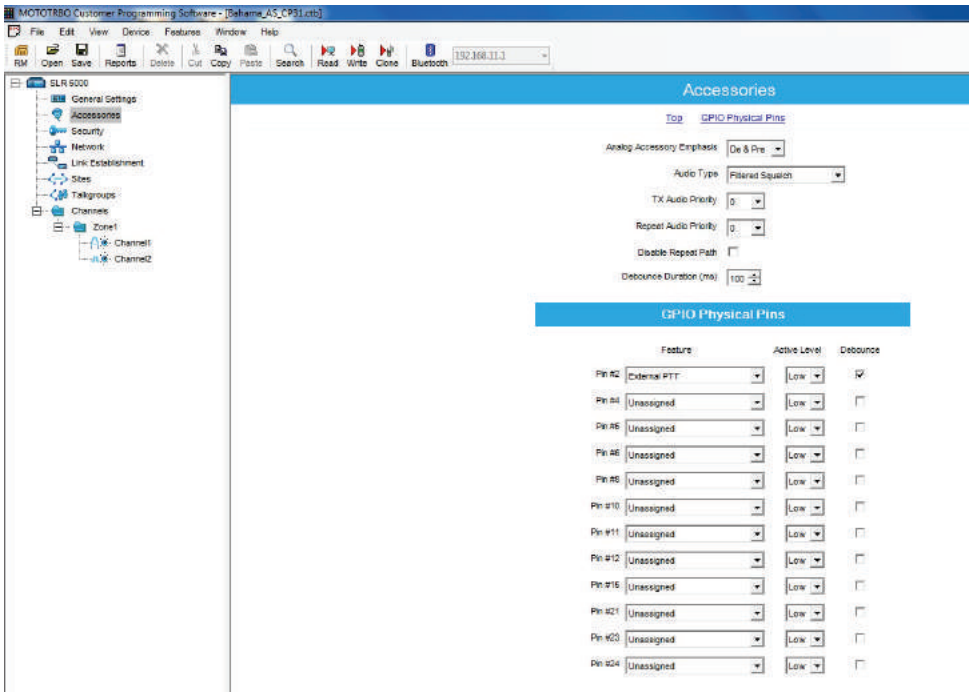


CPS Configuration

The SLR 5000 Series 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 99: CPS Configuration for Trident Model Raider, Marauder and NTS



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 5000 Series Repeater.

Discriminator

The Receiver audio yields 330 mV rms into 50 kΩ with an RF input signal deviating at 60% RSD. With the trunking controllers own loading impedance, the "Discriminator" signal delivered to the trunking controller requires a boost by setting the following jumpers in the noted position:

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

Tx Audio

The transmitter yields 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.

Tx Data

transmitter yields 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)

Appendix F: MOTOTRBO Repeater – EME ASSESSMENT

NOTICE: 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.

Executive Summary

The Electromagnetic Energy (EME) compliance boundaries in a typical system configuration of the MOTOTRBO SLR 5000 Series 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 44: 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

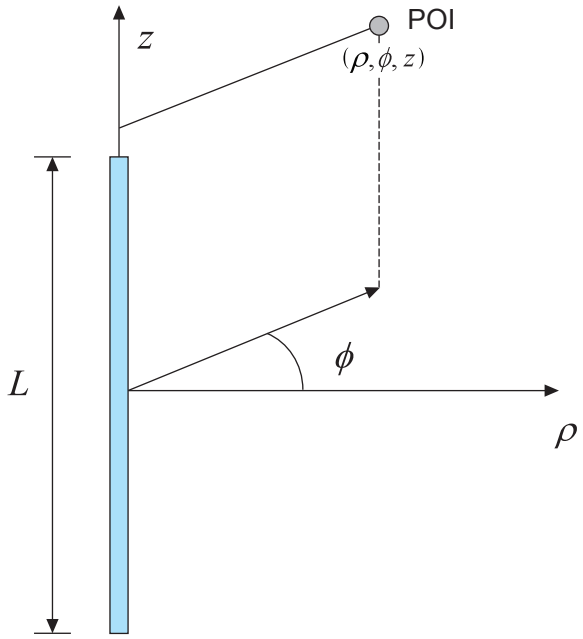
Indoor Exposure Prediction Model

This section describes how to determine the indoor exposure model prediction of an antenna or at ground level.

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 SLR 5000 Series Repeater.

Figure 100: Reference Frame for the Point of Interest (POI) Cylindrical Co-Ordinates



Per the reference frame in Figure 100: Reference Frame for the Point of Interest (POI) Cylindrical Co-Ordinates on page 156, the cylindrical-wave model is applicable in the volume described in cylindrical co-ordinates (ρ, ϕ, z) for omni-directional array antennas as follows:

$$\hat{S}(r,\phi)=\frac{P}{\pi r L\cos^2\gamma\sqrt{1+\left(2\frac{r}{r_0}\right)^2}},\quad r_0=\frac{1}{2}D_A L\cos^2\gamma \qquad (1)$$

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

$$r=\frac{\rho}{\cos\gamma}$$

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.

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
Exposure in Front of the Antenna on page 156. 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:

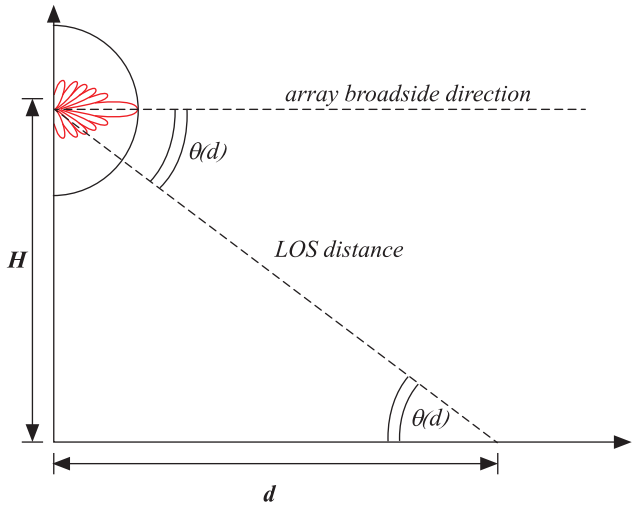
$$S(d)=(2.56)\frac{P\cdot G(\theta)}{4\pi(H^2+d^2)}$$

where $G(\theta)$ is the elevation gain pattern, which is approximated by the following expression:

$$G(\theta)=G_A\left|\frac{\sin\left(\frac{k_0 L}{2}\sin\theta\right)}{\frac{k_0 L}{2}\sin\theta}\right|^2$$

$k_0 = 2\pi / \lambda$ where 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 the following figure). 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 101: Schematic of the Ground-Level Exposure Model Adopted for the Assessment



Typical System Configuration

The SLR 5000 Series 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 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 has to be verified that the resulting compliance distances are indeed smaller than r_0). Such an antenna (such as, Andrew DB408) would exhibit a typical elevation beamwidth of about 14 degrees.

Exposure Limits

Guidelines are used for the EME exposure assessment.

Based on the operating frequency range, the most conservative power density limits are those defined in the ICNIRP guidelines [1]. The guidelines are 10.1 W/m^2 for occupational exposure, and 2.02 W/m^2 for general public exposure.

EME Exposure Evaluation

This section describes how to evaluate the EME exposure of an antenna or at ground level.

Exposure in Front of the Antenna

The assessment is based on the following characteristics of the Andrew DB408 antenna:

$$G_A = 10^{\frac{6.6+2.15}{10}} = 7.5 \qquad P = 200\,W \qquad \gamma = 0 \qquad L = 2.7\,m$$

The parameter r_0 is thus $r_0 = 10.1m$. Upon inserting the power density limits established in Exposure Limits on page 158 into formula (1), the following distances for occupational and general public exposure compliance are respectively determined:

$$r_{occupational} = 2.15m$$

and

$$r_{general\ public} = 6.9m$$

As both these distances are less than r_0, the aforementioned choice (Typical System Configuration on page 158) 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.

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 Exposure in Front of the Antenna on page 159, the EME exposure at ground level is always compliant with the exposure limits defined in the ICNIRP guidelines.

Compliance Boundary Description

Based on the analysis in EME Exposure Evaluation on page 159, the compliance boundaries for occupational and general public exposure are defined as cylinders enclosing the antenna (see Figure 102: Compliance Boundary for General Public (GP) and Ocupational (OCC) Exposure on page 160), extending 75 cm (one wavelength) above and below the physical antenna, with radii:

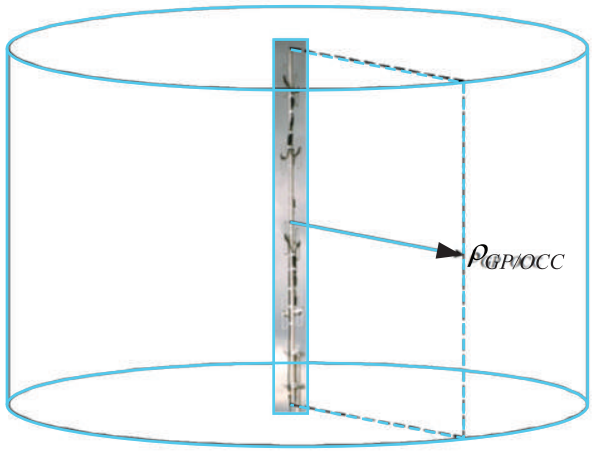
Occupational exposure:

$$\rho_{OCC} = 2.15\,m$$

General Public exposure:

$$\rho_{GP} = 6.9\ m$$

Figure 102: Compliance Boundary for General Public (GP) and Ocupational (OCC) Exposure



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 (such as, 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.

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).

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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.

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.

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).

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.

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