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RF-7800W-OU470/OU500 MULTIMISSION HCLOS RADIO

INSTALLATION/OPERATION MANUAL

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Broadband Ethernet Radio
RF-7800W-OU470



Broadband Ethernet Radio
RF-7800W-OU500

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SAFETY SUMMARY

1. INTRODUCTION

All operators and maintenance personnel must observe the following safety precautions during operation and maintenance of this equipment. Specific warnings and cautions are provided in the manual and at the end of this Safety Summary. Warnings, Cautions, and Notes appear before various steps in the manual and will be used as follows:

- **WARNING** Used when injury or death to personnel and damage to equipment is possible
- **CAUTION** Used when there is a possibility of damage to equipment
- **NOTE** Used to alert personnel to a condition that requires emphasis

2. PERSONNEL AND EQUIPMENT SAFETY

Basic safety precautions consider factors involved in protecting personnel from injury or death. Electrical, mechanical, thermal, electromagnetic radiation (EMR), or chemical hazards are the most common types of hazards found in electronic equipment. The following are types of hazards that may exist:

- | | |
|-------------------|--|
| ELECTRICAL | Hazardous voltage and current levels may exist throughout the equipment. Contact with these hazards could cause electrocution, electrical shock, burns, or injury due to involuntary reflexes of the body. |
| THERMAL | Burn hazards may exist in the equipment that could cause personal injuries and/or serious equipment damage. Internal surfaces of the equipment may be in excess of 65°C, the point at which personnel could be burned. Extreme caution should be used when working with any hot assemblies (for example, power supply or power amplifier assemblies). Physical injury or damage may result to personnel and/or equipment as a result of a reflex action to a burn. |
| EMR | Overexposure to electromagnetic radiation from amplified radio frequencies may produce a health hazard. |

3. OPERATIONAL AND MAINTENANCE SAFETY GUIDELINES

Good safety discipline is critical to prevent injury to personnel. All other safety measures are useless if personnel do not observe the safety precautions and do not follow safety disciplines. Once aware of a hazard, personnel should ensure that all other personnel are aware of the hazard. The following basic safety disciplines are stressed:

- a. Read a procedure entirely before performing it. Personnel must always perform each assigned task in a safe manner.
- b. Prior to applying equipment power after maintenance, personnel must ensure that all unsecured hand tools and test equipment are disconnected from the serviced/maintained equipment and properly stored.
- c. Power to the equipment must be removed before a piece of equipment is removed.
- d. Extreme care must be used when adjusting or working on operating equipment. Voltages in excess of 70 V or current sources in excess of 25 A are covered with barriers. Barriers include warning information about the hazard encountered upon barrier removal.

- e. Personnel must react when someone is being electrically shocked. Perform the following steps:
 1. Shut off power.
 2. Call for help.
 3. Administer first aid if qualified.

Under no circumstances should a person come directly in contact with the body unless the power has been removed. When immediate removal of the power is not possible, personnel must use a non-conductive material to try to jolt or pry the body away from the point of shock.

- f. Personnel should work with one hand whenever possible to prevent electrical current from passing through vital organs of the body. In addition, personnel must never work alone. Someone must be available in the immediate area to render emergency first aid, if necessary.
- g. Lifting can cause injury. Items weighing more than 37 pounds must be lifted by two or more people.
- h. Some electrolytic capacitors contain aluminum oxide or tantalum. If connected incorrectly, the capacitor will explode when power is applied. Extreme care must be used when replacing and connecting these capacitors. The capacitor terminals must always be connected using the correct polarity: positive to positive and negative to negative.

The next section contains general safety precautions not directly related to specific procedures or equipment. These precautions are oriented toward the maintenance technician. However, all personnel must understand and apply these precautions during the many phases of operation and maintenance of the equipment. The following precautions must be observed:

DO NOT SERVICE EQUIPMENT ALONE

Never work on electrical equipment unless another person familiar with the operation and hazards of the equipment is near. When the maintenance technician is aided by operators, ensure that operators are aware of the hazards.

GROUNDING

Always ensure that all equipment and assemblies are properly grounded when operating or servicing.

TURN OFF POWER AND GROUND CAPACITORS

Whenever possible, power to equipment should be turned off before beginning work on the equipment. Be sure to ground all capacitors that are potentially dangerous.

KEEP AWAY FROM LIVE CIRCUITS

Operators and maintainers must observe all safety regulations at all times. Do not change components or make adjustments inside equipment with a high voltage supply on unless required by the procedure. Under certain conditions, dangerous potentials may exist in circuits with power controls off, due to charges retained by capacitors.

DO NOT BYPASS INTERLOCKS

Do not bypass any interlocks unnecessarily. If it is necessary to employ an interlock bypass for equipment servicing, use extreme care not to come in contact with hazardous voltages.

USE CARE HANDLING HEAVY EQUIPMENT

Never attempt to lift large assemblies or equipment without knowing their weight. Use enough personnel or a mechanical lifting device to properly handle the item without causing personal injury.

HEED WARNINGS AND CAUTIONS

Specific warnings and cautions are provided to ensure the safety and protection of personnel and equipment. Be familiar with and strictly follow all warnings and cautions on the equipment and in technical manuals.

PROTECTIVE EYEWEAR

All personnel must wear protective eyewear when servicing or maintaining equipment. Protective eyewear must be worn at all times when using tools.

4. PROTECTION OF STATIC-SENSITIVE DEVICES

The above symbol denotes a static-sensitive device. Diode input-protection is provided on all CMOS devices. This protection is designed to guard against adverse electrical conditions such as electrostatic discharge. Although most static-sensitive devices contain protective circuitry, several precautionary steps should be taken to avoid the application of potentially damaging voltages to the inputs of the device.

To protect static-sensitive devices from damage, the following precautions should be observed.

- a. Keep all static-sensitive devices in their protective packaging until needed. This packaging is conductive and should provide adequate protection for the device. Storing or transporting these devices in conventional plastic containers could be destructive to the device.
- b. Disconnect power prior to insertion or extraction of these devices. This also applies to PWBs containing such devices.
- c. Double check test equipment voltages and polarities prior to conducting any tests.
- d. Avoid contact with the leads of the device. The component should always be handled carefully by the ends or side opposite the leads.
- e. Avoid contact between PWB circuits or component leads and synthetic clothing.
- f. Use only soldering irons and tools that are properly grounded. Ungrounded soldering tips or tools can destroy these devices. SOLDERING GUNS MUST NEVER BE USED.

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CHAPTER 1

GENERAL INFORMATION

1.1 INTRODUCTION

The scope and overall intent of this manual is to help the user understand how to install and operate the RF-7800W High Capacity Line of Sight (HCLOS) radio.

1.2 RELATED MANUALS

[Table 1-1](#) identifies the related manuals that support the RF-7800W HCLOS radio.

Table 1-1. Related Equipment Manuals

Part Number	Manual Description
10515-0426-4000	RF-7800W-OU47x/-OU50x Multimission HCLOS Security Supplement
10515-0426-4020	RF-7800W-OU47x/-OU50x Multimission HCLOS CLI Supplement
10515-0426-4030	RF-7800W-OU47x/-OU50x Multimission HCLOS System Messages Supplement
10515-0426-4040	RF-7800W-OU47x/-OU50x Multimission HCLOS SNMP Supplement
10515-0426-4050	RF-7800W-OU47x/-OU50x Multimission HCLOS RF-7800W-OU44x Interoperability Supplement

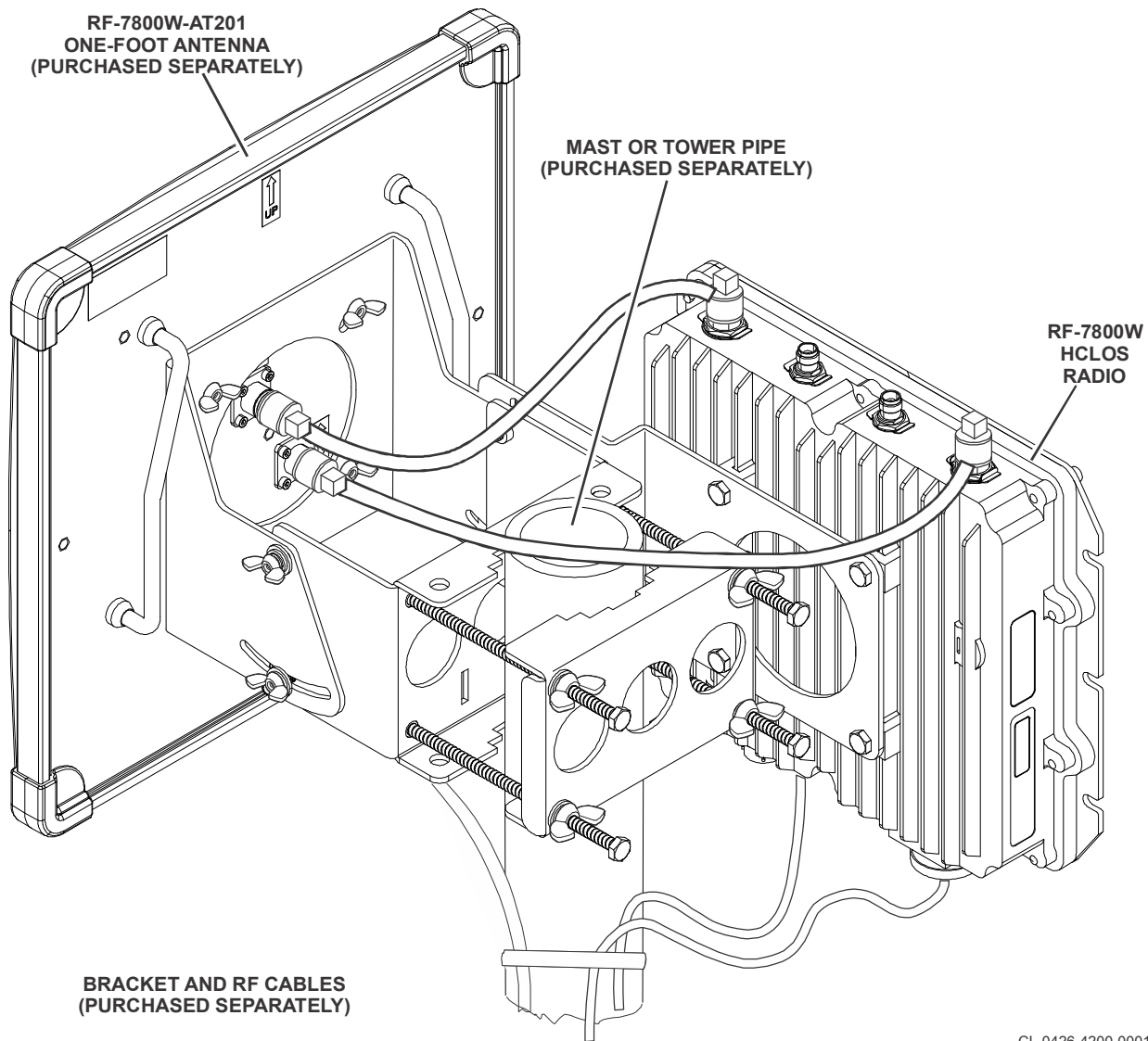
1.3 SYSTEM DESCRIPTION

The RF-7800W HCLOS broadband Ethernet radio is designed to be used in multiple mission configurations to provide a seamless extension of Layer 2 Ethernet Local Area Networks (LANs) and Wide Area Networks (WANs). The RF-7800W-OU47x and RF-7800W-OU50x models provide high data rates by way of Multiple-Input, Multiple-Output (MIMO) technology. Each wireless network consists of two or more RF-7800W systems configured either for Simple Point-to-Point (SPTP) or Simple Point-to-MultiPoint (SPMP) operation. One radio in each wireless network operates as a Sector Controller (SC) while the others operate as Subscriber Stations (SS).

The RF-7800W-OU47x and RF-7800W-OU50x model radios are designed to provide robust, long-range backbone connectivity. The frequency range for the RF-7800W-OU47x is 4.4 to 5.0 GHz and the frequency range for the RF-7800W-OU50x is 4.4 to 5.875 GHz. The radio models support four channel bandwidths (5, 10, 20, 40 MHz) in both SPTP and SPMP modes of operation with operating frequency selection in increments of 0.5 MHz. The radios feature easy-to-use management interfaces, an internal Global Positioning System (GPS) module, and a management-only port. The GPS module provides the radio location and very accurate time synchronization. The management port can be used to ensure isolation of user and management traffic when external Inline Network Encryption (INE) devices are in use.

The RF-7800W-OU47x/-OU50x radio is FIPS 140-2 level 2 certified. Refer to RF-7800W-OU47X/-OU50X Security Operation Supplement (10515-0426-4000) for more information.

The RF-7800W-OU47x and RF-7800W-OU50x radios can be installed with various antennas. [Figure 1-1](#) shows a typical installation of the radio with the RF-7800W-AT201 One Foot MIMO Panel Antenna.



CL-0426-4200-0001

Figure 1-1. RF-7800W HCLOS Radio Installed With One-Foot Panel MIMO Antenna

1.3.1 Ancillary Kit

The RF-7800W HCLOS Radio is supplied with an Ancillary Kit (12069-3030-01). Refer to [Table 1-2](#).

Table 1-2. RF-7800W HCLOS Radio Ancillary Kit (12069-3030-01)

Item Name	Part Number	Quantity
Kit, Midspan Injector, Gigabit, PoE, All Regions	12069-3800-01	1
Bracket Assembly, Mounting, Radio Antenna	12069-3810-01	1
RF Coaxial Cable	12069-3940-A20	2

Table 1-2. RF-7800W HCLOS Radio Ancillary Kit (12069-3030-01) (Continued)

Item Name	Part Number	Quantity
User Documentation CD-ROM	10515-0426-6000	1
Operator Card	10515-0426-4100	1

1.3.1.1 PoE Injector Kit

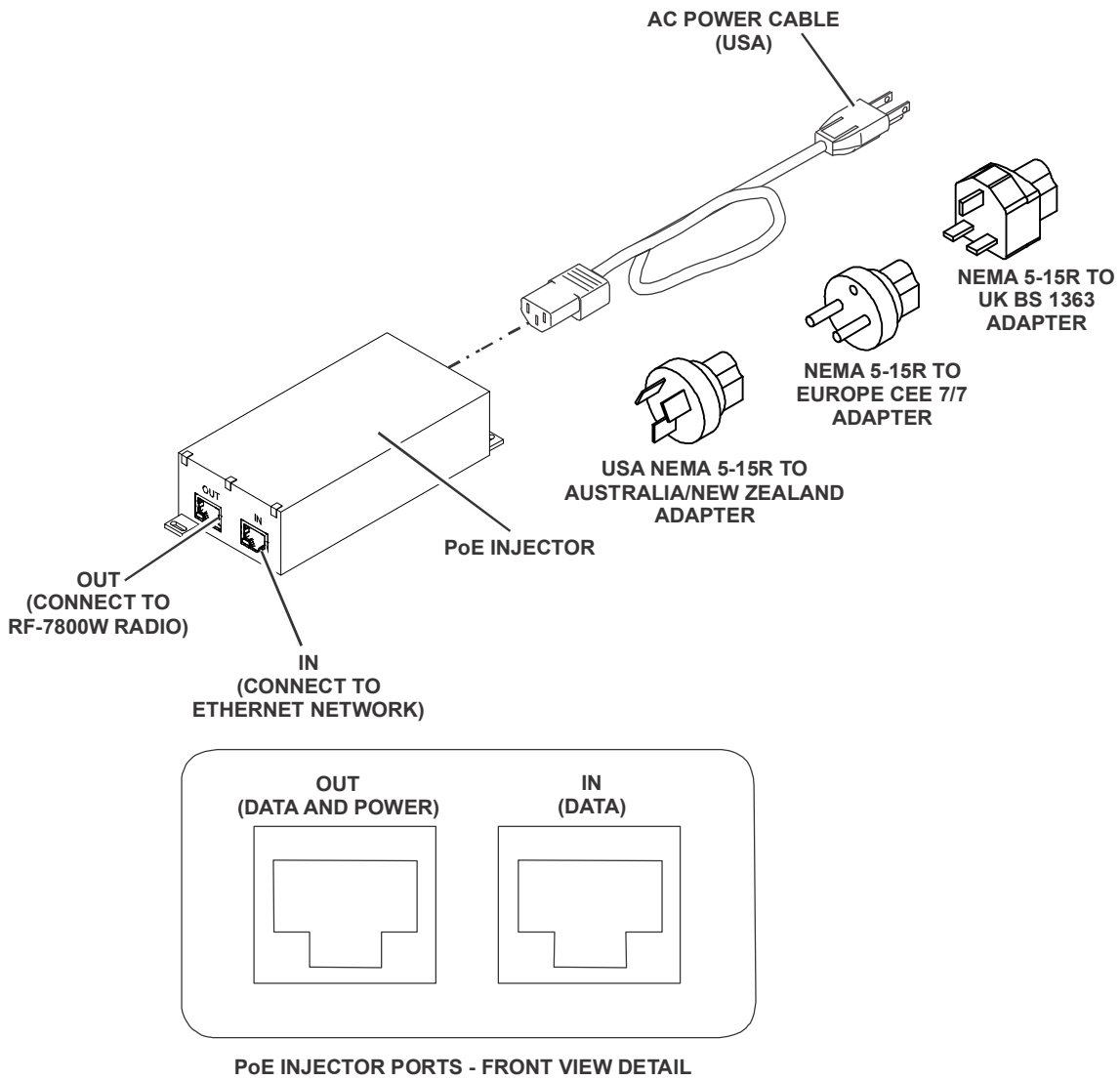
See [Figure 1-2](#). The indoor-mounted Power over Ethernet (PoE) Injector is an in-line power injector that provides operational power for the radio as well as connection to the network. AC power plug adapters are included for USA National Electric Manufacturers Association (NEMA) 5-15R to Australia/New Zealand, UK, and Europe. [Figure 2-3](#) shows the PoE Injector connector interface.

1.3.1.2 Mast Mount Bracket

A bracket assembly (12069-3810-01) can be used to mount the radio antenna to an existing mast or tower up to 4 inches (10.16 cm) in diameter.

1.3.1.3 RF Coaxial Cables

Two (2) 20-inch (51 cm) RF coaxial cables (12069-3940-A20) can be used to connect the radio and antenna.



CL-0426-4200-0019

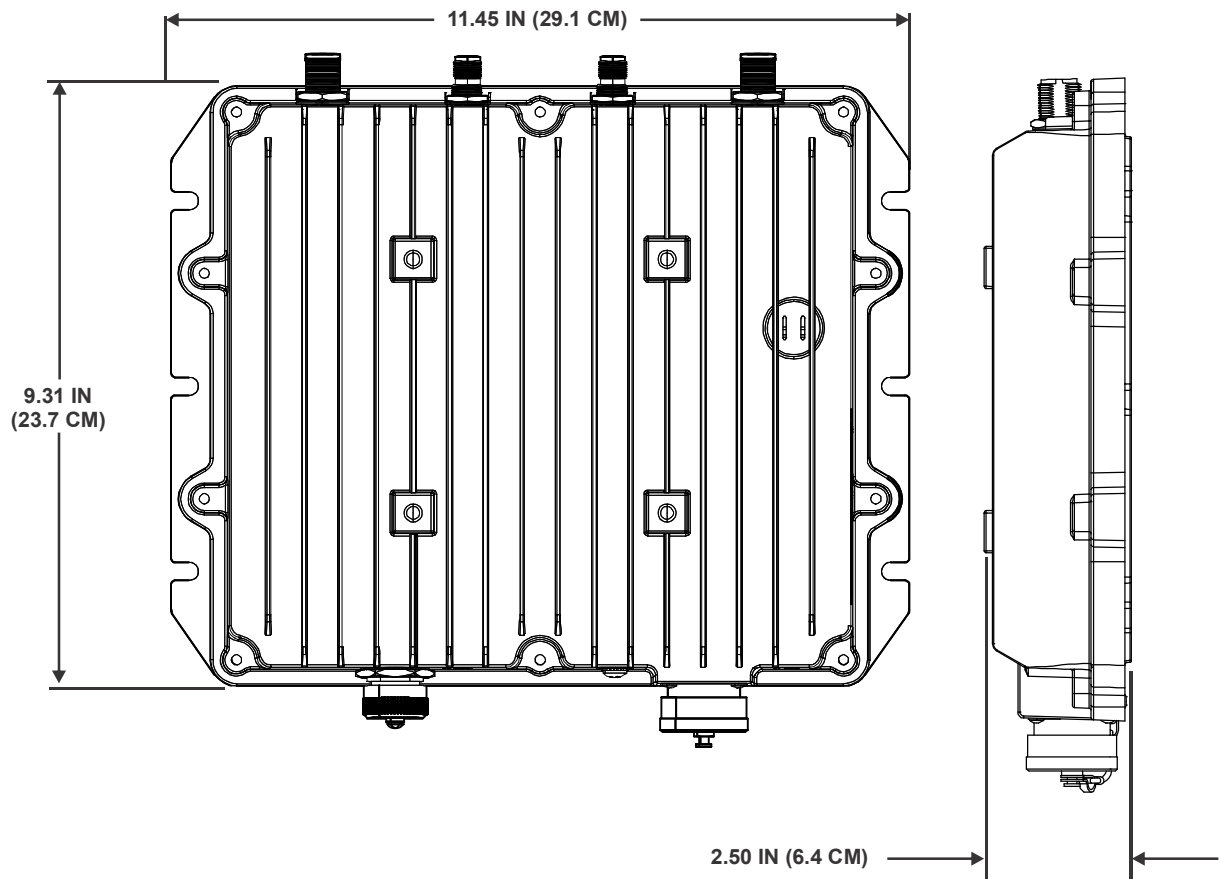
Figure 1-2. PoE Injector Kit - All Regions

1.4 EQUIPMENT DESCRIPTION

The radio is housed in a weatherproof aluminum alloy case and is mounted outdoors to the included mast mount bracket. The main unit contains all of the RF and digital electronics. Power delivery is accomplished via an IEEE 802.3at PoE standard power injector.

1.4.1 Radio Dimension and Weight Information

Figure 1-3 shows the dimensions of the RF-7800W HCLOS Radio. Refer to Table 1-3 for the dimensions and weights.

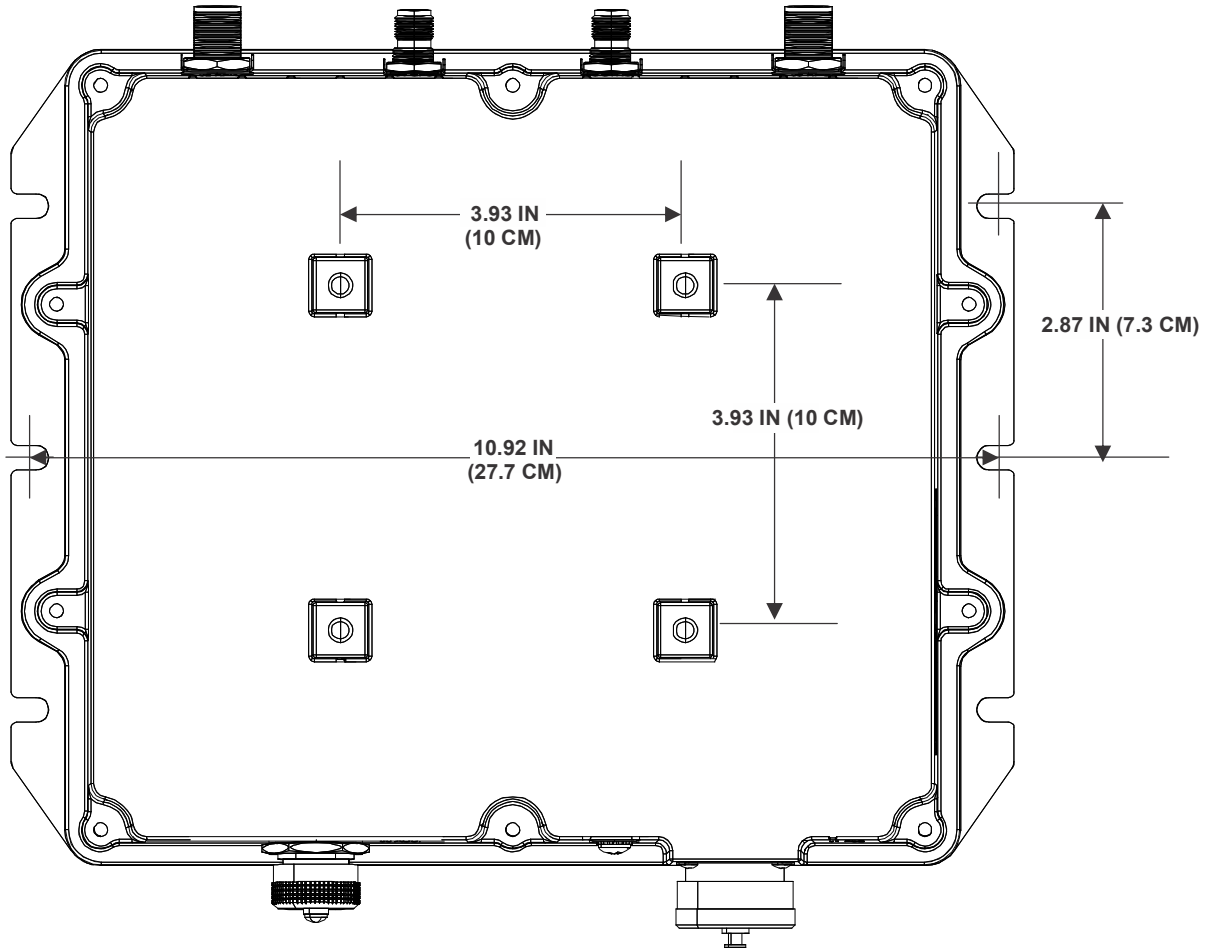


CL-0426-4200-0002

Figure 1-3. RF-7800W HCLOS Radio Dimensions

1.4.2 Radio Mounting Hole Pattern

Figure 1-4 shows the RF-7800W HCLOS radio mounting hole pattern.



CL-0426-4200-0025

Figure 1-4. RF-7800W HCLOS Radio Mounting Hole Pattern

1.5 SPECIFICATIONS

Table 1-3 provides specifications for the RF-7800W HCLOS Radio.

Table 1-3. RF-7800W HCLOS Radio Specifications

Function	Specification
GENERAL	
Frequency Range	RF-7800W-OU47x: 4.4 to 5.0 GHz RF-7800W-OU50x: 4.4 to 5.875 GHz
Power Requirements	IEEE 802.3at Compliant PSE, 30W Maximum
WIRELESS	
Wireless Transmission	Time Division Duplexing (TDD) Orthogonal Frequency Division Multiplexing (OFDM), 2x2 MIMO Capable, Space-Time Coding (STC), Spatial Multiplexing (SMX)
Uncoded Data Rate	Up to 476 Mbps
Channel Size	5 MHz, 10 MHz, 20 MHz, 40 MHz
Channel Spacing	Step Size is every 0.5 MHz
Receive Sensitivity	-98 dBm best
Transmit Power	18 dBm (4.4-4.7 GHz), 20 dBm (4.7-4.9 GHz), 22 dBm (4.9-5.875 GHz) Max per port
Modulation	Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK), 16 Quadrature Amplitude Modulation (QAM), 64 QAM, 256 QAM
NETWORK	
Network Connection	10/100/1000 BASE-T Ethernet
Management	HTTP, HTTPS, Telnet, Secure Shell (SSH), SNMP v2c/v3
Quality of Service (QoS)	802.1p with 4 Priority Queues; strict priority queuing with tail drop
Virtual Local Area Network (VLAN)	802.1Q Management Tagging
SECURITY	
Encryption	128 and 256-bit AES
Interference Control	Enhanced Interference Mitigation (EIM), Adaptive Modulation, Automatic Transmit Power Control (ATPC), Dynamic Frequency Selection (DFS)
MECHANICAL	
Dimensions	11.45 W x 9.31 H x 2.50 D in (29.1 W x 23.7 H x 6.4 D cm)
Weight	Less than 5.5 lbs (2.5 kg)

1.6 FCC NOTICES (FOR DEPLOYMENTS WITHIN THE USA)

a. Installation

The RF-7800W-OU47x and RF-7800W-OU50x must be installed by a qualified professional installer who is knowledgeable of and follows local and national codes for electrical grounding and safety, and is knowledgeable of and follows the local and regional regulatory RF requirements.

b. RF Exposure Warnings

To satisfy FCC RF exposure requirements for RF transmitting devices, the following distances should be maintained between the antenna and persons during device operation.

Notice - FCC Recommended Safe Separation Distances (RF)

Frequency (GHz)	Separation Distance
4.94 - 4.99	170 cm (66.93 in)
5.150 - 5.250	40 cm (15.75 in)
5.250 - 5.350	20 cm (7.87 in)
5.470 - 5.725	20 cm (7.87 in)
5.725 - 5.850	170 cm (66.93 in)

To ensure compliance, operation at closer than these distances is not recommended. The antenna used for this transmitter must not be collocated in conjunction with any other antenna or transmitter.

c. FCC Information to Users (Part 15.105):

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. The limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

d. FCC Information to Users (Part 15.21):

Changes or modifications not expressly approved by Harris Corporation could void the user's authority to operate the equipment.

e. Frequency Band Considerations

Although the radio supports a wide range of frequencies, only a subset of bands within this range have been FCC certified. In order to comply with applicable regulations, the radio must maintain specific configurations.

f. 5.150-5.250 GHz band (U-NII-1: Part 15.401-Part 15.407)

- In order to ensure that the radio remains on designated center frequencies, e.g. due to EIM-induced frequency change, Frequency Ranges must be defined. Refer to [Paragraph 3.8.4.4](#). Refer to [Table 1-4, FCC 5.150-5.250 GHz Band RF Frequencies](#) for Frequency Ranges.

- The Tx Power must be reduced in order to achieve Equivalent Isotropically Radiated Power (EIRP) limits. Refer to [Paragraph 6.4](#).

Table 1-4. FCC 5.150-5.250 GHz Band RF Frequencies

Channel Width (MHz)	RF Frequency (MHz)		Frequency Range (MHz)	
	Min	Max	Begin	End
5	5170	5242.5	5167.5	5245
10	5170	5240.5	5165	5245.5
20	5170	5235.5	5160	5245.5
40	5170	5230	5150	5250

g. 5.250-5.350 GHz band (U-NII-2A: Part 15.401-Part 15.407)

- Use of Dynamic Frequency Selection (DFS) is required. Refer to [Paragraph 3.8.9.1](#).
- In order to ensure that the radio remains on designated frequencies, e.g. due to a DFS-induced frequency change, Frequency Ranges must be defined. Refer to [Paragraph 3.8.4.4](#). Refer to [Table 1-5, FCC 5.250-5.350 GHz Band RF Frequencies](#) for example Frequency Ranges.
- The Tx Power must be reduced in order to achieve Equivalent Isotropically Radiated Power (EIRP) limits. Refer to [Paragraph 6.4](#).

Table 1-5. FCC 5.250-5.350 GHz Band RF Frequencies

Channel Width (MHz)	RF Frequency (MHz)		Frequency Range (MHz)	
	Min	Max	Begin	End
5	5252.5	5330	5250	5332.5
10	5255	5330	5250	5335
20	5260	5330	5250	5340
40	5270	5328	5250	5348

h. 5.470-5.725 GHz band (U-NII-2C: Part 15.401-Part 15.407)

- Use of Dynamic Frequency Selection (DFS) is required. Refer to [Paragraph 3.8.9.1](#).
- In order to ensure that the radio remains on designated frequencies, e.g. due to a DFS-induced frequency change, Frequency Ranges must be defined. Refer to [Paragraph 3.8.4.4](#). Refer to [Table 1-6, FCC 5.470-5.725 GHz Band RF Frequencies](#) for example Frequency Ranges.
- The Tx Power must be reduced in order to achieve Equivalent Isotropically Radiated Power (EIRP) limits. Refer to [Paragraph 6.4](#).

Table 1-6. FCC 5.470-5.725 GHz Band RF Frequencies

Channel Width (MHz)	RF Frequency (MHz)		Frequency Range (MHz)	
	Min	Max	Begin	End
5	5490	5700	5487.5	5702.5
10	5490	5700	5485	5705

Table 1-6. FCC 5.470-5.725 GHz Band RF Frequencies (Continued)

20	5490	5700	5480	5710
40	5492	5700	5472	5720

i. 5.725-5.850 band (U-NII 3: Part 15.401-Part 15.407)

- In order to ensure that the radio remains on designated center frequencies, e.g. due to EIM-induced frequency change, Frequency Ranges must be defined. Refer to [Paragraph 3.8.4.4](#). Refer to [Table 1-7, FCC 5.725-5.850 GHz Band RF Frequencies](#) for Frequency Ranges.
- The Tx Power must be reduced in order to achieve Equivalent Isotropically Radiated Power (EIRP) limits. Refer to [Paragraph 6.4](#).

Table 1-7. FCC 5.725-5.850 GHz Band RF Frequencies

Channel Width (MHz)	RF Frequency (MHz)		Frequency Range (MHz)	
	Min	Max	Begin	End
5	5727.5	5847.5	5725	5850
10	5730	5845	5725	5850
20	5735	5840	5725	5850
40	5740	5830	5725	5850

j. 4.940-4.990 GHz band (Part 90.1201-90.1217)

- Only 5 MHz, 10 MHz, and 20 MHz Channel Widths are allowed. Refer to [Paragraph 3.8.5](#).
- Specific RF center frequencies must be used. Refer to [Paragraph 3.8.4.1](#). Refer to [Table 1-8, FCC 4.940-4.990 GHz Band RF Frequencies - 5 MHz Channel Width](#), [Table 1-9, FCC 4.940-4.990 GHz Band RF Frequencies - 10 MHz Channel Width](#), and [Table 1-10, to FCC 4.940-4.990 GHz Band RF Frequencies - 20 MHz Channel Width](#).
- In order to ensure that the radio remains on designated center frequencies, e.g. due to EIM-induced frequency change, Frequency Ranges must be defined. Refer to [Paragraph 3.8.4.4](#). Refer to [Table 1-8, FCC 4.940-4.990 GHz Band RF Frequencies - 5 MHz Channel Width](#), [Table 1-9, FCC 4.940-4.990 GHz Band RF Frequencies - 10 MHz Channel Width](#), and [Table 1-10, to FCC 4.940-4.990 GHz Band RF Frequencies - 20 MHz Channel Width](#) for Frequency Ranges.
- The Tx Power must be reduced in order to achieve Equivalent Isotropically Radiated Power (EIRP) limits. Refer to [Paragraph 6.4](#).

Table 1-8. FCC 4.940-4.990 GHz Band RF Frequencies - 5 MHz Channel Width

RF Frequency (MHz)	Frequency Range (MHz)	
	Begin	End
4942.5	4940	4945
4947.5	4945	4950
4952.5	4950	4955
4957.5	4955	4960
4962.5	4960	4965

Table 1-8. FCC 4.940-4.990 GHz Band RF Frequencies - 5 MHz Channel Width (Continued)

4967.5	4965	4970
4972.5	4970	4975
4977.5	4975	4980
4982.5	4980	4985
4987.5	4985	4990

Table 1-9. FCC 4.940-4.990 GHz Band RF Frequencies - 10 MHz Channel Width

RF Frequency (MHz)	Frequency Range (MHz)	
	Begin	End
4945	4940	4950
4950	4945	4955
4955	4950	4960
4960	4955	4965
4965	4960	4970
4970	4965	4975
4975	4970	4980
4980	4975	4985
4985	4980	4990

Table 1-10. FCC 4.940-4.990 GHz Band RF Frequencies - 20 MHz Channel Width

RF Frequency (MHz)	Frequency Range (MHz)	
	Begin	End
4950	4940	4960
4955	4945	4965
4960	4950	4970
4965	4955	4975
4970	4960	4980
4975	4965	4985
4980	4970	4990

1.7 ETSI NOTICES (FOR DEPLOYMENTS WITHIN EUROPE)

a. Frequency Band Considerations

Although the radio supports a wide range frequencies, only a subset of bands within this range have been CE certified. In order to comply with applicable regulations, the radios must maintain specific configurations.

b. 5.725-5.875 GHz band (ETSI EN 302 502)

- Use of Dynamic Frequency Selection (DFS) is required. Refer to [Paragraph 3.8.9.1](#).
- Only 10 MHz and 20 MHz Channel Widths are allowed. Refer to [Paragraph 3.8.5](#).
- Specific RF center frequencies must be used. Refer to [Paragraph 3.8.4.1](#). Refer to [Table 1-11](#) and [Table 1-12](#) for example non-overlapping RF Frequencies. The nominal center frequencies are defined as follows:
 - (a.) 10 MHz: $5725+(n*2.5)$ MHz [where $n = 2$ to 58]
 - (b.) 20 MHz: $5725+(n*2.5)$ MHz [where $n = 4$ to 56]
- In order to ensure that the radio remains on designated center frequencies, e.g. due to a DFS-induced frequency change, Frequency Ranges must be defined. Refer to [Paragraph 3.8.4.4](#). Refer to [Table 1-11](#) and [Table 1-12](#) for example non-overlapping Frequency Ranges.
- The Tx Power must be reduced in order to achieve Equivalent Isotropically Radiated Power (EIRP) limits. Refer to [Paragraph 6.4](#).

Table 1-11. Example RF Frequencies - 10 MHz Channel Width

RF Frequency (MHz)	Frequency Range (MHz)	
	Begin	End
5730	5725	5735
5740	5735	5745
5750	5745	5755
5760	5755	5765
5770	5765	5775
5780	5775	5785
5790	5785	5795
5800	5795	5805
5810	5805	5815
5820	5815	5825
5830	5825	5835
5840	5835	5845
5850	5845	5855
5860	5855	5865
5870	5865	5875

Table 1-12. Example RF Frequencies - 20 MHz Channel Width

RF Frequency (MHz)	Frequency Range (MHz)	
	Begin	End
5735	5725	5745
5755	5745	5765
5775	5765	5785
5795	5785	5805
5815	5805	5825
5835	5825	5845
5855	5845	5865

c. RF Exposure Warnings

To satisfy ETSI RF exposure requires for RF transmitting devices, the following distances should be maintained between the antenna and persons during device operation.

Table 1-13. Notice - ETSI Recommended Safe Separation Distance (RF)

Frequency (GHz)	Separation Distance
5.725 - 5.875	20 cm

d. EU Declaration of Conformity

A full copy of the Declaration of Conformity can be found in [Appendix B](#).

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CHAPTER 2

SYSTEM INSTALLATION

2.1 INTRODUCTION

Consider the following before installing a RF-7800W High Capacity Line of Sight (HCLOS) Radio system:

- Environmental and Line of Sight concerns
- Link Availability
- System Configuration
- Co-location

2.1.1 Environmental and Line of Sight Concerns

The RF-7800W is a microwave radio, which demands better Line of Sight (LOS) conditions than other radios that operate with a lower frequency. Optical Line of Sight (OLOS) alone may not be adequate enough to maintain a healthy link between radios. The radio operates at a lower power than other Harris radios, but high-gain antennas give it the ability to link over many tens of kilometers in some situations. At these distances, weather and the curvature of the Earth can become major factors affecting link quality. A thorough propagation study and analysis using industry standard ITU recommended guidelines should be performed before deploying radios in an unknown or unfamiliar location.

2.1.2 Link Availability

Harris provides a free tool to users that wish to perform a simple evaluation of a single RF-7800W radio link under ideal environmental and terrain conditions. The Link Budget Tool (included with CD-ROM) provides a rudimentary calculation of annual Link Availability (Uptime) and can help users choose the right antenna for their specific installation.

2.1.3 System Configuration

There are two configuration types:

- Simple Point to Point (SPTP) - Two RF-7800W radios are used, one as a Sector Controller (SC) and one as a Subscriber Station (SS).
- Simple Point to Multipoint (SPMP) - Two or more RF-7800W radios are used, one as a Sector Controller (SC) and the rest as Subscriber Stations (SS).

NOTE

Previous generations of the RF-7800W radio used the terms Master/Slave instead of SC/SS.

Some RF-7800W link configuration and statistics are split into downlink and uplink. The downlink direction always refers to data or signals transmitted away from the SC toward an SS. The uplink direction always refers to data or signals transmitted by the SS toward the SC.

2.1.4 Co-location

Radio co-location on a single mast or tower system is sometimes unavoidable. A number of strategies can be employed to reduce the possibility of interference between radios. Higher gain antennas typically have a narrower beamwidth, which can help increase the signal to noise ratio (SNR) if they are not pointed in the same direction. If possible, co-located radios should use operating frequencies that are at least one full channel width away from each other.

2.2 INSTALLATION REQUIREMENTS

Refer to [Table 2-1](#). In preparation for installing a RF-7800W HCLOS Radio system, the following items that are not included are required.

Table 2-1. Tools and Materials

Item	Description
1	7/16" Open or Close Ended Wrench
2	7/16" Socket Wrench
3	#2 Drive Phillips-tip Screwdriver
4	Cable Ties, Zip Ties, or Tie-Wraps
5	Silicone Grease (Dow Corning DC-5 or similar corrosion preventative compound)
6	Electrical Tape (3M Scotch Super 33+ or similar)
7	Polyurethane Sealant (Vulkem 116, Sikaflex 201, or similar)
8	Ground Wire - 10 AWG min, with a 10/32" (M5) ring terminal

These items are also not included, but are needed in order to maximize equipment performance:

- Outdoor rated, shielded Category 5e (or higher) Ethernet cable with shielded RJ-45 connectors. Amphenol RJF6B backshells (key code 'A') should be added to any cables used to protect the radio's internal from moisture. (Harris PN 12069-0030-Axxx and 12069-0031-Axxx)
- Dual-linear (V/H) polarized antennas in order to operate at full throughput capacity. (Harris PN RF-7800W-AT2XX)

The installation site should be free from major twist or sway under wind loading. A higher mounting location will help guarantee better Line of Sight (LOS) conditions, but can increase the risk of damage due to lightning. The mounting location should also provide a clear view of the sky for GPS, if required.

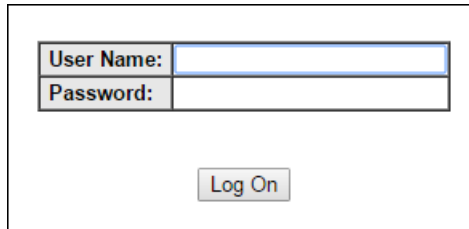
2.3 PRE-INSTALLATION CONFIGURATION

Time can be saved and hassle avoided by configuring all of the RF-7800W radios before they are permanently installed. Two Ethernet cables and a computer with an Ethernet port are required for this step.

2.3.1 Connecting to a Radio

- Connect an Ethernet cable between the J1 PoE port in the radio and the OUT port on the PoE injector, allowing up to three (3) minutes for the radio to boot.

- b. Connect an Ethernet cable between the IN port on the PoE injector and computer.
- c. Configure the computer's IP address so that it is different than the radio's default IP address (192.168.26.2), but also on the same subnet (255.255.255.0). The address should be in the range 192.168.26.1 - 192.168.26.254.
- d. Open a web browser to the radio's address and log in using the default credentials (admin/admin). See [Figure 2-1](#).



User Name:	<input type="text"/>
Password:	<input type="password"/>

Figure 2-1. Log In

2.3.2 Configure the Subscriber Stations

- a. Select System Configuration, change the IP Address from the default to a unique value, and select Apply & Save All. This ensures that each radio can be properly accessed once wireless Links establish. See [Figure 3-4](#).
- b. Reconfigure the computer's IP Address if necessary (e.g. if the radio IP Address was set outside of the range 192.168.26.1-192.168.26.254).
- c. Open a web browser to the radio's new address and log in.
- d. Select Wireless Configuration, configure the Frequency and Channel Size based on frequency availability, and select Apply & Save All. These settings must be the same for all radios that are to be linked. See [Figure 3-16](#).
- e. Change the Tx Power, if necessary, and select Apply & Save All.
- f. Perform the System and Wireless Configuration for all other SS radios, recording each radio's MAC address if using Normal Links as they will be needed when configuring the SC radio. Otherwise, ensure that the STID and STID Password match those of the SC radio if using Link templates.

NOTE

STID Password defaults to “default”.

2.3.3 Configure the Sector Controller

- a. Select System Configuration, change the IP Address from the default to a unique value, and select Apply & Save All. This ensures that each radio can be properly accessed once wireless Links establish. See [Figure 3-4](#).
- b. Reconfigure the computer's IP Address if necessary (e.g. if the radio IP Address was set outside of the range 192.168.26.1-192.168.26.254).
- c. Open a web browser to the radio's new address and log in.
- d. Select Wireless Configuration and change the System Mode to SPMP SC. See [Figure 3-14](#).

- e. Configure the Frequency and Channel Size based on frequency availability, and select Apply & Save All. These settings must be the same for all radios that are to be linked.
- f. Change the Tx Power, if necessary, and select Apply & Define Link. This navigates to the Subscriber Link Configuration screen. See [Figure 3-19](#).
- g. In the Subscriber Link Configuration screen, enter a name for the Link, as well as the unique MAC address of the SS radio if using Normal Links. Otherwise, ensure that the STID and STID Password match those on the SS radio if using Link Templates. Then select Apply.
- h. Perform the Link Configuration for any other subscriber Links, if using Normal Links or multiple Link Templates. In the navigation menu go to Configuration > Subscriber Links, click the Add Link button, then repeat [Step g](#).
- i. Select Save All in the Dashboard once all Links have been added.

2.4 INSTALLATION

2.4.1 Hardware Installation

- a. Mounting the Radio

A radio ancillary kit is available with a bracket that is designed to mount the radio and an antenna to a vertical pipe or mast with a diameter of 1.5 to 4.0 inches. The radio can be mounted on either side of the bracket but should be installed with the Ethernet port facing the ground (see [Figure 2-2](#)). 7/16" tools (Items 1 & 2) are needed to assemble the bracket and install the radio. If using an RF-7800W-PA50x, refer to the RF-7800W-PA50x Op Card (10515-6835) for additional information.

- b. Mounting the Antenna

Most of the antennas designed for use with the radio will mount to the front portion of the mounting bracket. Support for other mounting styles like a vertical whip antenna can be achieved by swapping out the front bracket with another design. The antenna bracket that comes in the ancillary kit is designed to tilt the antenna through 45° of elevation about the horizon.

- c. Lightning Protection (recommended)

Cables running down from equipment that is mounted on a roof, tower, or portable mast system provide a path for lightning to surge into other equipment on the premise. A properly grounded lightning protector installed at the bottom of the mast or at the entrance to a building can protect both personnel and other equipment from damage due to lightning.

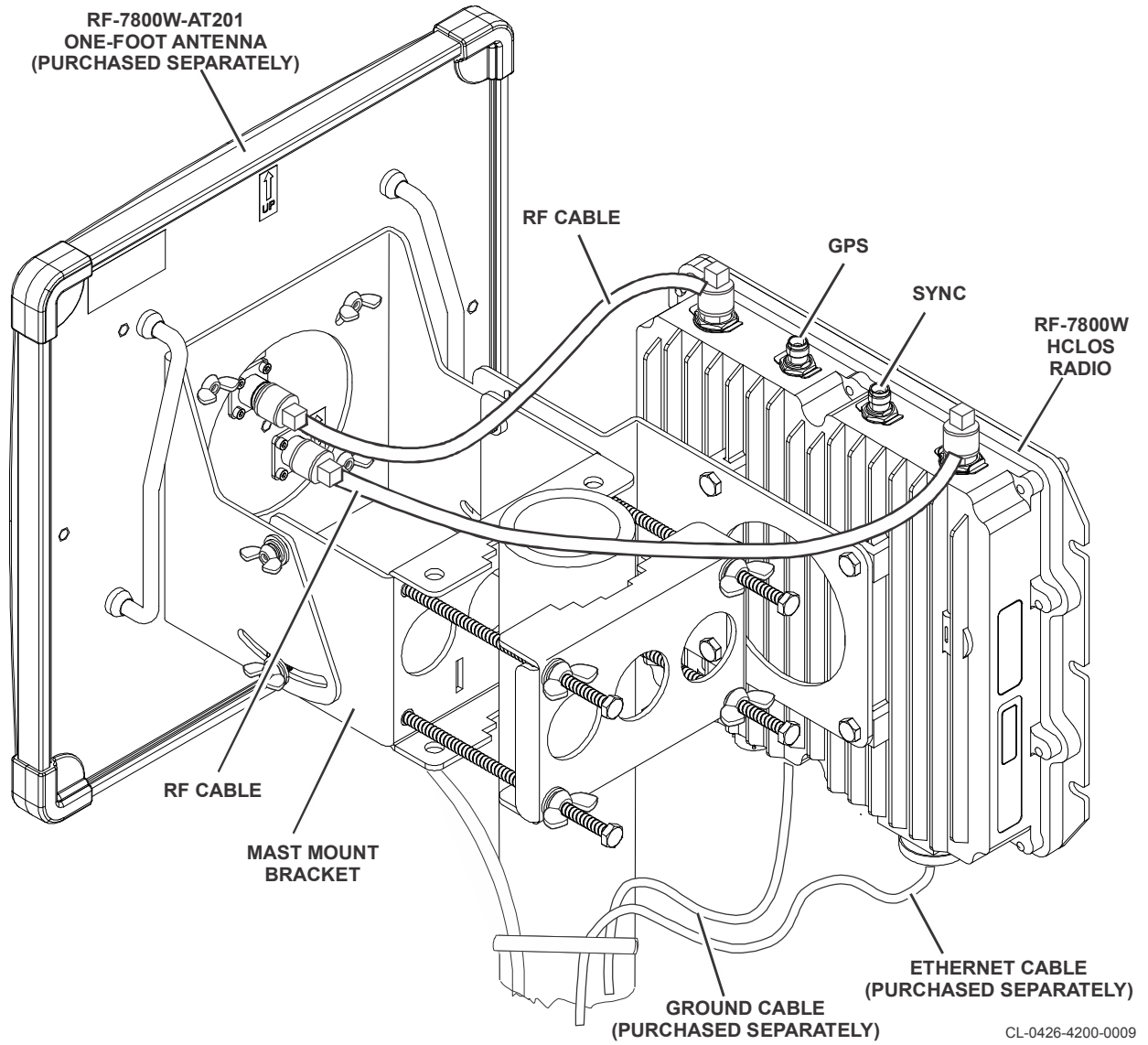


Figure 2-2. Radio and Antenna Mounting

2.4.2 Connecting Cables

a. Grounding (recommended)

Connect the ring terminal of a grounding wire (Item 8) to the radio's ground terminal (see [Figure 2-3](#)) using a #2 Phillips driver (Item 3). Connect the other end to a single, central grounding point. Avoid sharp bends in the wire. Apply silicone grease (Item 5) to ground connection points to maximize corrosion protection.



Inadequate grounding presents a personnel hazard that could damage the equipment or result in serious injury or death.

b. RF Cables

The radio's ancillary kit comes with two RF cables. Under most circumstances (using dual-linear polarized antennas), it does not matter which radio RF port (see [Figure 2-4](#)) is connected to which antenna RF port. For troubleshooting purposes, it can be helpful to be consistent by connecting RF-1 to the Vertical port and RF-2 to the Horizontal port.

c. Ethernet Cable

Connect the weather-protected end of an Ethernet cable to the J1 PoE port on the radio. Provide proper strain relief for the cable with a zip tie (Item 4), providing a drip loop. Connect the other end of this cable to either a lightning protector, or to the OUT port of the PoE injector provided in the ancillary kit. Connect the IN port of the PoE injector to the network, then plug the power cord into a power source.

d. Weather Resistance

Wrap any exposed RF and Ethernet cable connectors with several layers of weather resistant electrical tape (Item 6). Wrap the tape as close as possible to the radio chassis and far enough up the cable to prevent moisture from contacting any part of the connector. If desired, wrap vapor seal compound (Item 7) around the electrical tape around the connectors. This will provide additional water resistance in harsh environments.

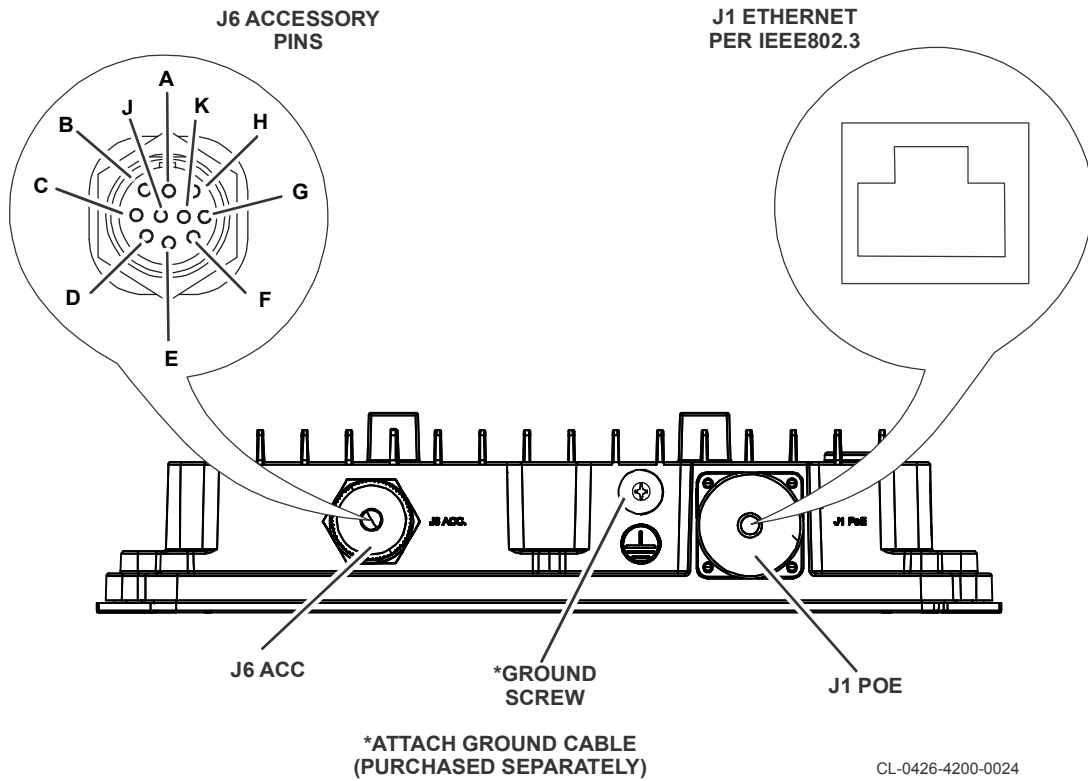
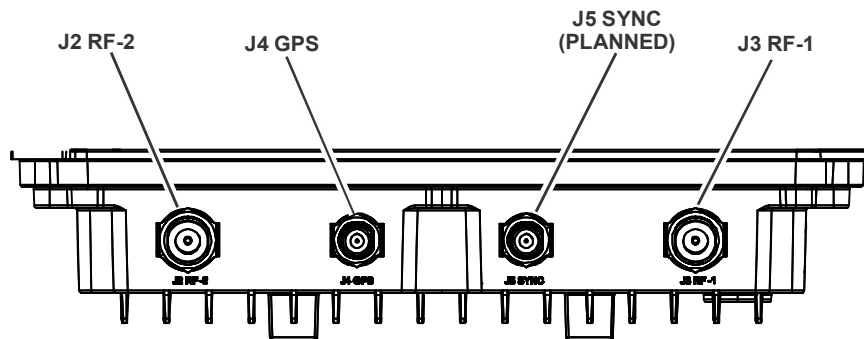


Figure 2-3. RF-7800W HCLOS Radio Bottom Ports



CL-0426-4200-0023

Figure 2-4. RF-7800W HCLOS Radio Top Ports

2.4.3 Alignment

a. Determining RSSI

Using the audio buzzer works best when the installer is in close proximity to the radio. The buzzer can be controlled by logging into the radio and navigating to Wireless > Antenna Alignment Buzzer Enable. It will buzz fast for higher RSSI levels and slow for lower RSSI levels.

Using the radio GUI works best when the installer is too far away to hear the audio buzzer. Launch a web browser from a computer that is connected to the same network as the radio. Log into the radio and either click on Subscriber Links (SPMP SC) or Antenna Alignment (SPMP SS, SPTP SC, SPTP SS). See [Figure 2-5](#).

b. Establish a Preliminary Link

Loosen the long bolts on the mounting bracket to adjust the antenna's azimuth to within a few degrees of line of sight. Tighten the bolts back up when finished.

Loosen the bolts on the mounting bracket's sides to adjust the antenna's elevation. If the linked radio is more than 22.5° above or below the horizon, additional hardware may be required to properly aim the antenna. Tighten the bolts back up when finished.

c. Tips for Fine Tuning the Link

- Use a pair of installers that are able to communicate with each other.
- Align one end at a time, starting with the Sector Controller (SC).
- Monitor changes to one site at the other, i.e. look for the best signal at the SC from the SS radio and vice-versa.
- Do not make simultaneous adjustments to the azimuth and elevation.
- Incrementally adjust the azimuth until the best RSSI is found, then adjust the elevation.
- If propagation conditions and antenna alignments are good, both RF ports of a given radio should be within 3 dB of each other.
- When alignment is complete, lock down all brackets using a wrench.

RSSI 1:	-80
RSSI 2:	-80
SNR 1:	8
SNR 2:	8

Figure 2-5. Antenna Alignment

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CHAPTER 3**SYSTEM ADMINISTRATION AND CONFIGURATION****3.1 INTRODUCTION**

The scope of this chapter is to provide a logical grouping of system administration and configuration items relative to the following management interfaces; Graphical User Interface (GUI), Command Line Interface (CLI), and Simple Network Management Protocol (SNMP).

For each item, an interface indicator is shown that lets the user know that the item can be accessed through one or more of the three management interfaces (see below for an example).



Refer to the following sections:

- General Radio Configuration Information - [Paragraph 3.2](#)
- Navigating User Interfaces - [Paragraph 3.3](#)
- Basic Information - [Paragraph 3.4](#)
- Network Interface - [Paragraph 3.5](#)
- Management Interfaces - [Paragraph 3.6](#)
- Time and Location - [Paragraph 3.7](#)
- Wireless Interface - [Paragraph 3.8](#)
- Subscribers Links - [Paragraph 3.9](#)
- Maintenance - [Paragraph 3.10](#)

3.2 GENERAL RADIO CONFIGURATION INFORMATION

The radio has two data ports and two RF ports. RF ports are described in [Paragraph 3.8](#). The Console data port provides an interface to locally manage the radio's configuration, while remote management can be performed via the Ethernet data port.

Default values of IP management interfaces are shown in [Table 3-1](#).

Table 3-1. IP Management Interface Parameters

Parameter	Default Value
IP Address	192.168.26.2*
HTTP	Enabled
HTTPS	Enabled
Telnet	Enabled
SSH	Enabled
SNMP	None

* In addition to the default static IP Address, the radio uses ZeroConf technologies to automatically self-assign a second unique IP Address and a hostname and to advertise the presence of its management interfaces (HTTP and SSH). The ZeroConf services are intended solely to ease initial configuration and are disabled once an operator configures a new static IP Address.

The Console data port interface uses RS-422 with port settings as shown in [Table 3-2](#).

Table 3-2. Console Port Settings

Port Parameter	Value
Speed (baud rate)	115200
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	None

The factory default login credentials are shown in [Table 3-3](#). The “Admin” user group is meant to be used for changing the configuration of the radio. The “User” user group has access to less configuration permissions, but is simpler to use. The “Monitor” user group is meant to be used by machine interfaces that only need read access to small set of commands.

Table 3-3. Factory Default Login Credentials

User Name	Password	User Group
admin	admin	admin
user	user	user
monitor	monitor	monitor

Changes to the radio's configuration are not applied until an “apply” or “save” command is issued in any of the management interfaces. Even after applying the changes to the active configuration, the changes must be saved to the on-board memory by issuing a “save” command. If the configuration is applied but not saved, a power loss or an intentional reboot will cause any changes made since the last “save” to be lost.

3.3 NAVIGATING USER INTERFACES

3.3.1 Navigating the GUI

Most functionality of the radio can be configured or monitored through the GUI. The information dashboard (shown in Figure 3-1) can be found at the top of the page and provides important information about the radio's current status. Clicking different links in the navigation menu (shown in Figure 3-2) provides access to different detailed sections of the radio's configuration.



Figure 3-1. Dashboard

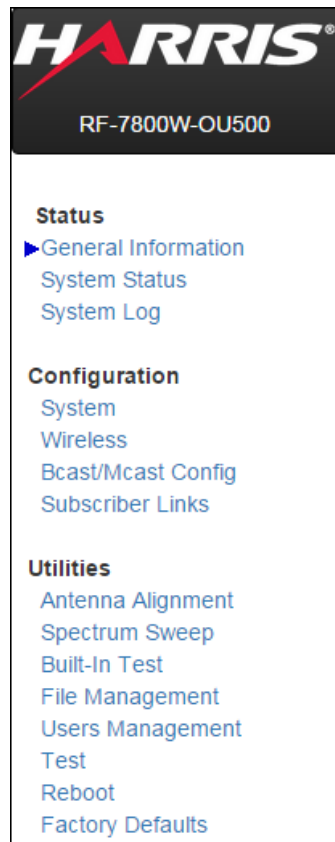


Figure 3-2. Navigation Menu (SPMP SC Configuration Shown)

3.3.2 Navigating the CLI

The CLI is designed for power users and machine interfaces. In order to assist a user with the command line, the syntax of a command can be displayed by entering a single question mark “?” after a command or at the prompt. Typing the “up arrow” scrolls through the most recently entered commands. The CLI also allows a user to auto-complete commands by pressing the “tab” key after typing the first few letters. Summaries of the radio's current configuration and statistics can be viewed using the “show” commands. Additional information pertaining to the CLI, including a comprehensive list of CLI commands, is available in the RF-7800W-OU47x/-OU50x CLI Supplement (10515-0426-4020).

3.3.3 Navigating SNMP

The radio implements SNMP for remote network management functionality. Many of the functions available in the GUI and/or the CLI are also available via SNMP. In the interest of security, functions related to encryption certificates, keys and secure management interfaces are not accessible via SNMP. The latest version of the radio's Management Information Base (MIB) part number (12069-8900) can be found on the Harris Premier site (<https://tcpremier.harris.com>). Additional information pertaining to SNMP, including a comprehensive list of MIB objects, is available in the RF-7800W-OU47x/-OU50x SNMP Supplement (10515-0426-4040).

3.4 BASIC INFORMATION

The subsections below describe radio system information and hardware details.

3.4.1 System Information



The System Name, Details, Location and Contact fields can be used to describe details about a particular radio's installation.

The unique Serial Number given to each radio is encoded on the 2D-UID label on the side of the radio chassis and available in software.

The Start-Up Time and Current Time are recovered via SNTP or GPS if either is available. Both times are adjusted from GMT by the Time Zone setting. See [Figure 3-3](#).

3.4.2 Hardware Details



The Radio Model and Radio Type fields describe details about the radio's hardware configuration. The radio includes a number of temperature sensors inside the chassis. The current internal temperature of the radio is available and displayed on the Dashboard.

General Information	
System	
System Name	SC
System Details	
System Location	
Contact	
System S/N	A00845
Radio Type	T502C
System Mode	SPMP SC
Software Version	5.00
Time Since System Start	51 min, 6 sec
Start Up Time	11/22/2016 20:41:36 (GMT +0:00)
Current Time	11/22/2016 21:32:42 (GMT +0:00)
Host	
Ethernet MAC Address	00:00:c3:9c:92:d3
IP Address	192.168.26.70
IP Subnet Mask	255.255.255.0
Default Gateway Address	192.168.26.1

Figure 3-3. General Information

3.5 NETWORK INTERFACE

The radio hosts a number of management interfaces that can be accessed via IP. This section describes the information and configuration options available for basic network configuration. See [Figure 3-4](#).

3.5.1 Ethernet Port



The subsections below describe Ethernet Port configuration parameters. All parameters for Ethernet Port can be accessed using GUI, CLI, and SNMP interfaces.

3.5.1.1 MAC Address

This is the unique Media Access Control (MAC) address of the Ethernet port. It is set by the factory and not user-configurable. This address may be required when setting up the wireless interface.

3.5.1.2 Port Mode

The Ethernet port can be configured to automatically detect the port settings based on the capabilities of the attached device, or fixed to a particular port speed and duplex setting. Note that the port speed and duplex settings must be compatible with the attached device, or communication could be disrupted.

3.5.1.3 Current Port Speed

When the radio is set to automatically detect the Ethernet port settings, this is the port speed and duplex setting that is detected and in use.

3.5.2 Statistics

The radio logs the number of Ethernet data packets that have been transmitted and received. The radio also provides the number of packets that are received with errors, which could indicate problems with the port speed or duplex settings.

3.5.2.1 Addressing



The subsections below describe Addressing configuration parameters. All parameters for Addressing can be accessed using GUI, CLI, and SNMP interfaces.

3.5.2.2 IP Address

This is the IP address of the radio's management interfaces. The factory default address is **192.168.26.2**.

3.5.2.3 Subnet Mask

This is the subnet mask of the radio's management interfaces. The factory default for this address is 255.255.255.0, which means that only devices with a 192.168.26.x IP address can access the radio.

3.5.2.4 Default Gateway

This is the default gateway of the radio's management interfaces. The factory default for this address is 192.168.26.1. If access to the radio's management interfaces is needed from multiple subnets, this address must be the IP address of a router that can forward traffic to and from those subnets.

System Configuration

System Identification

System Name	<input type="text" value="SC"/>
System Details	<input type="text"/>
System Location	<input type="text"/>
Contact	<input type="text"/>

Basic Host Configuration

IP Address	<input type="text" value="192.168.26.70"/>
IP Subnet Mask	<input type="text" value="255.255.255.0"/>
Default Gateway Address	<input type="text" value="192.168.26.1"/>

Advanced Host Configuration

Ethernet Mode	<input type="text" value="Auto"/>
SNTP Enable	<input checked="" type="checkbox"/>
SNTP Server IP Address	<input type="text" value="192.168.26.1"/>
SNTP Polling Interval [hours]	<input type="text" value="1"/>
Time Zone (GMT) [hh:mm]	<input type="text" value="+0:00"/>
SysLog Enable	<input checked="" type="checkbox"/>
SysLog Server IP Address	<input type="text" value="192.168.26.1"/>
HTTP Enable	<input checked="" type="checkbox"/>
HTTPS Enable	<input checked="" type="checkbox"/>
Telnet Enable	<input checked="" type="checkbox"/>
Telnet Port	<input type="text" value="23"/>
SSH Enable	<input checked="" type="checkbox"/>
User Authentication	<input type="text" value="Local Only"/> RADIUS Configuration
SNMP Enable	<input type="text" value="V2"/> SNMP Configuration
Management VLAN Tagging Enable	<input checked="" type="checkbox"/>
Management 802.1q VLAN ID [0...4095]	<input type="text" value="0"/>
GUI Timeout Enable	<input checked="" type="checkbox"/>
FIPS Mode Enable	<input type="checkbox"/>

Miscellaneous System Configuration

GPS Antenna Power Supply	<input checked="" type="checkbox"/>
GPS Coordinates Format	<input type="text" value="dd.ddddd"/>

Figure 3-4. System Configuration

3.6 MANAGEMENT INTERFACES

The radio can be managed over a number of IP-based interfaces. This section describes how to configure these different management interfaces. A standard web browser can be used to configure the radio over HTTP or HTTPS. See [Figure 3-4](#).

3.6.1 Graphical User Interface (GUI)

The subsections below describe GUI Management Interfaces configuration parameters.

3.6.1.1 HTTP



The HTTP service is turned on by default, but can be turned off in the interest of security. Google Chrome 45, Mozilla Firefox 38 and Microsoft Internet Explorer 11 are currently the only supported web browsers, but others might also be functional.

3.6.1.2 HTTPS



The HTTPS service can be turned on and off. A host X.509 certificate and private key pair are pre-installed, but can be overwritten with a user-generated certificate. A host X.509 certificate and private key pair must be loaded in order to use HTTPS in FIPS Mode. Refer to [Paragraph 3.10.2](#).

3.6.1.3 GUI Idle Timeout



The GUI can be set up to automatically log off after ten minutes of inactivity. After nine minutes of inactivity, a warning message is displayed to draw attention to a foreground tab, while the web browser Favicon is toggled between two states to draw attention to a background tab that is about to log off. See [Figure 3-5](#).



Figure 3-5. Favicon States

3.6.2 Command Line Interface (CLI)

The subsections below describe CLI Management Interfaces configuration parameters.

3.6.2.1 Telnet



The Telnet service is turned on by default, but can be turned off in the interest of security. The operating port can also be changed from the default port number 23.

3.6.2.2 SSH



The SSH service can be turned on and off. A host key is pre-installed, but can be overwritten with a user-generated host key. Refer to [Paragraph 3.10.2](#).

3.6.3 Local Users (Role-Based Authentication)



The subsections below describe Users Management Interfaces configuration parameters. All parameters for Users Management can only be accessed using GUI or CLI interfaces. See [Figure 3-6](#).

3.6.3.1 Viewing User Accounts

The list of accounts that are able to access the GUI and CLI can be viewed from each interface. Each account has a password, group, SNMP v3 Authentication and SNMP v3 Privacy method assigned. These accounts are designed for Role-Based authentication, defined by the account groups. If User-Based authentication is required, a separate RADIUS server can be used to expand the number of possible user accounts beyond the five account limit.

3.6.3.2 Adding a User Account

User accounts can be added to the list by members of the Admin group. An Admin account user name and password is required before a new user account can be added. New user account passwords must be longer than eight characters.

3.6.3.3 Changing a User Account

User accounts can be modified by members of the Admin user group. An Admin account user name and password is required before an account can be modified. User accounts are permitted to modify their own password.

3.6.3.4 Deleting a User

User accounts can be deleted by members of the Admin user group. An Admin account user name and password is required before a user account can be deleted.

Users Management

☰ System Users

User Name	Group	Authentication	Privacy
admin	admin	none	none
user	user	none	none
monitor	monitor	none	none
cdinse	admin	none	none

Manage User Settings

User Name	<input type="text" value="admin"/>
Group	<input type="text" value="admin"/>
Authentication	<input type="text" value="none"/>
Privacy	<input type="text" value="none"/>
New Password	<input type="text"/>
Confirm Password	<input type="text"/>
Admin User	<input type="text"/>
Admin Password	<input type="text"/>

Change
Delete

New User

User Name	<input type="text"/>
Group	<input type="text" value="admin"/>
Authentication	<input type="text" value="none"/>
Privacy	<input type="text" value="none"/>
New Password	<input type="text"/>
Confirm Password	<input type="text"/>
Admin User	<input type="text"/>
Admin Password	<input type="text"/>

Add

Figure 3-6. Users Management

3.6.4 SNMP

The subsections below describe SNMP Management Interfaces configuration parameters. Click on the blue **[SNMP Configuration]** link shown in [Figure 3-4](#) to access the screen. See [Figure 3-7](#).

3.6.4.1 SNMP Versions

GUI	CLI
-----	-----

SNMP v2c and SNMP v3 are the supported network management versions. Only one version can be active at a time.

3.6.4.2 Communities

GUI	CLI
-----	-----

Community configuration is required for SNMP v2c only. The communities are simple passwords for an SNMP polling agent that control whether the agent can perform read, write, or both types of operations on SNMP objects in the radio. The default communities are “public” and “private” with read-only and read-write operations permitted, respectively.

3.6.4.3 Traps

GUI	CLI	SNMP
-----	-----	------

SNMP traps are notifications that are sent to pre-defined destinations when certain events occur. These event notifications are useful in large, heavily managed network infrastructures because they simplify the network manager's monitoring responsibilities. Depending on the network management tool used, traps can initiate high-priority e-mails or SMS text messages to a network administrator that can be used to quickly diagnose a problem with the network.

SNMP Configuration

[-] SNMP Communities

Community Name	Access	
public	r	Edit
private	w	Edit
		Add

[-] SNMP Trap Destinations

IP Address(IPV4)	Port	Community	
192.168.26.100	162	private	Edit
			Add

[-] SNMP Trap Configuration

SNMP Traps Enabled	<input type="checkbox"/>
Link Up/Down Trap Enabled	<input type="checkbox"/>

Figure 3-7. SNMP Configuration

3.6.5 Access



The interface for radio management traffic and over-the-link traffic is shared on the Ethernet port. In certain situations, it may be desirable to separate the management traffic from the over-the-link traffic. This can be done within the radio by tagging management traffic with a specific 802.1Q Virtual Local Area Network (VLAN) Identification (ID).

3.6.6 Remote Users (User-Based Authentication)

The subsections below describe RADIUS Management Interfaces configuration parameters. Click on the blue **[RADIUS Configuration]** link shown in [Figure 3-4](#) to access the screen. See [Figure 3-8](#).

3.6.6.1 RADIUS



RADIUS support ties the radio's user-authentication system into an existing enterprise system to enable existing user names and passwords to be used to log into the radio. It can be configured to work with the radio's user-authentication system, or as a replacement for it.

RADIUS Configuration

▢ **Primary Server Configuration**

Server Enable	<input checked="" type="checkbox"/>
Server IP Address	<input type="text" value="192.168.26.1"/>
Server Authentication Port	<input type="text" value="1812"/>
Shared Secret	<input type="text" value="secret.1"/>
Request Retries	<input type="text" value="2"/>
Request Time-out [sec]	<input type="text" value="3"/>

▢ **Secondary Server Configuration**

Server Enable	<input type="checkbox"/>
---------------	--------------------------

Figure 3-8. RADIUS Configuration

3.6.7 FIPS Mode



The radio can be placed into a high security FIPS 140-2 compliant mode when certain security configuration criteria is met. The “FIPS” text in the dashboard of the GUI links to a summary that indicates the current status of configuration parameters against the corresponding requirements. Once all criteria is met, FIPS Mode can be activated. A reboot is prompted by the radio and is required before FIPS Mode is fully active. Refer to RF-7800W-OU47X/-OU50X Security Operation Supplement (10515-0426-4000) for more information on FIPS. See [Figure 3-9](#).

FIPS Status			Close Window
FIPS Status:		Off	
FIPS Components:	Status	FIPS	
Configured FIPS Mode	Off	On	
Power UP Self Test	PASS		
Users Validation	FAIL		
User Authentication	Local	Local	
HTTP	On	Off	
Telnet	On	Off	
SNMP	On(V2)	Off or V3 only	
HTTPS	On		
SSH	On		
Not all passwords meet FIPS requirements (minimum 8 characters).			

Figure 3-9. FIPS Status

3.7 TIME AND LOCATION

The radio has some time and location options available that can help with system troubleshooting and maintenance. See [Figure 3-4](#).

3.7.1 SNTP

GUI | CLI | SNMP

The subsections below describe Simple Network Time Protocol (SNTP) configuration parameters. All parameters for SNTP can be accessed using GUI, CLI, and SNMP interfaces.

3.7.1.1 Server IP Address

This is the IP address of a valid SNTP server that the radio can use to determine the current time.

3.7.1.2 Polling Interval

This interval defines the period of time between polls to the SNTP server for time. Periodic polling is required to synchronize time with other network devices. The radio can be directed to poll the SNTP server on demand using SNMP.

3.7.1.3 Time Zone (GMT)

This defines how much offset is applied to time that is received by the SNTP service. This should be set to the time zone where the radio is located in order to provide an accurate time.

3.7.2 GPS

GUI | CLI | SNMP

The subsections below describe Global Positioning System (GPS) configuration parameters. All parameters for GPS can be accessed using GUI, CLI, and SNMP interfaces.

3.7.2.1 Antenna Power

The radio can power active GPS antennas with an internal 3.3 VDC power supply. The power supply has automatic short-circuit protection that will protect the radio in the event of an incompatible or broken antenna.

3.7.2.2 Coordinates Format

A number of latitude and longitude datum formats can be selected, depending on a user's preference.

3.7.2.3 GPS Position

If a GPS antenna is properly attached and configured and has good line-of-sight to enough GPS satellites, the position of the radio is made available.

3.7.2.4 GPS Status

A more detailed overview of the internal GPS module's state can be obtained, which displays the radio's altitude, GPS-recovered time, and information about the satellites in view of the GPS antenna.

The radio can be configured to send an SNMP trap if the number of GPS Satellites in view is low, or if the number of GPS satellites in view has been low for 12 hours. Both of these traps could indicate a problem with the GPS antenna configuration. See [Figure 3-10](#).

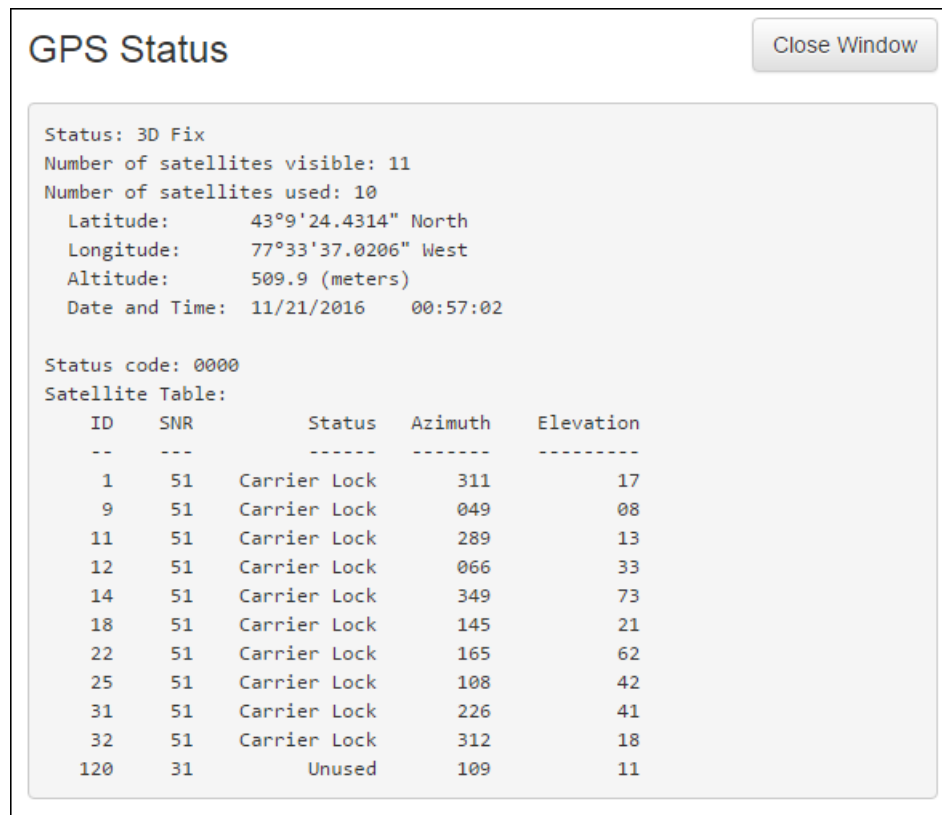


Figure 3-10. GPS Status

3.8 WIRELESS INTERFACE

The radio has one wireless interface that consists of two RF ports. This section describes the information and configuration options available for the wireless interface. See [Figure 3-14](#), [Figure 3-15](#), [Figure 3-16](#), and [Figure 3-17](#).

3.8.1 System Mode



The radio can operate in multiple system modes under two configuration types. Refer to [Paragraph 2.1.3](#) for more information about the configuration types.

Simple Point to Multiple Points (SPMP) and Simple Point to Point (SPTP) provide simple setup and configuration.

The central radio in a SPMP system, or Sector Controller (SC), is responsible for transmitting management, timing, and provisioning information to all configured radios within a sector. It controls the list of radio links and periodically transmits a beacon that allows new radios in the sector to link up. The Subscriber Station (SS) is one of the edge nodes in a SPMP system. The SS is responsible for feeding back information about the quality of the radio link to the SC, which allows the SC to optimize transmissions.

3.8.2 Radio Mode



The radio has two RF ports, which can be used either together or individually. The RF ports can also be turned off, for maintenance or troubleshooting.

3.8.3 Transmit Power

The transmit power settings are described below.

3.8.3.1 Maximum



The maximum transmit power applies to both RF ports. This is used to limit the transmit power for Effective Isotropic Radiated Power (EIRP) or co-channel interference reasons.

Even though the Transmit Power may be set to a particular value, the radio will not necessarily operate at that level. There are a few factors which dictate what actual Transmit Power will be used for a particular transmission burst: current RF Frequency and current Burst Rate. Refer to [Table 3-4](#) for details regarding the Transmit Power behavior. Refer to [Table 3-5](#) for Burst Rates.

Table 3-4. Maximum Transmit Power

Modulation/ Coding Rate	Max Tx Power (dBm) per RF Frequency		
	4400-4700 MHz	4700-4900 MHz	4900-5875 MHz
BPSK 1/2	18	20	22
QPSK 1/2	18	20	22
QPSK 3/4	18	20	22
16-QAM 1/2	18	20	20

Table 3-4. Maximum Transmit Power (Continued)

16-QAM 3/4	18	20	20
64-QAM 2/3	18	18	18
64-QAM 5/6	18	18	18
256-QAM 3/4	15	15	15
256-QAM 7/8	15	15	15

3.8.3.2 ATPC

GUI CLI SNMP

ATPC stands for Automatic Transmit Power Control and is useful for reducing co-site interference or dealing with dynamically changing link conditions. A target RSSI is set on the SC radio, which is used as the goal for all radio links. If link conditions are degraded and the current transmit power is lower than the maximum configured transmit power, radios will increase their power in order to meet the target RSSI. When link conditions improve, radios reduce their power accordingly. All radios will respect the configured maximum transmit power setting. ATPC supports adjusting the Tx Power for the following System Modes: SPTP SC, SPTP SS, and SPMP SS.

3.8.3.3 External PA

An external Power Amplifier (PA) can be attached to the radio in order to extend range and increase signal coverage. Entering the nominal transmit gain and receive gain (or loss) of the PA provides the radio awareness of the actual power level being transmitted and received by the system. This information can be used by various features to improve performance compared to if the radio was not aware of the presence of the PA.

3.8.3.4 Statistics

CLI SNMP

The actual transmit power depends on a number of things, including Automatic Transmit Power Control (ATPC) settings and dynamic link conditions. The current transmit power and other related statistics are logged. Transmit power statistics are adjusted when using an external PA such that the values shown correspond with the output of the PA to the antenna.

3.8.4 Frequency

The frequency settings are described below.

3.8.4.1 Configuration

GUI CLI SNMP

The frequency of operation can be configured at 0.5 MHz intervals anywhere within the radio's operating band. The configured frequency is limited to half of the configured channel width away from the low and high ends of the operating band. Depending on DFS or EIM settings, the actual operating frequency might differ from the configured operating frequency.

3.8.4.2 Auto-Scan

GUI CLI SNMP

Radios configured as Subscriber Stations have the ability to quickly auto-scan frequency and channel width if a Sector Controller is not detected within a period of time. This allows SS radios to automatically locate a valid SC

without prior knowledge of the SC operating frequency. It can also be helpful when an SS is configured on multiple SCs and one of the SC is interfered with or is taken down for maintenance.

3.8.4.3 Roaming

GUI	CLI	SNMP
-----	-----	------

Subscriber Stations have the ability to scan different frequencies and channel sizes for Sector Controllers while maintaining a link to an SC. Once an SC is discovered that is sufficiently better than the old SC, the SS will deregister with the old SC and register with the new SC. The new SC then sends Layer 2 updates to the network for each MAC address that is located on the SS side of the link in order to make the network aware of the new location of the nodes. Refer to [Paragraph 4.3](#) for additional Roaming information. Enabling Roaming will implicitly enable Auto-Scan.

NOTE

Roaming reduces the maximum possible user data throughput by around 10 percent.

NOTE

The Link ID may change when Roaming between SCs.

NOTE

LLC packets are used for Layer 2 updates.

3.8.4.4 Frequency Lists

GUI	CLI
-----	-----

The operating frequency band is sometimes wider than necessary for a given installation. Frequency lists allow for the radio to be further restricted from known interference or licensed frequency bands. The Auto-Scan, DFS and EIM features respect these frequency band limits. See [Figure 3-11](#).

Frequency Management

Add Frequency Range

Begin Frequency [MHz]

End Frequency [MHz]

Local Frequency Ranges

Begin	End	
4450.0	4550.0	<input type="button" value="Del"/>
4900.0	5500.0	<input type="button" value="Del"/>

Figure 3-11. Frequency Management

3.8.5 Channel Width

GUI | CLI | SNMP

The radio supports a number of different channel widths from 5 MHz to 40 MHz. Narrower channel widths allow for greater range due to improved receiver sensitivity, but the trade-off is lower throughput. Likewise, wider channel widths allow for higher throughput at the cost of link range. Some situations require restricting the channel widths due to co-site interference.

3.8.6 Link Distance

GUI | CLI | SNMP

The radio supports restricting the maximum link distance if the installation is fixed-site in order to improve latency. The default value for this is 50 km (31 miles) and must be adjusted to be greater than the actual link distance or link performance will suffer.

3.8.7 Antenna Alignment

GUI | CLI | SNMP

The radio provides aids to aligning the antenna to a remote radio. Radios can be configured to emit a chirping sound (referred to as a buzzer) that chirps faster with higher average Receive Signal Strength Indication (RSSI). The radio GUI also contains a page that refreshes every second and displays the RSSI and Signal-to-Noise and Distortion Ratio (SINADR) for the link.

NOTE

This aid is not available on a SPMP SC if more than one link is present.

3.8.8 Security



Security settings are described below. All parameters for Security can only be accessed using GUI and CLI interfaces.

3.8.8.1 Encryption Type

The radio supports AES encryption of all user and management data sent over the air. AES is implemented and available in both 128-bit and 256-bit block lengths.

3.8.8.2 Shared Secret

AES encryption uses a key that is derived from a pre-shared secret. The secret must be between 32 and 64 alphanumeric characters.

3.8.8.3 Shared Secret Hash

A convenient and secure method of ruling out mismatched shared secrets is to compare a truncated, one-way hash of the shared secret. If shared secrets have been entered properly on both sides of a radio link, the shared secret hashes will be identical.

3.8.8.4 X.509 Authentication

An additional method of security is implemented that uses X.509 certificates to authenticate the radios that are configured to link over the air. The radio authenticates the certificate of its link partner before finishing the link-up process. Refer to RF-7800W-OU47x/-OU50x Security Operation Supplement (10515-0426-4000) for more information.

3.8.8.5 SC MAC Address

The MAC address of an SC can be used to restrict a radio configured for SS operation to only link with that SC. To link with any valid SC, the default value 00:00:00:00:00:00 should be used.

3.8.9 Interference Mitigation



Interference Mitigation settings are described below. All parameters for Interference Mitigation can be accessed using GUI, CLI, and SNMP interfaces.

The radio employs multiple methods of dealing with co-channel interference. Dynamic Frequency Selection (DFS) and Enhanced Interference Mitigation (EIM) are mutually exclusive. DFS is required for Federal Communications Commission (FCC) and European Telecommunications Standards Institute (ETSI) compliance in certain frequency bands and designed for radar detection and avoidance. EIM is intended for general interference detection and designed to maintain healthy operating links in response to both deliberate and accidental interference.

NOTE

DFS is currently supported for the 5.725 - 5.875 GHz band per ETSI EN 302 502.

3.8.9.1 DFS Action

DFS can be configured to either turn off the radio transmitter for 30 minutes or change the radio's operating frequency. If either event occurs, a DFS event trap is sent via SNMP to any configured receivers. The channel change feature respects the configured frequency list. When the radio changes channels, it also turns the transmitter off for one minute and monitors the channel. If radar is detected again, the radio will continue to change channels until a vacant channel is found.

3.8.9.2 Antenna Gain

DFS requires knowledge of the antenna in use in order to properly set the trigger sensitivity. The default gain is set to the highest gain antenna that is offered for use with the radio, but should be changed to the gain of the actual antenna in use. When this setting is higher than the actual antenna gain, the radio is not sensitive enough to radar signals. Conversely, the radio will be too sensitive and may inadvertently trigger a DFS event if this is set lower than the actual antenna gain.

3.8.9.3 EIM Detection

Since interference may not affect both radios in a link, EIM is configured to detect interference separately on the SC and SS radios. EIM looks for unusually low SINADR for a given RSSI, unusually high bit-error rates and an unusually high noise floor. Link Min Burst Rates are used as the threshold for interference detection. The Min Burst Rate should be set to the lowest value that achieves the necessary throughput for a particular Link. SNMP traps are sent to network managers when EIM events occur and when interference has cleared.

3.8.9.4 EIM Auto Channel Change

When interference is detected, the radio has the option of initiating all radios to jump to a new, potentially cleaner operating frequency. There is minimal downtime when this occurs. The radios will iterate through a number of frequencies. If interference is found on many different frequencies, one likely conclusion is that the radio is being deliberately interfered with over its entire operating band. This situation is known as "barrage interference" and results in the radios settling on the last operating frequency. Auto-Scan should be enabled on SS when using EIM Auto Channel Change to account for situations in which radios are unable to link after a channel change due to high interference levels. When the radios change channels and if barrage interference is detected, different SNMP traps are sent to network managers.

NOTE

EIM Auto Channel Change reduces the maximum possible user data throughput by around 10 percent.

3.8.9.5 EIM Relative Noise Floor

While EIM is turned on, the radios monitor the noise floor of the channel during the quiet periods between transmissions. The difference between the expected noise and the measured noise is displayed as the relative noise floor. This value will vary with different installation environments. A sharp increase in this value relative to the average value could indicate the presence of interference.

3.8.10 Multi-Hop

GUI **CLI** **SNMP**

Sector Controllers can act as the root of a tree-like, Multi-Hop sector. In a Multi-Hop sector, subscribers are able to relay data directly to/from other subscribers that are below them in the hierarchy. Radios lower in the hierarchy (i.e. further away from the SC) are referred to as “children”, while those higher in the hierarchy are referred to as “parents”. Subscribers continuously check for the presence of potential parents and select the one that should provide the best throughput. Refer to [Paragraph 3.8.4.3](#).

Throughput decreases when data travels through multiple hops since the data needs to be transmitted multiple times in order to get to the end destination. See [Figure 3-12](#). Latency increases when data travels through multiple hops since each relay station needs to store and forward the data. See [Figure 3-13](#).

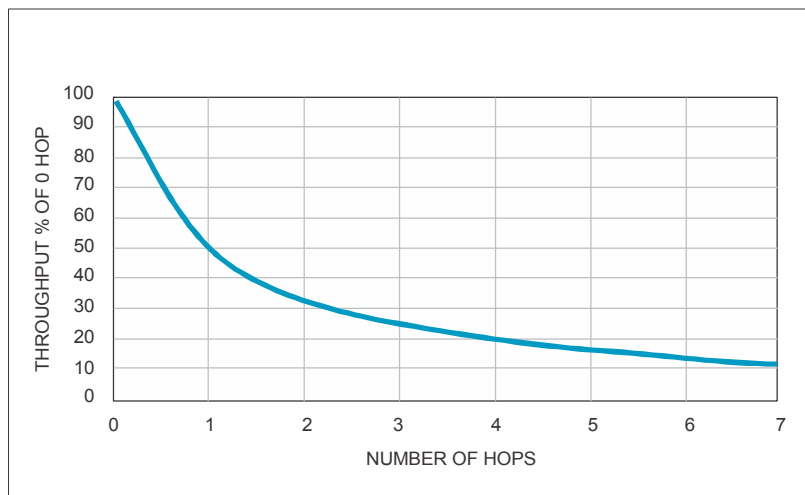


Figure 3-12. Throughput vs Number of Hops

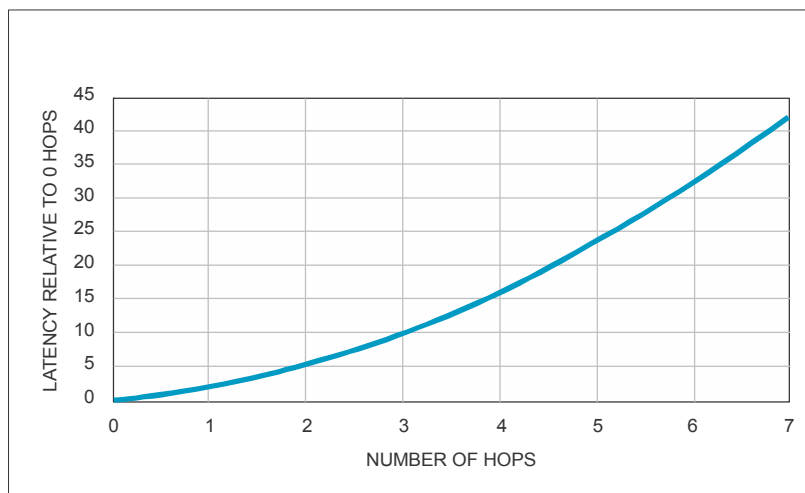


Figure 3-13. Latency Increase per Hop

3.8.10.1 Multi-Hop Failover

A subscriber can be designated to support Multi-Hop Failover, which allows it to act as a temporary Failover SC if the actual SC becomes inaccessible. Once the actual SC becomes accessible again, the Failover SC reverts back to its role as an SS.

NOTE

Only one subscriber in a Multi-Hop sector should be configured to support Multi-Hop Failover.

3.8.11 Registration Period

GUI	CLI	SNMP
-----	-----	------

The Registration Period defines how frequently an SC will check for new subscribers and also how frequently the SC will transmit multicast data (for SPMP). A short Registration Period will decrease the potential unicast throughput and increase the potential multicast throughput. A long Registration Period will increase the potential unicast throughput and decrease the potential multicast throughput.

3.8.12 Scheduling Cycle

GUI	CLI	SNMP
-----	-----	------

The Scheduling Cycle defines how frequently the different Links will be allowed to transmit. A short Scheduling Cycle can reduce latency at the expense of throughput, while a long Scheduling Cycle can improve throughput at the expense of latency.

3.8.13 Statistics

GUI	CLI	SNMP
-----	-----	------

The radio provides the number of transmitted and received data packets, along with how many packets were retransmitted or discarded due to errors.

Wireless Configuration

Basic Wireless Configuration

System Mode	SPMP SC ▾	
Channel Size [MHz]	40 ▾	
New RF Frequency [MHz]	<input type="text"/>	Frequencies
Tx Power [dBm]	<input type="text" value="22"/>	
Antenna Alignment Buzzer Enable	<input type="checkbox"/>	
Radio Mode	RF Port 1&2 ▾	

Advanced Wireless Configuration

Max. Distance	<input type="text" value="50"/> km	<input type="text" value="31"/> miles
DFS Action	None ▾	
Antenna Gain [dBi]	<input type="text" value="30"/>	
External PA Present	<input checked="" type="checkbox"/>	
External PA Tx Gain [dBi]	<input type="text" value="20"/>	
External PA Rx Gain [dBi]	<input type="text" value="6"/>	
Registration Period [frames]	<input type="text" value="16"/>	
Scheduling Cycle [ms]	<input type="text" value="2"/>	
ATPC Enable	<input checked="" type="checkbox"/>	
ATPC RSSI Level [dBm]	<input type="text" value="-65"/>	
Multi-Hop Enable	<input checked="" type="checkbox"/>	

Traffic Flow Security Configuration

Encryption Type	AES 256 ▾	
Shared Secret	<input type="text" value="....."/>	
Shared Secret Confirmation	<input type="text" value="....."/>	
Shared Secret Hash	a8ae6e6ee929abea3afcf5258c8ccd6	
X509 Authentication Enable	<input checked="" type="checkbox"/>	

Enhanced Interference Mitigation (EIM)

SC Interference Detection Enable	<input checked="" type="checkbox"/>
SS Interference Detection Enable	<input checked="" type="checkbox"/>
Automatic Channel Change Enable	<input type="checkbox"/>

Figure 3-14. Wireless Configuration - SPMP SC

Wireless Configuration

Basic Wireless Configuration

System Mode	SPTP SC ▼	
Channel Size [MHz]	40 ▼	
New RF Frequency [MHz]	<input type="text"/>	Frequencies
Tx Power [dBm]	<input type="text" value="22"/>	
Antenna Alignment Buzzer Enable	<input type="checkbox"/>	
Radio Mode	RF Port 1&2 ▼	

Advanced Wireless Configuration

Max. Distance	<input type="text" value="50"/> km	<input type="text" value="31"/> miles
DFS Action	None ▼	
Antenna Gain [dBi]	<input type="text" value="30"/>	
External PA Present	<input checked="" type="checkbox"/>	
External PA Tx Gain [dBi]	<input type="text" value="20"/>	
External PA Rx Gain [dBi]	<input type="text" value="6"/>	
Registration Period [frames]	<input type="text" value="16"/>	
Scheduling Cycle [ms]	<input type="text" value="2"/>	
ATPC Enable	<input checked="" type="checkbox"/>	
ATPC RSSI Level [dBm]	<input type="text" value="-65"/>	

Traffic Flow Security Configuration

Encryption Type	AES 256 ▼	
Shared Secret	<input type="password" value="....."/>	
Shared Secret Confirmation	<input type="password" value="....."/>	
Shared Secret Hash	a8ae6e6ee929abea3afcfc5258c8ccd6	
X509 Authentication Enable	<input checked="" type="checkbox"/>	

Enhanced Interference Mitigation (EIM)

SC Interference Detection Enable	<input checked="" type="checkbox"/>
SS Interference Detection Enable	<input checked="" type="checkbox"/>
Automatic Channel Change Enable	<input type="checkbox"/>

Figure 3-15. Wireless Configuration - SPTP SC

Wireless Configuration

Basic Wireless Configuration

System Mode	SPMP SS ▾
Channel Size [MHz]	40 ▾
Auto Frequency Scan	<input type="checkbox"/> Rescan
New RF Frequency [MHz]	<input type="text"/> Frequencies
Tx Power [dBm]	<input type="text" value="22"/>
STID	<input type="text" value="default"/>
STID Password	<input type="password" value="....."/>
STID Password Hash	37a8eec1ce19687d132fe29051dca629
Antenna Alignment Buzzer Enable	<input type="checkbox"/>
Radio Mode	RF Port 1&2 ▾

Advanced Wireless Configuration

Antenna Gain [dBi]	<input type="text" value="30"/>
External PA Present	<input checked="" type="checkbox"/>
External PA Tx Gain [dBi]	<input type="text" value="20"/>
External PA Rx Gain [dBi]	<input type="text" value="6"/>
Roaming Enable	<input type="checkbox"/>
Multi-Hop Failover Enable	<input type="checkbox"/>

Traffic Flow Security Configuration

Encryption Type	AES 256 ▾
Shared Secret	<input type="password" value="....."/>
Shared Secret Confirmation	<input type="password" value="....."/>
Shared Secret Hash	a8ae6e6ee929abea3afcf5258c8ccd6
X509 Authentication Enable	<input checked="" type="checkbox"/>
SC MAC	<input type="text" value="00:00:00:00:00:00"/>

Figure 3-16. Wireless Configuration - SPMP SS

Wireless Configuration

Basic Wireless Configuration

System Mode	SPTP SS ▾	
Channel Size [MHz]	40 ▾	
Auto Frequency Scan	<input type="checkbox"/>	<input type="button" value="Rescan"/>
New RF Frequency [MHz]	<input type="text"/>	Frequencies
Tx Power [dBm]	22	
Antenna Alignment Buzzer Enable	<input type="checkbox"/>	
Radio Mode	RF Port 1&2 ▾	

Advanced Wireless Configuration

Antenna Gain [dBi]	30	
External PA Present	<input checked="" type="checkbox"/>	
External PA Tx Gain [dBi]	20	
External PA Rx Gain [dBi]	6	

Traffic Flow Security Configuration

Encryption Type	AES 256 ▾	
Shared Secret	
Shared Secret Confirmation	
Shared Secret Hash	a8ae6e6ee929abea3afcfc5258c8ccd6	
X509 Authentication Enable	<input checked="" type="checkbox"/>	
SC MAC	00:00:00:00:00:00	

Figure 3-17. Wireless Configuration - SPTP SS

3.9 SUBSCRIBER LINKS

The overall number of configured subscribers is available, along with how many of them are currently active. An administrator can also purge all subscriber information from the radio. Click the **New Link** button on the **Subscriber Links** screen, [Figure 3-22](#), to access the **Subscriber Link Configuration** screen. See [Figure 3-18](#) and [Figure 3-19](#).

3.9.1 Management



Links can be added, modified or removed on the SC. They are given unique IDs that are used heavily in the CLI and SNMP when configuring or monitoring. Links can be viewed in summary on the SC or in detail on both the SC and the SS. The summary views include metrics that are useful for evaluating the performance of the radio system as a whole, including per-link RSSI, SINADR and burst rate. The detail views provide complete information about a link's configuration and current state.

3.9.2 Basic Link Information

Basic link settings are described below.

3.9.2.1 Link Type



SPMP supports configuration of two Link Types—Normal Links and Link Templates—on the SC. Normal Links allow a particular SS to register with the SC, with access controlled via the unit's MAC Address. Link Templates allow an arbitrary number of SS to register with an SC, with access controlled via a Station Template Identifier (STID) and STID Password.

A Derived Link is automatically generated when an SS registers with an SC and inherits the properties of its parent Link Template. Normal Links take precedence over Link Templates when a Normal Link is defined for a particular SS and that SS is configured with an STID and STID Password which correspond with a Link Template.

3.9.2.2 Enable



Normal Links, Link Templates, and Derived Links may be enabled or disabled in order to permit or deny registration. While enabling or disabling a Normal Link or Derived Link affects the ability of a single SS to register, enabling or disabling a Link Template affects the ability of all SS configured with the correct STID and STID Password to register.

3.9.2.3 Link Name



Each Normal Link can be given a name to help an administrator keep track of it. It may be helpful to use the SS radio's serial number or install location. Derived Links are automatically given a name composed of its parent Link Template STID and the SS System Name.

NOTE

In the event that there is a naming conflict between Derived Links, the SS MAC Address will be used instead of the SS System Name.

3.9.2.4 Subscriber MAC

GUI	CLI	SNMP
-----	-----	------

The unique MAC address of the SS radio is required when defining a new Normal Link.

3.9.2.5 STID

The STID is used as a name to differentiate between Link Templates.

3.9.2.6 STID Password

The STID Password provides authentication to associate with a particular STID. The STID Password Hash provides a way of determining whether the STID Password is configured the same on two radios without disclosing the actual passwords.

3.9.2.7 Link Partner IP Address

GUI	CLI	SNMP
-----	-----	------

Once the SS radio has successfully linked up with the SC, each radio's IP address is made available in the link details of the opposite radio as a convenient way to quickly log into the radio's management GUI.

3.9.3 Modulation and Coding Rates

Modulation and Coding rate settings are described below.

3.9.3.1 Adaptive Modulation

GUI	CLI	SNMP
-----	-----	------

In order to handle dynamic link conditions, Adaptive Modulation should be employed. The radio monitors the bit-error rate of data that is received over the link and dynamically controls both the downlink and uplink burst rates in order to minimize bit errors and prevent links from dropping altogether.

Subscriber Link Configuration

Basic Subscriber Link Configuration

Link Type	Normal Link ▼
Enable	<input checked="" type="checkbox"/>
Subscriber Link Name	test
Link ID	0
Subscriber MAC	00:00:C3:9C:95:C4

Advanced Subscriber Link Configuration

Adaptive Modulation	<input checked="" type="checkbox"/>
Max. DL Burst Rate	476 Mb/s ▼
Max. UL Burst Rate	476 Mb/s ▼
Min. DL Burst Rate	476 Mb/s ▼
Min. UL Burst Rate	476 Mb/s ▼
DL CIR [50..500000 kb/s]	500000
UL CIR [50..500000 kb/s]	500000
DL PIR [50..500000 kb/s]	500000
UL PIR [50..500000 kb/s]	500000
Operating Mode	MIMO A/B ▼
Data Smoothing	<input type="checkbox"/>

Qos Configuration

802.1p Prioritization Enable	<input checked="" type="checkbox"/>
Priority for Untagged Traffic	0 ▼
Priority for 802.1p = 0	0 ▼
Priority for 802.1p = 1	0 ▼
Priority for 802.1p = 2	1 ▼
Priority for 802.1p = 3	1 ▼
Priority for 802.1p = 4	2 ▼
Priority for 802.1p = 5	2 ▼
Priority for 802.1p = 6	3 ▼
Priority for 802.1p = 7	3 ▼

Apply

Figure 3-18. Subscriber Link Configuration - Normal Link

Subscriber Link Configuration

Basic Subscriber Link Configuration

Link Type	Normal Link ▼
Enable	<input checked="" type="checkbox"/>
Subscriber Link Name	test
Link ID	0
Subscriber MAC	00:00:C3:9C:95:C4

Advanced Subscriber Link Configuration

Adaptive Modulation	<input checked="" type="checkbox"/>
Max. DL Burst Rate	476 Mb/s ▼
Max. UL Burst Rate	476 Mb/s ▼
Min. DL Burst Rate	476 Mb/s ▼
Min. UL Burst Rate	476 Mb/s ▼
DL CIR [50..500000 kb/s]	500000
UL CIR [50..500000 kb/s]	500000
DL PIR [50..500000 kb/s]	500000
UL PIR [50..500000 kb/s]	500000
Operating Mode	MIMO A/B ▼
Data Smoothing	<input type="checkbox"/>

Qos Configuration

802.1p Prioritization Enable	<input checked="" type="checkbox"/>
Priority for Untagged Traffic	0 ▼
Priority for 802.1p = 0	0 ▼
Priority for 802.1p = 1	0 ▼
Priority for 802.1p = 2	1 ▼
Priority for 802.1p = 3	1 ▼
Priority for 802.1p = 4	2 ▼
Priority for 802.1p = 5	2 ▼
Priority for 802.1p = 6	3 ▼
Priority for 802.1p = 7	3 ▼

Figure 3-19. Subscriber Link Configuration - Link Template

3.9.3.2 Burst Rate

GUI | CLI | SNMP

When adaptive modulation is not used, a single set of downlink and uplink burst rates must be configured. If the burst rate is set too high for a given link budget, it will be difficult to initiate and maintain a reliable link. When adaptive modulation is used, maximum and minimum downlink and uplink burst rates must be configured. The radio will attempt to stay above the minimum, but will adapt to lower modulations if link conditions deteriorate. Refer to [Table 3-5](#).

Table 3-5. Burst Rates per Channel Width

	Modulation/ Coding	Burst Rate per Channel Width			
		5 MHz	10 MHz	20 MHz	40 MHz
SISO/ MIMO-A	BPSK 1/2	2	4	8	17
	QPSK 1/2	4	8	17	34
	QPSK 3/4	6	12	25	51
	16-QAM 1/2	8	17	34	68
	16-QAM 3/4	12	25	51	102
	64-QAM 2/3	17	34	68	136
	64-QAM 5/6	21	42	85	170
	256-QAM 3/4	25	51	102	204
	256-QAM 7/8	29	59	119	238
MIMO-B	BPSK 1/2	4	8	17	34
	QPSK 1/2	8	17	34	68
	QPSK 3/4	12	25	51	102
	16-QAM 1/2	17	34	68	136
	16-QAM 3/4	25	51	102	204
	64-QAM 2/3	34	68	136	272
	64-QAM 5/6	42	85	170	340
	256-QAM 3/4	51	102	204	408
	256-QAM 7/8	59	119	238	476

3.9.4 Information Rate

GUI | CLI | SNMP

The Committed Information Rate (CIR) defines a link's minimum required user data rate. The Peak Information Rate (PIR) defines a link's maximum allowed user data rate. On a per-link basis, there are separate CIR and PIR values for both the downlink and uplink. The SC uses these values to assist with prioritizing how much traffic is sent over each link when there is not enough transmission time to get all data to all subscribers. The SC will attempt to ensure that the CIR is met on all subscribers, but may be forced to proportionally scale them if link conditions deteriorate and the burst rate is not able to support them.

3.9.5 Data Smoothing

GUI	CLI
-----	-----

This is a security option that can be activated on a per-link basis. Data Smoothing adds random data to existing user traffic in order to even out each radio's transmission time. This can help obscure the radios from timing-related attacks, but may have an impact on maximum user throughput when turned on (e.g. unidirectional traffic patterns).

3.9.6 802.1p Prioritization

GUI	CLI	SNMP
-----	-----	------

In high-congestion situations, the SC can use 802.1p QoS Priority Code Point values to prioritize certain types of critical data streams (e.g. VoIP or RTSP video). The radio has four prioritization queues for traffic that are mapped to each of the eight 802.1p codes and untagged traffic. In times of high user throughput or congestion, data in the highest queues is transmitted before data in lower queues. This allows for trading off low priority data in favor of more important information.

3.9.7 Broadcast and Multicast

GUI	CLI	SNMP
-----	-----	------

Non-unicast traffic like ARP broadcasts and multicast video streams are transmitted by the SPMP SC during its dedicated broadcast/multicast time slot. This time slot uses a similar subset of configuration parameters as the subscriber link configuration parameters. See [Figure 3-20](#). Configuration and statistics can be accessed in the CLI by using 'bcast' in place of the subscriber Link ID for some commands.

This time slot is dedicated only to downlink traffic (SC to SS), only one set of burst rates, CIR and PIR can be configured. This time slot can also be prioritized with 802.1p QoS Priority Code Point values. Deviating from the default settings is discouraged, since this can significantly affect the performance of certain types of traffic and is difficult to troubleshoot.

SS and SPTP SC do not differentiate between broadcast/multicast and unicast traffic and treat them equally.

3.9.7.1 SS to SS Communication

GUI	CLI	SNMP
-----	-----	------

Non-unicast traffic originating from SS radios can be kept segregated from or rebroadcast to all SS radios by the SC during the broadcast/multicast time slot.

Broadcast/Multicast Configuration

Basic Broadcast & Multicast Configuration

Burst rate	Auto
SS to SS Broadcast/Multicast Enable	<input checked="" type="checkbox"/>
DL Bcast/Mcast CIR [50..50000 kb/s]	25000
DL Bcast/Mcast PIR [50..100000 kb/s]	500000
Operating Mode	MIMO A/B

Qos Configuration

802.1p Prioritization Enable	<input checked="" type="checkbox"/>
Priority for Untagged Traffic	0
Priority for 802.1p = 0	0
Priority for 802.1p = 1	0
Priority for 802.1p = 2	1
Priority for 802.1p = 3	1
Priority for 802.1p = 4	2
Priority for 802.1p = 5	2
Priority for 802.1p = 6	3
Priority for 802.1p = 7	3

Apply

Figure 3-20. Broadcast/Multicast Configuration

3.9.8 Statistics

The subsections below describe subscriber link statistics parameters.

3.9.8.1 Link Metrics

GUI	CLI	SNMP
-----	-----	------

This indicates whether RF associated with a link partner radio has been detected. As the link comes up or goes down, an SNMP trap is sent out to indicate the event. When an SS radio has successfully completed authentication and registration with the SC, there will be a positive indication for a Data Link. When an SS radio successfully registers or is turned away from the SC, an SNMP trap is sent out to indicate the event.

The number of times a link has been lost since boot time is recorded for troubleshooting purposes, along with the link uptime. See [Figure 3-21](#).

Subscriber Link Status		Reset	
General			
Subscriber Link Name	default_SS1		
Subscriber Link ID	5		
Subscriber IP	192.168.26.71		
Subscriber MAC	00:00:c3:9c:92:d3		
Active	Yes		
Link Up Time	1 h, 41 min, 50 sec		
Link Lost Count	6		
Status Code	0x0000		
Data Link Condition	On		
Link distance	0 km		
Link Operating Mode	SISO/MIMO A		
Descendants	3		
Parent ID	SC		
Wireless			
	Downlink	Uplink	
Burst Rate	51 Mb/s	51 Mb/s	
Tx Power	-10 dBm	-10 dBm	
RSSI RF1	-82 dBm	-80 dBm	
RSSI RF2	-120 dBm	-120 dBm	
SINADR RF1	7 dB	8 dB	
SINADR RF2	0 dB	0 dB	
Lost Frames	1,428	1,142	
Throughput	1 kb/s	20 kb/s	
Wireless Packets			
	Downlink	Uplink	
Total	25,717	31,303	
Retransmitted	86	22	
Lost	0	0	
Unicast Ethernet Packets			
	Downlink	Uplink	
Discarded Packets	0	0	
Transmitted Packets	972	974	
Received Packets	973	974	




Figure 3-21. Subscriber Link Status

3.9.8.2 RF Metrics

GUI **CLI** **SNMP**

The current RSSI and SINADR are available for each RF port and for both the SC and the SS radios. Downlink refers to the SC to SS direction, while uplink refers to the SS to SC direction. Min, mean, and max statistics for RSSI and SINADR are also available via SNMP only. RSSI statistics are adjusted when using an external PA such that the values shown correspond with the input of the PA from the antenna. Refer to [Table 3-6](#) for descriptions of the Link Status icons. See [Figure 3-22](#).

Table 3-6. Link Status Icons

Icon	Description
	Link Down
	Registering
	Link Up

3.9.8.3 Data Metrics

GUI **CLI** **SNMP**

For each link, the radio provides the number of transmitted and received data packets, along with how many packets were retransmitted or discarded due to errors. These statistics can be reset on a per-link basis. The current uplink/downlink throughput is also available.

Subscriber Links

Name			D [km]	TxPwr [dBm]		RSSI [dBm]				SINADR [dB]				UBR [Mb/s]		Tput [Mb/s]		On Off	
						RF1		RF2		RF1		RF2							
				DL	UL	DL	UL	DL	UL	DL	UL	DL	UL	DL	UL	DL	UL		
▲▼			▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	
default	⚙️	🗑️																🔗	
📄 default_SS1	⚙️	🗑️	✓	0	-10	-10	-82	-80	-82	-80	8	8	8	8	34	51	0	0	🔗
📄 default_SS2	⚙️	🗑️	✓	0	-10	-10	-81	-82	-81	-82	7	7	7	7	51	51	0	0	🔗
📄 default_SS3	⚙️	🗑️	✓	0	-10	-10	-80	-79	-80	-79	8	8	8	8	68	51	0	0	🔗
default_SS4	⚙️	🗑️	✓	0	-10	-10	-76	-75	-76	-75	12	11	12	11	102	102	0	0	🔗
📄 default_SS5	⚙️	🗑️	✓	0	-10	-10	-79	-80	-79	-80	8	8	8	8	51	51	0	0	🔗
📄 default_SS6	⚙️	🗑️	✓	0	-10	-10	-81	-79	-81	-79	7	7	7	7	51	51	0	0	🔗
📄 default_SS7	⚙️	🗑️	✓	0	-10	-10	-80	-80	-80	-80	8	7	8	7	51	51	0	0	🔗
default_SS8	⚙️	🗑️	✓	0	-10	-10	-77	-77	-77	-77	11	11	11	11	102	102	0	0	🔗

Figure 3-22. Subscriber Links

3.9.8.4 Miscellaneous Status

Additional information related to the link is available. The MAC address of the radio linked to the radio currently being managed is displayed. A hyperlink to the linked radio's web interface allows easy access to the other radios within a given sector. The current approximate distance between linked radios provides additional context when analyzing RF metrics.

3.10 MAINTENANCE

Maintenance features are described in the following subsections.

3.10.1 Script



The radio's configuration can be exported to a text file that can be edited and loaded into other radios. This is useful for backup and as a way to quickly configure many settings at once.

NOTE

Configuration scripts generated by software versions prior to version 4 may not result in the intended configuration when loaded onto a radio running software version 4 or later.

3.10.2 Security Files



Files related to HTTPS, SSH and over-the-air X.509 authentication can be delivered to the radio via various IP-based file transfer mechanisms. Refer to RF-7800W-OU47x/-OU50x Security Operation Supplement (10515-0426-4000) for more information. The radio also contains a direct-load feature that utilizes XMODEM file transfer via the Console port.

3.10.3 GUI Localization



The GUI may be modified to provide an alternate display language, number format, and/or layout. Perform the following to update the GUI:

- a. Download the default English Language File or the modified Active Language File for use as a template by selecting the corresponding Download button in the File List section of the File Management screen. See [Figure 3-24](#).
- b. Edit the Language File using a text editor that supports UTF-8 and dynamic end-of-line detection (such as Notepad++).
- c. Replace the file by uploading the edited file using the File Upload section of the File Management screen.

NOTE

Some text content is controlled by the web browser. Ensure that the browser and host Operating System are configured for the appropriate language. Although multiple languages can be used simultaneously, unexpected behavior may result.

3.10.4 Spectrum Sweep

GUI

The radio comes with the ability to survey the area for potential sources of interference, including weather radar, Wi-Fi devices, high voltage power distribution, or other high-power radios. See [Figure 3-23](#).

NOTE

Spectrum Sweep reduces the maximum possible user data throughput by around 10 percent.

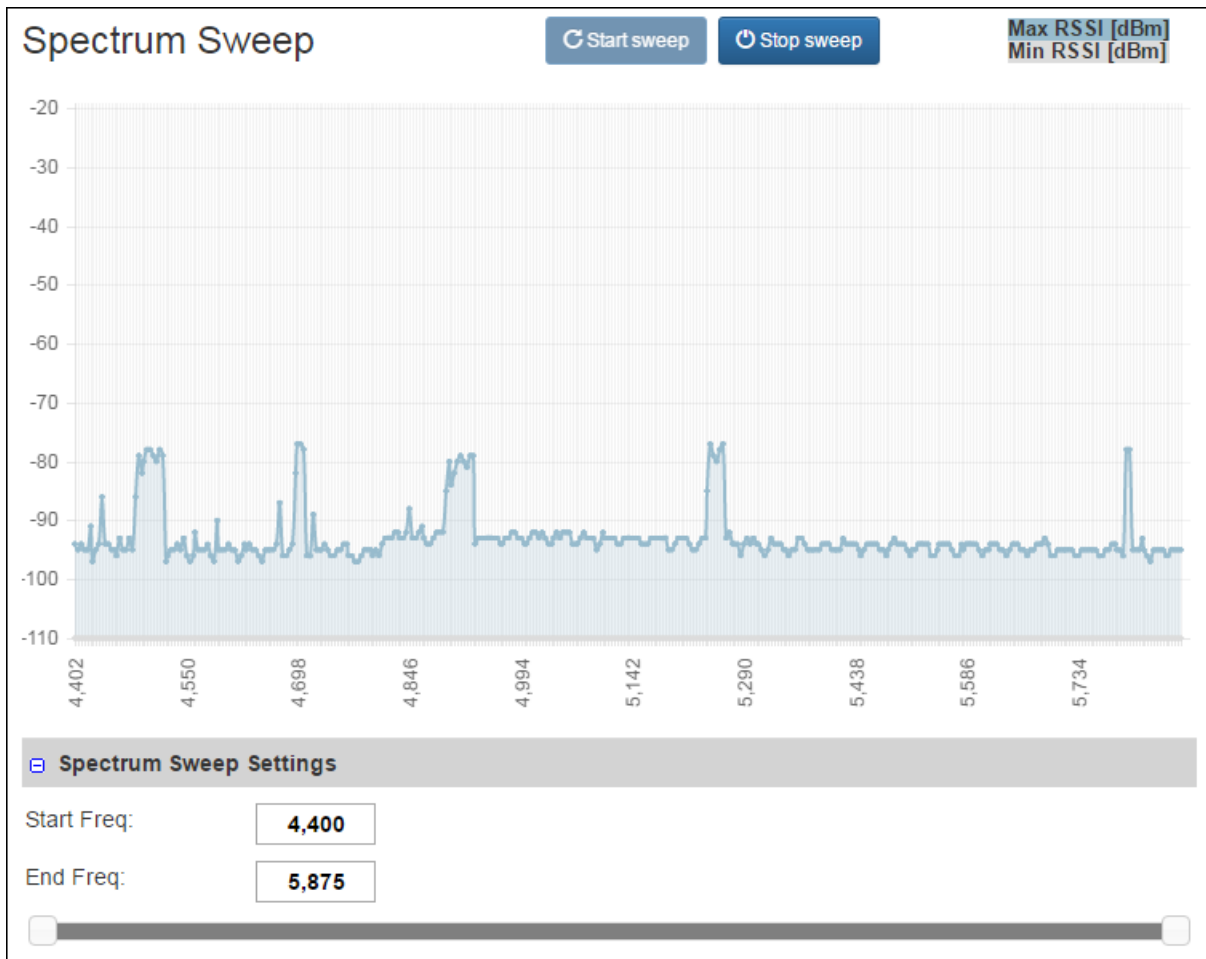


Figure 3-23. Spectrum Sweep

3.10.5 Network

CLI

The radio contains some network test and troubleshooting commands. The arp table can be viewed, edited and cleared. Administrators also have the ability to ping a remote IP destination for network connectivity troubleshooting.

3.10.6 Firmware Upgrade



See [Figure 3-24](#). The radio can be upgraded with new software that is posted to the Harris Premier site (<https://tcpremier.harris.com>). The upgrade files can be delivered to the radio via FTP, TFTP, SFTP, or directly via the GUI. The radio contains enough memory to store two versions of software. When a new version is uploaded, it overwrites the inactive version. In order to complete the upgrade process, the radio must be switched to the new, alternate version. On SC, firmware may be quickly distributed to all linked radios by initiating a sector upgrade. Upgrade success and failure SNMP traps can be generated by the radio to notify network administrators of the event.

NOTE

For example, version 3.0 may be the active version and you may want to upgrade (downgrade) to version 2.0 which may be loaded in the inactive version.

File Management

▣ Firmware Version

Active	5.00
Alternate	3.02
Version Change Type	<input type="radio"/> Local <input checked="" type="radio"/> Sector
Version Change Countdown	<input type="text" value="5"/> Seconds

Tip: Select the desired operating version before upgrading. The upload will overwrite the alternate (inactive) version.

▣ File Upload

Transfer Protocol	<input type="radio"/> TFTP <input type="radio"/> FTP <input type="radio"/> SFTP <input checked="" type="radio"/> HTTP/HTTPS
File Name	<input type="button" value="Choose File"/> No file chosen
Upgrade type	<input checked="" type="radio"/> Local <input type="radio"/> Sector

▣ Key Generation

File Types	SSL Keys & CSR
Country	<input type="text"/>
State or Province	<input type="text"/>
Locality	<input type="text"/>
Organization	<input type="text"/>
Email	<input type="text"/>
Common Name	192.168.26.70

▣ File List

	Size	Id	Download
Radio Configuration Script	n/a	n/a	⬇
English Language File	72,633	n/a	⬇
usr_wacert.der	837	08a2facfe1cc35272e003987c49ee42e	
usr_wcetert.der	972	b003ca99215bb647dbd2712cce5dc010	
usr_wkey.der	1,192	3ce5160da7cbebb9311500a4c712b513	
Active Language File	72,329	1e78c5ec36562250851bc116422d448b	⬇

Tip: Customize the Web Interface by downloading either the English Language File or the Active Language File, modifying and uploading using the File Upload section

Figure 3-24. File Management

3.10.7 System Log

GUI | CLI | SNMP

Important events that occur during the course of the radio's operation are logged. Messages can be viewed either through the GUI and CLI or they can be logged to a central network SysLog server. See [Figure 3-25](#). Additional information pertaining to the system messaging interfaces, including a comprehensive list of system messages, is available in the RF-7800W-OU47x/-OU50x System Messages Supplement (10515-0426-4030).

System Messages			Clear Log
Filter the Log by Minimum Severity: <input type="text" value="Informational"/>			
11/22/2016	21:06:37	1043 - ID "default_SS8" (12) defined: OK	
11/22/2016	21:05:55	1043 - ID "default_SS7" (11) defined: OK	
11/22/2016	21:05:49	1043 - ID "default_SS6" (10) defined: OK	
11/22/2016	21:05:35	1043 - ID "default_SS5" (9) defined: OK	
11/22/2016	20:44:03	1043 - ID "default_SS4" (8) defined: OK	
11/22/2016	20:43:38	1043 - ID "default_SS3" (7) defined: OK	
11/22/2016	20:43:33	1043 - ID "default_SS2" (6) defined: OK	
11/22/2016	20:43:18	1043 - ID "default_SS1" (5) defined: OK	
11/22/2016	20:43:01	1074 - GPS number of satellites used: Low	
11/22/2016	20:42:58	1009 - Network Configuration: OK	
11/22/2016	20:42:58	1049 - Radio Enabled	
11/22/2016	20:42:58	1001 - System Configuration Load: OK	
11/22/2016	20:42:58	1005 - User Configuration Load: OK	
11/22/2016	20:42:57	1061 - GPS unit detected: OK	

Figure 3-25. System Messages

3.10.8 BIT

GUI | CLI

The radio contains Built-In-Test (BIT) hardware diagnostics that allows an Administrator to diagnose specific problems with the unit. See [Figure 3-26](#).

Built-In Test

BIT: Passed

11/22/2016 22:44:35

▣ **Memory**

Subsystem	Status
FLASH1	OK
RAM1	OK
RAM2	OK

▣ **I/O**

Subsystem	Status
Ethernet	OK
SGMII	OK
MDIO	OK
Console	OK
GPS	OK
RF Temperature	OK
Board Temperature	OK
FPGA	OK
Boot Vector	OK

▣ **Power Supply**

Subsystem	Status
PoE Input	OK
0.9V FPGA	OK
1.8V FPGA	OK
2.5V FPGA	OK
3.3V FPGA	OK
VCC5A	OK
0.9V Proc	OK

▣ **RF**

Test	RF1	RF2
Power Out	OK	RF2 Disabled
VSWR	OK	RF2 Disabled

Figure 3-26. Built-In Test

3.10.9 Reboot

GUI	CLI	SNMP
-----	-----	------

Occasionally, an Administrator may wish to remotely reboot the radio. All three management interfaces provide the ability to do this.

3.10.10 Test

GUI

An Administrator can temporarily test the configuration before saving it permanently. This is done by entering “Test” mode and applying (but not saving) settings. This can be useful if the desired configuration change could result in dropping communication to a radio that is being configured. For example, changing the maximum transmit power of a radio from over its active link could result in the link dropping. By testing the configuration, a misconfigured radio link would return at the end of the test period.

3.10.11 Factory Defaults Reset

GUI	CLI
-----	-----

If desired, an Administrator can return a radio to its factory default settings in order to provide a fresh starting point for configuration.

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**CHAPTER 4
DEPLOYMENT SCENARIOS**

4.1 INTRODUCTION

The RF-7800W radio can be deployed in various At-the-Halt and On-the-Move scenarios, which may require different configurations.

4.2 AT-THE-HALT

For fixed and nomadic infrastructure deployments, the appropriate System Mode should be selected, depending on the number of required Subscriber Stations (SS).

4.2.1 SPMP

Simple Point to Multipoint (SPMP) supports an arbitrary number of SS—up to 124 per Sector Controller (SC)—but is optimized for deployments of less than 10 SS. See [Figure 4-1](#). All radios must operate on the same Frequency and Channel Width. SS can communicate between each other by relaying through the SC, which reduces throughput and increases latency.

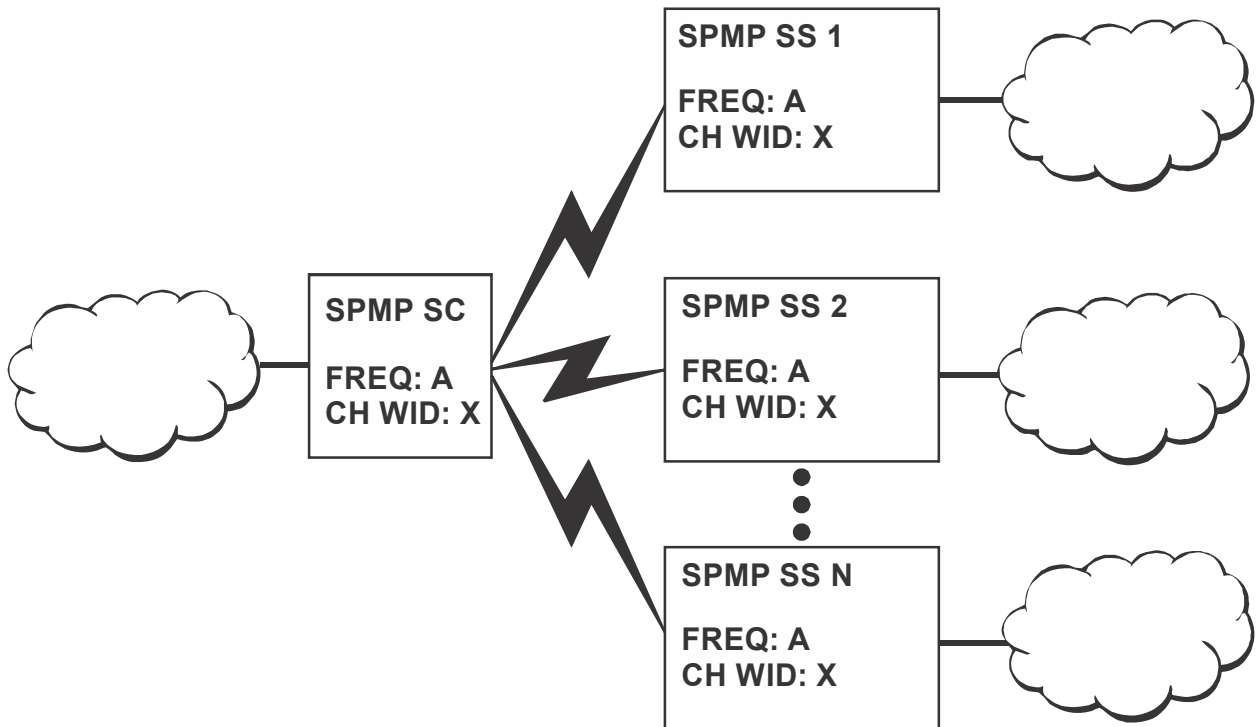


Figure 4-1. SPMP Deployment

4.2.2 SPTP

Simple Point to Point (SPTP) supports one SS at a time per SC. See [Figure 4-2](#). Both radios must operate on the same Frequency and Channel Width. While SPMP can be used with one SS, SPTP is optimized to operate with only one SS and therefore has slightly different behavior.



Figure 4-2. SPTP Deployment

4.3 ON-THE-MOVE

While the RF-7800W radio can operate On-the-Move with SPTP and SPMP, two mutually exclusive features supported by SPMP (Multi-Hop and Roaming) provide better performance.

4.3.1 Multi-Hop

Multi-Hop allows SS to communicate directly with other SS in certain situations in order to maintain connectivity. Refer to [Paragraph 3.8.10](#). All radios must operate on the same Frequency and Channel Width. All SS and the SC must be configured to use the same Link Template.

See [Figure 4-3](#), the panels of the figure are described below:

Panel 1 - Multiple SS are linked directly to the SC.

Panel 2 - SS N relays through SS 2.

Panel 3 - SS N and SS 1 relay through SS 2.

Panel 4 - SS N relays through SS 1 and SS 1 relays through SS 2.

Panel 5 - SS 1 operates as a Failover SC, since the original SC is no longer accessible. When the original SC becomes accessible again, the SS not acting as Failover SC would link to the SC and eventually the Failover SC would revert to being an SS.

4.3.2 Roaming

Roaming allows SS to move between SC without losing network connectivity. Refer to [Paragraph 3.8.4.3](#). All SC must be connected to the same network via their Ethernet ports. SC which can see each other must be on different Frequencies and may be on different Channel Widths. All SS and SC must be configured to use the same Link Template.

See [Figure 4-4](#), the panels of the figure are described below:

Panel 1 - The SS is linked to SC 1, while also seeing signal from SC 2.

Panel 2 - The SS maintains a link to SC 1, while the signal from SC 2 improves and the signal from SC N becomes present.

Panel 3 - The SS registers to SC 2 since it has the best signal, while the signal from SC N improves and the signal from SC 1 degrades.

Panel 4 - The SS registers to SC N since it has the best signal, while the signals from SC 1 and SC 2 degrade.

Panel 5 - The SS maintains a link to SC N, while the signal from SC 2 degrades and the signal from SC 1 is no longer present.

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CHAPTER 5

TROUBLESHOOTING AND MAINTENANCE

5.1 INTRODUCTION

This chapter provides troubleshooting data necessary for fault isolation and preventive maintenance guidelines.

5.1.1 Scope of this Chapter

The procedures presented in this chapter assume that a Level I fault has led the user to suspect a fault with the RF-7800W HCLOS Radio. The user begins the troubleshooting process with the Factory Reset procedure.

The maintainer will use the status code/system log troubleshooting procedures if there is a fault as a result of a status code or system log. The maintainer will use the non-BIT troubleshooting procedure if there is a non-Built-in Test (BIT) fault. The radio system is returned to operational readiness once the problem is found and corrected.

5.2 TROUBLESHOOTING PROCEDURES

Troubleshooting starts with the factory reset procedure described below.

NOTE

Factory defaults can be restored using either the Command Line interface (CLI) command of **save defaultconfig [Enter]** or **Factory Defaults** utility in the Navigation menu (left side pane) of the GUI.

5.2.1 Factory Reset Procedure

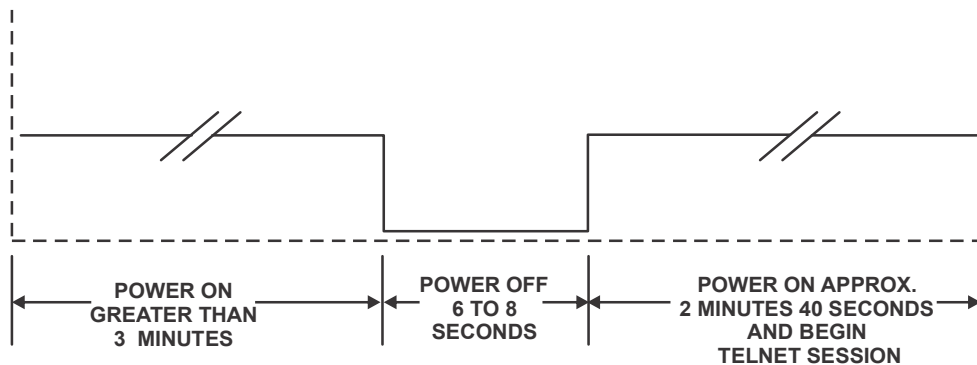
See [Figure 5-1](#). It may be necessary to reset to the factory IP address (e.g. due to lost admin user name and password). This can be accomplished by having local access to the Power over Ethernet (PoE) Injector, the ability to power-cycle the RF-7800W HCLOS Radio, a PC with a Telnet client, and an Ethernet cable. Perform the following procedure to reset the factory default IP address:

- a. Connect a PC to the input connector of a PoE Injector using an Ethernet cable.
- b. Connect the RF-7800W HCLOS Radio to the output connector of the PoE supply using an Ethernet cable and leave the radio powered on for a few minutes.
- c. Open a command prompt window on the PC and type **telnet 192.168.26.2** without pressing **[Enter]**.
- d. Open a second command prompt window, type **ping 192.168.26.2 -t**, and press **[Enter]**.
- e. Remove power from the radio for approximately six to eight seconds by disconnecting the Ethernet cable from the Output connector of the PoE Injector and then reconnecting.
- f. Observe that pings return from 192.168.26.2 (approximately 2 minutes 40 seconds).
- g. Press **[Enter]** in the Telnet window on the PC.
- h. Observe the Login prompt, and if you do not see the Login prompt, repeat the command **telnet 192.168.26.2** and press **[Enter]** until you see the prompt.

NOTE

The Telnet session must connect to the RF-7800W HCLOS Radio within approximately 20 seconds from when the radio starts responding to pings. Logging into the default IP Address will cause the unit to be reset to the factory default configuration.

- i. Enter the following to log in:
 - 1. User Name - type **admin** and press **[Enter]**.
 - 2. Password - type **admin** and press **[Enter]**. The password characters do not echo to the computer screen.
- j. Enter the command **save defaultconfig** and press **[Enter]** to ensure that all parameters are set to default values.
- k. Enter the following commands to set a new IP address. A **192.168.26.2#** prompt is shown at each step.
 - 1. **set ipaddr <IP Address>** followed by **[Enter]**.
Note the spaces in this example: **set ipaddr 192.168.100.1**
 - 2. **save config** followed by **[Enter]**. A message such as, "Connection to host lost." will display.
- l. Log in to the new IP address and use the **user** command to enter new user name and password information, if required.



CL-0426-4200-0020

Figure 5-1. Factory Default Reset Time Frame

5.2.2 Factory Default Reset Behavior

When a factory default reset is detected, some parameters are reset to their default value:

- Users (default user names and passwords).
- All cryptographic material (keys, certificates, encryption settings).
- All System Description information.

The unit will automatically load the previous configuration if no one connects to the unit using telnet within 20 seconds after the radio is available at the default IP address.

5.3 NETWORK TROUBLESHOOTING

Problem: The radio IP address is unknown.

- Symptom: The radio is not able to be managed remotely.
- Solution: The default radio IP address is 192.168.26.2. A Console Port cable (Harris PN 12069-3901-Axxx) can be used to locally log into the radio to determine the IP address if the IP address has been changed. If this is not an option, the radio can be power cycled in such a way that will reset the radio's IP address to the default. Refer to [Paragraph 5.2.1](#) for the factory reset procedure.

Problem: The radio IP address is the same as another device on the local network.

- Symptom: The radio's management interfaces (HTTP, HTTPS, Telnet, SSH, SNMP) are not accessible to a computer on the same network.
- Solution: Change the radio IP address to be unique.

Problem: The radio IP address is the same as another device on the other end of the radio link.

- Symptom: The radio's management interfaces are not accessible to a computer on the same network segment, but only when the local radio has an active RF link to the remote radio.
- Solution: Change the radio IP address to be unique.

Problem: The radio has Management VLAN tagging enabled and set to a VLAN ID that is not the same as other computers on the network.

- Symptom: The radio's management interfaces are not available.
- Solution: The network administrator needs to enable the VLAN ID on switch ports for computers that need to access the radio's management interfaces.

Problem: The radio and computer are configured for different subnets.

- Symptom: The radio's management interfaces are not accessible to a computer on the same network segment.
- Solution: Change the IP addresses and subnet masks so both devices are on the same subnet. If this is not an option, the network is not configured properly.

Problem: HTTP, Telnet, and SNMPv2 are not accessible when FIPS Mode is enabled.

- Symptom: Some of the radio's management interfaces are accessible, but others are not.
- Solution: This is a requirement for FIPS mode. Use the HTTPS, SSH, and SNMPv3 interfaces.

Problem: An untrusted SSL Certificate has been loaded into the radio.

- Symptom: A warning is displayed when attempting to access the radio's HTTPS management interface.
- Solution: Obtain or generate a valid SSL Certificate that is trusted by the computer's browser.

5.4 WIRELESS TROUBLESHOOTING

- a. Are both radios powered up?
 1. Test this by pinging each radio from a locally connected computer.
- b. Do both radios pass BIT with antennas attached?
 1. Log into the GUI and click Utilities > Built-In Test > Run BIT.
 2. VSWR failure could indicate a cabling problem.
 3. Power Out failure could indicate a radio problem.
- c. Are both radio antennas generally pointing towards each other?
 1. Test this with a compass (not included) or use a long-range sighting scope (not included).
- d. Are both radios on the same Frequency?
 1. Log into the GUI and check Status > System Status > Channel Frequency.
- e. Are both radios on the same Channel Size?
 1. Log into the GUI and check Configuration > Wireless > Channel Size.
- f. Is one of the radios configured as a Sector Controller (SC)?
 1. Log into the GUI and check Configuration > Wireless > System Mode.
- g. Do both radios have the appropriate RF port(s) enabled?
 1. Log into the GUI and check Configuration > Wireless > Radio Mode.
- h. Is the transmit power high enough to reach the remote radio?
 1. Log into the GUI and check Status > System Status > Current Tx Power.
- i. Is the maximum distance set high enough for the link?
 1. Log into the GUI and check Configuration > Wireless > Max. Distance.
- j. Is the operating channel free from interference?
 1. Log into the GUI and click Utilities > Spectrum Sweep.
 2. Disable the Sector Controller (SC) transmitter while sweeping on the Subscriber Station (SS).

- k. Is the link properly configured on the SC?
 - 1. (SPMP) Log into the SC GUI and click the name of the link in Configuration > Subscriber Links.
 - 2. (SPTP) Log into the SC GUI and check Configuration > Link.
 - 3. Subscriber MAC must be the MAC address of the SS radio for Normal Links or the STID and STID Password Hash must match that of the SS if using a Link Template.
 - 4. Ensure Adaptive Modulation is enabled with the Max DL and UL Burst Rates set to the appropriate values based on propagation analysis.
- l. Is the link properly configured on the SS?
 - 1. Log into the SS GUI and check Configuration > Wireless.
 - 2. SC MAC must be 00:00:00:00:00:00 or the MAC address of the SC radio.
 - 3. STID and STID Password Hash must match that of the SC if using a Link Template.
- m. Do both radios have the same security configuration?
 - 1. Log into the GUI and check Configuration > Wireless > Traffic Flow Security Configuration.
 - 2. If the Shared Secret Hash values are not the same, the Shared Secret was not entered properly.
- n. Is there a problem with X.509 authentication?
 - 1. (SPMP SC and SPMP SS) Log into the GUI and click the Configuration icon of the link in Status > Links Summary.
 - 2. (SPTP SS, SPTP SC) Log into the GUI and check Status > Link Status.
 - 3. The link will be Active but not have a Data Link Condition.
 - 4. Refer to the Security Supplement (10515-0426-4000) for more information.

5.5 PREVENTIVE MAINTENANCE

Preventive maintenance is the systematic, scheduled care and inspection of equipment to prevent equipment failure and to reduce downtime. This consists of keeping the equipment clean, dry, and dust-free. Clean equipment using a soft brush, a moist sponge, and a cloth. Check all hardware for looseness and make sure units are secure. Check all connectors for debris, damage or corrosion. Ensure protective caps are in place if connectors are not in use. Check all cables and antennas for damage (cracks, breaks, or strains) and repair or replace as required.

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**CHAPTER 6
SUPPORT DOCUMENTATION**

6.1 INTRODUCTION

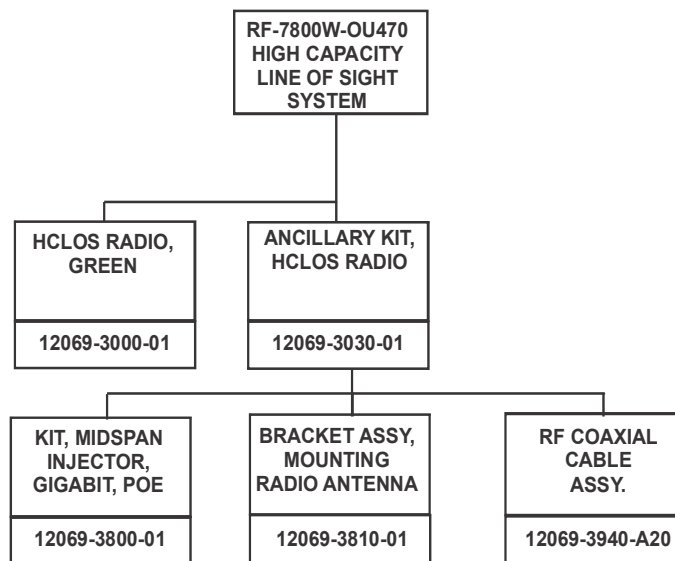
This chapter contains reference data for system level fault isolation and maintenance of the RF-7800W HCLOS Radio. This information consists of suggested tools, parts lists, and assembly component references.

6.2 ADDITIONAL SUPPORT

To ensure our customers have continued success with our products, Harris provides logistics planning, spares, tools, technical documentation, training, product service, and field service. For any of these services, call 585-244-5830 (toll free: 866-264-8040), or visit the Harris Support web site at <https://tcpremier.harris.com>.

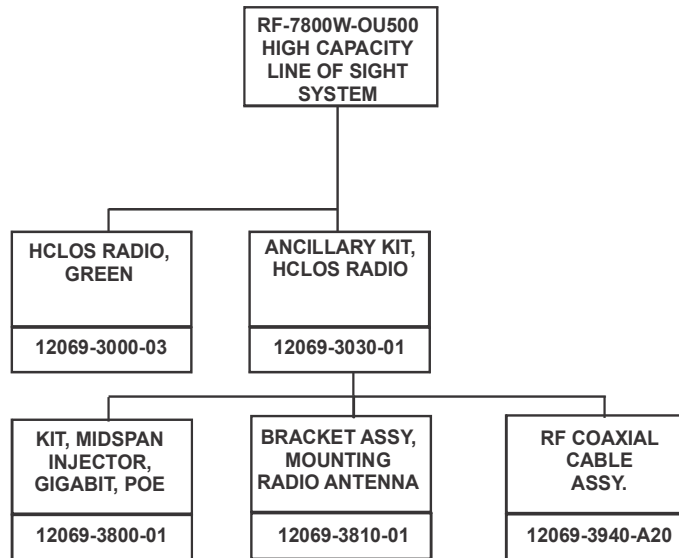
6.3 PARTS LISTS

The following provides parts lists for the systems. [Figure 6-1](#) shows the family tree for the RF-7800W-OU470 System (green), [Figure 6-2](#) shows the family tree for the RF-7800W-OU500 System (green), [Figure 6-3](#) shows the family tree for the RF-7800W-OU471 (tan), [Figure 6-4](#) shows the family tree for the RF-7800W-OU501 (tan).



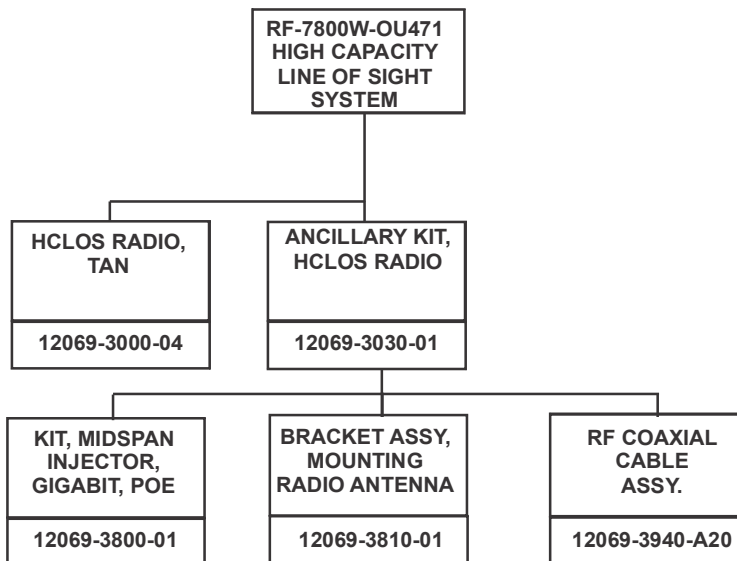
CL-0426-4200-0016

Figure 6-1. RF-7800W-OU470 Family Tree



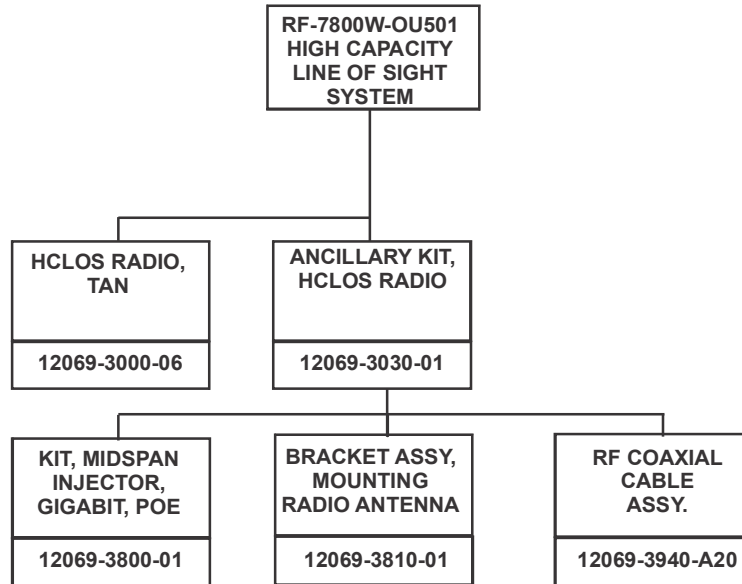
CL-0426-4200-0017

Figure 6-2. RF-7800W-OU500 Family Tree



CL-0426-4200-0026

Figure 6-3. RF-7800W-OU471 Family Tree



CL-0426-4200-0027

Figure 6-4. RF-7800W-OU501 Family Tree

6.3.1 Units and Cables

Table 6-1 lists the units and cables that make up the RF-7800W HCLOS Radio configuration. The units and cables are called out in the fault isolation and maintenance procedures. The right column references the relevant figures for the RF-7800W HCLOS Radio configuration in the corresponding row.

Table 6-1. RF-7800W HCLOS Radio Units and Cables

Description	CAGE	Part Number	Figure Number
HCLOS Radio	14304	12069-3000-01 (OU470) 12069-3000-03 (OU500) 12069-3000-04 (OU471) 12069-3000-06 (OU501)	Figure 6-5
Ancillary Kit, Broadband Ethernet Radio	14304	12069-3030-01	Figure 6-5
Kit, MidSpan Injector - Power over Ethernet (PoE), Gigabit (with Plug Adapters and Power Cord)	14304	12069-3800-01	Figure 6-5
Bracket Assembly, Mounting, Radio Antenna	14304	12069-3810-01	Figure 6-5
RF Coaxial Cable, 20-Inch	14304	12069-3940-A20	Figure 6-5

6.3.2 Attaching Hardware

Table 6-2 lists the attaching hardware supplied with the RF-7800W HCLOS Radio. Item names, descriptions, quantities, and part number are provided. Attaching hardware items are also identified in Figure 6-5.

Table 6-2. Attaching Hardware Supplied with RF-7800W HCLOS Radio

Letter Code	Item Name	Description	Quantity	Part Number	Figure Number
A	Flat Washer	.281 x .625 x .065	12	*MS15795-810B	Figure 6-5
B	Lock Washer	1/4-Inch, Split	12	*MS35338-139B	Figure 6-5
C	Nut	1/4-20	4	*MS35649-2254B	Figure 6-5
D	Hex head Bolt	1/4-20 x 3/4 Inch	8	*MS35307-306B	Figure 6-5
E	Hex Cap Screw	1/4-20 x 6 Inch	4	*12069-3817-01	Figure 6-5
F	Lock Washer	#10, Star	1	MS35335-60	Figure 6-5
G	Phillips-head Screw	#10-32 x 3/8 Inch	1	MS51958-61B	Figure 6-5
H	Wing Nut Bolt	1/4-20 x 3/4 Inch	4	*12069-3815-01	Figure 6-5
I	Wing Nut	1/4-20	4	*12069-3818-01	Figure 6-5

NOTE

*These items are part of supplied radio mounting bracket assembly (12069-3810-01).

6.4 ANTENNAS

- a. Antennas for FCC Compliance at 4.9 GHz:

This device has been designed to operate with the antennas listed in the following table, operating with the maximum specified gain settings.

FCC 4.94 - 4.99 GHz SPTP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)		
			5 MHz	10 MHz	20 MHz
RF-7800W-AT206	8	Omni	22	22	22
RF-7800W-AT207	14	90°	22	22	22
RF-7800W-AT201	21	10°	22	22	22
RF-7800W-AT202	26	6°	22	22	22
RF-7800W-AT203	30	4.4°	21	22	22

- b. Antennas for FCC Compliance at 5.2 GHz:

This device has been designed to operate with the antennas listed in the following table, operating with the maximum specified gain settings.

Table 6-3. FCC 5.150-5.250 GHz SPTP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)			
			5 MHz	10 MHz	20 MHz	40 MHz
RF-7800W-AT201	21	10°	7	6	-2	-10
RF-7800W-AT202	26	6°	-2	0	-1	-10
RF-7800W-AT203	30	4.4°	-4	-1	-1	-10

Table 6-4. FCC 5.150-5.250 GHz SPMP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)			
			5 MHz	10 MHz	20 MHz	40 MHz
RF-7800W-AT246	5	Omni	14	17	10	3
RF-7800W-AT206	8	Omni	11	15	9	4
RF-7800W-AT207	14	90°	6	9	6	0

- c. Antennas for FCC Compliance at 5.3 GHz:

This device has been designed to operate with the antennas listed in the following table, operating with the maximum specified gain settings.

Table 6-5. FCC 5.250-5.350 GHz SPTP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)			
			5 MHz	10 MHz	20 MHz	40 MHz
RF-7800W-AT201	21	10°	-7	-4	-1	-10
RF-7800W-AT202	26	6°		-9	-6	-10
RF-7800W-AT203	30	4.4°			-10	-4

Table 6-6. FCC 5.250-5.350 GHz SPMP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)			
			5 MHz	10 MHz	20 MHz	40 MHz
RF-7800W-AT246	5	Omni	8	11	12	4
RF-7800W-AT206	8	Omni	6	9	10	1
RF-7800W-AT207	14	90°	0	3	6	-5

d. Antennas for FCC Compliance at 5.6 GHz:

This device has been designed to operate with the antennas listed in the following table, operating with the maximum specified gain settings.

Table 6-7. FCC 5.470-5.725 GHz SPTP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)			
			5 MHz	10 MHz	20 MHz	40 MHz
RF-7800W-AT201	21	10°	-6	-3	-3	-10
RF-7800W-AT202	26	6°		-10	-7	-6
RF-7800W-AT203	30	4.4°			-10	-9

Table 6-8. FCC 5.470-5.725 GHz SPMP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)			
			5 MHz	10 MHz	20 MHz	40 MHz
RF-7800W-AT246	5	Omni	8	11	11	4
RF-7800W-AT206	8	Omni	6	8	8	1
RF-7800W-AT207	14	90°	-1	2	5	0

e. Antennas for FCC Compliance at 5.8 GHz:

This device has been designed to operate with the antennas listed in the following table, operating with the maximum specified gain settings.

FCC 5.725 - 5.850 GHz SPTP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)			
			5 MHz	10 MHz	20 MHz	40 MHz
RF-7800W-AT206	8	Omni	22	22	22	22
RF-7800W-AT207	14	90°	22	22	22	22
RF-7800W-AT201	21	10°	22	22	22	22
RF-7800W-AT202	26	6°	22	22	22	22
RF-7800W-AT203	30	4.4°	22	22	22	22

FCC 5.725 - 5.850 GHz SPMP Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)			
			5 MHz	10 MHz	20 MHz	40 MHz
RF-7800W-AT206	8	Omni	22	22	22	22
RF-7800W-AT207	14	90°	19	19	19	19

- f. Antennas for ETSI Compliance at 5.8 GHz:

This device has been designed to operate with the antennas listed in the following table, operating with the maximum specified gain setting.

ETSI 5.725 - 5.875 GHz Operation

Model Number	Gain (dBi)	Description	Max Tx Power (dBm)	
			10 MHz	20 MHz
RF-7800W-AT206	8	Omni	22	22
RF-7800W-AT207	14	90°	19	22
RF-7800W-AT201	21	10°	12	15
RF-7800W-AT202	26	6°	7	10
RF-7800W-AT203	30	4.4°	3	6

6.5 CHASSIS CONNECTOR DATA

Table 6-9 provides pin out data for the J6 connector.

Table 6-9. RF-7800W HCLOS Radio J6 Accessory Port

Pin #	Signal Name	Dir	Description
A	Accessory Tx/Rx+	I/O	Per TIA/EIA-485
B	Accessory Tx/Rx-	I/O	Per TIA/EIA-485
C	Keyline	O	Floating, Active Low
D	-	N/C	Future Use

Table 6-9. RF-7800W HCLOS Radio J6 Accessory Port (Continued)

Pin #	Signal Name	Dir	Description
E	Accessory Ground	N/A	Ground
F	Console Rx+	I	Per TIA/EIA-422
G	Console Rx-	I	Per TIA/EIA-422
H	Console Tx+	O	Per TIA/EIA-422
J	Console Tx-	O	Per TIA/EIA-422
K	Console Ground	N/A	Per TIA/EIA-422

6.5.1 Mating Connectors

Table 6-10 provides part number information for the cable connectors that mate to the chassis connectors.

Table 6-10. Connectors and Mating Connector Part Numbers

Chassis Connector	Mating Connector Part Number
RF-7800W HCLOS Radio J1 Ethernet PoE	Amphenol RJF6B, Plug Key Code 'A'
RF-7800W HCLOS Radio J6 Accessory	MS3116F12-10P

APPENDIX A**GLOSSARY****A.1 GLOSSARY**

The following provides a glossary of terms used in this manual.

-A-

AC	Alternating Current
Admin	Administrator
AES	Advanced Encryption Standard
ARP	Address Resolution Protocol
ATPC	Automatic Transmit Power Control
Azimuth	Horizontal direction containing bearing from Global Positioning System [GPS] or compass

-B-

bit	A binary digit that can have a value of 0 or 1.
BIT	Built-in Test
BPSK	Binary Phase Shift Keying

-C-

C	Celsius
CA	Certification Authority
CAGE	Commercial and Government Entity
Cat5e	Category 5e, Used in reference to Ethernet cabling that conforms to Cat5e specification.
CD-ROM	Compact Disk-Read-Only Memory
CE	Conformité Européene (European Conformity)
CIR	Committed Information Rate
CLI	Command Line Interface
cm	Centimeter
CN	Common Name
config	Configuration

-D-

D	Depth
dB	Abbreviation for decibel, which is one-tenth of a bel.
dB_i	The amount of power relative to isotropic (power equal in all directions).
dB_m	The amount of power relative to that represented by a 1 kHz signal which is fed one milliwatt of power into a 600 ohm resistive load; or 1 dB relative to one milliwatt, 0 dB _m = 1 mW.
DC	Direct Current
DFS	Dynamic Frequency Selection
DL	Downlink

-E-

EIM	Enhanced Interference Mitigation
EIRP	Effective Isotropic Radiated Power
Elevation	Vertical direction in degrees
EMR	Electromagnetic Radiation
EN	European Standard, telecommunications series
ETSI	European Telecommunications Standards Institute

-F-

F	Fahrenheit
FCC	Federal Communications Commission
FD	Full Duplex
FEC	Forward Error Correction
ft	Foot/Feet
FTP	File Transfer Protocol

-G-

GHz	Abbreviation for Gigahertz, or one billion cycles per second.
GMT	Greenwich Mean Time
GPS	Global Positioning System
GUI	Graphical User Interface

-H-

H	Height
HCLOS	High Capacity Line-Of-Sight
HD	Half Duplex
Hex	Hexagonal

-H- (Continued)

HTTP	Hypertext Transfer Protocol (world wide web protocol)
HTTPS	Hypertext Transfer Protocol Secure
Hz	Abbreviation for hertz, or cycles per second.

-I-

ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
in	Inches
IN-LBS	Inch-Pounds
INE	Inline Network Encryptor
IP	Internet Protocol

-J-**-K-**

kg	Abbreviation for kilogram, or one thousand grams.
km	Kilometers or one thousand meters

-L-

LAN	Local Area Network
lbs	Abbreviation for pound
LED	Light Emitting Diode
LLC	Logical Link Control
LOS	Line of Sight

-M-

m	Meter
MAC	Media Access Control
Mbps	Mega or one million bits per second.

-M- - Continued

MHz	Abbreviation for Megahertz, or one million cycles per second.
MIB	Management Information Base
MIL-STD	Military Standard
MIMO	Multiple Input Multiple Output
mW	milli Watt

-N-

N/A	Not Applicable
NEMA	National Electric Manufacturers Association

-O-

OFDM	Orthogonal Frequency Division Multiplexing
OLOS	Optical Line of Sight

-P-

PA	Power Amplifier
PC	Personal Computer
PIR	Peak Information Rate
PLL	Phase Lock Loop
PMP	Point-to-Multiple Points
PoE	Power Over Ethernet
PTP	Point-to-Point

-Q-

QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase-Shift Keying

-R-

RADIUS	Remote Dial-In User Service
RF	Radio Frequency
RMA	Return Material Authorization
RSSI	Receive Signal Strength Indication
Rx	Receive

-S-

SC	Sector Controller
SFTP	SSH File Transfer Protocol
SINADR	Signal-to-Noise and Distortion Ratio
SISO	Single Input, Single Output
SMX	Spatial Multiplexing
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol

-S- - Continued

SPMP	Simple Point-to-Multiple Point
SPTP	Simple Point-to-Point
SS	Subscriber Station
SSH	Secure Shell
SSL	Secure Socket Layer
STC	Space-Time Coding
STID	Station Template Identifier

-T-

TDD	Time Division Duplexing
TELNET	Telecommunication Network
TFS	Traffic Flow Security
TFTP	Trivial File Transfer Protocol
Tx, TX	Transmit

-U-

UBR	Uncoded Burst Rate
UK	United Kingdom
UL	Uplink
US/USA	United States (of America)
UTF-8	Universal Coded Character Set Transformation Format - 8 Bit

-V-

V	Volt(s)
VDC	Volts Direct Current

-V - Continued

VLAN	Virtual Local Area Network
VSWR	Voltage Standing Wave Ratio

-W-

W	Watts, Width
WAN	Wide Area Network

-X-

-Z-

APPENDIX B

EU DECLARATION OF CONFORMITY

EU Declaration of Conformity (DoC)

We

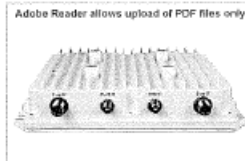
Company name: Harris Corporation, Communication Systems
Postal address: 1680 University Avenue
Postcode and City: 14610 Rochester
Telephone number: 1-585-244-5830
E-Mail address: legalconnections@harris.com

declare that the DoC is issued under our sole responsibility and belongs to the following product:

Apparatus model/Product: RF-7800W-OU470/471/492/500/501
Type: N/A
Batch: N/A
Serial number: N/A

Object of the declaration (identification of apparatus allowing traceability; it may include a colour image of sufficient clarity where necessary for the identification of the apparatus):

MIMO Radio in the 5.725 - 5.875 GHz band



The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

EMC Directive 2014/30/EU
Radio Equipment Directive: 2014/53/EU

The following harmonised standards and technical specifications have been applied:

Title, Date of standard/specification:
BRAN: EN 302 502 1.2.1 2008-07
RF Exposure: EN 62311 2008-01
EMC: EN 301 489-1 V1.9.2 2011-09
EMC: EN 301 489-17 V2.2.1 2012-09

Notified body (where applicable): N/A
4 digit notified body number: N/A

Additional information:
N/A

Signed for and on behalf of:
Rochester, New York, USA 2016/10/06 Jacquelyn Marthinsen, Subcts Mngr
Place of issue Date of issue Name, function, signature

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NAME: _____ DATE: _____

COMPANY: _____

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CITY: _____ STATE: _____

ZIP: _____ COUNTRY: _____

PHONE NUMBER (INCLUDE AREA CODE): _____



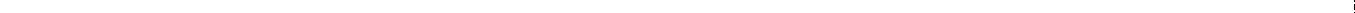
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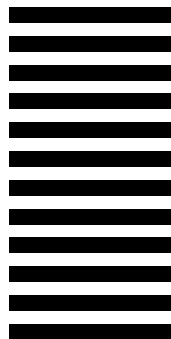
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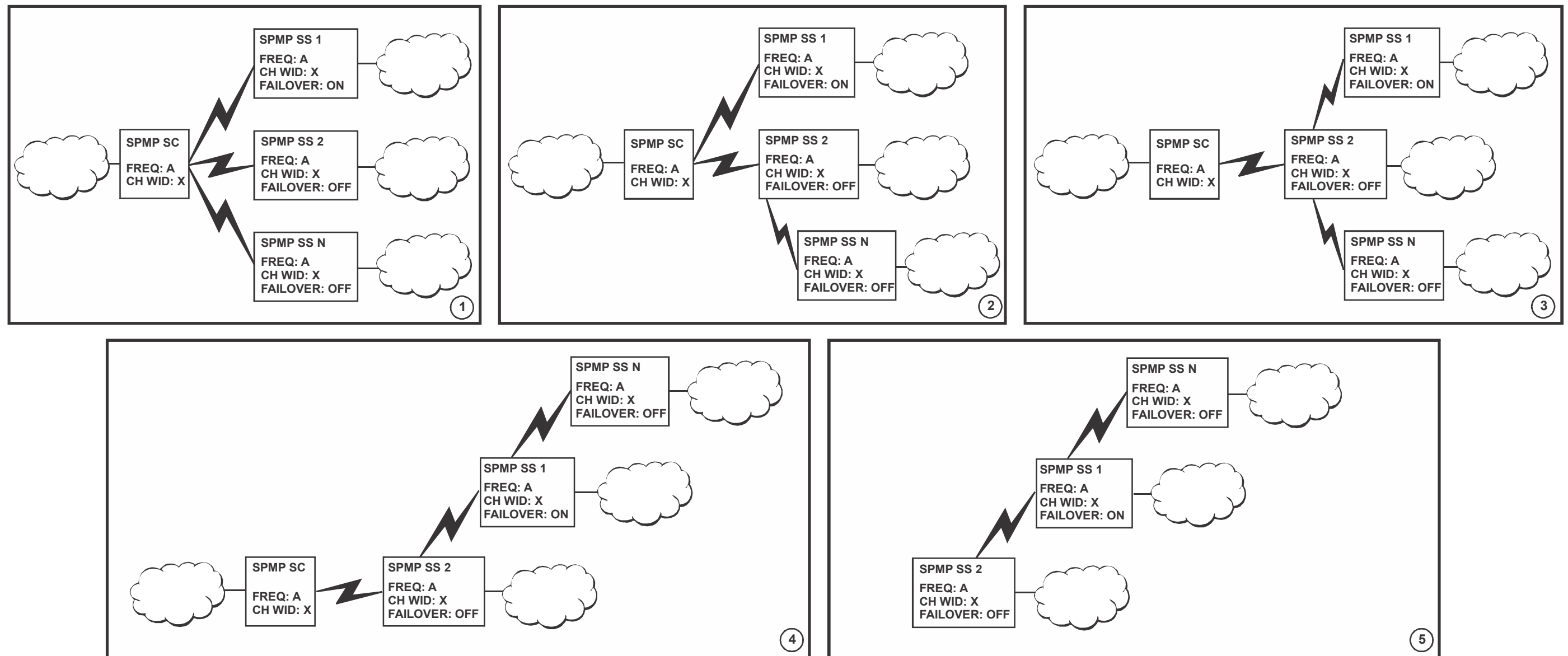


Figure 4-3. Multi-Hop Deployment

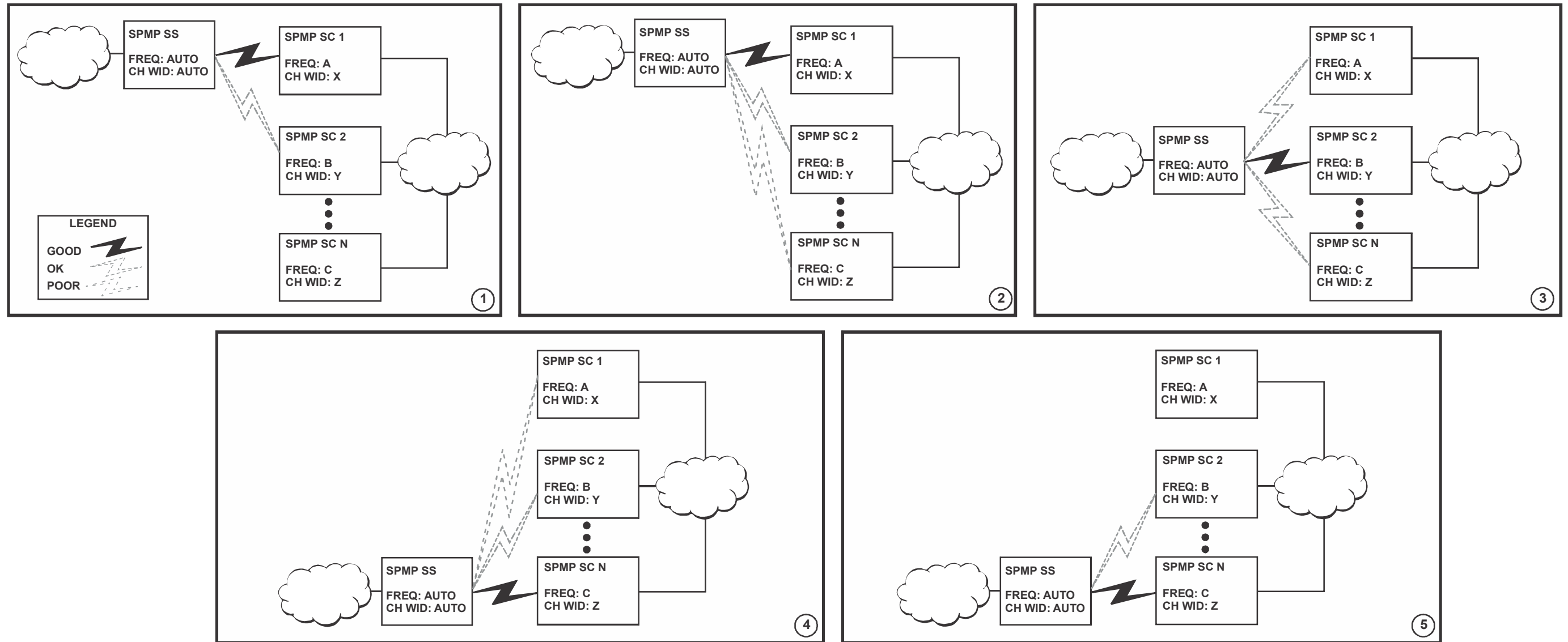
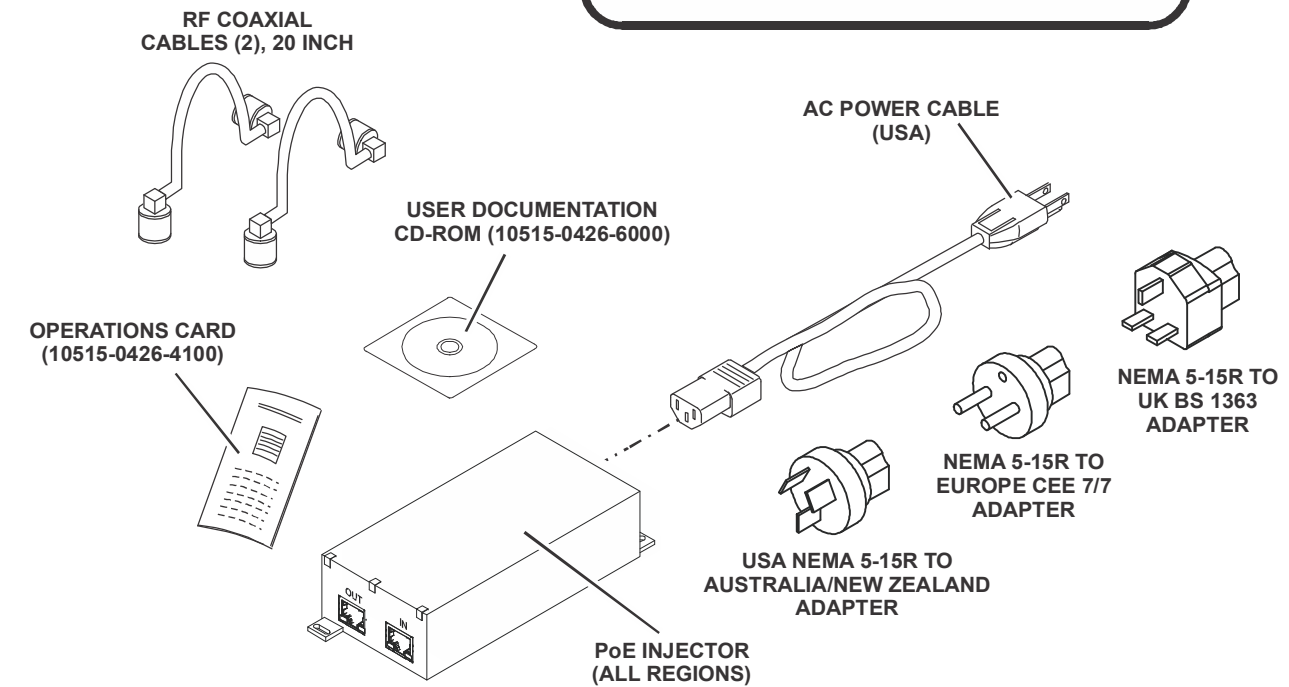
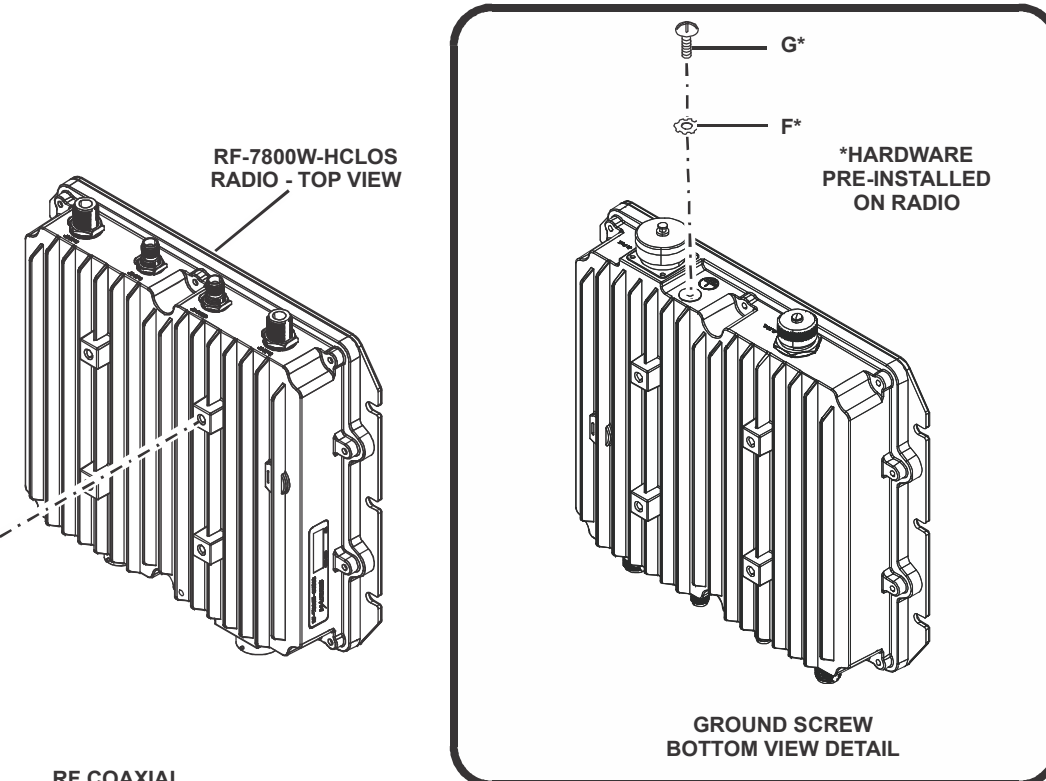
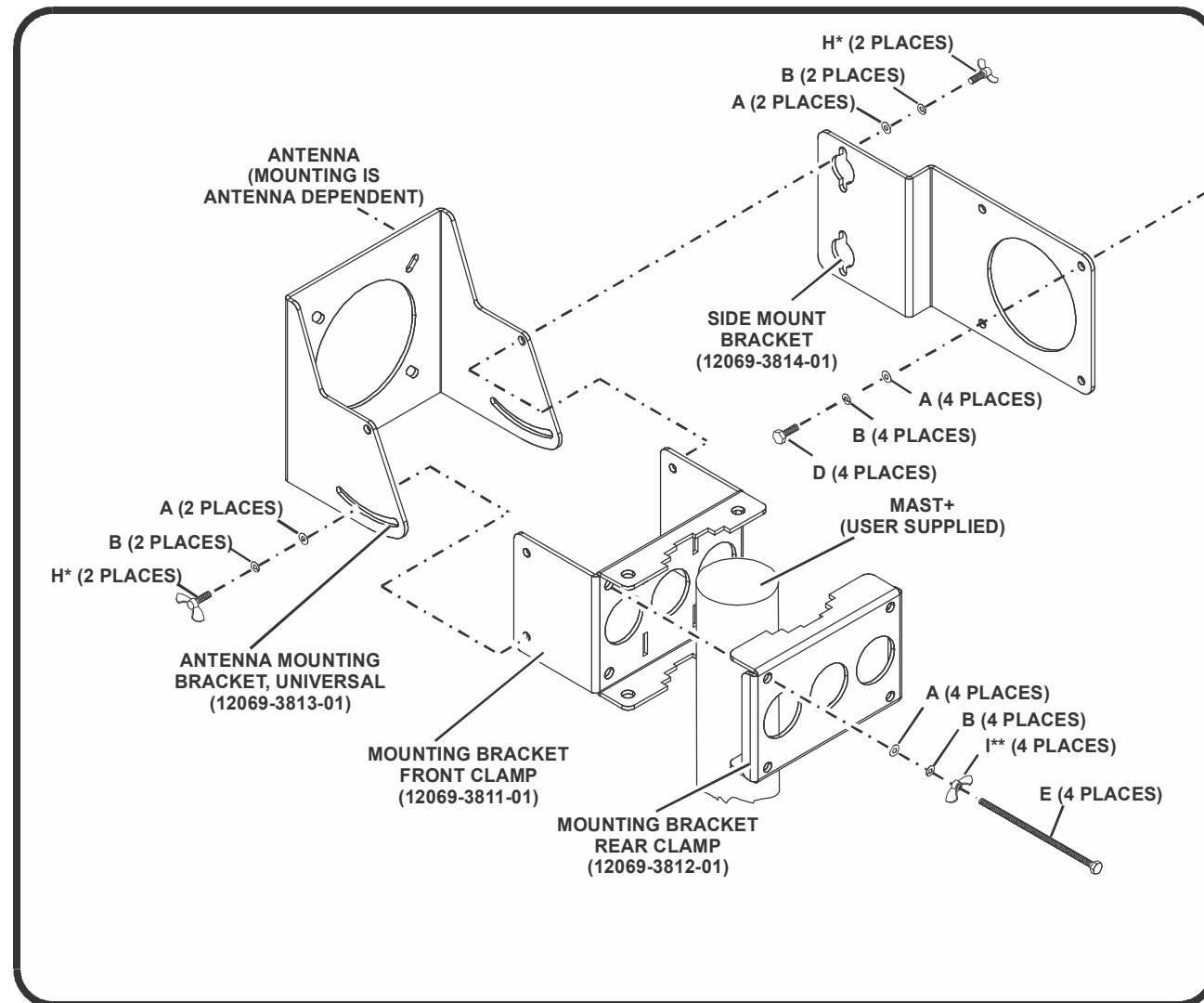


Figure 4-4. Roaming Deployment

TORQUE TO APPROXIMATELY 10 FT-LBS (120 IN-LBS) (14 N-M).
 *ALTERNATIVELY USE D IN PLACE OF H.
 **ALTERNATIVELY USE C IN PLACE OF I.
 + MAST MUST BE 1.5 INCHES TO 4.0 INCHES OUTER DIAMETER.

LETTER	DESCRIPTION	PART NUMBER
A	FLAT WASHER, .281 X .625 X .065	MS15795-810B
B	LOCK WASHER, 1/4-INCH, SPLIT	MS35338-139B
C	NUT, 1/4-20	MS35649-2254B
D	HEX HEAD BOLT, 1/4-20 X 3/4-INCH	MS35307-306B
E	HEX CAP SCREW, 1/2-20 X 6 INCH	12069-3817-01
F	STAR WASHER, #10	MS35335-60
G	PHILLIPS-HEAD SCREW, 10-32 X 1/2 INCH	MS51958-61B
H	WING NUT BOLT, 1/4-20 X 3/4-INCH	12069-3815-01
I**	WING NUT, 1/4-20	12069-3818-01



CL-0426-4200-0018

Figure 6-5. RF-7800W HCLOS Radio System Illustrated Parts List