ExtremeAir®, ExploreAir® HP, and ExploreAir® LR rc-Series (FDD)

Digital Microwave Radios
Installation and Management Guide

Models:

rc6150LR FCC/ITU/ETSI
rc7150LR ITU/ETSI
rc111xxHP FCC
rc11150LR FCC
rc112xx FCC/ITU/ETSI
rc182xx FCC
rc232xx FCC
rc152xx ITU/ETSI
rc182xx ITU/ETSI
rc232xx ITU/ETSI

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About this Document

This manual provides a complete description of the ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) family of Exalt Digital Microwave Radios and related software. This manual provides planners, engineers, installers, system administrators, and technicians general and specific information related to the planning, installation, operation, management, and maintenance of these devices.

Revision History

Date	Products and Release code
2011-10-28	Initial release
2012-02-17	Ethernet Loopback and RMON features; new rc11150 product release
2012-03-26	Performance Mode and ATPC features release
2012-06-04	ExploreAir LR XPIC and NTP features release
2012-09-14	ExploreAir LR QoS features release
2012-11-21	ExploreAir Enhanced ATPC, Overload Protection, and ATPC/ACM combination features release
2013-03-11	ExploreAir LR Ethernet Aggregation feature release
2013-12-16	ITU/ETSI models release
2014-01-31	ExploreAir LR Spectrum Analyzer feature release
2014-05-05	ExploreAir LR Space Diversity feature and ETSI/ITU model releases of 6GHz-Upper and 7GHz models

Icons

The following icons denote specific types of information:

Note: This symbol means take note. Notes contain helpful suggestions or references to materials not contained in the manual.

Warning! This symbol means there is a risk of electric shock or bodily injury. Before working on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

Caution! This symbol means be careful. There is a risk of doing something that might result in equipment damage or loss of data. This is a general warning, caution, or risk of danger.

Introduction

Exalt Communications, Inc. thanks you for your purchase. Our goal is to build the highest quality, highest reliability digital microwave radio products. This commitment to quality and reliability extends to our employees and partners alike. We appreciate any comments on how we can improve our products, as well as your sales and Customer Care experience.

Customer Care Hotline (USA):	(408) 688-0202
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Direct-Dial Telephone (USA):	(408) 688-0200
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Related Documentation and Software

This manual makes reference to other documentation and software files that may be necessary. To access all documents and software mentioned in this manual visit:

http://login.exaltcom.com

You must have a user account to view all downloads. Follow the online instructions to create a user account and request access.

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) Digital Microwave Radios

The Exalt ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) digital microwave radios are the most advanced carrier-class point-to-point terrestrial radio communications devices operating in the 6, 7, 11, 18, and 23GHz FCC and 6, 7, 8, 11, 15, 18, and 23GHz ITU/ETSI licensed frequency bands.

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios connect voice and/or digital data from one location to another, obviating the need for copper or fiber connectivity or enhancing existing connectivity by providing a redundancy solution, a primary solution, and/or additional capacity. Figure 1 and shows the ExtremeAir rc-Series (FDD) digital microwave radio.

Figure 1 ExtremeAir (FDD) digital microwave radio shown direct mounted on antenna

The ExtremeAir model number scheme uses the first two digits to define the general frequency band (in GHz), followed by the digit 2 and the last two digits to define the connector and base configuration.

The following ExtremeAir models of radios are covered in this manual:

- ExtremeAir rc112xx, rc182xx and rc232xx models for the 11, 18, and 23GHz FCC part 101 licensed bands, respectively
- ExtremeAir rc112xx, rc152xx, rc182xx, and rc232xx models for the 11, 15, 18, and 23GHz ITU/ESTI licensed bands, respectively
- ExtremeAir xxx00 models with one Gigabit-Ethernet PoE port
  - configured with 400Mbps of full-duplex Ethernet capacity
  - with license key upgrades for 600, 800, and 1000Mbps full-duplex capacity
  - with license key upgrade for High-power Tx (11GHz band option only)
  - with license key upgrade for FIPS-197 compliant 128-bit or 256-bit AES encryption
- ExtremeAir xxx05 models with three Gigabit-Ethernet ports (plus one PoE)
  - configured with 400Mbps of full-duplex Ethernet capacity
  - with license key upgrades for 600, 800, and 1000Mbps full-duplex capacity
  - with license key upgrade for High-power Tx (11GHz band option only)
  - with license key upgrade for FIPS-197 compliant 128-bit or 256-bit AES encryption

The ExploreAir HP model number scheme uses the first two digits to define the general frequency band (in GHz), followed by the digit 1 and the last two digits to define the connector and base configuration.

The following ExploreAir HP models of radios are covered in this manual:

- ExploreAir 111xx HP 11GHz FCC part 101 licensed band
- ExploreAir HP xxx00 models with one Gigabit-Ethernet PoE port
  - configured with 100Mbps of full-duplex Ethernet capacity
  - with license key upgrades for 200, 300, 400, and 500Mbps full-duplex capacity
  - with license key upgrade for FIPS-197 compliant 128-bit or 256-bit AES encryption
- ExploreAir HP xxx05 models with three Gigabit-Ethernet ports (plus one PoE)
  - configured with 100Mbps of full-duplex Ethernet capacity
  - with license key upgrades for 200, 300, 400, and 500Mbps full-duplex capacity
  - with license key upgrade for FIPS-197 compliant 128-bit or 256-bit AES encryption
- ExploreAir HP xxx10 models with one Gigabit-Ethernet PoE port, one Gigabit-Ethernet port, and two 2xT1/E1 ports
  - configured with 100Mbps of full-duplex Ethernet capacity and 4x T1/E1
  - with license key upgrades for 200, 300, 400, and 500Mbps full-duplex capacity
  - with license key upgrade for FIPS-197 compliant 128-bit or 256-bit AES encryption

The ExploreAir LR model number scheme uses the first two digits to define the general frequency band (in GHz), followed by “150” to define the connector and base configuration.

The following ExploreAir LR models of radios are covered in this manual:

- ExploreAir LR 6150 (6L), 6150 (6U/7L), and 11150 models for the 6-Lower, 6-Upper/7-Lower, and 11GHz FCC part 101 licensed bands, respectively. Also the 6150 (6U) and 7150 models for the 6-Upper and 7GHz ITU/ETSI bands, respectively. 11GHz models are also ITU/ETSI.
- ExploreAir xx150 models with one Gigabit-Ethernet PoE port, one 1000BaseX (SFP) port for direct fiber access, one DC port for power-over-coaxial cable connection, and two ports supporting SD or XPIC configurations (XCON1 and XCON2)
  - configured with 100Mbps of full-duplex Ethernet capacity
  - with license key upgrades for 200, 300, 400, 500, and 600Mbps full-duplex capacity
  - with license key upgrade for FIPS-197 compliant 128-bit or 256-bit AES encryption

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) models require a clear line-of-sight and proper path clearance to achieve a high-performance, reliable connection. Perform professional path engineering and site planning *before* installing this equipment.

The primary focus of this document is the installation and maintenance of the digital microwave radio, and assumes that path engineering and site planning were already performed.

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios utilize radio frequencies that are considered ‘licensed’ in most countries. This means that the frequency plans and radio configuration are coordinated with other users of the spectrum to minimize the opportunity of interference from neighboring systems. Also, the frequency channel center frequencies, occupied bandwidth and the Transmitter-to-Receiver frequency separation (also known as T/R spacing) are governed by the regulations that apply to the use of the frequency band that is applied. In many bands, it is necessary to offer unique part numbers to allow coverage of a ‘sub-band’ of the entire frequency band, and also to address the specific T/R spacing that is required. The following tables list supported configurations.

Table 1 ExtremeAir supported configurations

Band Name	Frequency Band Edges (GHz)	T/R Spacing (MHz)	Supported Channel Bandwidths (MHz)	# of Sub-Bands (diplexers)	Waveguide Flange Type
11GHz FCC/ITU/ETSI	10.700–11.700	490 or 500	30, 40, 80	3	Proprietary
15GHz ITU/ETSI	14.400-15.350	315, 420, 490, or 728	14, 28, 56	3, 4, 4, 1	Proprietary
18GHz FCC	17.7–19.7	1560	30, 40, 50, 80	1	Proprietary
18GHz ITU/ETSI	17.700-19.700	1010	13.75/14, 27.5/28, 55/56	4	Proprietary
23GHz FCC	21.2–23.61	1200	30, 40, 50	3	Proprietary
23GHz ITU/ETSI	21.200-23.600	1008, 1232	14, 28, 56	2, 3	Proprietary

Table 2 ExploreAir HP models supported configurations

Band Name	Frequency Band Edges (GHz)	T/R Spacing (MHz)	Supported Channel Bandwidths (MHz)	# of Sub-Bands (diplexers)	Waveguide Flange Type
11GHz FCC/ITU/ETSI	10.700–11.700	490 or 500	10, 30, 40, 80	3	WR75/UBR120

Table 3 ExploreAir LR models supported configurations

Band Name	Frequency Band Edges (GHz)	T/R Spacing (MHz)	Supported Channel Bandwidths (MHz)	# of Sub-Bands (diplexers)	Waveguide Flange Type
6GHz-Lower FCC	5.925–6.425	252.04	10, 29.65/30, 40, 60	3	1.259" (285.98mm) diameter
6GHz-Upper FCC	6.525–6.875	160	10, 30	5	1.259" (285.98mm) diameter
6GHz-Upper ITU/ETSI	6.425–7.125	340 or 350	28, 56, 80	4	1.259" (285.98mm) diameter
7GHz-Lower FCC	6.875–7.125	150	12.5, 25	4	1.025" (26.025mm) diameter
7GHz ITU/ETSI	7.125–7.900	154, 161, 168, 196 or 245	14, 28, 56	3, 16, 3, 5, 3	1.025" (26.025mm) diameter
11GHz FCC/ITU/ETSI	10.700–11.700	490 or 500	10, 30, 40, 80	3	WR75/UBR120

In most cases, there are regulations, or device-based conditions that limit the use of the device, such as minimum or maximum gain antenna, antenna polarization, and maximum output power, as well as, in some cases, application limits, limited geography of use, and other unique regulations. **The link design engineer and/or professional installer must determine these limitations and engineer/ install the system within the confines of all local regulations.** Also, it is required to examine any regulations that may apply to peripheral equipment, installation and cabling of the system that may be regulated for human safety, electrical code, air-traffic control, and other safety-related categories. In some cases, a need for link registration, coordination, and fees that may apply to the system usage. Please consult your local regulatory organization(s) to determine usage requirements.

In almost all cases, the product itself must be authorized for use in your country. Either Exalt or Exalt's agent must have applied for certification or authorization to allow the sale and deployment of the system within the country. It is also possible that only certain versions or configurations of the device

are allowed within a particular country. Please contact Exalt or your authorized Exalt representative for information pertaining to your country.

Note: It is the professional installer's responsibility to ensure that the radio system is implemented in a legal fashion. Exalt is not liable for any unsafe or illegal installations.

Basic Features

The ExtremeAir Digital Microwave Radios are intended for all-outdoor mounting and come with an indoor-mounted power injector. In some cases, the radio can be mounted indoors or in an enclosure.

For most implementations, the entire unit is typically mounted on a tower or rooftop mast structure, with Ethernet/Power and other optional interface cables running from the unit location, through a structure penetration, and to the power injector and connected communications equipment.

When mated to the proper antenna, the radio is mounted directly to the antenna, which eliminates RF cabling and associated losses. Alternatively, the ExploreAir unit can be mounted very close to a standard waveguide feed antenna, and a flexible waveguide is connected between the antenna and the radio. The distance between the radio and the antenna should always be minimized to, in turn, minimize waveguide length and associated losses.

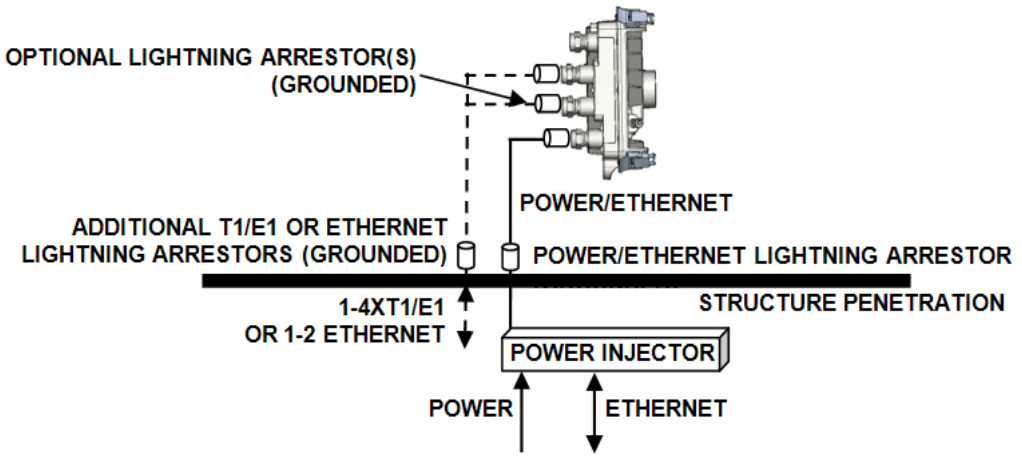


Figure 2 Cabling and surge suppression

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios provide connections for a combination of the following data communication interfaces:

- ExtremeAir & ExploreAir: 10/100/1000BaseT Ethernet (up to 4 ports, depending on model)
- Up to 4xT1/E1 interfaces for synchronous voice traffic (xxx10 and xxx20 models only)
- SFP (Gigabit-Ethernet) connector (ExploreAir LR xxx50 model only)
- Coaxial DC power (ExploreAir LR xxx50 model only)

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios are powered by a combined Power/Ethernet cable, and associated power injector. The power injector provides 55VDC to the unit (xxx00, xxx05, and xxx10 models). The power injector and/or external power supply are sold separately. The ExploreAir LR xxx50 models are also equipped with a direct coaxial DC power connection.

All models provide the following primary features and benefits:

- Low-latency optimization for voice and data connections

- Very high throughput and flexible interface configurations with voice+data combinations
- Encryption for extreme wireless security
- Easy-to-use management and configuration
- Flexible utilized channel bandwidth and modulation selections
- Field-interchangeable diplexers for low-cost sparing and easy capacity and frequency coordination (ExploreAir models only)
- Flexible center frequency tuning for interference avoidance and frequency coordination
- Flexible capacity to meet current connection requirements and future growth needs
- Carrier-class reliability and performance
- Connector covers (for weatherproofing unused connectors)

Pre-installation Tasks

This section describes the steps necessary to prepare a site for the installation of the Exalt Digital Microwave Radio.

Link Engineering and Site Planning

Design all terrestrial wireless links prior to purchase and installation. Generally, professional wireless engineering personnel are engaged to determine the viability and requirements for a well-engineered link to meet the users' needs for performance and reliability.

The link engineering will determine the following attributes:

- Antenna type/gain at each end of the link
- Antenna mounting height/location for proper path clearance
- Antenna polarization orientation
- Waveguide (if any), cabling, lengths, connectors, routes, and mounting
- Antenna system grounding
- Lightning arrestor type(s), location(s), and grounding
- Radio mounting location and mechanisms
- Radio grounding
- Radio transmitter output power setting
- Anticipated received signal level (RSL) at each end
- Anticipated fade margin and availability performance at each end
- Radio settings for modulation and occupied bandwidth
- Anticipated throughput performance (TDM circuit support and Ethernet)

With respect to radio path and site planning, these radios are generally identical to other microwave terrestrial wireless systems. Engineering of these systems requires specific knowledge about the radios, including:

- RF specifications (transmitter output power, receiver threshold, occupied channel bandwidth, and carrier-to-interference tolerance)
- Regulatory limitations on transmitter output power setting and antenna type/gain
- Noise/interference profile for the intended location (where applicable)

Familiarization with the ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) Radios

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios utilize frequency division duplex (FDD) radio transmission. This means that the signal transmits on one center frequency in one direction while simultaneously transmitting on a different center frequency in the opposite direction. This provides *full-duplex* configuration with equal capacity in both directions and minimal latency.

The ExtremeAir models also use dual-polarization which, when enabled, provides two transmission carriers on the same frequency, in opposite polarizations, for each direction. This implementation uses

built-in cross-pol interference cancelling (XPIC) technology, effectively doubling the capacity of the system in comparison to single-polarization systems.

The radios are configured in High (Hi) and Low (Lo) pairs, with alternate frequency settings for Transmit and Receive on the opposite ends of the link. This configuration is determined by the installed internal diplexer, which determines the specific tunable frequencies of the radio (relative to the occupied bandwidth setting) and the Lo/Hi orientation. These diplexers can be configured in the field to ease sparing and re-configuration.

Exalt recommends using the Exalt GUI for radio configuration. This interface requires a computer with an Ethernet port and web browser software, such as Microsoft Internet Explorer 5.0 or above. See Configuration and Management for details on how to connect to and use the browser-based GUI interface.

Shipping Box Contents

The terminals are shipped as individual endpoints. As mentioned, it takes two terminals–one Hi and one Lo–to make a complete link. An outer box has labeling that indicates the contents of the box, with the part number and serial number details for the radio terminal. The terminal box contains the following items:

- Radio terminal
- Registration card
- Quick-start guide

Power solutions for ExtremeAir models are sold separately:

- For direct 55VDC power over Ethernet (PoE), power injector solutions are available (sold separately).
- For AC-powered applications, a POE/adapter combination, or AC adapter that can connect to the DC power injector are available.

The radio is typically mounted to the proper direct-mount antenna, therefore no mounting hardware is required. For remote-mount solutions of the ExploreAir models where the radio will use a flexible waveguide for connection to the antenna, a separate pole-mounting kit is sold separately.

Inspect the outer packaging and the contents of the boxes upon receipt. If you suspect any shipping damage or issues with the contents, contact Exalt Customer Care (see Introduction).

Note: Register your system as soon as possible. A 2-year Warranty period applies to products registered within 90 days of purchase. The Warranty period is reduced to 1-year for unregistered products and products registered after the first 90 days. See Exalt Limited Hardware Warranty. Register your product at the Exalt Product Registration web page.

Outdoor-rated and shielded CAT5e or CAT6 cable, such as Beldon 1300A, with RJ-45 or RJ-48C connectors is recommended for the Ethernet and/or TDM connections. For Ethernet connections, a maximum length of 100 meters applies to the total length of the cabling between the radio terminal and the first network-aware connection (such as a switch or router).

Initial Configuration and Back-to-Back Bench Test

Every Exalt digital microwave radio goes through extensive quality testing and performance evaluation over the full operating temperature range prior to shipment. However, before installation, it is strongly advised to perform several tests and tasks that are much more difficult to perform once the

radio link endpoints are distant from one another. A back-to-back bench test and pre-configuration will provide confidence that the radio link is operational and properly configured *prior* to installation, so that if troubleshooting is necessary, the radio hardware and configuration settings are eliminated from the troubleshooting process. Verify the following in the back-to-back testing:

- Confirm that the radio system is generally operational
  - Radios power-up with planned power and wiring solutions
  - Radio firmware version matches on each terminal (and is ideally the latest version)
  - Upgrade license key entry successful
  - RF link connects in both directions
  - Traffic passes across the link
- Configure connected equipment and cabling
  - Test Ethernet (CAT5e or CAT6) cabling and configure all interfaces
  - Configure IP settings for configuration and management
  - Configure passwords and security modes
  - Become familiar with the configuration and management interfaces through the Exalt GUI interface
  - Configure radio parameters
  - Set transmitter output power to engineered or allowed level (see RF Output Power Setting)
  - Set operating center frequency
  - Set occupied channel bandwidth and modulation
- Make detailed radio performance measurements
  - Measure transmitter output power
  - Measure receiver threshold performance
  - Confirm unfaded error-free performance

Some of these tasks may not be possible or practical within a bench test environment due to the nature of the remote connectivity of peripheral equipment. However, it is good practice to perform as much as possible in this environment to minimize field/installation time and troubleshooting efforts.

Detailed performance measurements are usually not required for pre-installation, but can be better performed at this stage and may be helpful for later troubleshooting efforts or for internal records. During troubleshooting, there may often be a point at which a back-to-back bench test should be performed to verify many or all of the above items, and in the case of a suspected faulty device, to help confirm the fault and determine which end of the system is at fault and in need of repair or replacement.

Note: See Back-to-back Bench Testing for detailed instructions.

RF Output Power Setting

The maximum RF output power is bounded by one of the following criteria:

- Maximum RF output power setting capability of the radio device
- Maximum RF output power allowed/authorized by the local government regulations and for this specific device
- Maximum effective isotropic radiated power (EIRP) of the transmission system allowed/ authorized by the local government regulations and for this specific device
- Desired RSL to not exceed the maximum RSL allowed by the device
- Desired RSL to minimize/eliminate interference into neighboring systems

Note: In many cases the radio must be pre-configured for legal maximum output power before connecting to the antenna and transmission system. Instructions for adjusting the output power can also be found in Power.

Critical Configuration Considerations

The ExtremeAir radios are very dynamic, allowing the installer to optimize and control the performance of the radio system for the intended application. The following parameters must be carefully determined during the link engineering phase:

- Bandwidth
- Mode (modulation)

The setting of the above parameters determines the following performance factors:

- Ethernet throughput

Note the following generalizations regarding these factors:

- The higher the bandwidth, the higher the capacity
- The higher the mode, the higher the capacity

Radios arrive from manufacture in default configuration configured as shown in Table 4.

Table 4 Factory default settings

Parameter	**ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD)**
Frequency	Lowest frequency pair supported by software-configured diplexer
Transmit Power	0 or lowest value for default modulation supported by model
Bandwidth	Minimum value supported by model
Mode (modulation)	Minimum modulation supported by model
Link Security Key	000000000000
Administration Password	password
User Password	password
IP Address	10.0.0.1 (for Tx Low); 10.0.0.2 (for Tx High)
IP Mask	255.0.0.0

Table 4 Factory default settings (Continued)

Parameter	ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD)
IP Gateway	0.0.0.0
Ethernet Interfaces	Alarm Enabled; Auto-negotiation
T1/E1 Enabling	All Disabled

Note: In many cases, the system design will not be identical to the factory default configuration, and in some cases, these differences prohibit the installation of the radio. If at all possible, obtain a computer and configure the radio terminals using the browser-based GUI. See Exalt Graphical User Interface (GUI).

Radio Reset

Use the reset function if the IP address and/or passwords are lost. Use the following steps to perform a critical parameter reset:

1 Remove power from the radio by disconnecting the power source from the power injector.

2 While reapplying the power on the PoE interface, hold down RESET button until the left DATA+POWER LED flashes (approximately two minutes; firmware dependent).

3 Release the RESET button to complete the boot cycle (approximately one minute).

The following configurations are reset on the radio:

- IP address = 10.0.0.1
- IP mask = 255.0.0.0
- IP gateway = 0.0.0.0
- Administration password = password
- User password = password
- VLAN = disabled
- Ethernet ports = Auto Negotiation.
- (ExploreAir LR models only) Management = Inband

Virtual Local Area Network (VLAN)

VLAN segments information in a single connection and creates multiple separate connections to secure information of one type or for one set of users from other information types or for other sets of users. Exalt's VLAN communications implementation adheres to the IEEE standard 802.1q.

In most cases, an Exalt radio acting as a Layer 2 bridge between two locations is only required to pass traffic with VLAN tagging. Without additional configuration, all Exalt radios support frame sizes in excess of 1900 bytes, which currently supports all defined VLAN packet sizes.

Note: If an application only requires the transparent passing of VLAN traffic, disable the VLAN function.

Some situations require Exalt radios to act upon VLAN traffic and perform any or all of the following functions:

- Connect specific traffic, using VLAN tagging, to a specific port on the radio, such as management traffic to the ETH1 port.
- Allow only traffic with specifically assigned VLANs to pass across the link, blocking all other VLANs or any non-VLAN traffic.
- Allow management access only through a VLAN connection, leaving the main traffic transparent.
- Allow management access without a VLAN connection, but flowing only specific VLAN traffic across the link.

Simple Network Management Protocol (SNMP)

The Exalt radios primarily use a browser-based graphical user interface (GUI) for radio configuration and management, as described in Exalt Graphical User Interface (GUI). In addition, a command line interface (CLI) is provided for serial and/or Telnet access, as described in Command Line Interface (CLI). SNMP is often used for management of larger networks as described here. Use SNMP to manage networked devices and execute the following functions:

- GET: Obtain information from the device, such as a configuration setting or parameter.
- SET: Change a configuration setting on the device.
- TRAP: The device proactively informs the management station of a change of state, usually used for critical alarms or warnings.

One feature of the SNMP implementation is that system configuration changes do not take effect using the SET command. Instead, groups of configuration settings can be preconfigured for global change, and a single 'Save' (Commit) command implements all changes.

When some parameters are changed, a link may drop and/or management control lost. MIB files allow many parameters to be set at once, allowing only a temporarily dropped link or management control issue. The opposite end radio can be quickly reconfigured, with little downtime for the link and management control. The save (Commit) command is similar to the Update button.

Dropped links or management control issues do not occur with every parameter change. Many configuration changes do not impact traffic or management access.

Exalt radios utilize SNMPv3, a high security version of SNMP, to ensure secure access to and storing of management data. The SNMPv3 security string matches the admin and user passwords. Passwords must be eight characters or longer. Some models also have “legacy” SNMP support for SNMPv1 and SNMPv2.

Note: MIB files are available on the File Transfer Page.

System Installation and Initiation Process

The tasks required for radio installation and initiation are outlined in the following figure.

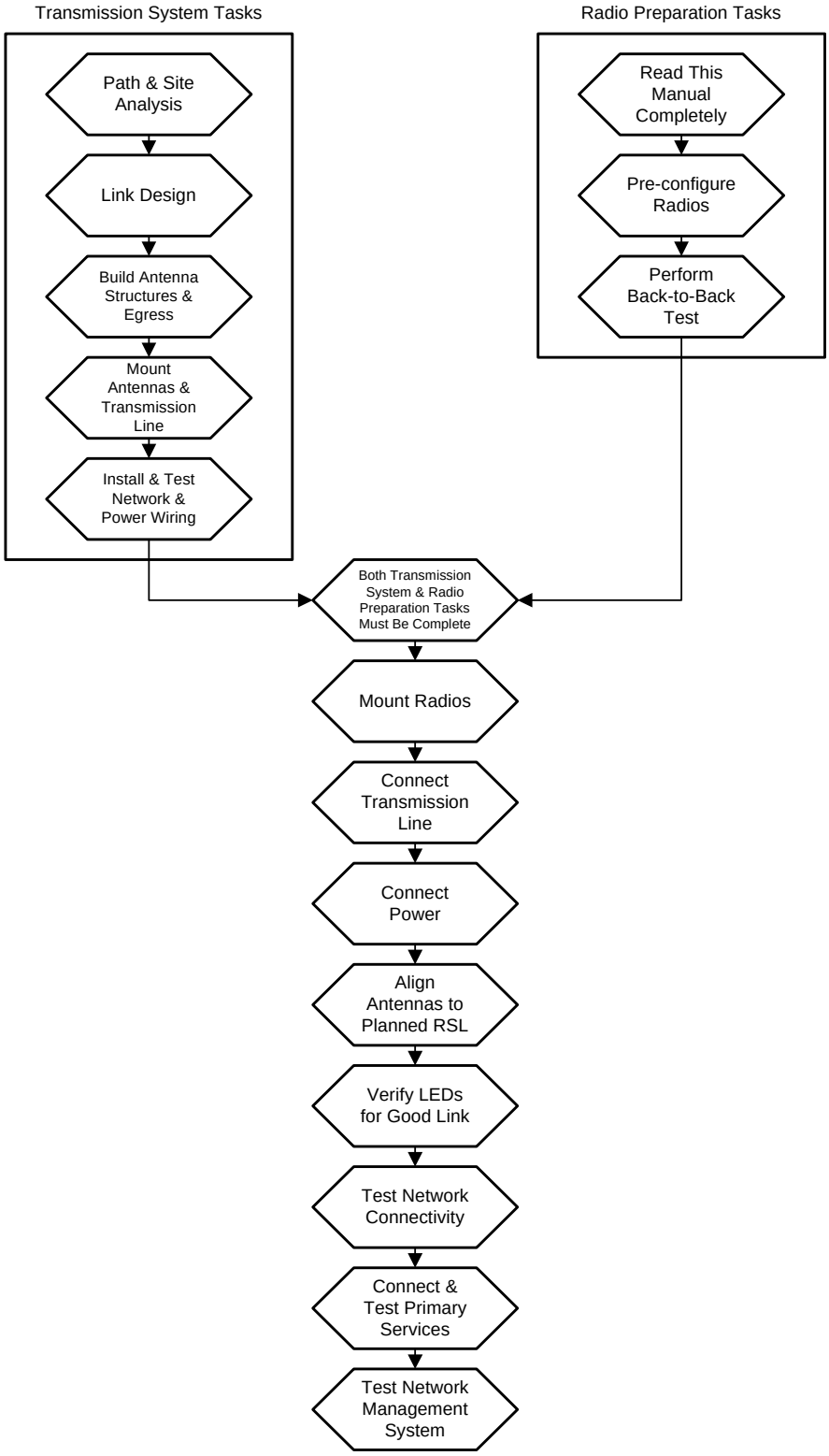


Figure 3 Radio installation tasks

Record Keeping

After installation, record the following items for ongoing maintenance and future troubleshooting. Keep a record for each end of the radio link and store a copy of these records at the radio location, at the opposite end radio location, and a central record storage location.

- GPS coordinates for antenna locations at each site
- Antenna heights above ground level (AGL), as mounted
- Antenna model numbers, serial numbers, and specifications
- Antenna polarization as mounted
- Length/type of primary transmission lines at each site
- Model number and serial number of lightning arrestors
- Transmitter output power setting as installed at each site
- RSL as measured after antenna alignment at each site
- Designed RSL per original design at each site
- RSL reading with far-end power off (from each end)
- Spectrum analyzer plot with far end off at each site
- Radio’s network management IP address at each site
- Radio’s network management gateway address at each site
- Radio’s operating frequency, bandwidth setting, and mode of operation
- Optionally purchased extended warranty and/or emergency service contract details

In addition, certain information may be desired for central record-keeping only:

- Link security codes and log in passwords (stored in a secure place)
- Photographs of complete installation
- End-user sign-off/acceptance documentation (if any)
- Photo of product identification label (part number, serial number, MAC address information)
- Electronic copy of radio’s configuration file
- Electronic copy of radio’s installed software

Installation

This section presents all tasks required to install the Exalt Digital Microwave Radio.

Mechanical Configuration and Mounting

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios are environmentally sealed units intended for deployment outdoors. The device must be deployed within an ambient temperature range as specified, and with non-restrictive airflow around the chassis.

The power injector and power supply must be placed indoors or in an enclosure.

Provide proper clearance for all cables and connectors attached to the device.

Mounting the System

The radio is typically mounted directly to the antenna. The antenna must be the proper type for this to be accomplished (see Antennas).

Figure 4 Direct-mount configuration–ExtremeAir model

Use the following steps to direct-mount the radio:

1 Mount the antenna with the proper polarization alignment, following the instructions provided with the antenna.

2 Using non-corrosive silicone grease (typically provided with the antenna), grease the rubber O-ring on the antenna fitting.

3 Inspect the waveguide slot on the radio and the antenna.

The waveguide slot aligns in the same orientation.

4 Align the radio to the antenna, slowly press the radio onto the antenna waveguide fitting until snug.

5 Secure the mounting clips on the four corners of the radio chassis to the mating clips on the antenna, one at a time.

Note: Clip two opposite corners first, then clip the remaining two corners.

Use the following steps for remote-mount configurations (ExploreAir HP and LR models only):

1 Mount the antenna with the required polarization orientation.

2 Mount the ExploreAir radio as closely as possible to the antenna, using the remote-mount bracket (sold separately).

3 Connect and secure the two ends of a flexible waveguide to the antenna feed and to the radio using four (4) threaded screws per end.

Note: Do not over-bend or twist the flexible waveguide.

If a flange adapter is required, mount the flange adapter to the antenna, not to the radio. If required, install waveguide stabilization hardware.

Figure 5 Remote-mount waveguide connection

Radio Ports and Indicators

This section provides a brief overview of the connectors, controls, and indicators on the device. Details about each item are in other sections of this document. Figure 7 shows the connectors on the ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios.

Figure 6 Radio connectors (xxx00 model shown)

Connector Overview

Table 5 provides details of the connectors. Detailed pin structures for each connector are in Interface Connections.

Table 5 Connectors

Connector	Description
RSL (BNC connector on radio chassis)	Antenna alignment RSL voltage (during installation)
TDM 2&4	Ports for up to two user T1 or E1 circuits to traverse link, port numbers 2 and 4 (xx10 and xx20 models only).
TDM 1&3	Ports for up to two user T1 or E1 circuits to traverse link, port numbers 1 and 3 (xx10 and xx20 models only).
Power/ETH1	Connected cables traverse to the power injector (Data+Power side), and provide the following functions: • Primary ports for user Ethernet data to traverse link (for ExtremeAir, 10/100BaseT, for ExploreAir 10/100/1000BaseT) • DC power from power injector
ETH2, ETH3, and ETH4	Ports for additional Ethernet connections, management and/or traffic (xx05 models only).
EXP	Expansion port for capacity aggregation and other unique configurations.
XCON1&2	For XPIC (cross-polarized interference cancellation) or SD (space diversity) configurations (ExploreAir LR models only). See Interface Connections for cabling details.
DC (N connector on chassis)	Direct 55V DC power connection (ExploreAir LR xxx50 models only).
ETH2 (SFP)	Accepts a GBIC (Gigabit Interface Connector, ExploreAir LR models only).
(Ground)	Threaded (M5) receptacle.

Note: Use a connector cover on all unused connectors for weatherproofing. The connector covers are included with shipped units.

LED Indicators

Table 6 provides details of the LED indicators on the ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios. Note that there are two LEDs, left and right, associated with each connector. See Alarms Page for information on how the Exalt GUI displays LED status.

Note: When referring to LED placement, right/left orientation is as shown in Figure 6, with the handle of the radio up, the connectors down, and viewed from the heat sink side of the chassis, not the antenna side.

Table 6 LED indicators

Location/Label	Type	Function
TDM 2&4 Left	Green LED	Solid = T1 clocking present for input #2.
TDM 2&4 Right	Green LED	Solid = T1 clocking present for input #4.
TDM 1&3 Left	Green LED	Solid = T1 clocking present for input #1.
TDM 1&3 Right	Green LED	Solid = T1 clocking present for input #3.
ETH2, ETH3, or ETH4 Right	Green LED	Unused
ETH2, ETH3, or ETH4 Left	Green LED	Solid = Ethernet link present. Flash = Ethernet traffic present.
EXP Left	Green LED	Solid = Expansion link present.
EXP Right	Green LED	Solid = Expansion activity present.
Power/ETH1 Right	Green LED	Solid = Power applied.
Power/ETH1 Left	Green LED	Solid = Ethernet link established. Flash = Ethernet traffic present.

Reset Button

Performing a reset brings the RF link down.

There is only one external control on the ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radio system, a button labeled “RESET” located on the power injector. This button performs a critical system parameter reset. The reset button is on the right side of the DC injector.

ExploreAir LR rcxxx50 models normally do not use the PoE injector for power (except for lab testing and configuration). However, you must use the power injector to reset the radio.

Use the reset function if the IP address and/or passwords are lost. Use the following steps to perform a critical parameter reset:

1 Remove power from the radio by disconnecting the power source from the power injector.

2 While reapplying the power, hold down RESET button until the left DATA+POWER LED flashes (approximately two minutes; firmware dependent).

3 Release the RESET button to complete the boot cycle (approximately one minute).

The following configurations are reset on the radio:

- IP address = 10.0.0.1
- IP mask = 255.0.0.0
- IP gateway = 0.0.0.0
- Administration password = password
- User password = password
- VLAN = disabled
- Ethernet ports = Auto Negotiation
- (ExploreAir LR models only) Management = Inband

Reset ExploreAir LR Model rc11150 Radios

These models are normally powered over the coaxial cable connection. However, you must use the included PoE injector to perform a radio reset. Use a short CAT5e or CAT6 cable to make the connection between the PoE injector and the radio's ETH1/PoE port. Remove power from the coaxial DC connection during reset, and restore power after the reset completes. Follow the instructions in Reset Button.

Power

ExtremeAir and ExploreAir HP rc-Series (FDD) Radios

These radios can be powered by a 55VDC power source to a passive PoE injector to provide adequate input voltage for a full-length PoE cable. There is an AC adapter solution that provides a 55VDC power output, which connects to an Exalt passive DC PoE injector. If using a DC source (such as, 24 or 48 volts), Exalt supplies active PoE injectors that provide the 55VDC output voltage on the PoE interface.

Note: Read this section completely before applying power.

PoE Injector

Optional PoE active injectors are available in 1/2 RU and 1 RU sizes. They are rack mountable, and include brackets for mounting on available rack frame space or on the wall. A cooling fan assembly is also optionally available.

Perform the following steps to connect the active or passive PoE injector to the radio:

1 Connect the network Ethernet connection to the DATA connection of the PoE injector.

2 Connect the cable for the radio to the DATA+POWER connection of the PoE injector.

3 Ground the PoE injector using the grounding receptacle.

Warning! Only use the 55VDC AC adapter with passive power injector or 24 or 48VDC power with active power injector.

ExploreAir LR rc-Series (FDD) Model (rcxx150) Radios

These radios are normally powered over the coaxial cable connection. These models also use a fiber optic management and traffic interface. Alternatively, the previously mentioned DC power injector solutions for the HP and ExtremeAir models can be used for PoE power.

Terminating the RF Connection

Before applying power, the device's RF connection must be properly terminated into a 50-Ohm load. If this is not performed, the radio may be damaged by simply applying power. Also, there are human safety factors to consider regarding potentially harmful RF radiation.

There are a few simple means to accommodate proper termination:

- Connect a waveguide/coaxial adapter and 50-Ohm coaxial termination device to the RF port of the radio. The termination must be rated to 1W (or more).
- Connect the complete transmission system. That is, the waveguide and the antenna. The connected antenna provides a proper termination for the RF output.

AC Power

Warning! Exalt provides an AC power injector kit (sold separately) for ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios. See PoE Injector.
It is important that the DC power injector is supplied with 55VDC.
Do not use a 48VDC AC power adapter to power the DC power injector.

The AC power injector kit (sold separately) easily connects to the customer-supplied CAT5e or CAT6 PoE cable. Refer to the input voltage requirements stated on the label affixed to the adapter to ensure that the adapter can be used with the AC mains supply.

The AC plug outlet provided with the adapter may need to be replaced to match the country configuration. The adapter cable uses a standard connector for this cable for use of a pre-wired cable appropriate to the outlet configuration. If the appropriate cable is not available, the existing AC plug end can be severed and a replacement plug affixed. Consult a qualified electrician for this activity.

Do not plug the adapter into the mains power. First, verify that the RF connector is properly terminated (see Power), and then plug in the radio-side connector from the AC adapter to the radio. If the AC mains can be turned off using a switch, disable the power, plug the AC side of the adapter into the AC mains socket, and then enable power to the circuit. If the AC mains cannot be turned off, plug in to the AC main socket to apply power.

Exalt strongly recommends that the AC mains supply be fused or on a separate breaker to ensure against over-voltage and/or over-current situations and to provide some form of protection to the radio electronics and other devices connected to the same supply. In addition, if the AC power is subject to significant spikes or variation, power conditioning is a worthwhile investment, as the quality of mains power may have a direct impact on the device operation, performance and/or reliability. An Uninterruptible Power Source (UPS) or other form of battery-backed system protects against brown-out and black-out conditions, and condition the power presented to the adapter.

Evaluate the opportunity for lightning or other similar surges to be present on the powering system, including the ability for surges to couple to the power wiring system. If an evaluation indicates that there is a potential likelihood for these conditions to occur, additional surge protection is recommended for the input power wiring, especially to protect the radio electronics between the adapter and the radio's DC input connector.

The above statement is similarly true for every wired connection to the device. While the configuration for surge suppression or line conditioning is of a different type for each kind of signal interface, the opportunity for damage to the device, loss of communications and property is significant. In some cases, there can also be a risk to human life by not protecting against lightning entering a building through wiring or improper grounding. If you do not have experience in this type of installation practice, consult a qualified electrician and/or telecoms professional during the installation and wiring of the equipment.

Warning! Consult a qualified electrician if uncertain about how to properly ground the system and connect power.

CAT5e or CAT6 Lightning/Surge Protection

To provide for human safety and for the safety of connected network equipment, it is highly recommended to place a weatherproof lightning suppression device at the egress point where the CAT5e or CAT6 cable(s) enter the building, shelter, or cabinet.

To protect the radio equipment, install a weatherproof lightning suppression device near the radio for all connected CAT5e or CAT6 cables.

For the Power/Ethernet cable, specific voltage requirements must be met. The following devices are the only devices currently recommended:

- PolyPhaser IXG-05
- Transtector ALPU 1101-959
- Transtector ALPU-1000BT-R
- Citel C2MJ8-POE-A/SE
- Transtector 1101-1030
- Transtector 1101-1080

Generally, use a short CAT5e or CAT6 cable for the short connection between the radio and the first arrestor. Use bulk outdoor-rated CAT5e or CAT6 cable for the longer run between arrestors, and indoor- or outdoor-rated cable with a standard CAT5e or CAT6 termination for the connection from the egress arrestor and power injector.

Apply this same method for the TDM connections. There are no special requirements for lightning arrestors. Vendors, such as Transtector and Polyphaser offer single and multiple TDM weatherproof arrestors. Note that each connector on the radio can carry up to 2 TDM (Time Division Multiplexing) connections.

Note: Use only outdoor-rated UV-resistant CAT5e or CAT6 cable. This cable must have an outer diameter between 0.25"/6.35 mm and 0.31"/7.87mm. Belden 1300A is recommended. Securely hand-tighten all connectors on the ODU to ensure a weatherproof seal.

Reset to Critical Factory Settings

If necessary, the radio terminal may be reset to critical factory settings. This may be necessary if the IP address and/or passwords for the system are not known. All other configurations are left at their current settings. If a complete default factory configuration is desired, load the Default Configuration File into the system, as described in File Activation Page.

The following parameters are configured after a reset to critical factory settings:

- IP Address = 10.0.0.1
- IP Mask = 255.0.0.0
- IP Gateway = 0.0.0.0
- Administration password = password
- User password = password
- VLAN = disabled
- Ethernet ports = Auto Negotiation.
- (ExploreAir LR models only) Management = In band

Diplexer Channel and Polarization Configuration

ExploreAir HP and LR model radios have a unique feature that allows field reconfiguration of the channel plan and/or the Lo/Hi Tx/Rx orientation, as well as polarization. This allows a single spare unit to spare any configuration of the same frequency-band radio, as well as added flexibility for re-licensing if a link gets moved to a new location.

CAUTION! Removal of the front panel diplexer cover requires special care. The instructions in this section must be followed precisely to maintain performance and weatherproof operation. The Exalt Limited Hardware Warranty may be voided if damage to the radio occurs as a result of improper installation.

The transmitter (Tx) and receiver (Rx) frequency tuning range is determined by two things:

1 The model of the radio, and thus the frequency band and T/R spacing that is supported, and

2 The type and orientation of the diplexer filter that is installed in the radio, and thus the center frequencies for the Tx and Rx that can be set.

Three labels are provided on the radio to aid in the determination of the current configuration, as shown in Figure 7.

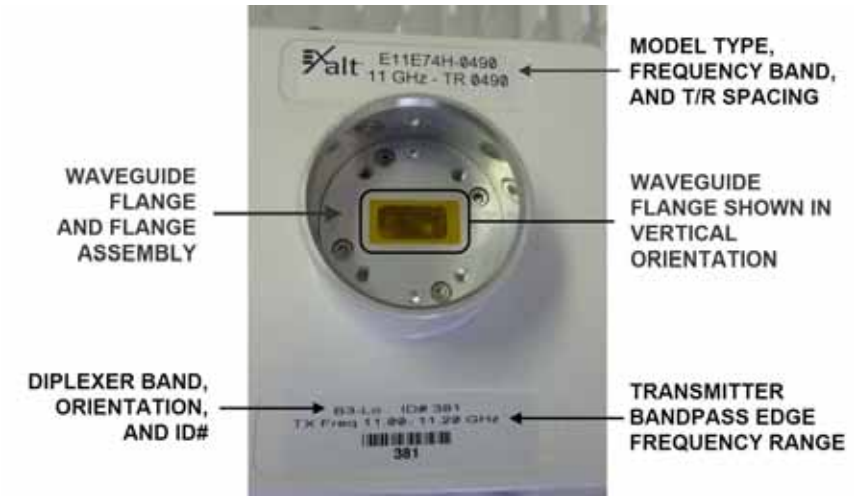


Figure 7 Diplexer waveguide flange assembly and configuration labels

- **Model Type** indicates the radio's base model part number, the frequency band of the radio (11GHz), and the T/R spacing supported.
- **Diplexer Band, Orientation, and ID#** indicates the sub-band of the diplexer (such as B1, B2, or B3), the orientation of the diplexer (such as Hi or Lo, indicating the Transmitter side of the diplexer), and the ID number. The ID number is used to program the radio's tuned frequency on the System Configuration Page.
- **Transmitter Bandpass** provides additional details about the diplexer configuration, indicating the Transmitter bandpass edge frequency tuning range. This frequency range is the edge frequency within which the transmitter can tune. It is NOT the tunable frequency range.
  - The tunable frequency range is determined by the selected occupied BW and is inside the bandpass edge frequency by half the selected bandwidth. For example, if the transmitter bandpass edge frequency range is 11.00GHz to 11.20GHz and the selected Occupied Bandwidth is 20MHz, then the tunable range must be *one-half* of the occupied bandwidth away from the bandpass edges–10MHz in this case–making the tunable range 11.01GHz to 11.19GHz.

Note: Since the diplexer cannot be seen without removing the front cover, it is critical that the external labeling is changed if the diplexer is changed. For convenience, additional labels are provided.

Channel Configuration

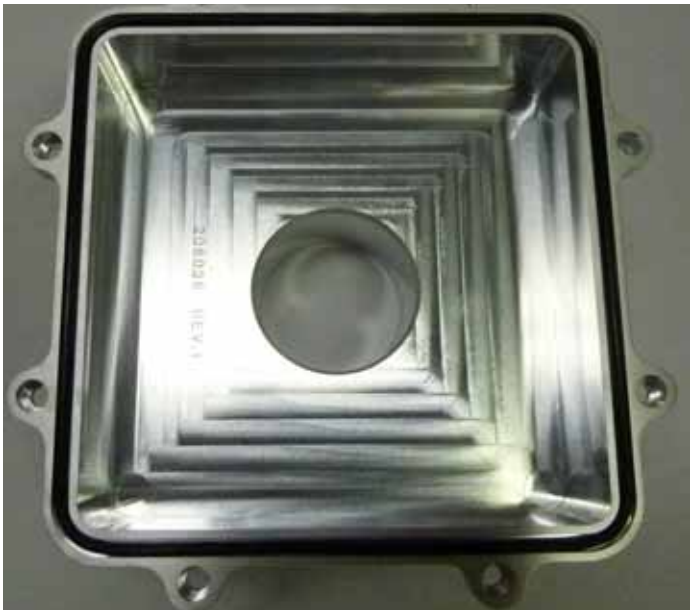
CAUTION! DO NOT PERFORM THE FOLLOWING PROCEDURES ON THE TOWER!
Perform these procedures on a bench to minimize the chances of losing small parts.

To change diplexer channel configuration:

1 Use the 3mm Hex wrench to remove the 8 diplexer cover screws shown below.

The open case is shown below.

2 Ensure that the black weatherproof O-ring remains inside the cover groove, as shown below.



3 Use a 3mm Hex wrench to remove the 8 diplexer assembly mounting screws shown below.

4 Remove the entire diplexer assembly.

5 To change the diplexer from Hi configuration to Lo configuration, with the radio oriented with the handle at the top and the connectors at the bottom, orient the diplexer assembly so that the labels are right-side up for the desired configuration. For example, referring to the figure in step 3, the radio is configured as B3 Lo (transmitter is in the B3 Lo band).

6 Similarly, if you are changing the diplexer to a new diplexer, remove the diplexer assembly and ensure that the new diplexer assembly has the desired orientation.

7 Re-mount the completed and properly oriented assembly using the 8 hex screws removed in Step 3.

8 Replace the cover on the radio chassis.

CAUTION! Do not pinch the rubber O-ring gasket.

9 Tighten the hex screws until completely secure.

10 Place new labeling on the cover plate, as necessary.

Note: The cover must have the right labels. Either use the cover with the right labeling from the source of the diplexer, the labels supplied with the diplexer, or the labels supplied with the radio.

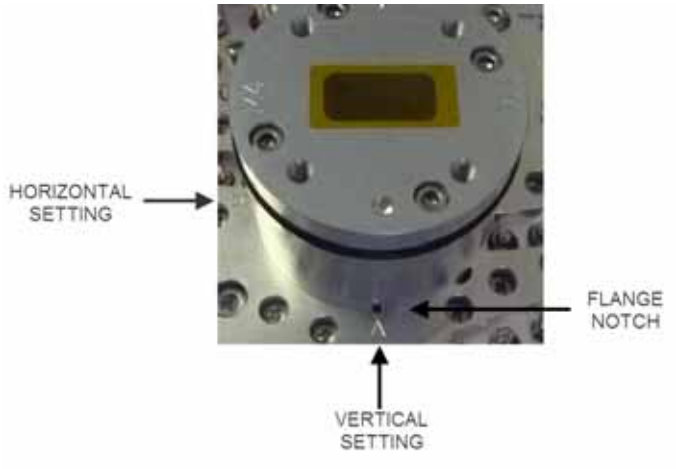
Polarization Configuration

Use the following steps to rotate the waveguide flange assembly to change diplexer polarization:

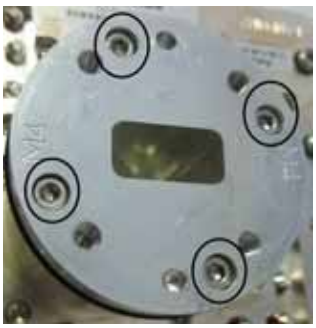
1 Follow steps 1–2 above to remove the diplexer cover.

2 Note the orientation of the notch on the waveguide flange assembly with respect to the “H” and “V” symbols on the diplexer body.

The waveguide flange assembly in the image below is in vertical orientation (the “V” is upside down). The notch is positioned over the “V” hole.



3 Use a 2.5mm hex wrench to unscrew the four waveguide flange screws, shown below.



Do not remove these screws completely. Only unscrew them enough to free them and allow the waveguide flange to rotate. These screws are long and it should only take a few turns to free them from the diplexer body.

4 Rotate the waveguide flange so that the notch is positioned over the desired polarization setting; “V” for vertical, “H” for horizontal.

5 Tighten the four waveguide flange screws.

6 Reassemble the diplexer housing, as outlined in steps 8–9 above.

Antenna/Transmission System

This section provides guidance to mounting and connecting the RF transmission system, which consists of the antenna, and flexible waveguide (if applicable). Consult the manufacturer’s instructions for proper mounting, grounding, and wiring of these devices, and for definitive direction. These manufacturer's instructions supersede any information in this section. See Antennas for a list of supported antennas.

Initial Antenna Mounting

The antenna must be an exact model recommended by the path and site planning engineer(s). Mount the antenna at the proper height, mast/mounting location and polarization orientation as determined by the path and site planning engineer(s). The model type, location, and orientation of the antenna is critical with respect to achieving proper path clearance, as well as to mitigate external or self- interference from nearby or collocated systems operating in or near the same frequency band.

Warning! Mount the antenna in a restricted area and in a manner preventing long-term human exposure to the transmitted RF energy. Consult your government guidelines for proper signage and/or safe distance considerations for radio equipment.

The antenna structure must be secure and safe with respect to the mounting of the antenna, transmission system weight, radio housing, and the combined weight of any personnel that may climb or attach to the structure.

The combined weight of items and forces on the structure must be carefully considered in the design and construction of the structure. This must include the weight bearing on the structure in the highest wind conditions possible in the region, and with respect to all objects affixed to the structure.

If additional objects are affixed to the structure in the future, it may be important to evaluate both the mechanical impact of these planned additions (with respect to wind and weight loading), as well as the potential impact to RF interference and frequency coordination (if additional radio equipment is anticipated). This is especially important if future equipment is likely to operate within the same frequency band.

Once the antenna is mounted, cabled, and aligned, your goal is to never require modification. This prior planning is important in the path and site planning stages and in construction of the antenna structure.

Follow the antenna manufacturer’s instructions for mechanical mounting of the antenna. Ensure that there is enough room around the antenna for alignment activities (moving the antenna in vertical and horizontal arcs), and for the RF transmission line to connect to the antenna connector unobstructed and within the specified bend radius requirements of the transmission line.

At this point, the antenna mounts should be fully secure to the structure, the feed of the antenna securely mounted to the antenna (if the feed is a separate assembly), and the azimuth and elevation adjustments not completely tightened in preparation of the antenna alignment activity. It is a good practice to connect the radio to the antenna connector as early in the process as possible, to reduce the opportunity for debris or moisture to enter the antenna connector. Take extra care if the antenna is installed during inclement weather to ensure that no moisture gets inside the antenna connector at any time.

Now the antenna can be aimed in the general direction required for the link. Use a compass, a reference bearing, binoculars or any other similar device to point the antenna in the direction (generally) of the far end radio, and then slightly tighten the azimuth and elevation adjustments so that the antenna maintains its general position and is safe to be left without additional securing. Refer to the Exalt white paper, *Antenna Alignment*, for more information on antenna alignment techniques.

Transmission Line from Antenna to Radio (ExploreAir Remote Mount only)

For remote-mount ExploreAir models, it is recommended using a direct-mount antenna and mount the radio directly to the antenna. Using a ‘standard’ waveguide antenna is considered a ‘remote mount’ implementation. Use the remote-mount kit to mount the radio near the antenna feed. Generally, the orientation of the waveguide slot on the radio will be the same as the antenna feed (either vertical or horizontal).

If using an antenna that does not allow a direct-mount solution, use a short segment of flexible waveguide between the radio and antenna. Always minimize the length of the waveguide to reduce additional RF losses in the system, which may negatively impact performance.

The flexible waveguide may have a piece of mylar tape over the entrances of the guide. The antenna feed and radio may also have a similar piece of tape. This tape assures that no dust, dirt, or moisture enters the transmission system. It is recommended to remove the tape from the waveguide and allow it to remain on the antenna and radio. All pieces can be removed, but always ensure that no debris or moisture can enter the system.

A proper waveguide flange provides a weatherproof seal to both the antenna and radio. The waveguide should have a rubber seal that encompasses the waveguide entry. When the flanges are connected and mechanics tightened, this forms the weatherproof seal.

In some cases, waveguide stabilization arms (supplied separately from the waveguide supplier) may be needed. If the waveguide is long and/or mounted in a way that allows the waveguide to move (for example, in windy conditions), it may introduce bit errors and/or RSL variation.

If the installation requires the radio be mounted more than three meters from the antenna, use a traditional rigid waveguide (not flexible) for all or most of the connection between the radio and antenna. A rigid waveguide exhibits lower losses, but requires more effort and cost for installation, and potentially requires pressurization equipment.

Refer to Table 3 for the flange type ExploreAir radio. This flange type must mate properly to the flexible waveguide, and the opposite end of the flexible waveguide must mate with the antenna flange. In some cases, a waveguide transition may be needed, for example, if there is a different waveguide size between the radio and the antenna. In these cases, mount the transition to the antenna flange, ensuring that the flexible waveguide flange mates properly with the opposite end of the transition. Consult your antenna and/or waveguide provider to ensure flange type compatibility and that it has proper weatherproof connections.

XPIC (Cross-polarized Interference Cancellation) – ExploreAir LR models only

XPIC combines two radio links to a cross-polarized antenna to double capacity as compared to one link. The two links can then be configured on the same center frequency, with the same bandwidth and modulation, which can ease frequency licensing (where applicable).

XPIC configurations require a dual-polarized antenna. Some antennas present two separate waveguide flanges (one per polarization), in which case the two radios are mounted using remote-mount hardware and a flexible waveguide that connects each radio to each flange on the antenna. If the waveguide size of the radio does not exactly match that of the antenna, a tapered transition is required. A properly mated flange for the connection to the radio and antenna is required. Outdoor connections must have flanges with gaskets for weatherproofing.

A dual-polarized direct-mount feed (usually –EXD for Exalt Dual-polarization) can also be used. An Orthogonal Mode Transducer (OMT–sold separately) is required to couple to the antenna and provide the two connections for mounting the two radio terminals. Consult with Exalt to ensure that the OMT is compatible with the antenna.

XPIC configurations require cabling between the XCON1 and XCON2 terminals at each end. See Interface Connections for pinouts.

The radios must also be configured for XPIC in the GUI or CLI. On the System Configuration Page one radio at each end is designated for Horizontal polarization, and the other for Vertical polarization. XPIC-specific alarms and status are also provided (see XPIC Status Page–ExploreAir LR models).

Space Diversity (SD) – ExploreAir LR models only

Space Diversity (SD) configurations improve the performance of links that may experience significant multipath fading such as long-distance links, links over flat terrain, links over water, and other weather-challenged implementations. SD configuration uses a second radio terminal at one or both ends of the link. This radio is connected to a separate antenna usually mounted at a lower antenna height than the primary radio/antenna. The separation distance between the antennas is determined through detailed path planning that also considers suitable mounting locations and cabling requirements.

The SD terminal is for receive-only communications (that is, it does not transmit an RF signal to the opposite end of the link). The antenna for the diversity-receive terminal is aligned to the transmitter on the opposite side of the link.

Two cables connect the primary and SD terminal at each end. The XCON1 ports are connected to each other, and the XCON2 ports are connected to each another. Special wiring applies to these cables, which are sold separately in various lengths. There are two important guidelines for the use of SD for the ExploreAir LR:

- For 256QAM or less modulation setting configurations or 512QAM modulations with 60MHz bandwidth or less, the maximum cable length for XCON connections is 50' (15.2m).
- For 512QAM modulation setting configurations with 80MHz bandwidth setting, the maximum cable length for XCON connections is 15' (4.6m).

  For this configuration, typical RF engineering will call for the antennas to be separated by more than 15'. The following are potential solutions:

  – Direct-mount the primary radio terminal to the primary antenna, and remote-mount the SD terminal within 15' of the primary radio. You can then–using a remote mount kit for the SD terminal–transition to a coaxial RF interface using a proper waveguide adapter to connect to

the diversity antenna. In some cases, using a waveguide instead of coaxial cable can be accommodated, but may require pressurization at certain limits of waveguide length.

– Remote-mount both radio terminals within 15' of one another, roughly halfway between the two antennas. You can then–using waveguide adapters on both remote mounts–transition to a coaxial connection for both antenna connections. Again, a waveguide can be used for connection without adapters, as long as you are compliant for any pressurization limits.

Unique configuration settings accommodate the SD configuration of both terminals, as described inSystem Configuration Page and Space Diversity Status Page–ExploreAir LR models.

Ethernet connections to the SD terminal are limited to management access of the local terminal. Since this terminal only receives, it does not have telemetry or management access to the far-end of the link.

Antenna Alignment

Antennas must be installed at both ends of the planned link to commence precision alignment. Refer to the Exalt white paper, *Antenna Alignment*.

Antennas are typically aligned using the radio hardware for precise alignment. However, there are many very useful tools available to aid in this process, inclusive of devices specifically designed for the purpose of aligning antennas. Some examples are:

- XL Microwave Path Align-R
- Teletronics 17-402

Use of these devices may be extremely advantageous as compared to using the radio, because they employ many unique facilities to aid in this process. Using these tools also makes it possible to align the antennas before the radio equipment is delivered. However, many installers successfully use the radios as the means for antenna alignment.

There are two primary facilities when using the radio to align the antenna:

- RSL voltage test point using a volt meter (recommended)

  A voltmeter with a BNC male connector can be directly connected to the RSL connector on the front face of the radio. The RSL test point DC voltage is inversely proportional and numerically calibrated to the received signal level. The voltage rises as the antennas are less in alignment, and falls as antennas are more in alignment. The voltage measurement corresponds to the received signal level in measurements of dBm (a negative number for RSL measurements). For example, an RSL of –60dBm yields an RSL voltage measurement of 0.60VDC; an RSL of –45dBm measures 0.45VDC.

- Audio alignment buzzer

  Enable the audio alignment buzzer through the Exalt GUI. When enabled, the radio enclosure emits a sound. The pitch rises when higher (better) levels of RSL are achieved. Align the antennas until the highest pitch is accomplished. The tone is continuous when the two ends of the radio system are in communication. Otherwise, the buzzer beeps.

The Exalt GUI RSL reading indicates the current RSL in dBm.

Note: There is a slight delay in RSL readings in the GUI as the RSL levels change. In this case, fine alignment can be done in small adjustments allowing a small gap of time so that the impact of the adjustment on the GUI display catches up to real time.

Note: Only use the browser-based GUI for antenna alignment if there are no other means available. If this method is required, refer to Exalt Graphical User Interface (GUI). The RSL reading can be read on a PC or any handheld computing device that supports an HTML browser and Ethernet connectivity.

Configuration and Management

This section describes the command line interface (CLI) and Exalt graphical user interface (GUI).

Command Line Interface (CLI)

Exalt Digital Microwave Radios provide a CLI to set key parameters on the system. Use the Ethernet port for a Telnet session over a network connection.

Telnet into the Command Line Interface (CLI)

Use a Telnet connection to access the CLI in the Exalt Digital Microwave Radios. Use the CLI to set key parameters on the system.

Connect to the Radio in a Telnet Session

Make the Telnet connection to the radio through the Ethernet (ExtremeAir and ExploreAir HP rc-Series (FDD) models) or fiber optic (ExploreAir LR rc-Series (FDD) models) port. Use Windows and perform the following steps:

1 Open a command prompt or MS-DOS prompt (**Start>Run**).

2 Type C:\>Telnet <IP Address> at the command line.

The default IP address is **10.0.0.1** (for the Tx Lo radio, or after default reset). **10.0.0.2** is the IP address for a new (from factory) Tx Hi radio.

Note: The accessing computer must be on the same IP subnet as the radio. If the radio supports DHCP and DHCP is enabled (see Ethernet Interface Configuration Page), which is the default setting for a radio shipped from Exalt (for the models with this feature), and your computer's Ethernet port is set for DHCP addressing, the radio will configure your computer to 10.0.0.3 or 10.0.0.4, and no manual IP configuration is required.

Telnet

Use Telnet when prompted to enter the administration level login and password. The default administration login is *admin* and password is *password*. It is recommended that the default administration password be reset by performing a radio reset (see Reset to Critical Factory Settings).

Figure 8 shows the menu choices available after log in.

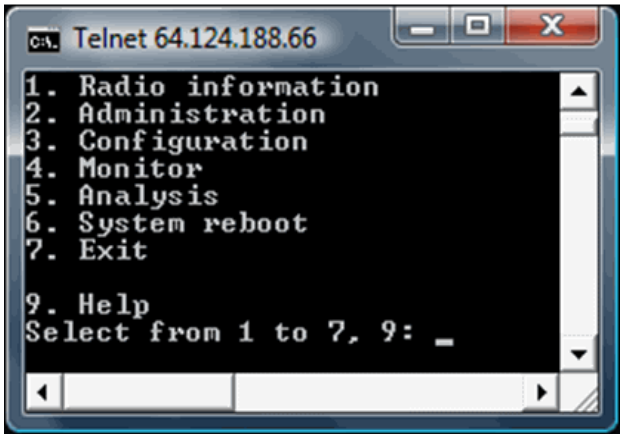


Figure 8 CLI root menu

The following selections can be made on all screens:

- 0 = back to previous screen
- 9 = help
- Ctrl+\ (control and backslash keys) = exit session

Exalt Graphical User Interface (GUI)

The Exalt GUI is the primary user interface for configuring and troubleshooting the radio and radio system. A computer or hand-held device with a conventional HTML browser and Ethernet port is required. Microsoft Internet Explorer is the preferred browser. Netscape, Mozilla, and Firefox are also supported.

Preparing to Connect

If the radios are new, both radios are preconfigured as Tx Lo and Tx Hi with default IP addresses of 10.0.0.1 and 10.0.0.2, respectively. If the radios are not new, the IP addresses and Lo/Hi and diplexer configurations may need to be changed. The initial priority is to connect to the radio's management system to completely configure the radio. Assign the radios different IP addresses, unique to each radio. There are two ways to change the IP address:

1 Reset the radio to the critical default factory settings (see Reset to Critical Factory Settings).

2 Connect to the GUI using the default IP address (10.0.0.1 or 10.0.0.2), and change the IP address through the GUI interface.

Note: To connect to the radio's Ethernet port and use the GUI interface, the accessing computer must match the radio's IP address subnet. It is therefore necessary to either change the radio's IP address through the CLI to match the subnet of the computer, or change the computer's IP address to match the subnet of the radio (such as, a computer IP address of 10.0.0.10 if trying to connect to a radio set to the factory default IP address of 10.0.0.1).

If the radio supports DHCP and DHCP is enabled (see Ethernet Interface Configuration Page), which is the default setting for a radio shipped from Exalt (for the models with this feature), and your computer's Ethernet port is set for DHCP addressing, the radio will configure your computer to 10.0.0.3 or 10.0.0.4, and no manual IP configuration is required.

Make Connections

It is recommended that one radio at a time be configured, on a bench, before taking the radios to the field for installation. Terminate the RF connector with a 50-Ohm termination or a fixed attenuator of at least 20dB (see Power).

CAUTION! Do not connect the radios in a back-to-back configuration unless the IP addresses of the two radios are verified as different from each other.

Note: The IP address subnet of the accessing computer must match the radio's IP address subnet to connect using Ethernet.

Once connected to the radio using Ethernet, log in to the Exalt GUI.

Log In

Use the following steps to log in to the Exalt GUI.

1 Open a browser window.

Microsoft Internet Explorer is the recommended browser. Netscape, Mozilla, and Firefox are also supported. If there are issues with your browser, please report it to Exalt Customer Care. You may be required to use a different browser to immediately overcome issues.

2 Type the IP address of the radio in the address bar.

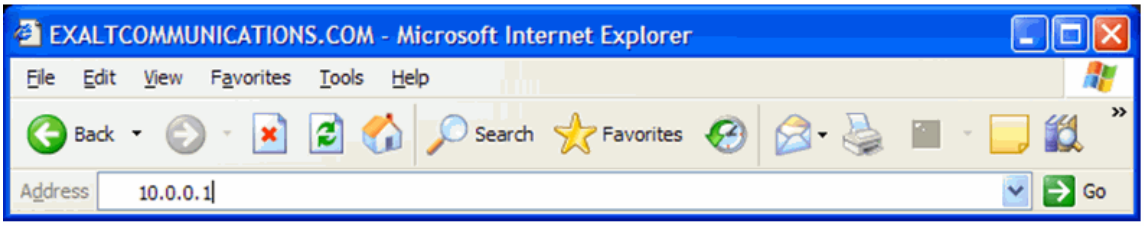


Figure 9 Initiating the browser connection

The following window displays after pressing the Enter key or clicking the Go button in the browser window.

Figure 10 Browser Login screen

Login Privileges

There are two levels of login privileges:

- Administrator (admin) – assigned complete permissions to view, edit, and configure
- User (user) – assigned limited, view-only permissions with no edit or configuration rights

The default login names and passwords are as follows:

Table 7 Default login information

Privilege level	User name	Default password
Administrator	admin	password
User	user	password

Administrator login credentials are required for configuration purposes. Type the user name and passwords for Administrator level and click OK. The following screen displays.

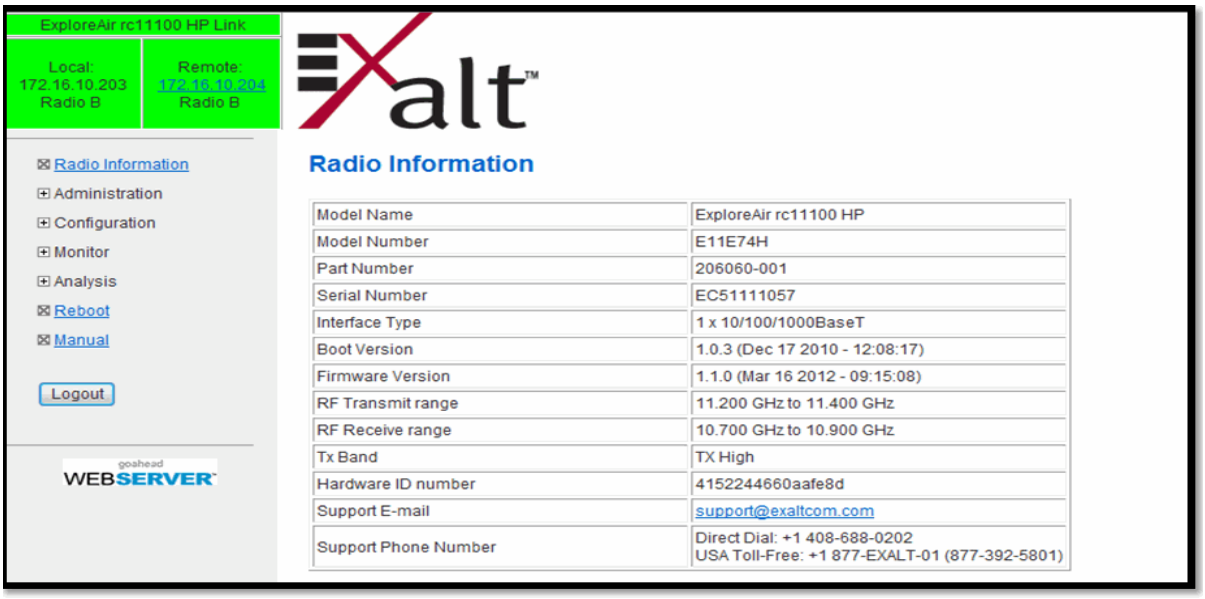


Figure 11 Radio Information page

Quick Start

To establish a link on the bench, apply the following basic configurations to the radio terminal. Use the steps in the *Quick Start Guide* included with the radio. A summary of the items that need to be configured are:

- Radio IP address for each end.
  - Each end must have a different IP address and cannot match the accessing computer's IP address or any address assigned if radios are part of a larger network.
  - It may be required to change the IP address of the accessing computer after changing the IP address of the radio so that the IP subnet matches.
  - The radio IP address is listed on the Administration Settings Page.
- Verify that the two terminals are opposite channel plans.
  - The product label indicates the frequency band and sub-band of the shipped configuration, such as ending in 1H or H1 (for Band 1, Hi Tx). The opposite end should be 1L or L1 in this case (for Band 1, Lo Tx).
  - If the warranty warning label is missing or broken on the antenna-connector side of the chassis, the internal diplexer may have been adjusted since shipment. Check the label affixed to the cover to ensure that it matches the product label. If it does not, the channel configuration likely matches THIS label instead of the product label. If in doubt, remove the diplexer cover to inspect the orientation of the installed diplexer to ascertain the installed configuration. See Diplexer Channel and Polarization Configuration.

If all other parameters are still configured at their factory default settings, the radios can now be connected back-to-back to verify that the link is communicating and perform any other desired tests. See Back-to-back Bench Testing for test information.

Navigating the GUI describes each page of the GUI. Most configuration parameter settings are intuitive. The following link parameters must match at both ends for the link to communicate:

- Link Security Key (Administration Settings Page)

- Bandwidth (System Configuration Page)
- RF Frequency (System Configuration Page), the channel plans match, but are opposite Tx and Rx frequencies for a link.

Note: Changing any of these parameters causes a temporary loss of link. The GUI displays a warning and provides an opportunity to cancel changes.

Navigating the GUI

The GUI provides the primary interface for all configuration and management. There are three sections of the main GUI window:

- Summary status information section (upper-left corner)
- Navigation panel
- Main window

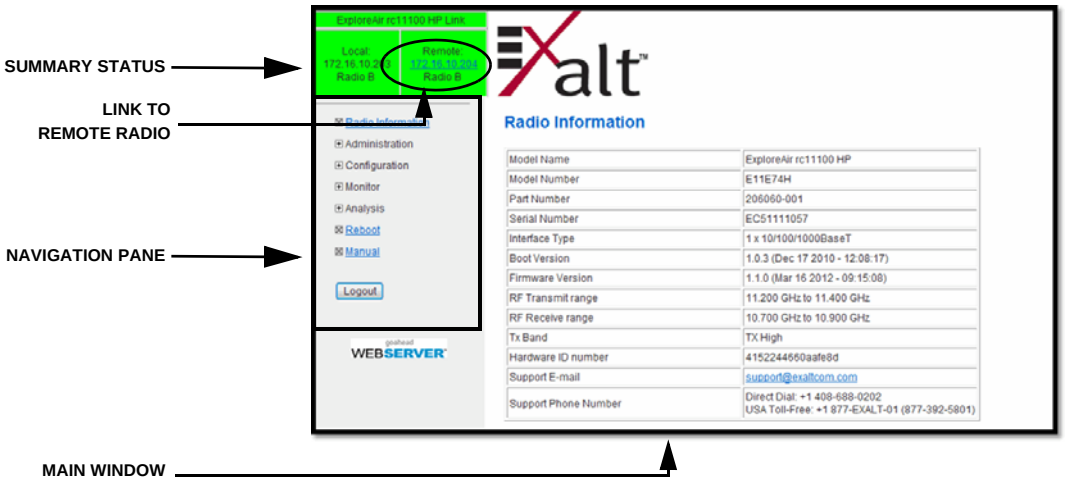


Figure 12 Exalt GUI window description

Summary Status Section

This section of the Exalt GUI provides a review of the system status.

Note: Click the radio IP address link to access that radio for management.

In the screens in Figure 13, the top bar illustrates the alarm condition of the link. The information inside the bar is equivalent to the entry of the Link Name set by the administrator in the Administration Settings Page.

The color of the panel indicates alarm status:

- Green indicates the system is communicating and all functions are normal
- Yellow indicates a minor non-traffic affecting alarm condition
- Red indicates a major traffic affecting alarm condition

The left panel summarizes the alarm conditions of the local radio (the radio that matches the IP address). The information displayed is the IP address and the endpoint identifier (Radio A or Radio B).

The right panel summarizes the alarm conditions of the remote radio (the radio linked to the local radio).

Note: The 'local' radio might be the near-end or the far-end radio, depending on the management interface connection. The terms local and remote refer to the orientation of the radio terminals relative to the IP address you are managing. When making certain changes to a near-end radio without first making changes to the far-end radio, the link may become disconnected unless configuration changes are reverted to their original settings. When making changes that may disrupt the link, **always change the far-end radio first, and then the near-end radio to match**.

The Summary Status Section allows the Exalt GUI to be a rudimentary management system. Minimize the browser window to display just the top bar or the top bar and radio information, and open several browsers on the desktop. When a window status changes to yellow or red, you can quickly maximize that window to determine the issues.

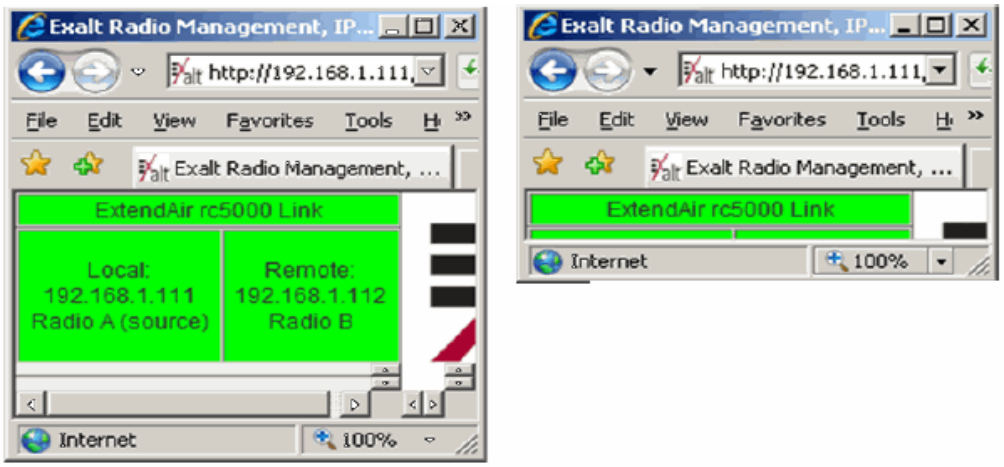


Figure 13 Summary status information

Navigation Panel

In the navigation panel, pages with sub-pages have a plus (+) to the left of the page link. Click the plus sign or page name title to view sub-page titles. The pages can be collapsed to hide the sub-pages when a minus (–) sign appears to the left of the page link.

Management pages are indicated with an X to the left of the page name. Click the X or page name to display the page within the main window.

Radio Information Page

This page provides general information about the local radio terminal. This information is helpful for troubleshooting and for record keeping.

Figure 14 Radio Information page

Administration Settings Page

This page allows contains general parameters for the radio system. The Current Value column lists entries actual settings. Desired changes are entered in the New Value column.

After all desired changes are entered, click the **Update** button to accept and enable changes.

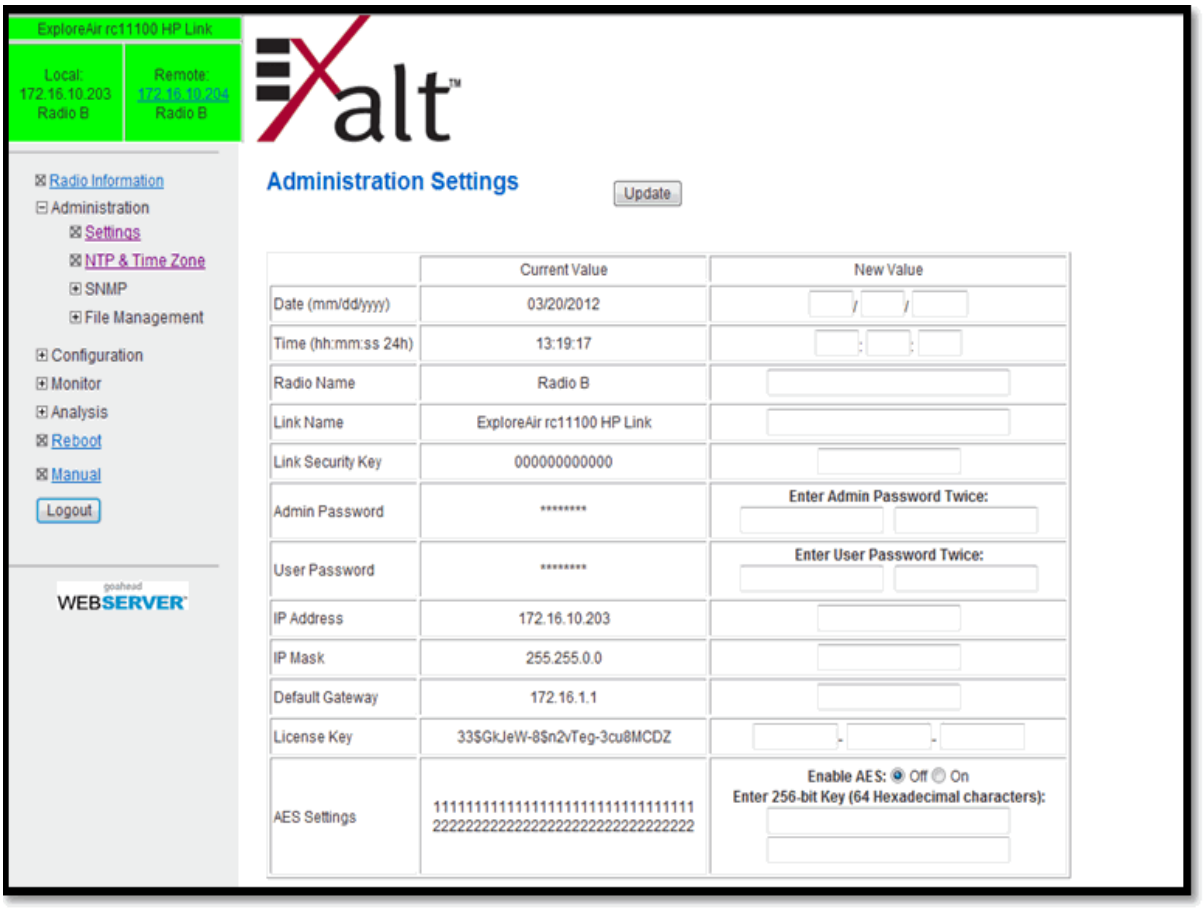


Figure 15 Administration Settings page

Most entries on this page are self-explanatory. The following lists unique or important parameters.

- Fill in the date and time fields as soon as practical. Events are captured with time/date stamps, which is valuable information for troubleshooting.
- Set the Link Security Key to something other than the factory default setting (12 characters, all zeros) at each end. The link security key must match at both sides of the link. If the security key remains at the factory setting, the radio link is open to sabotage by a party with the same radio model. Each link should have a unique security key. If using the same security key for every link in the network, the radio could link to any other radio with the same security key. This is problematic in multi-radio networks.
  - Note that the security key must be exactly 12 characters. Any alphanumeric character can be used. The link security key is case sensitive.

Note: Changing the link security key interrupts transmission until the opposite end is changed to match. **Always change the far-end radio first, and then change the near-end radio**.

- Reset the admin and user passwords. These passwords should not match. If the admin password remains at the factory default setting, it provides an opportunity for random reassignment by a network-connected user.
  - The new password must be entered twice. If the passwords do not match and the Update button clicked, the password is not changed and remains set to the previous password.
- Enter the license key provided by Exalt to access extended features or diagnostic capabilities. Click Update to accept the changes and enable the new features. License keys are issued by radio serial number, so ensure that the license key used was issued for this particular radio.
- AES (Advance Encryption Standard) can be implemented to provide additional data security for the wireless link. This function requires an upgrade license key (purchased separately). Both radios in the link must have a valid AES upgrade license key to implement AES. Different bit-length encryption license keys (for example, 128-bit and 256-bit) are also available, depending on model type. If the required upgrade license key is present, simply insert a matching hexadecimal string on both terminals and select the Enable AES On option for AES encryption. Note that similar to the administration and user passwords, the AES string must be entered twice for each terminal.

NTP and Time Zone Configurations Page

Use this page to set the Network Time Protocol (NTP), number of NTP client(s), and local time zone.

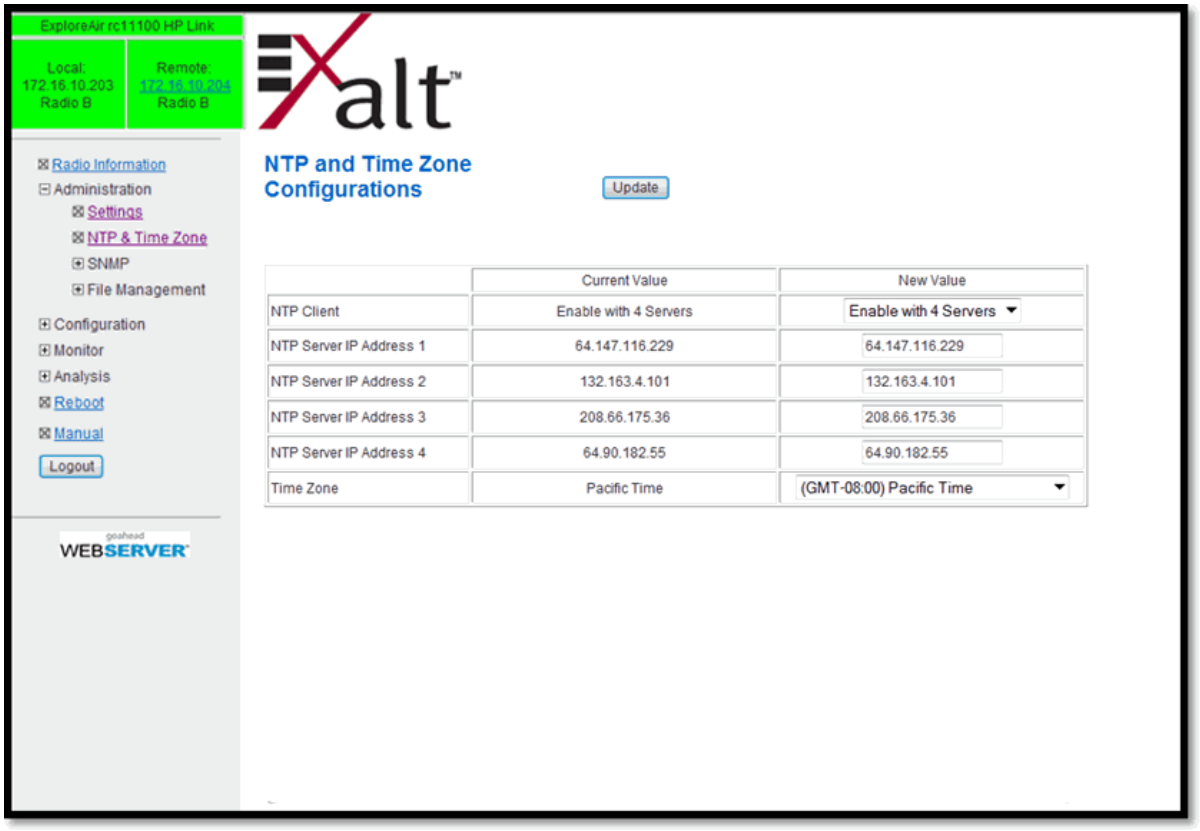


Figure 16 NTP and Time Zone Configurations page

Simple Network Management Protocol (SNMP) Configuration

This page allows the enabling and disabling of the Simple Network Management Protocol (SNMP) functions. Use SNMP to manage networked devices and execute the following functions:

- GET: Obtain information from the device, such as a configuration setting or parameter.
- SET: Change a configuration setting on the device.
- TRAP: The device proactively informs the management station of a change of state, usually used for critical alarms or warnings. See SNMP Traps.

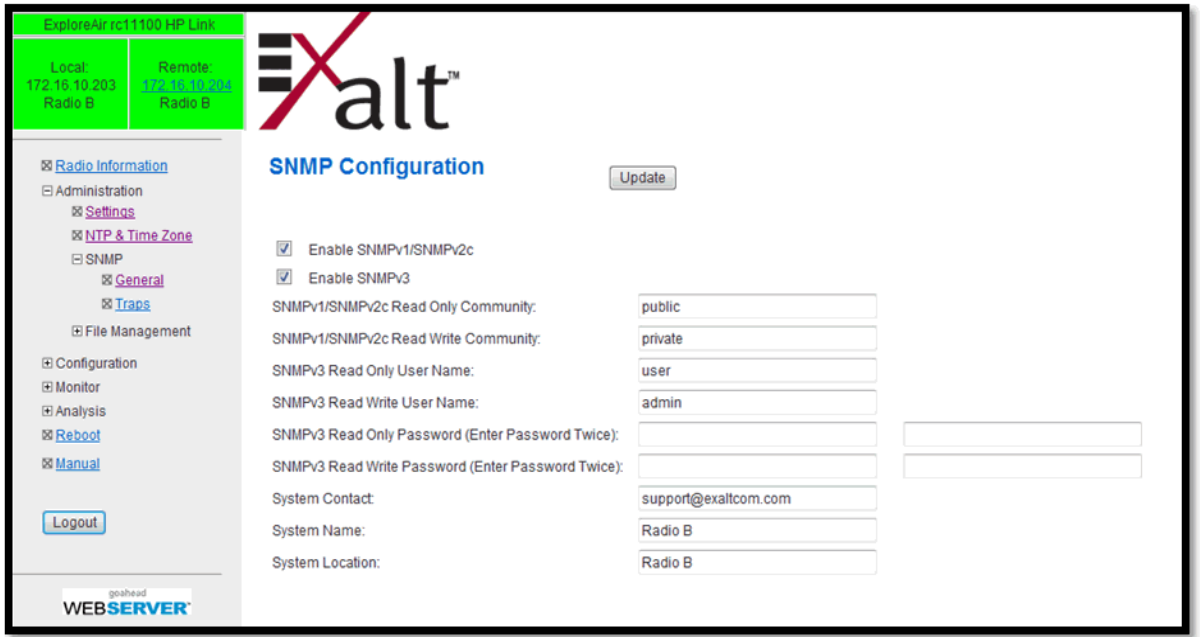


Figure 17 SNMP Configuration page

One feature of the SNMP implementation is that system configuration changes do not take effect using the SET command. Instead, groups of configuration settings can be preconfigured for global change, and a single ‘Save’ (Commit) command implements all changes.

When some parameters are changed, a link may drop and/or management control lost. MIB files allow many parameters to be set at once, allowing only a temporarily dropped link or management control issue. The opposite end radio can be quickly reconfigured, with little downtime for the link and management control. The save (Commit) command is similar to the Update button.

Dropped links or management control issues do not occur with every parameter change. Many configuration changes do not impact traffic or management access.

ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios utilize SNMPv3, a high security version of SNMP, to ensure secure access to and storing of management data. The SNMPv3 security string matches the admin and user passwords. Passwords must be eight characters or longer.

The SNMP MIBs are organized similar to the GUI. Become familiar with the GUI before using the SNMP function.

SNMP v1/v2c/v3 Support Options

Enable the SNMPv1/v2c options to allow entering read and read/write community strings.

Note: Users are encouraged to avoid enabling SNMPv1/V2c support due to known security loopholes in these protocols.

Enable the SNMPv3 options to allow entering read and read/write user names and passwords. These entries are de-coupled from the standard radio user names and passwords. SNMPv3 provides full management security.

SNMP Traps

SNMP traps alert the central network management system with important issues about the radio system. Trap filters are set on the Traps Configuration page (Figure 18).

Trap support for all versions of SNMP are provided and can be independently enabled. Enter the IP address to which the traps are directed in the Trap Destination IP Address field. The Ethernet port used for management (typically the ETH1 port or for ExploreAir models, often the SFP/ETH2 port) must be connected to the network to allow trap information to reach the designated IP address. In a bridged network, this may not require special network settings. In a routed network, the connected router must have a defined path for the IP address.

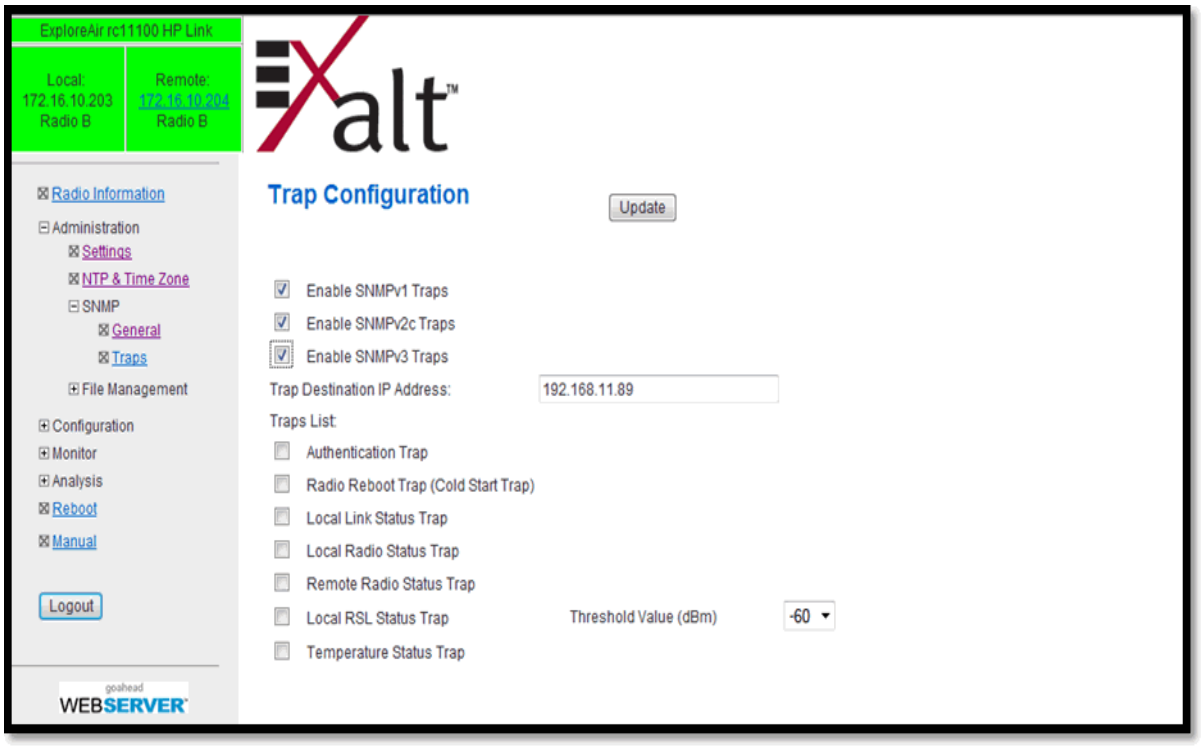


Figure 18 Trap Configuration page

Note: Click the **Update** button to save changes on any page. Also on all pages until saved, changed fields display with an orange background (Figure 22).

The following traps are available:

- Authentication Trap: This is an SNMP standard trap when password information for SNMP is incorrect. This can help identify unwanted intrusions into the management system and for diagnosis of SNMP issues for valid users.
- Radio Reboot Trap: This trap is sent after any radio reboot to inform the manager of the reboot status.

- Local/Remote Link Status Trap: This trap is sent when Link is in errored state (equivalent to the Link LED on the radio front panel or the Link status bar in the upper-left of the Exalt GUI window).
- Local/Remote Status Trap: This trap is sent when Status is in errored state (equivalent to the Status LED on the front panel or the radio status box in the upper-left of the Exalt GUI window). Note that ExtremeAir models provide both vertical and horizontal polarization status.
- Local RSL Status Trap: This trap is sent when the local RSL drops below the value set in the Threshold Value (dBm) field. Buffers are provided so that continuous traps are not sent if the RSL is bouncing near the set threshold value. This trap is reset only if the RSL rises to 3dBm above the set threshold value and then drops below that value. Exalt recommends that this trap be set to a value 5dBm or 10dBm above the threshold as a warning that the system has faded and may be approaching an outage. Note that ExtremeAir models provide both vertical and horizontal polarization status.
- Temperature Status Trap: This trap is sent when the internal temperature reaches the warning point. This conveys that the external temperature control is in a fault state. Buffers are applied to this trap to avoid multiple traps when the temperature remains near the warning point.

File Transfer Page

This page allows the administrator to upload and download files to and from the radio. Two types of files can be uploaded: configuration, and radio firmware. **When uploading Configuration Files, current configuration parameters are immediately overwritten, and the unit may reboot.** When uploading radio firmware files, the file is placed into reserve memory space. After the new radio firmware file uploads, use the File Activation page to enable the files (see File Activation Page).

Figure 19 File Transfer page

Up to four types of files can be downloaded: radio firmware, configuration, MIB, and event log. The MIB file refers to the Management Information Base related to the Simple Network Management Protocol (SNMP) function, and is only available on models which support SNMP. See Simple Network Management Protocol (SNMP) Configuration for more information.

Note: Check the File Activation Page before uploading radio firmware files. New file uploads overwrite the secondary file location. If important files reside in the primary or secondary file location, download them before uploading the new files. Only the active radio firmware file can be downloaded. Therefore, to download the reserve file, it must first be activated (using the Swap button).

Use the following steps to download a file.

1 Select the type of file to download (configuration, radio firmware, MIB or event log).

2 Click the Download button and wait for the radio to prepare the file for download.

For some file downloads, a second page/link appears (Figure 20).

3 Left-click the link on the page to download the file to a desired location.

Figure 20 File Transfer page—download file link

File download and upload is useful when configuring several radios with similar settings. A copy of the configuration file can also help restore radio settings. In addition, a copy of the Exalt default configuration file is helpful to restore the radio to factory settings.

Note: The configuration file name can be changed, but must have the .xml extension. Do not change radio firmware file names.

If copying the same configuration file into multiple radios, take as some parameters will match and that may be undesirable. However, it may be easier to change just a subset of parameters rather than every parameter. The following parameters can cause problems or confusion if they match at each of a link:

- Radio Name
- Endpoint Identifier
- IP Address
- IP Subnet Mask
- Default Gateway

The following parameters can match at both ends of the link:

- Link Name
- Link Security Key (although each link should be different)
- Admin and User passwords
- Bandwidth
- RF Frequency
- T1/E1 configurations
- Ethernet configurations

File Activation Page

Use this page to move stored or uploaded files for use on the radio. The page indicates which file is currently in use, and which file is available for use. Click the Swap button to place the file in the Alternative File column into the active state and move the file in the Current File column to the Alternative File column.

Figure 21 File Activation page

Note: In all cases, the radio reboots after a new file is selected using the Swap function. This places the radio out of service for a short time.

System Configuration Page

This page contains several critical system parameters. As depicted in Figure 22, on all pages changed fields display with an orange background. Click the **Update** button to save field changes.

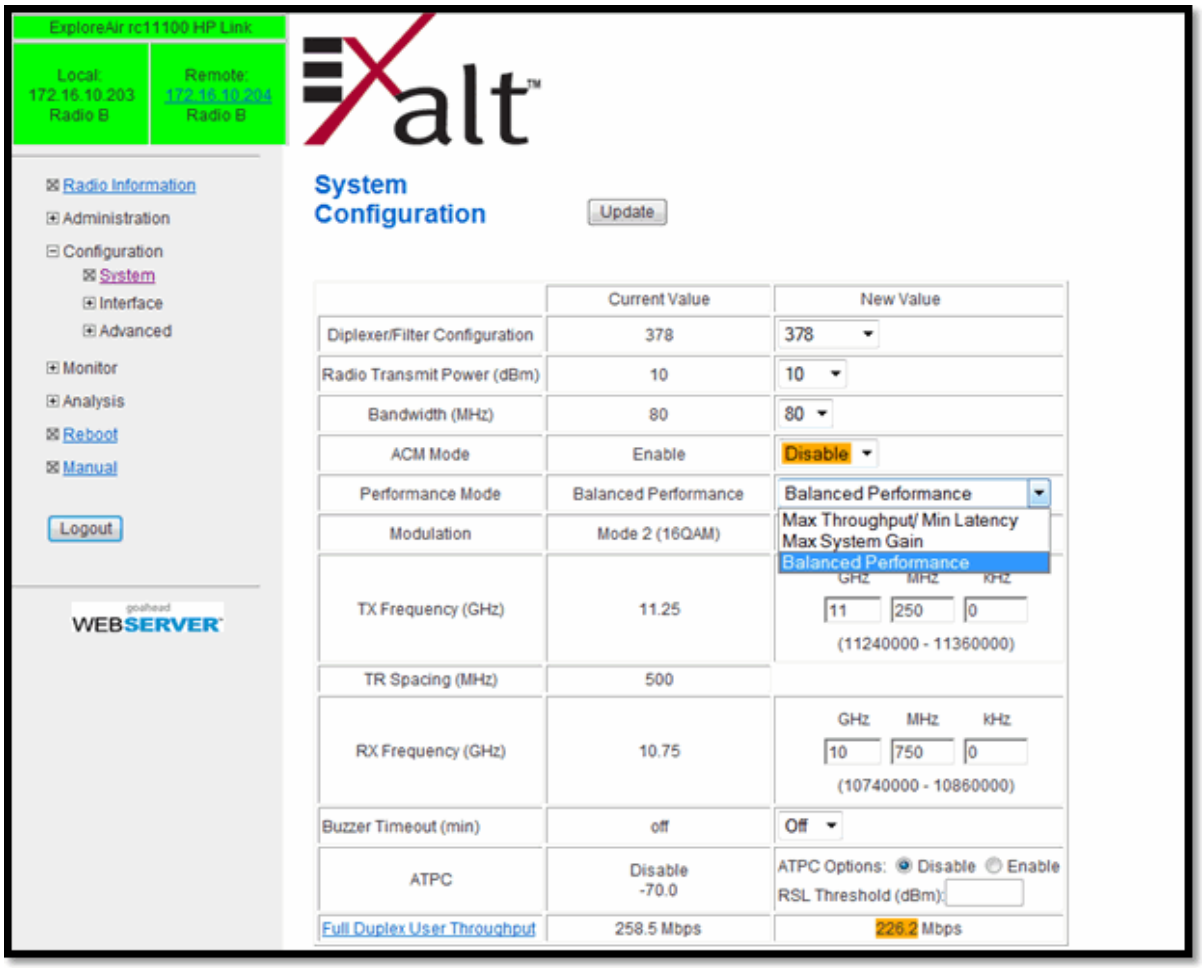


Figure 22 System Configuration page–ExploreAir model

Most entries on this page are self-explanatory. The following lists unique or important parameters.

- Set the Diplexer/Filter Configuration parameter to match the installed diplexer of the radio (see Diplexer Channel and Polarization Configuration). If the radio diplexer has never been changed from the manufacture configuration or the change was done following labeling directions in Diplexer Channel and Polarization Configuration, the label on the outside of the radio will match the diplexer configuration. If there is any doubt, remove the diplexer cover to reveal orientation.
- Set the Radio Transmit Power (dBm) parameter to the designed level. The professional installer sets this value or dictates the value of this setting to the system administrator following the system design and local regulations. In many cases, this value must be set to a proper value to comply with legal restrictions. Improper values can result in liability to the user and/or installer.

Note: ***Changing Radio Transmit Power may temporarily interrupt traffic.*** Small changes in output power do not normally interrupt traffic, but larger changes may.

  - Do not adjust the Radio Transmit Power parameter to a value higher than is legally allowed.
  - Do not adjust the Radio Transmit Power parameter lower than the link budget and fade margin can afford.

Note: The link may be lost and unrecoverable through GUI control. If the link is lost due to reduction of Radio Transmit Power, travel to the radio location(s) may be required to reset the value.

- Set the Bandwidth (MHz) parameter to the value assigned to the radio license. The value of this is determined in the design/engineering stage. The Bandwidth parameter must also match at both ends of the link. In conjunction with the Mode parameter, the Bandwidth parameter directly relates to the capacity and the number of TDM circuits supported.

Note: *Changing Bandwidth will temporarily interrupt traffic*. The Bandwidth parameter must match at each end. Adjust the far-end radio first, and then the near-end radio. Changing Bandwidth changes the radio's threshold. A narrower bandwidth has better threshold performance and improved interference immunity, therefore if changing to a wider bandwidth, there is an opportunity that the link may be lost and unrecoverable through GUI control. Check the available fade margin to determine if the impact to threshold and increased bandwidth is acceptable to maintain the link and the desired performance. If the link is lost due to increasing the Bandwidth parameter, travel to the radio location(s) may be required to reset the value.

- Performance Mode settings optimize performance. When ACM is disabled, three settings are available for Performance Mode. The specifications that apply to these settings can be found in the data sheet for the product.

This feature is not available on all models.

  - Maximum Throughput/Minimum Latency maximizes total radio capacity and minimizes link latency. For highly stable links in respect to fading or multipath propagation and/or links that have significantly high predicted availability, this setting is desirable to achieve the best possible throughput and/or latency.
  - Maximum System Gain maximizes transmitter output power and minimizes receiver threshold, optimizing total system gain. This setting is desirable for links requiring the highest possible fade margin and/or availability, especially for dynamic links that experience significant fading and/or multipath propagation.
  - Balanced Performance provides a mid-point in performance relative to throughput, latency and system gain.

- Set the Modulation parameter to the designed selection. The value of this setting is determined in the design/engineering stage and by the licensing process. The Mode parameter must match at both ends of the link. In conjunction with the Bandwidth parameter, the Mode parameter setting directly relates to the capacity of the system, as well as critical RF parameters, including receiver threshold, carrier-to-interference ratio, and in some cases, maximum radio transmit power.

Note: ***Changing Mode will temporarily interrupt traffic***. **The Mode setting must match at each end.** Adjust the far-end radio first, and then the near-end radio. Changing Mode changes the radio's threshold, carrier-to-interference ratio, and also may have impact on the Radio Transmit Power. A lower mode has better threshold performance and carrier-to-interference ratio, and in some cases, higher output power, therefore if changing to a higher mode (for example, from Mode 1 to Mode 2), there is an opportunity that the link may be lost and unrecoverable through GUI control. Check the available fade margin and interference profile, and determine if the impact to RF performance is sufficient to maintain the link and desired performance. If the link is lost due to increasing the Mode parameter, travel to the radio location(s) may be required to reset the value.

- (ExtremeAir models only) Set the Polarization parameter for either single polarization (H or V) or dual polarization (H plus V).
- Set the TX Frequency (GHz) parameter and Rx Frequency (GHz) parameter to the licensed center frequencies. The frequencies must match the same pair at both ends of the link, but in opposite Tx/Rx orientation.
- The Transmitter/Receiver (TR) frequency spacing is automatically determined based on the frequency settings. This is reported to verify the intended frequency settings, as a confirmation to proper input.

Note: ***Changing RF Frequency will temporarily interrupt traffic.*** **The RF Frequency parameter pair must be opposite at each end.** Adjust the far-end radio first, and then the near-end radio. If the link is lost due to changing the RF Frequency parameter, travel to the radio location(s) may be required to reset the value.

- Buzzer Timeout (minutes) parameter creates an audio signal for antenna alignment. Turn on the buzzer continuously during antenna alignment or preset a period of time that the buzzer will sound. If the buzzer stops before alignment activities are complete, change the selection and press the Update button or select the ON option until alignment activities are complete.
- ATPC (Automatic Transmit Power Control) parameter (if authorized) increases transmitter power if the RSL drops below the programmed value. The maximum output power for ATPC can be set up to the maximum power capable from the radio (including installed license keys) for the current modulation. Use the ATPC timers to ensure that the radio meets regulatory requirements. Timer information is provided on the ATPC Statistics Page. Also, the diagnostics chart for RSL illustrates the ATPC threshold level to accomplish a proper diagnosis of the RSL relative to ATPC.

Note: At publication, ATPC is not available on all models. Depending on model and firmware version, ATPC appears on a tab in the Advanced sub-menu.

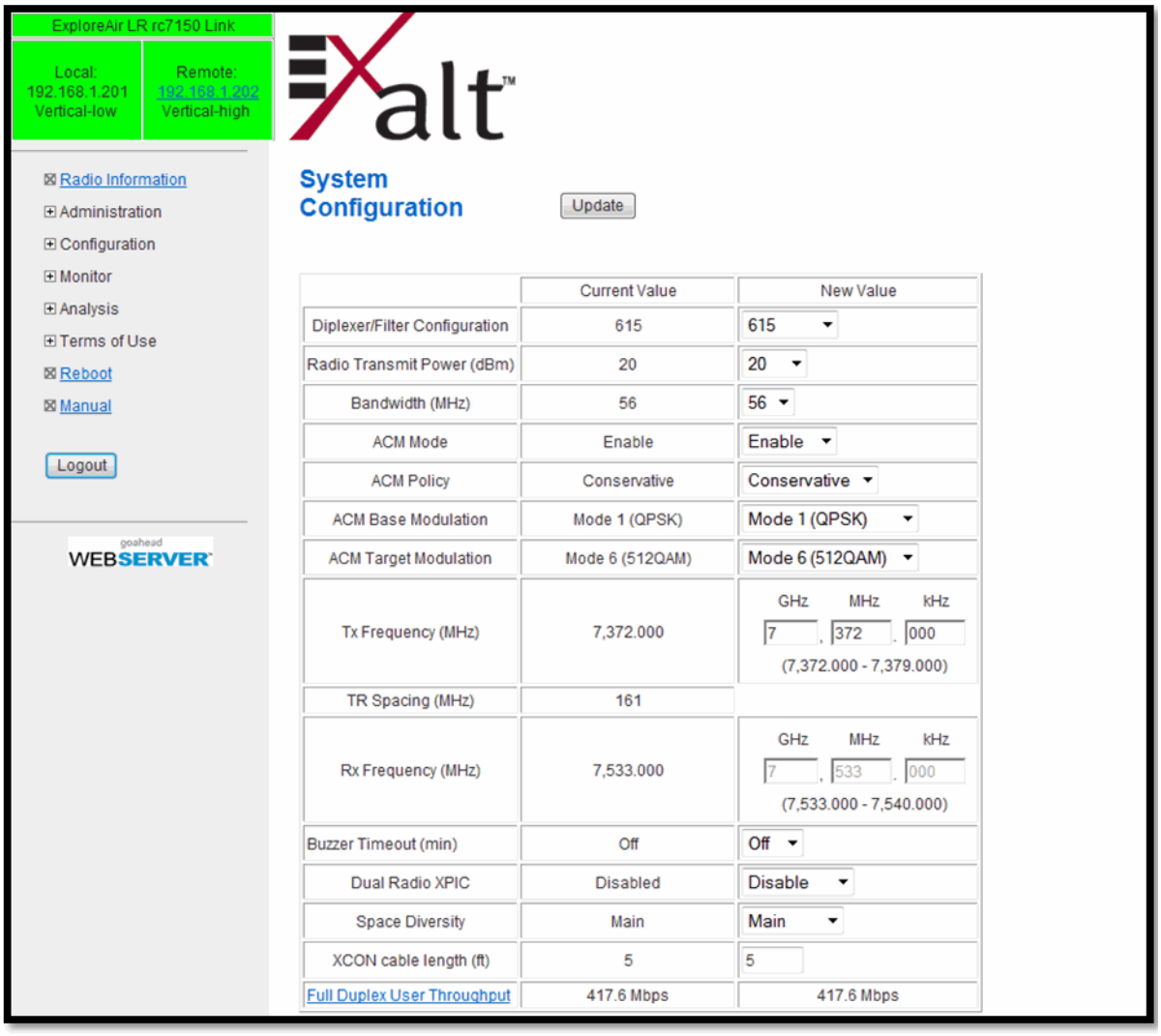


Figure 23 System Configuration page showing Space Diversity–ExploreAir LR model

- (ExploreAir LR models only) Dual Radio XPIC parameter provides a means to connect two parallel links across a cross-polarized antenna to achieve higher capacity than one independent link. One radio at each end of the link must be set to Vertical, and the other radio must be set to Horizontal. This configuration requires specific cabling and antennas. See XPIC and SD Cabling – ExploreAir LR models only and XPIC (Cross-polarized Interference Cancellation) – ExploreAir LR models only. The XPIC Status Page–ExploreAir LR models is provided in XPIC configurations.
- (ExploreAir LR models only) Space Diversity parameter provides performance improvement for paths likely to experience significant fading and multipath. SD is designed for longer distance paths and/or paths that extend over flat ground, water, and/or are in humid climates. Set each terminal for either Main (Tx/Rx) or Diversity (Rx-only), and set the XCON cable length to that connected between the terminals. See Space Diversity (SD) – ExploreAir LR models only, Space Diversity Status Page–ExploreAir LR models and XPIC and SD Cabling – ExploreAir LR models only.
- Full-Duplex Throughput parameter provides information about user capacity of the wireless link, in the current configuration. The ‘new value’ column reflects throughput if changes are made to

Bandwidth or Mode. Click the “Full-Duplex User Throughput” link for details on how capacity information is determined.

- XCON Cable Length parameter specifies the length of the XCON cable (maximum 50'/15.2m).

ACM Parameters

The GUI page for system configuration is the same as above, except for the Adaptive Coded Modulation (ACM) features noted in Figure 24.

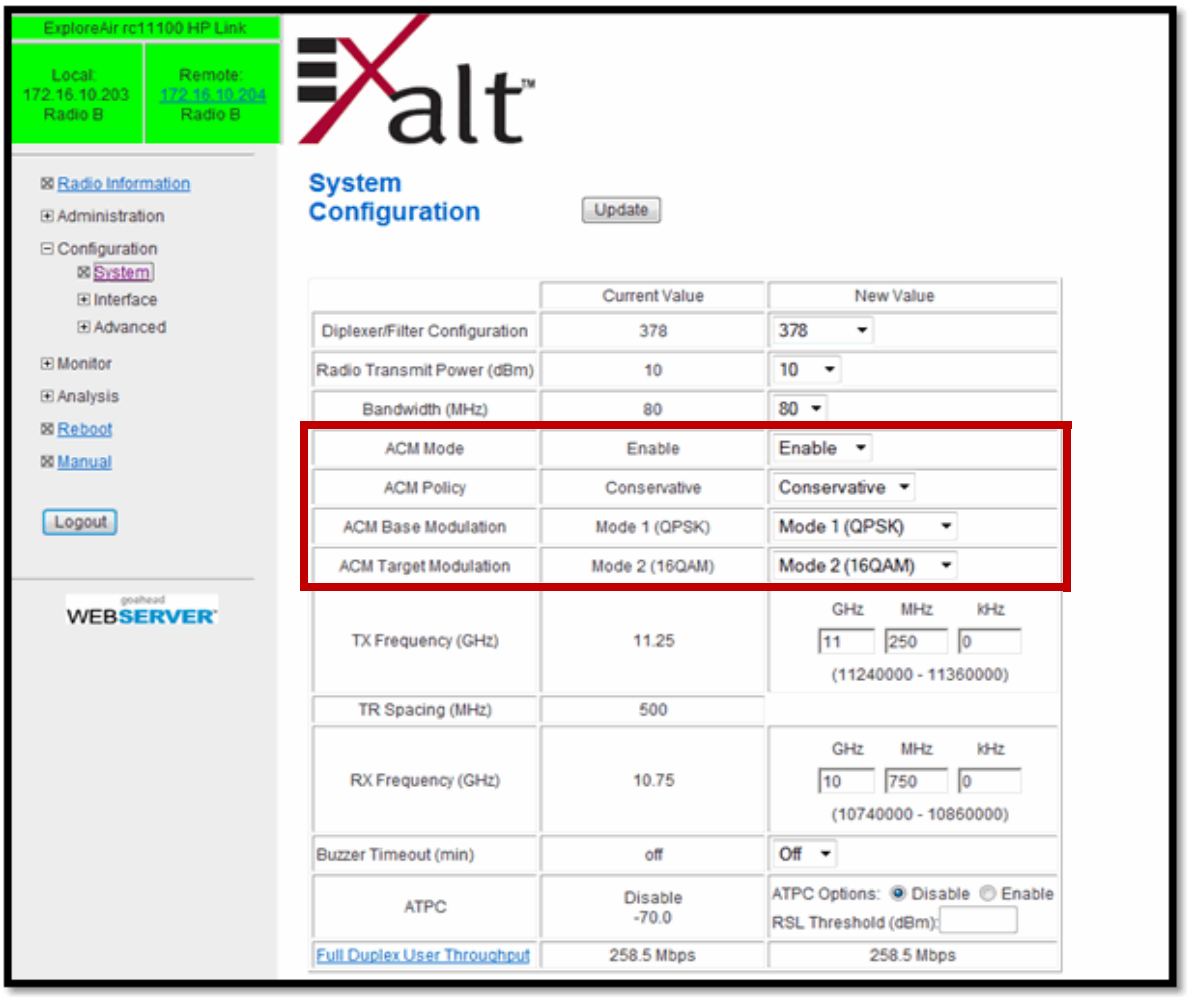


Figure 24 ACM parameters

Adaptive Coded Modulation (ACM) allows the radio to reduce throughput as link conditions fall below what can be supported during normal operation. The advantage is that instead of the link being down or highly errored, the link remains up for longer periods, but with reduced throughput.

- ACM Mode parameter enables or disables ACM. Some regulatory environments may not allow ACM or may require special licensing. Check your local regulations before enabling this feature.
- ACM Policy parameter selects the modulation to run and how fast to switch between settings.
  - Aggressive settings switch the radio from modulation to modulation at the moment that the signal-to-noise ratio allows. This can result in rapidly changing throughput characteristics, but always provides the highest throughput, even if the currently selected setting is not error-free.

  - Conservative applies hysteresis to the switching decision, waiting longer to make a change in the ‘upward’ direction. Switching to a lower modulation is instantaneous, but the radio ‘waits’ to switch back to a higher modulation state until the signal-to-noise ratio is above the threshold for that setting. The result is slightly slower changes between modulations and less overall switching (which could be less disruptive to some network operations).

- ACM Base Modulation parameter sets the minimum modulation for the radio to select. There are cases where regulatory limits may apply that govern the minimum modulation that can be used, which is sometimes based on licensing. Check your local regulations before deciding this parameter setting.
- ACM Target Modulation parameter sets the desired modulation for the link under normal unfaded conditions. The radio attempts to remain in mode at all times, unless link conditions cannot support it. Again, licensing and/or local regulations may govern the maximum setting for this parameter.

Ethernet Interface Configuration Page

This page allows the administrator to set the muting, alarm, and duplex settings of both the Ethernet connection.

For models with multiple Ethernet ports, this page also allows determination of the management information for in-band (carried over the air and available from both Ethernet connectors on either end of the link) or out-of-band (not carried over the air and only available from the local PoE connector).

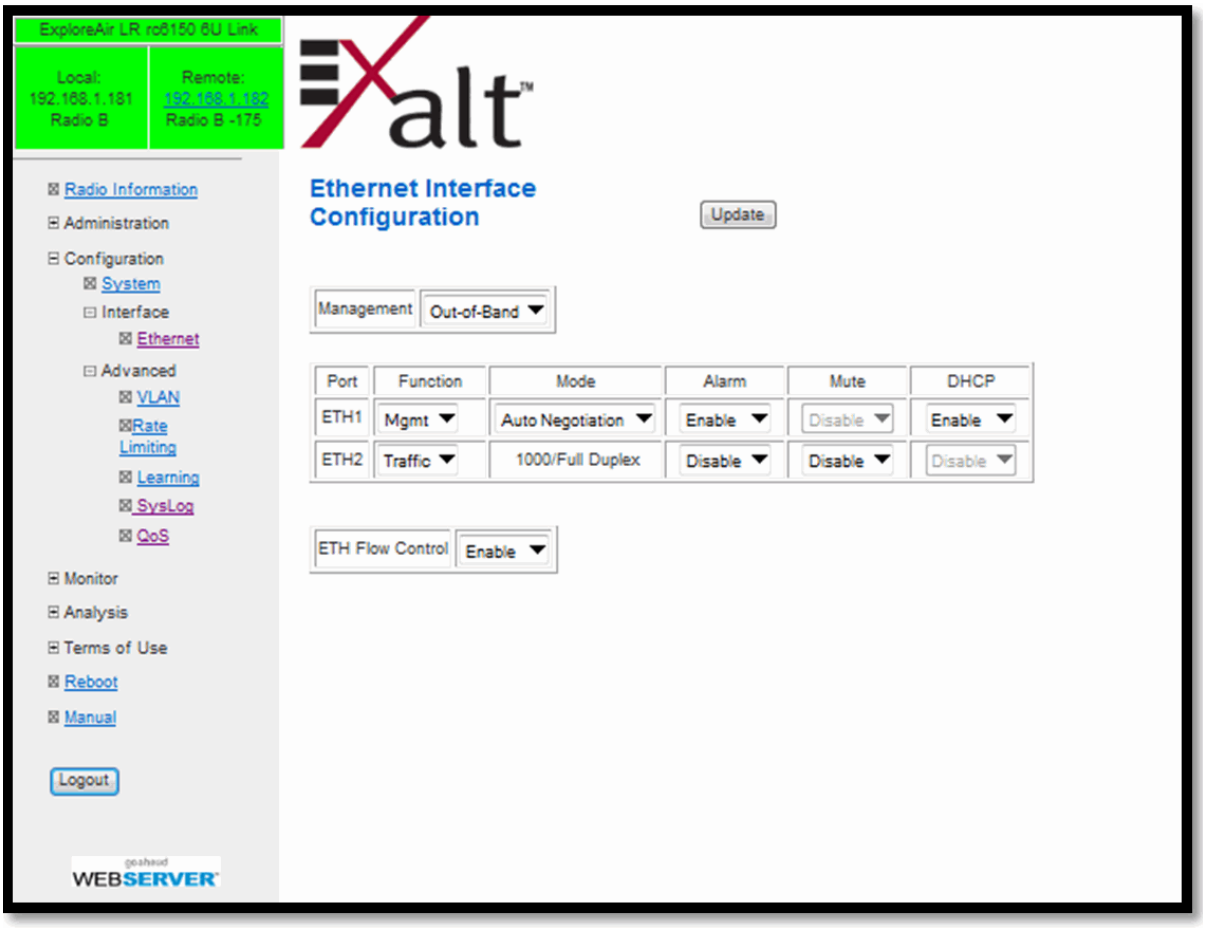


Figure 25 Ethernet Interface Configuration page

To ignore Ethernet alarms, disable the alarming of the connector. Muting a connection is desirable when connected equipment senses Ethernet signaling and makes decisions (such as, spanning tree protocol enable) based on the Ethernet signal. The ETH1 port cannot be muted, as it is always used for primary management and PoE.

It may be desirable to disable the alarming of any connector if it is not used.

NMS Management allows determination of the management information using the following management modes:

- In-band: Management traffic is carried over the air and is available from all connectors on either end of the link.
- Out-of-band: Management traffic is not carried over the air and is only available from the port(s) configured for Management.
- Port-to-Port: Management traffic remains separate from data traffic without requiring out-of-band management or VLAN configuration. This allows any Ethernet port on the link to be logically

mapped to the same port at the other end of the link without requiring VLANs to be configured. The traffic passing through these mapped ports is not accessible from any of the other available Ethernet ports on either side of the link.

For Gigabit Ethernet interfaces, configure the interface on the radio and the interface on the connected network equipment to Auto-Negotiation; the default setting for new radios. For 100BaseT (Fast Ethernet) interfaces, configure the interface on the radio and the interface on the connected network equipment to 100/Full; the default setting for new radios. It is not recommended for 100BaseT connections to be set to Auto-negotiate, as this can exhibit packet loss with an extremely adverse impact on throughput.

When enabled, DHCP provides basic DHCP functions to ease interfacing with a computer. By default DHCP is enabled for models that support it. If the Ethernet port on the computer is set for DHCP addressing, on radio bootup or upon Ethernet link (for up to 10 minutes) the radio provides an IP address to the computer that is two digits higher than the radio's IP address (for example, if the radio's IP address is 10.0.0.1, the computer's IP address will be 10.0.0.3). The radio also senses any DHCP server on the network and, if detected, mutes its own internal DHCP function.

The Flow Control setting allows the enabling of 802.3 Ethernet flow control, useful for systems implementing QoS or other traffic flow control implementations. This feature is selectable on all Ethernet interface ports individually, and enables flow control signaling from the radio to the connected network device. 'Pause' packets are issued when incoming traffic capacity is greater than current capacity. This feature is only operational when used in conjunction with Rate Limiting and/or QoS. When enabled, 'pause' packets are issued when incoming traffic capacity is greater then current capacity. When QoS is also enabled, increase the Time To Live (msec) on the QoS Queue configuration to a value higher than the default of 10,000 on the lower priority queues to ensure no packet loss.

T1/E1 Configuration Pages – rcxxx10 models only

These pages allow the administrator to selectively enable or disable the T1 or E1 circuits, one at a time. For enabled T1/E1 circuits, additional configuration, including loopback functions, are available. Disable the unused T1 or E1 so that the alarms are turned off and more throughput is allocated to the Ethernet interface. Every enabled T1 or E1 input, even if there is no T1 or E1 signal present, reduces the full-duplex throughput of the Ethernet interface by roughly 1.5Mbps (for T1) or 2Mbps (for E1).

This page toggles between T1 and E1, as required, by clicking the Set to T1 or Set to E1 button. A warning displays that a reboot is necessary, and the radio reboots if the administrator continues. This will interrupt traffic. It may be necessary to re-login to the radio after the reboot completes. T1/E1 mode self-coordinates across the link if the link is active. This means that it only needs to be set while connected at one end. In addition, enabling and disabling T1/E1 circuits also self-coordinates across the link if the link is active. If a link is not active and T1/E1 enabling is a mismatch when a link is first created, the Tx Hi configuration for T1/E1 enabling supersedes the settings on the Tx Lo configuration, and changes the settings on the TX Lo radio.

Note: Certain combinations of the Mode and Bandwidth parameter settings limit the number of T1/E1 circuits that can be carried by the radio. In these cases, certain fields on the T1/E1 Interface Configuration pages are not available, starting with the highest port number. For example, for a 4x T1/E1 radio version, if only three (3) circuits can be carried, port 4 is not available for configuration and is disabled. If only two circuits can be carried, both ports 3 and 4 are not available. Increasing the Mode parameter and/or increasing the Bandwidth parameter results in an increase in the supported number of T1/E1 circuits.

T1 Interface Configuration Page

This page allows the administrator to enable/disable each individual T1 channel, set the Line Build Out (LBO), Line Code (either AMI or B8ZS), and AIS enabling/disabling for each input. If enabled, the radio places an AIS code on the output of the associated interface if and when the link fails or when there is no T1 signal available from the far end to provide the user at the local end. Loopback controls are also provided (see T1/E1 Loopback).

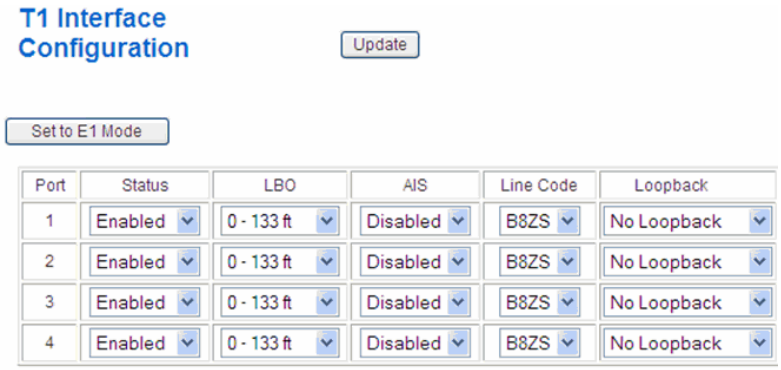


Figure 26 T1 Interface Configuration page

E1 Interface Configuration Page

This page (Figure 27) allows the administrator to enable/disable each individual E1 channel.The AIS can also be enabled and disabled for each input. If enabled, the radio places an AIS code on the output of the associated interface if and when the link fails or when there is no E1 signal available from the far end to provide the user at the local end. Loopback controls are also provided (see T1/E1 Loopback).

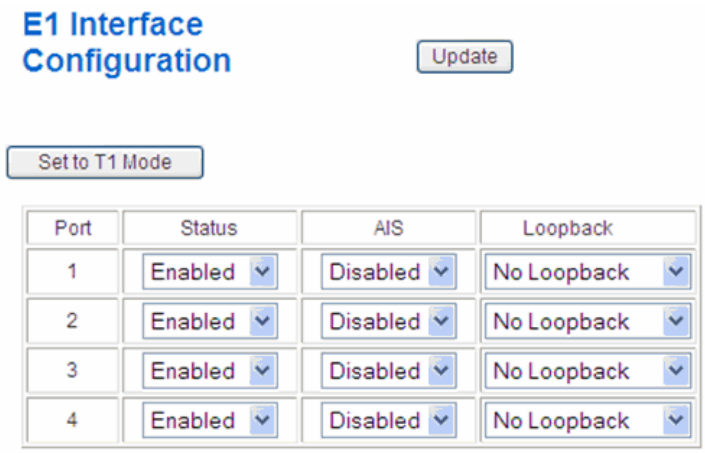


Figure 27 E1 Interface Configuration page

T1/E1 Loopback

Loopback is provided for any enabled T1 or E1 port. As shown in Figure 28 through Figure 30, the choices are:

- No Loopback (default)
- External (local)
- External (remote)
- Internal

Note: Only one Internal loopback can be enabled at any time.

All loopback configurations control the loop at the Line Interface integrated circuit, which is the device wired directly to the front panel ports.

External loopback modes are used in conjunction with an external test source. The designation of ‘local’ or ‘remote’ refers to where the loopback is occurring relative to the location where the loopback is implemented. That is, on the radio being accessed, if External (remote) is selected, this loops the signal back at the remote radio interface back towards the local radio. Likewise, if External (local) is selected, the signal loops back at the local interface towards the remote radio (Figure 28 and Figure 29).

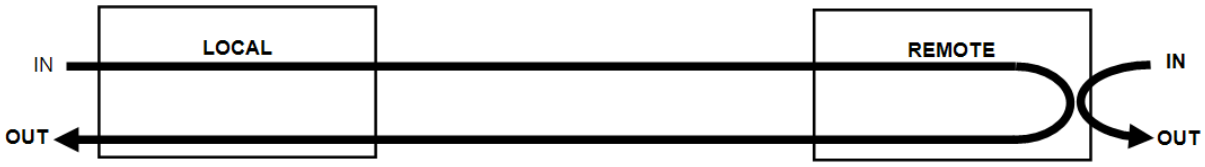


Figure 28 External (remote) loopback

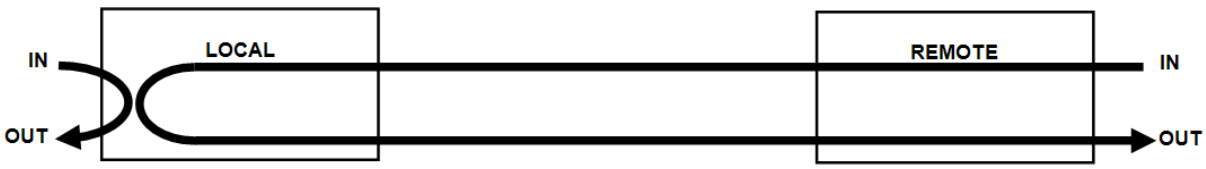


Figure 29 External (local) loopback

When a local T1/E1 port is configured for External (remote) loopback, it is the same as configuring the remote radio for External (local) loopback.

Internal loopback uses an internal test source, and sends the test source signal across the link, looped at the remote radio's interface, returned to the local radio, and looped at the local radio's interface back to the source. The inputs at both ends are looped back at the line level. Figure 30 illustrates the internal loopback function.

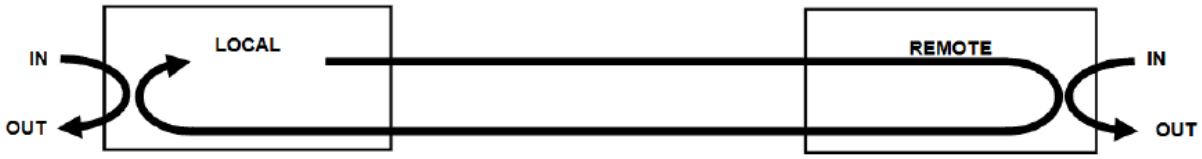


Figure 30 Internal loopback

VLAN Configuration Page

VLAN is disabled as the default setting for Exalt radios. The Exalt radios still pass VLAN and non-VLAN traffic across the link, but do not examine the VLAN traffic or act upon it. Enable VLAN using the Exalt GUI for expanded VLAN support.

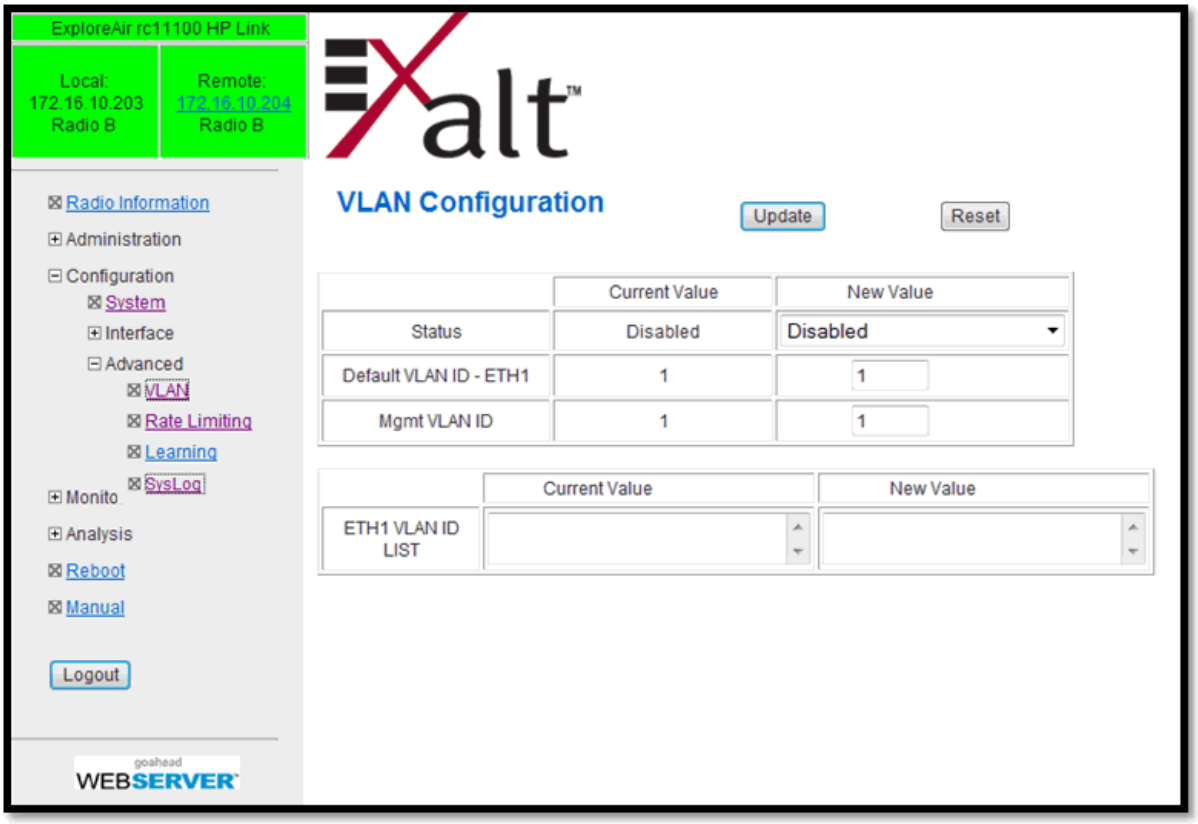


Figure 31 VLAN Configuration page

When VLAN is first enabled, all Ethernet interface ports are assigned as *Default VLAN*, until the ports are configured with specific VLAN IDs. For example, a specific VLAN for management access to the radio must be manually configured.

Note: Once a management VLAN is configured or modified and the Update button clicked, the management connection will likely be lost. The management connection to the radio must follow the configuration to the assigned VLAN. After configuring and enabling the management VLAN on the radio, reconfigure your network's management access to match the settings on the radio.

A list of up to 4094 VLAN IDs can be entered into each of the Ethernet interface entries. This list of VLAN IDs is allowed to pass across the link. Tagged packets that do not fall within the list of VLAN IDs are blocked. Packets that are untagged are handled in accordance with the Mode selection. The VLAN ID entries can be typed as individual numbers separated by commas, or ranges separated by commas, or any combination (for example: 1, 5, 10-22, 50, 70–80).

VLAN configurations are maintained even when VLAN is disabled. That is, the VLANs can be configured and the configuration saved, even though they are not active until VLAN is enabled. Reset the radio to the critical factory defaults (see Reset to Critical Factory Settings) to restore the management connection if a mistake was made assigning the management VLAN and access cannot be restored.

Ethernet Rate Limiting Page

This page enables radio Ethernet port rate limiting.

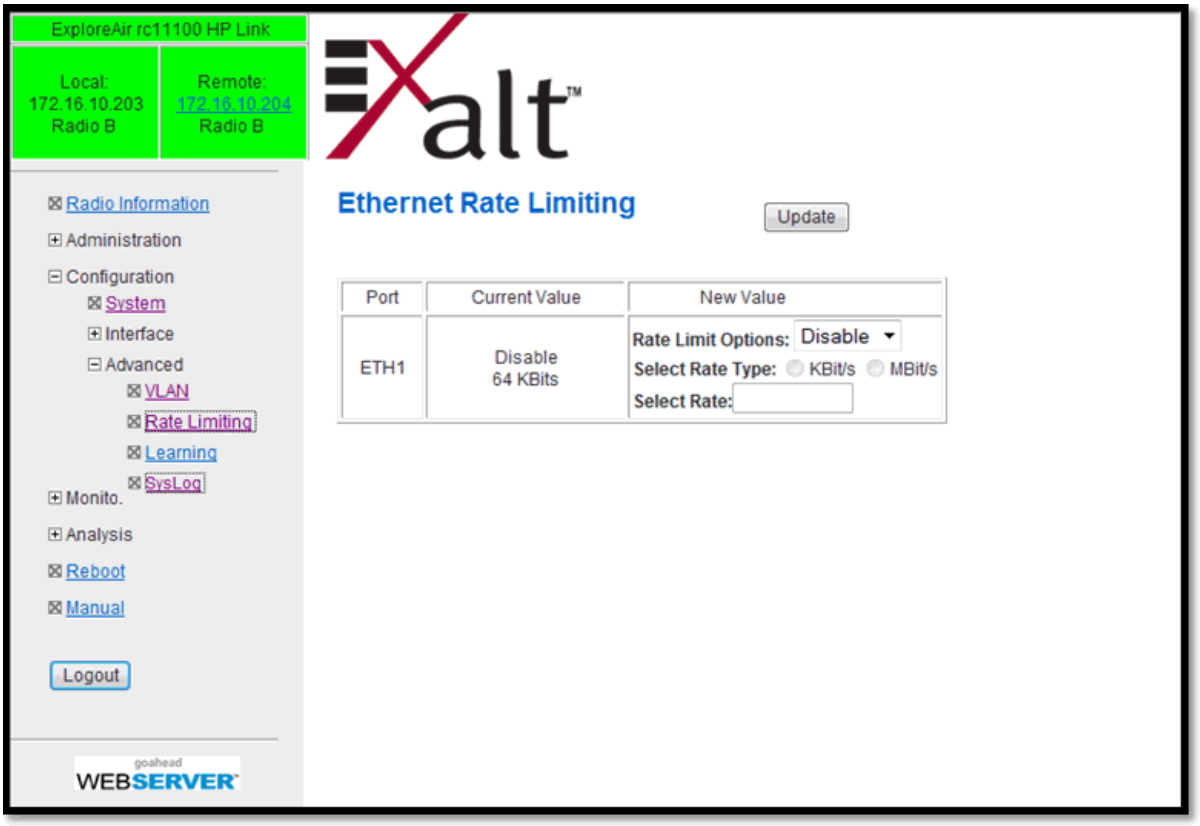


Figure 32 Ethernet Rate Limiting page

Enable this to limit the output information rate to at or below downstream networking equipment capabilities. The rate is in Mbps or kbps, as specified. The default setting is Disabled. Use the Update button to save changes.

Ethernet Learning Page

This page allows enabling or disabling Media Access Control (MAC) learning. This is a universal setting for all Ethernet interfaces.

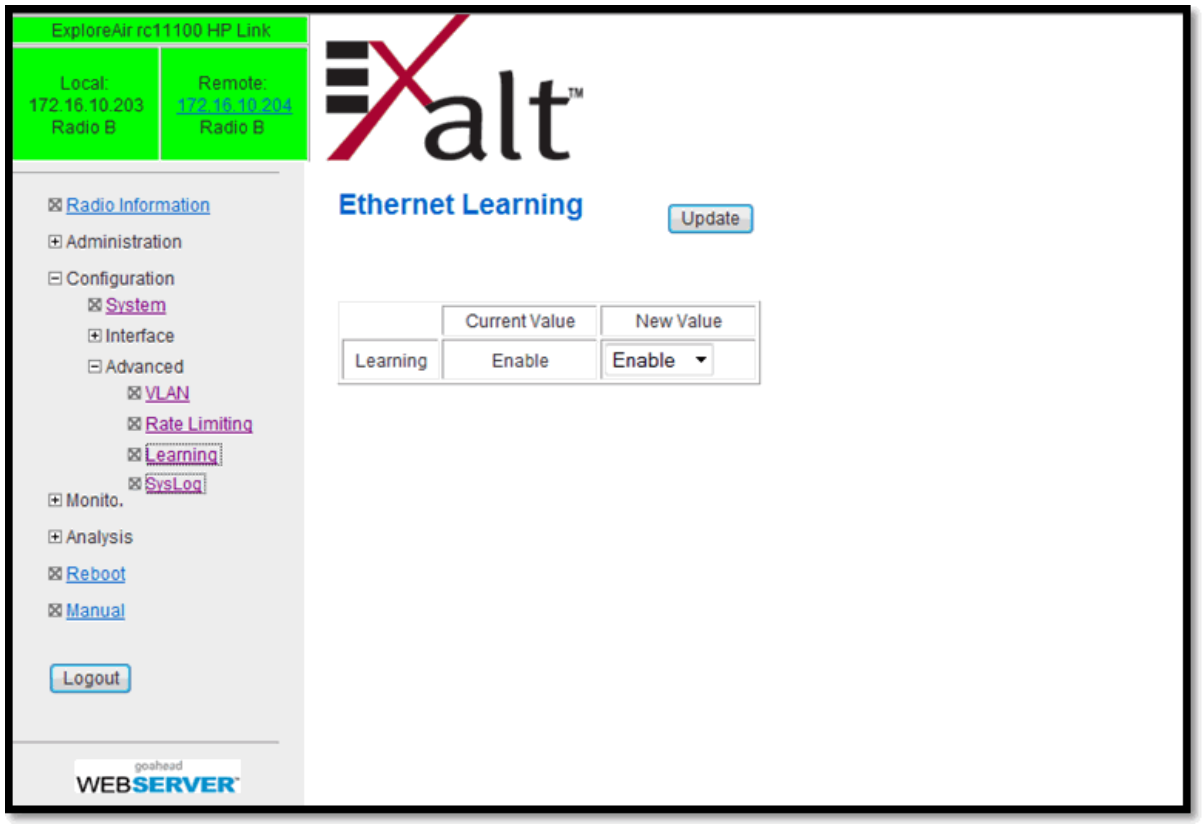


Figure 33 Ethernet Learning page

Some network configurations may broadcast the same MAC Source address on multiple interfaces, and if learning is enabled, data transport errors can result. For these cases, disable learning to improve networking functionality. However, disabling learning can cause unnecessary traffic to occupy the interfaces and the radio link, and lead to lower throughput performance.

Syslog Configuration Page

Note: This feature is not available on all models.

Syslog serves as a remote means to receive event log messages (configuration and alarm state changes) for network management and/or record keeping.

Figure 34 Syslog Configuration page

To enable the syslog, check the Remote host logging option and input the IP address for the remote host. See Event Log Page for filter descriptions.

QoS Configuration Page

This page provides configuration for the Quality of Service (QoS) feature. QoS is a network prioritizing feature that ensures high-priority traffic transfers during peak capacity demands. The priority hierarchy is adhered to when capacity demand is higher than the link can provide; highest priority traffic is allowed to transfer, while lowest priority traffic may be dropped.

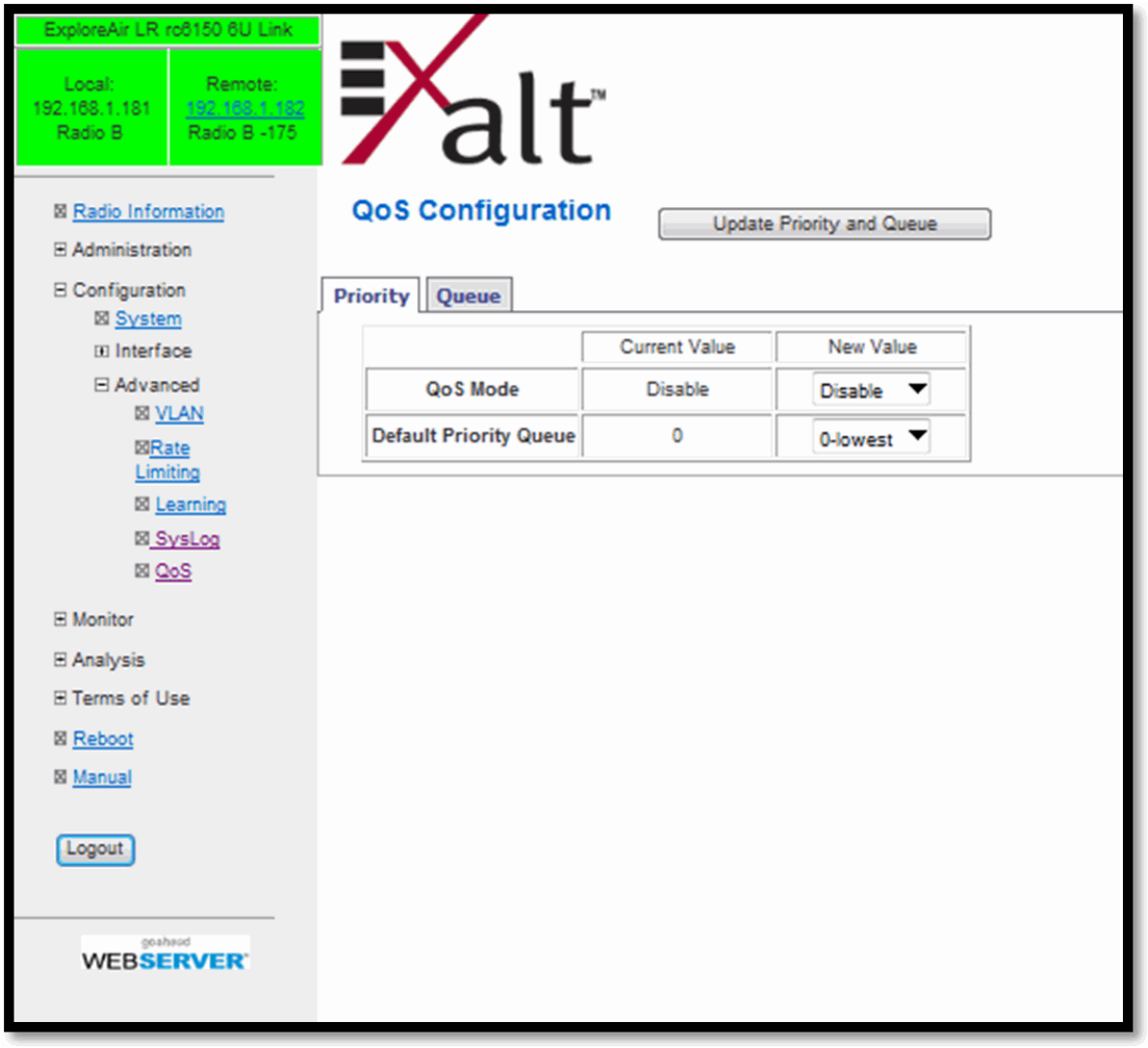


Figure 35 QoS Configuration page

These systems follow a 'round robin' QoS algorithm, ensuring a distribution of priority traffic. Some percentage of all priority classifications is carried across the link, with the largest percentage applied to the highest priority, and next largest percentage to the next highest priority, and so on. Thus low-priority traffic is not ignored when there is a high-capacity, high-priority traffic stream.

Priority 7 is the highest priority traffic; priority 0 is the lowest. The default priority queue is assigned to any traffic that does not comply to the selected priorities. For example, if MAC DA or MAC SA is selected and a packet comes in that does not match any of the programmed addresses, it is assigned to the queue selected as default, as are packets that do not have a VLAN tag (that is, no VLAN ID or 802.1p field exists), or VLAN ID or 802.1p DS values that do not match any defined classification values.

This page has two tabs. The first tab defines how the priority is classified by traffic type entering the radio. The following options are available; only one selection can be made:

- MAC DA (Media Access Control Destination Address): Prioritizes traffic based on the MAC destination address (recipient of the traffic) in the packet header. Up to 8 MAC destination addresses can be programmed per port for priority queuing, similar to the ExtendAir options shown in Figure 36.
- MAC SA (Media Access Control Source Address): Prioritizes traffic based on the MAC source address (sender of the traffic) in the packet header. Up to 8 MAC source addresses can be programmed per port for priority queuing. The MAC SA screen is similar to the ExtendAir options shown in Figure 36.

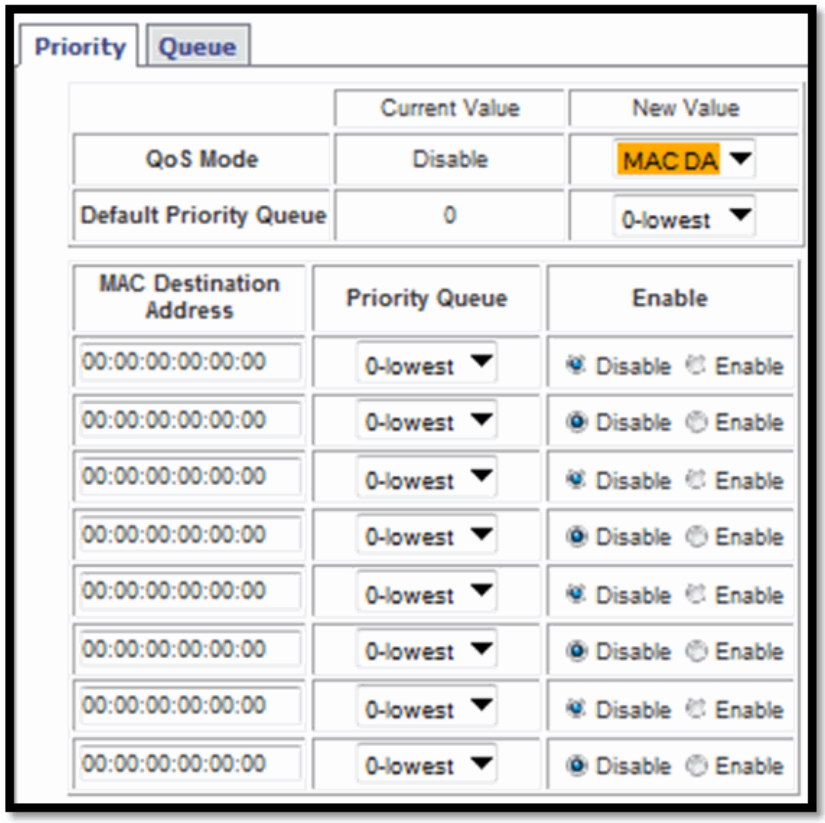


Figure 36 MAC DA based QoS

- VLAN ID (Virtual Local Area Network Identifier): Prioritizes traffic based on the VLAN ID (VID) field in the VLAN tag section of the packet header. A maximum of 8 VLAN IDs can be programmed for priority queuing (Figure 36).

If VLAN filtering and VLAN ID based QoS are enabled, all VLAN IDs listed for QoS must also be listed on the VLAN Configuration Page.

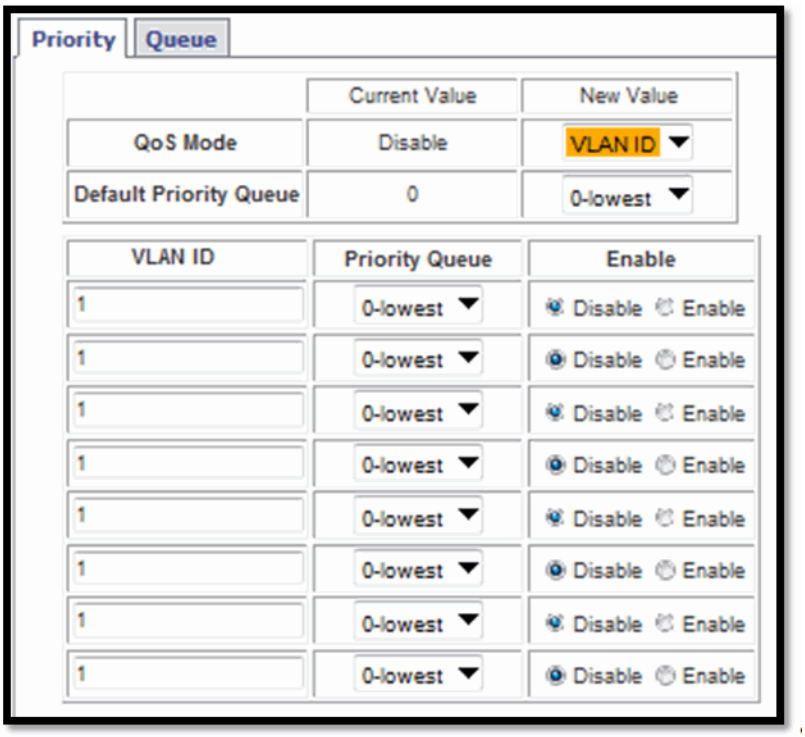


Figure 37 VLAN ID based QoS

- 802.1p: Prioritizes traffic based on the 802.1p (PCP or CoS) field in the VLAN tag section of the packet header. 802.1p based QoS supports a field value range of 0–7 (similar to the ExtendAir options shown in Figure 38.). Each field value can be assigned to the priority queues (0–7).

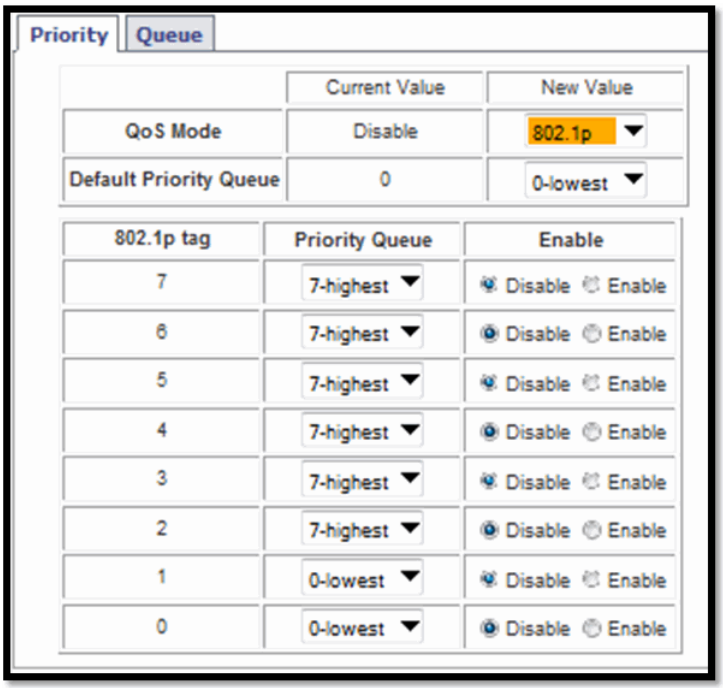


Figure 38 802.1p based QoS mode

The Queue tab provides assignments of two critical parameters for up to 8 queues: Time To Live (TTL) in microseconds and Queue Size (as a percentage). The size of the queue (percentage) is calculated in bytes.

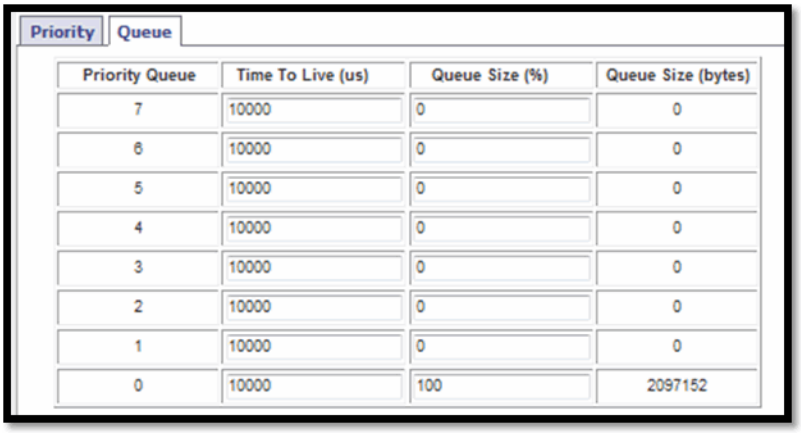


Figure 39 QoS Configuration page Queue tab

The TTL selection range is from 100 to 100,000 microseconds (100 milliseconds). This is the time a packet remains in the buffer for that queue before it is discarded. The shorter the TTL, the more discards when traffic for that queue exceeds the assigned capacity (queue size percentage relative to radio capacity). The longer the TTL, the less discards, but the longer the latency when traffic exceeds the assigned capacity.

Percentage queue size adds up to 100% with the last entry (Priority Queue 0) the lowest priority. Remaining traffic is automatically assigned to the default based on percentages allocated to the other queues.

It is important to assign some Queue Size Percentage (not zero) to any desired queue, including the default queue. It is ideal to program these percentages similar to the actual percentage of traffic matching these queues with emphasis on providing the highest percentage to the highest priority queues to handle typical peak capacity.

With QoS implementations, there is a careful balance between the amount of traffic applied to different queues by networking devices sending QoS traffic, as well as the two parameters controlled on this page. Graphical QoS diagnostic information is provided on the QoS Charts Page for monitoring traffic patterns of the different priorities and associated queues.

ATPC Configuration Page

Note: This feature is not available on all models.

Automatic Transmit Power Control (ATPC) is often required by regulatory agencies for radio systems in congested areas. The radio runs normally at a reduced output power level, and only raises its output power when necessary, such as during a fade. Regulatory agencies may mandate the transmit power standards used under normal conditions (set on the System Configuration Page), the maximum transmit power used with ATPC, ATPC-specific timers, and operator evaluations of the link if and when mandated conditions are exceeded.

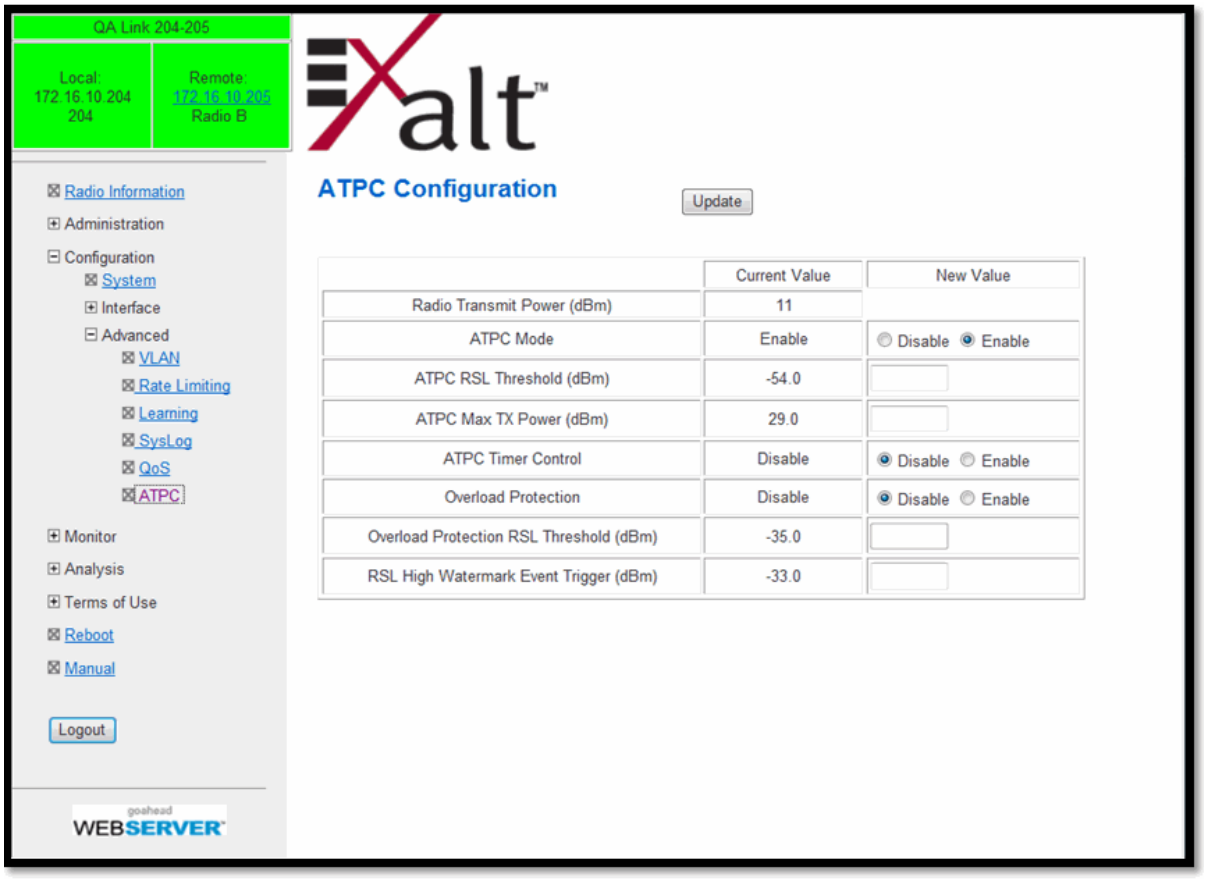


Figure 40 ATPC Configuration page

- Enable ATPC Mode to allow more radio links to share a spectrum providing less opportunity for interference.

On the Diagnostic Charts Page, the Far-End Transmit Power chart displays when any combination of ATPC or Receiver Overload Protection is enabled.

- ATPC RSL Threshold determines the RSL where ATPC becomes active. When ATPC is enabled, the far-end transmitter output power is increased to maintain the near-end ATPC receive threshold, dB-for-dB, as the link fades or recovers. Enable ATPC on both ends of the link for proper functionality.
- ATPC Max Tx Power controls the maximum power the radio transmits when ATPC is enabled. The Radio Transmit Power value shown at the top of this table indicates that entry for ‘normal’ (low transmit power) operation, which is set on the System Configuration page.

- When the ATPC Timer Control timers are enabled, the ATPC maximum status alarm turns yellow (minor) when the ATPC timers are exceeded (see Alarms Page). If timers are mandated, set the ATPC threshold as low as possible to reduce the time that ATPC is active. Current timer status is available on the ATPC Statistics Page. There are event log entries for all timer events.
- Receiver Overload Protection is similar to ATPC. It ensures that the maximum RSL is not exceeded by reducing transmit power of the far-end radio so that radio specifications are met. Receiver Overload Protection reduces far-end transmit power in un-faded conditions, or during up-fades, to ensure that the maximum input RSL specification is met at all times and not overloaded.

  Receiver Overload Protection and ATPC can run independently or simultaneously. The radio runs at standard transmit power levels as long as the Overload Protection RSL threshold is not exceeded. If exceeded, the radio reduces the far-end transmit power to maintain the target RSL.

  For links that normally run at a value exceeding radio specifications, use the licensed or maximum output power in the System Configuration setting and enable Receiver Overload Protection to attenuate the value for normal conditions and restore output power during fades.

Note: Ensure that radio implementation meets local regulations. There may be limitations to the use of the Receiver Overload Protection feature. Consult your local regulatory authorities.

- Set the RSL High Watermark Event Trigger value to a few dB above the normal (un-faded) RSL link or to a value at or above -33dBm, whichever is higher, to minimize the number of entries in the event log caused by running at or near the maximum RSL specification.

Ethernet Aggregation

This page allows enabling or disabling of the Ethernet Aggregation function for ExploreAir LR models only. When enabled, the radio can be interconnected with another radio (running in parallel) to aggregate Ethernet traffic so that only one connection is required at each end without external routers or aggregating switches.

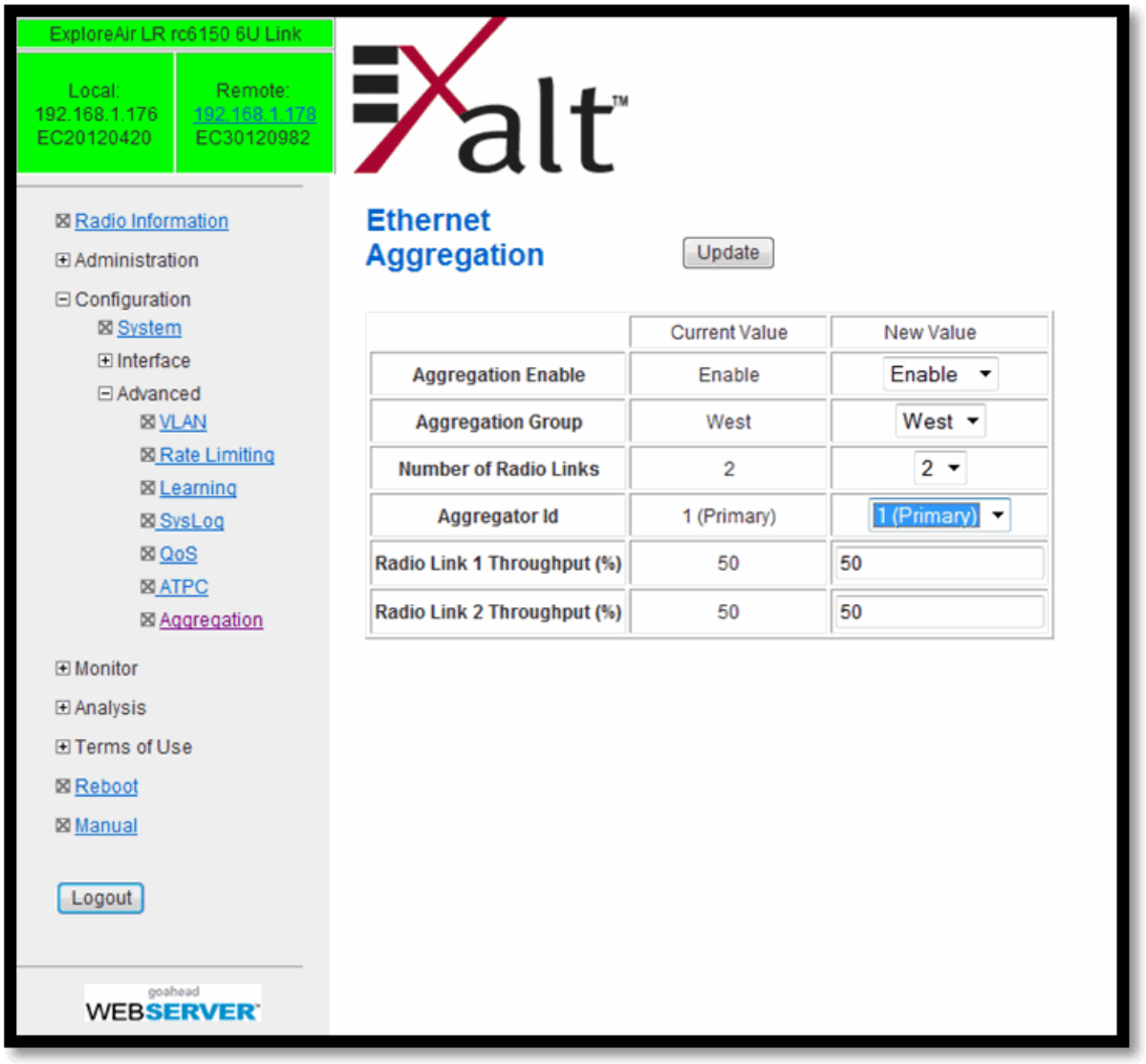


Figure 41 Ethernet Aggregation page

The radio with Ethernet Aggregation enabled is the *primary* radio in the aggregation arrangement. Connect the EXP port to the EXP port of the paired radio using a straight-wired CAT5e/CAT6 Ethernet cable.

This feature allows a set of radios to appear as one connection on the LAN/WAN. If a radio link fails or degrades, capacity scales accordingly (up or down dynamically), up to a maximum of 1Gbps full-duplex.

For the Aggregation Group, select East for both radios on one side, and West for both radios at the other end. Each radio has an *Aggregator ID* that corresponds to the Radio Link information at the bottom of the table on this page. Radio Link 1 is the radio itself.

For the primary radio, the relative throughput percentages are entered for each radio in the aggregation set. For links running ACM, use a percentage based on the maximum target modulation throughput. For example, if the primary radio carries a 300Mbps full-duplex capacity at target modulation and the second radio carries a 200Mbps full-duplex capacity, then the percentage entered for Radio Link 1 Throughput should be 60, and 40 for Radio Link 2, as the throughput balance between the two radios is 60/40.

Alarms Page

This page provides an easy-to-read summary of the alarm status of both local and remote radios. The colors on this page reflect the color of the alarms displayed on the radio front panel. However, additional detail displays on this page to aid in quick assessment of issues and status.

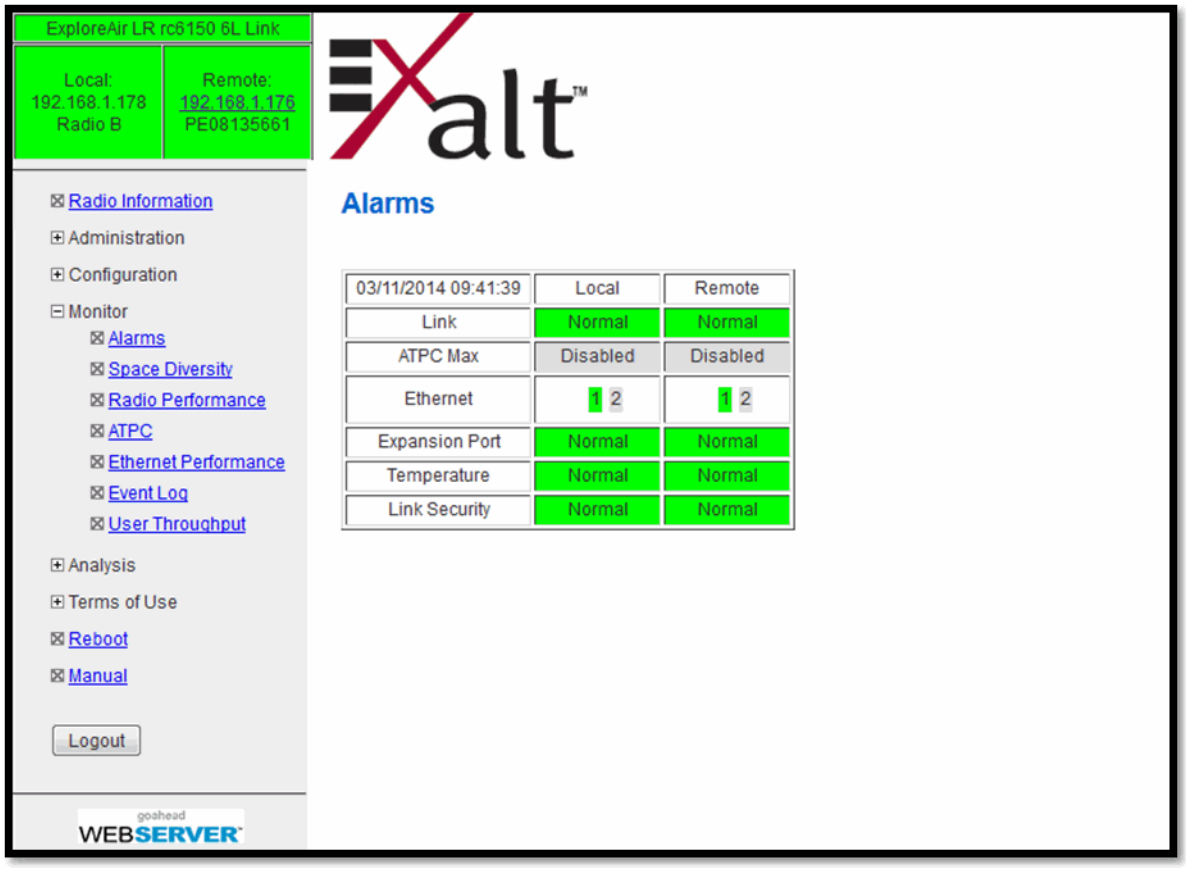


Figure 42 Alarms page

Table 8 lists alarm status conditions that appear on this page.

Table 8 Alarm status indicators

Label	Status
Link	Indicates RF link status: • Green Solid = Error-free connection (BER<10e-6) • Yellow Solid = Errored connection (10e-3>BER >10e-6) • Red Solid = No link (BER>10e-3) • Grey Solid = Radio is a Diversity terminal in an SD configuration
Link V/Link H	(ExtremeAir only) Indicates RF link status for the individual vertical and horizontal polarizations: • Green Solid = Error-free connection (BER<10e-6) • Yellow Solid = Errored connection (10e-3>BER >10e-6) • Red Solid = No link (BER>10e-3)

Table 8 Alarm status indicators (Continued)

Label	Status
ATPC Max	(ATPC enabled) Indicates Automatic Transmit Power Control maximum range status: • Green Solid = ATPC enabled, maximum range not active • Yellow Solid = ATPC maximum range active • Grey = ATPC disabled or ATPC Timer Control disabled • Red Solid = Radio link down and maximum range active for >5 minutes
ATPC	(ATPC enabled) Indicates Automatic Transmit Power Control status: • Green Solid = ATPC enabled, but not active • Yellow Solid = ATPC active • Grey = ATPC disabled • Red Solid = Radio link down and radio at maximum power for >5 minutes
Ethernet - ETH1	• Green Solid = Alarm enabled and Ethernet link present • Red = Alarm enabled and Ethernet link not present • Grey = Alarm disabled
T1/E1 Input	• Green = Enabled and connection present (clocking confirmed) • Yellow = Disabled and connection present • Red = Enabled and no connection present • Grey = Disabled or unavailable due to configuration
Expansion Port (only LR models with Aggregation enabled)	• Green = Expansion Port Data valid • Yellow = Expansion Port Data not valid or missing.
Temperature	• Green Solid = Normal temperature range • Yellow Solid = Exceeding normal temperature range
Link Security	• Green = Security keys match • Red = Security keys do not match • Grey = Link is down or radio is set to Diversity in an SD configuration

The Temperature alarm monitors the internal temperature of the unit based on specific points inside the radio chassis. It is normal for the internal temperature to be above the ambient temperature, so the temperature reading may be higher than the highest specified ambient temperature. When the internal electronics reach a point that is higher than the normal temperature rise at the highest ambient temperature, the temperature alarm turns yellow. Power down the radio as soon as possible, and investigate the cause of the temperature rise before the radio is put back into service. In almost all cases, a temperature alarm is due to an external cause.

XPIC Status Page–ExploreAir LR models

This page displays the status of radios with cross-polarity links. XPIC provides a means to run two links in parallel over a cross-polarized antenna. This configuration requires specific cabling (see Interface Connections) and antennas. Set the XPIC configuration parameters on the System Configuration Page.

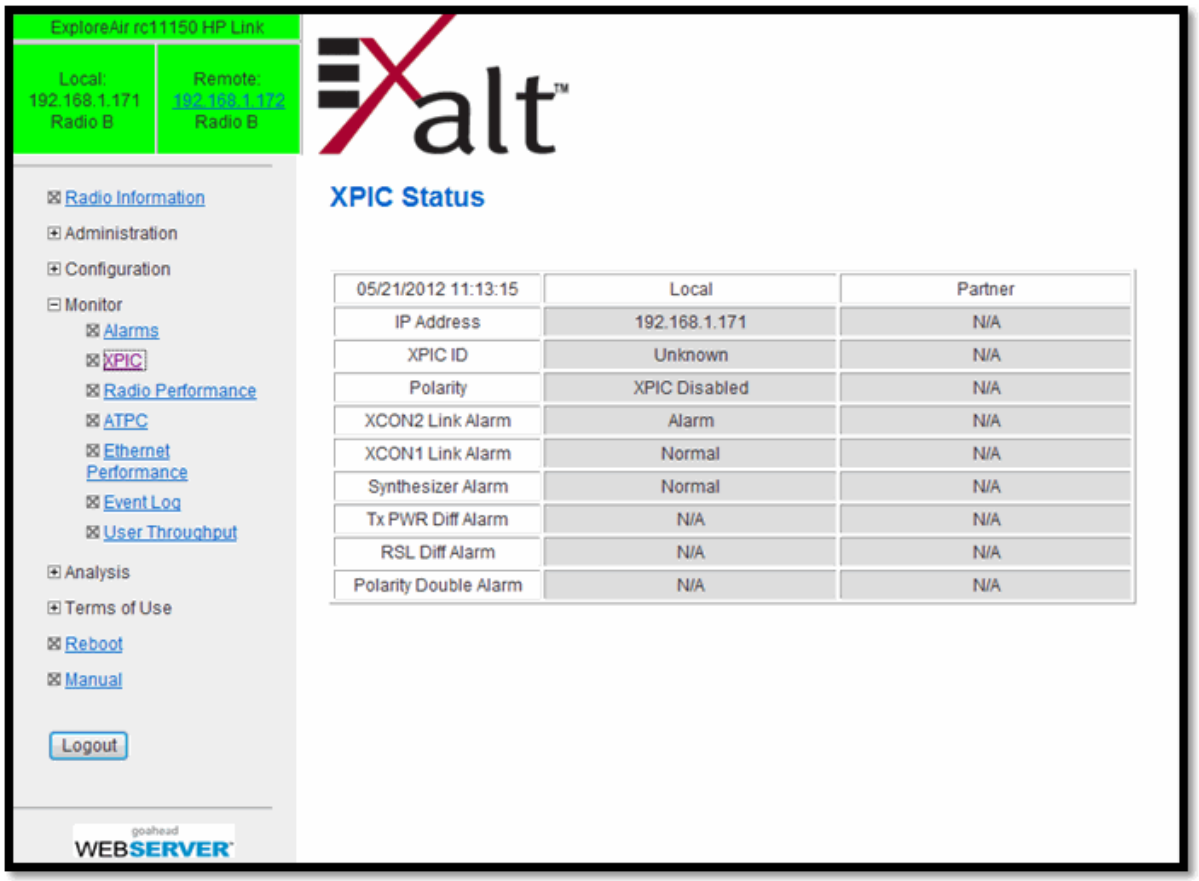


Figure 43 XPIC Status page

All XPIC alarms are minor (yellow) and are summarized in the Summary Status pane and display on the Event Log Page. The status information displayed is:

- IP Address is the address of both radios in the XPIC link.
- XPIC ID is Primary, Secondary, or Unknown. When XPIC is enabled and the radios are properly cabled, either the Local or Partner is Primary, and the other radio in the XPIC link is Secondary.
- Polarity is Vertical, Horizontal, or XPIC Disabled as set on the System Configuration Page.
- XCON2 Link Alarm displays Alarm when XCON2 communication is down.

When XCON2 is in the Alarm state, all partner alarms are N/A, because the status of the partner radio is not available unless XCON2 is operating normally.

- XCON1 Link Alarm displays Alarm when XCON1 communication is down.
- Synthesizer Alarm displays Alarm when an RF Transmitter and/or Receiver synthesizer alarm is detected.

- Tx PWR Diff Alarm displays Alarm when the TX power difference is greater than 3dB between the local and partner radio.
- RSL Diff Alarm displays Alarm when the RSL difference is greater than 10dB between the local and partner radio.
- Polarity Double Alarm displays Alarm when the polarity of both the local and partner radios is the same.

Space Diversity Status Page–ExploreAir LR models

Space Diversity (SD) provides performance improvement for paths likely to experience significant fading and multipath. SD is designed for longer distance paths and/or paths that extend over flat ground, water, and/or are in humid climates.

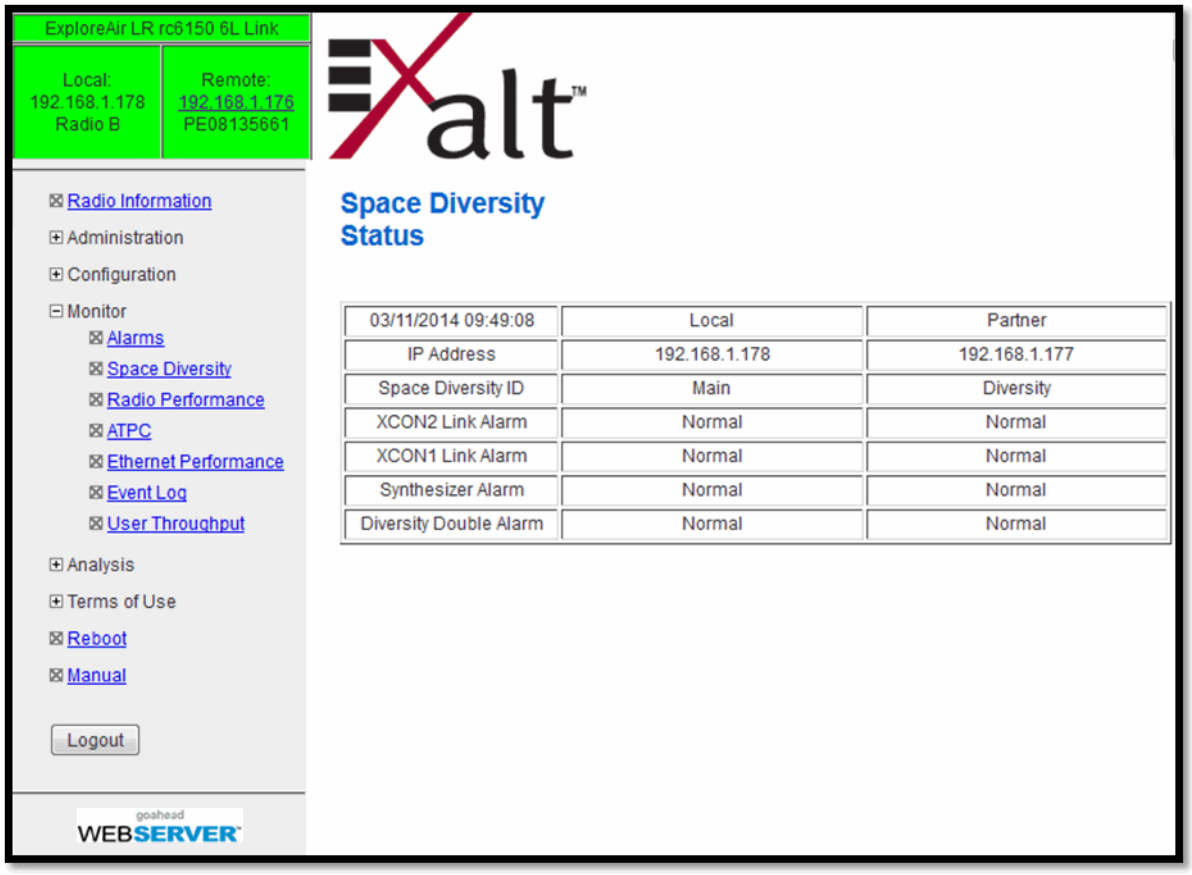


Figure 44 Space Diversity page

For SD a secondary receiver is located at a different height from the primary transmitter/receiver to receive signals at a different phase and, when combined with the Main receiver signal, constitute a more complete signal when fading and/or multipath occur, which results in significantly improved path availability.

For ExploreAir LR, the dual-receiver diversity approach used is Linear Combining, which combines the two receive signals together. This approach improves threshold of the system by 3dB (over single receiver approach) and typically creates an errorless receive signal combined stream, even in cases where one or both receivers would be experiencing errors by themselves. This approach has additional advantages in that antenna spacing for the diversity antenna does not necessarily need to be as great as traditional SD engineering designs would suggest. Virtually any amount of spacing between the antennas will have a benefit, although it is still recommended that approximately 200 times the wavelength is deployed, where practical. For systems between 6 and 11GHz, this distance ranges from 33 to 17 feet respectively.

To deploy Space Diversity, the two radios at each end must be connected by the XCON1 and XCON2 cables. These cables are wired in accordance with the wiring shown in XPIC and SD Cabling –

ExploreAir LR models only. It is advised to use CAT6 outdoor-rated and well-shielded cables for these interfaces. Note the following XCON cabling limitations:

- For systems utilizing modulations up to 256QAM, and 512 QAM up to 60MHz bandwidth, the maximum length of XCON cables is 50 feet (15.2 meters).
  - ExploreAir LR radios can be direct-mounted to the antenna or remote-mounted using short waveguide jumpers.
- For systems utilizing 512QAM modulation and 80MHz bandwidth, the maximum length of XCON cables is 15 feet (4.6m).
  - If antenna spacing is less than 15 feet, the radios can be direct- or remote-mounted using short waveguide jumpers.
  - The radios can be remote-mounted between the two antennas, using waveguide or coaxial jumpers to connect to the antennas. Coaxial jumpers may be preferred because longer waveguides may require pressurization and/or dehydration, which may not be practical for the antenna location. One radio could still be direct-mounted or remote-mounted with a short waveguide jumper, where just the SD radio uses coaxial cable or a longer waveguide.
- XCON2 Link Alarm displays Alarm when XCON2 communication is down.

When XCON2 is in the Alarm state, all partner alarms are N/A, because the status of the partner radio is not available unless XCON2 is operating normally.

- XCON1 Link Alarm displays Alarm when XCON1 communication is down.
- Synthesizer Alarm displays Alarm when an RF Transmitter and/or Receiver synthesizer alarm is detected.
- Diversity Double Alarm displays Alarm when the Space Diversity setting of both the local and partner radios is the same.

As well as the XCON cabling, Space Diversity implementations require specific configuration on the System Configuration Page.

Radio Performance Page

This page provides statistical information about the performance of the system in relation to the integrity of the user data and the RF link.

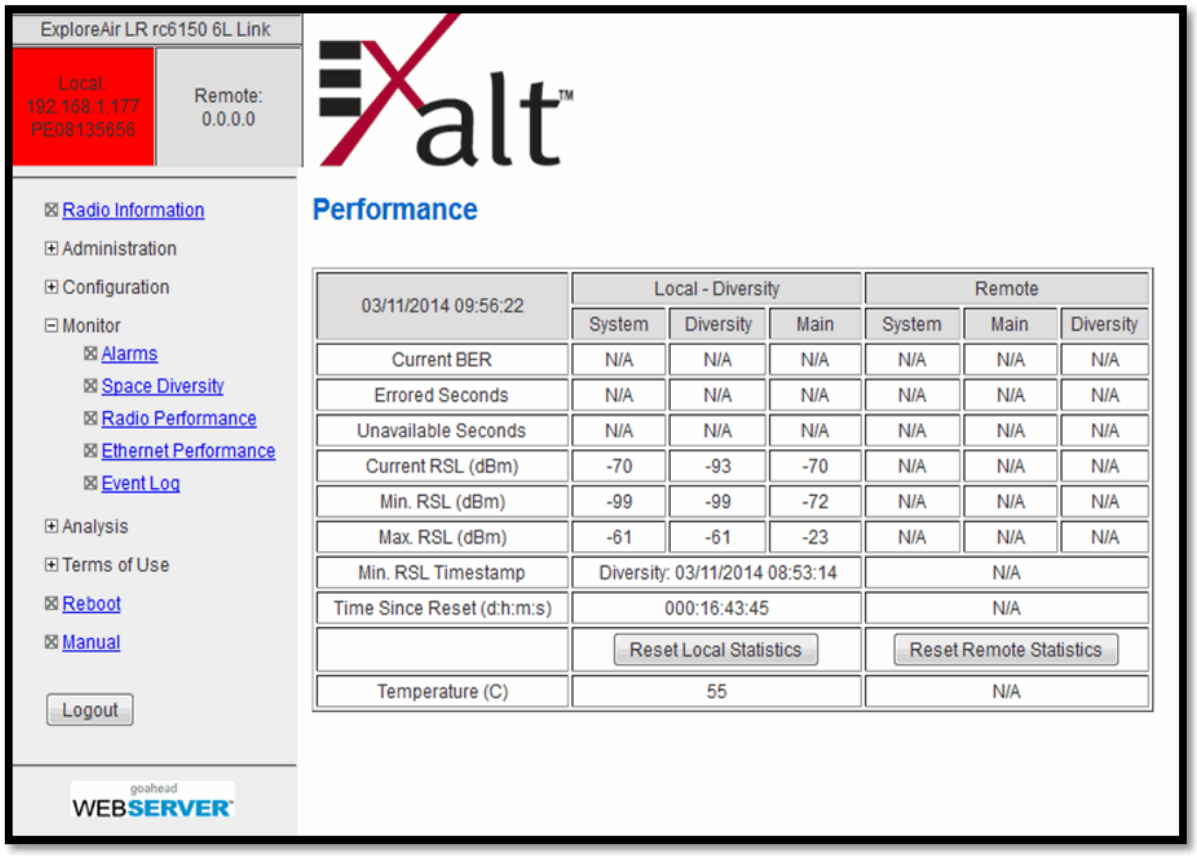


Figure 45 Performance page (ExploreAir LR model)

For Space Diversity implementations, on the Diversity terminal the BER, Errored Seconds, and Unavailable Seconds are not known because all demodulation and error counting is performed by the Main radio. There is also no telemetry from the remote side of the link as all communications from the remote side are to the Main terminal. Main terminal performance information is more complete and is best used for overall system performance and individual terminal performance. However, the local Diversity radio can report RSL information for each terminal in the system, as shown in Figure 45. The RSL for the Diversity radio may be inaccurate, as it is not aware of the current modulation state of the link and cannot properly calibrate RSL. The RSL shown in Figure 45 is assumed to be 512QAM (the highest modulation setting) at all times.

Note: ExtremeAir models indicate performance parameters for vertical and horizontal polarization. ExploreAir models do not support dual polarization, and only display one value for each parameter.

- The Current BER field indicates the current bit error rate of the link. If the link is operating perfectly, this should indicate zero. Generally, the link should remain at a BER less than $1x10^{-6}$ (one bit out of every million bits errored). This is the threshold performance specification and the standard to which the link was engineered. However, radio links can and are affected by weather, interference, and other external sources and will occasionally have a higher error rate. A link remains operational unless the BER exceeds $1x10^{-3}$ (1 bit out of every hundred bits errored).

Consult the link design engineer for an understanding of the predicted error rate of the radio link as it has been designed.

Many applications are unaffected by bit errors, but TDM circuits (for example, T1 or E1) are more sensitive. Also, if the link operator is providing a service guarantee, this value may need to be monitored or examined in cases of service issues. The behavior of BER in relation to other alarms or measurements and external events can be very helpful in troubleshooting activities.

- Current RSL is the measurement of the received signal level at the radio antenna port. This is the measured level of the RF signal coming from the opposite end of the radio link. The link was engineered to a specific RSL by the link design engineer, and this RSL should be obtained during installation and remain relatively stable during the operation of the link. RSL can and will vary as a result of weather changes and other external sources, such as path obstructions. Once again, this variation was part of the original design to achieve a certain level of performance over time. Bit errors occur when the RSL falls to a level within roughly 3dB of the threshold specification. When the RSL falls below the threshold specification, the link disconnects and will not reconnect until the RSL is above the threshold specification. The behavior of RSL in relation to other alarms or measurements and external events can be very helpful in troubleshooting activities.
- Errored Seconds (ES) indicates the total number of seconds that occurred where there was at least one bit error since the last time that the radio statistics counter was reset. Generally, ES are not a significant concern, so long as they are not continuous or above the anticipated performance based on the original link engineering goals. If ES are continuous or at a high rate, this is normally an indication of poor link performance due to poor RSL or interference, or severe impact by weather or other environmental factors. However, similar to the performance factors previously listed, ES can and will occur in any radio link. Once again, consult the link engineer to determine the original design goals, and compare actual performance to these expectations to determine if any improvements are necessary or if other problems may be causing excessive ES.

Note: Unavailable Seconds do not register as ES. In other words, the ES counter counts all seconds that are errored NOT INCLUDING the seconds that were classified as unavailable. The total number of seconds with errors or outages is the sum of ES and Unavailable Seconds.

- Unavailable Seconds (also called UAS) are similar to ES, but this counter keeps track of every second where the bit error rate equals or exceeds $1x10^{-3}$, as well as any seconds where there is a complete loss of radio communication, over the period since the last counter reset. If Unavailable Seconds are continuous or at a high rate, this is normally an indication of poor link performance due to poor RSL or interference, or severe impact by weather or other environmental factors. However, similar to the performance factors listed above, Unavailable Seconds can and do occur in any radio link. Consult the link engineer to determine the original design goals, and compare actual performance to these expectations to determine if any improvements are necessary or if other problems may be causing excessive Unavailable Seconds.
- Minimum RSL indicates the worst (lowest) received signal level that occurred since the last counter reset. It is helpful to know if the RSL dropped significantly from the normal level, or has reached a level near or below threshold.
- Minimum RSL Timestamp indicates the date and time when the Minimum RSL occurred. This is helpful for general troubleshooting, and especially comparing to items in the event log or diagnostic charts from the same time period.
- (ATPC and/or Receiver Overload Protection enabled) Far-End Transmit Power and Max Far End Tx Timestamp provide an instant record to assist with the interpretation of the current RSL as it

relates to ATPC and/or Receive Overload Protection actively changing the far-end transmit power. The timestamp is recorded for the last instance that maximum far-end transmit power initiated.

- Maximum RSL indicates the best (highest) RSL that occurred since the last counter reset. This indicates the best performance of the radio link, which is normally equal to the installed value, and is usually the designed value.
- Time Since Reset indicates the amount of time passed since the last counter reset. This helps to quantify the seriousness of other statistics, such as ES and Unavailable Seconds, if there have been high numbers of ES and/or Unavailable Seconds over a relatively short period of time.

All end-of-link statistics can be independently reset using the respective reset statistics button. It is good practice to reset the statistics during link commissioning (after all antenna alignment is complete and stable RSL at designed levels is achieved, and no more system reboots are anticipated). Regularly review this page to record performance and reset the statistics so that the counters can more precisely pinpoint issues.

Note: Resetting statistics from one end also resets the statistics for the same radio at the opposite end. That is, if the Local statistics are reset, logging into the remote end shows the Remote statistics on that end (which is the local radio in the first condition) as being reset at the same time.

ACM Parameters

When ACM is enabled, the Performance Page adds statistics to monitor the Adaptive Coded Modulation feature, as shown in Figure 46.

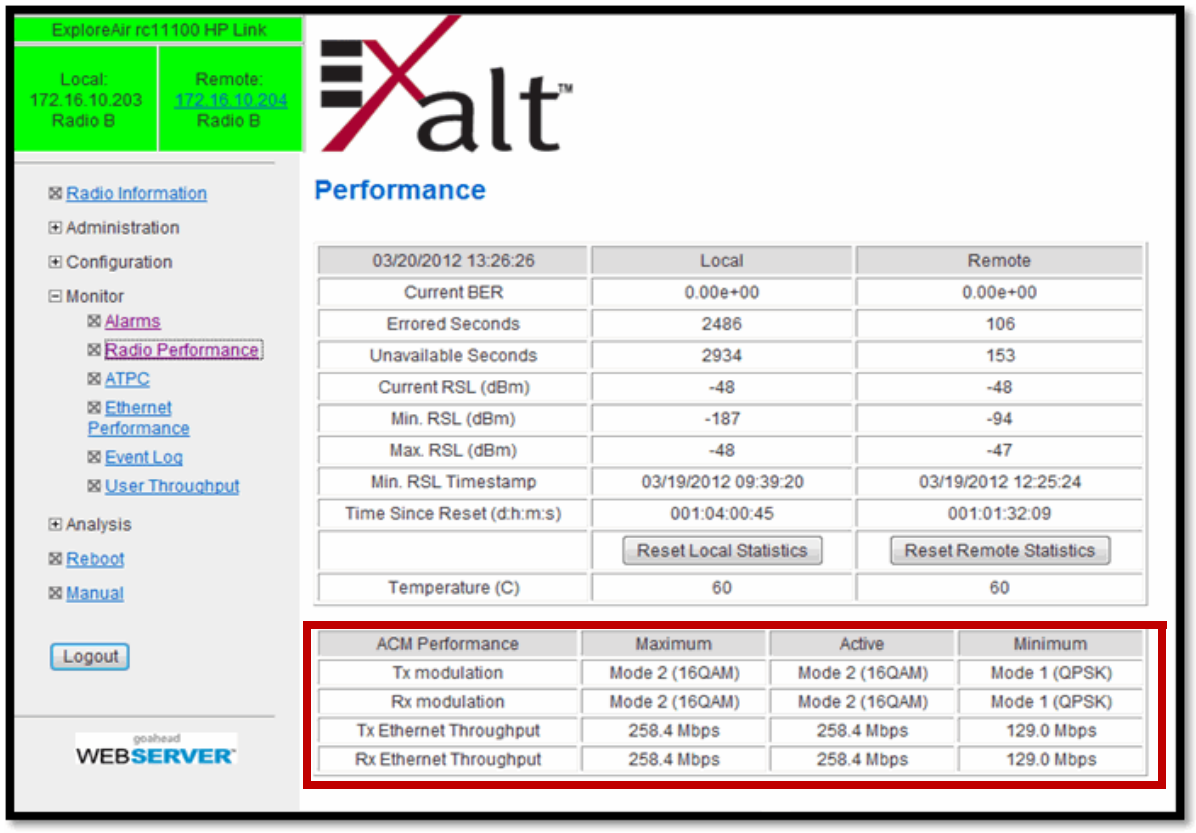


Figure 46 ACM parameters

The bottom pane, highlighted in Figure 46, provides information related to the present settings and state-of-modulation settings for both radios (transmit and receive), and associated throughput.

ATPC Statistics Page

Note: At publication, ATPC is not available on all models.

Timers on this page provides information when the Automatic Transmit Power Control (ATPC) function and timers are enabled. Regulations require timers for ATPC and ATPC may not operate over the authorized time (up to 5 minutes at maximum allowed power without returning to target RSL, thus returning to normal far-end transmit power).

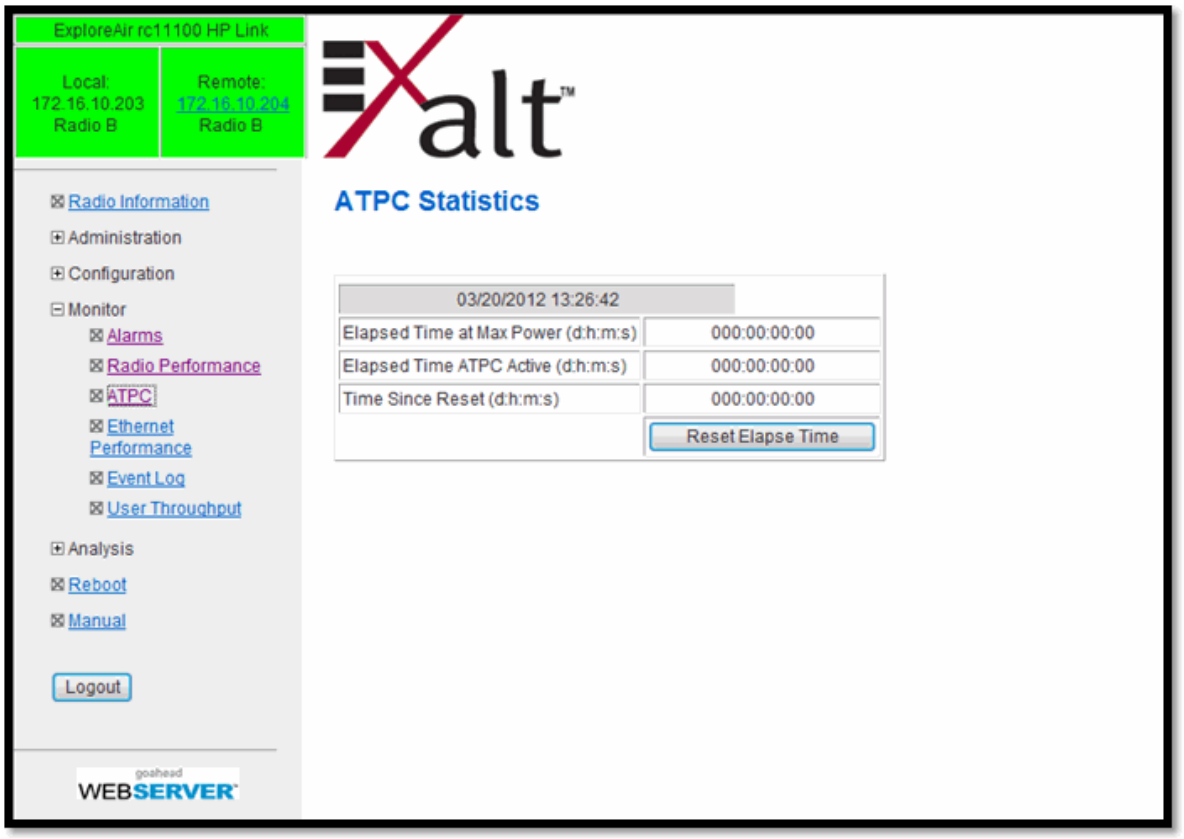


Figure 47 ATPC Statistics page–ExploreAir rc model

Ethernet Performance

This page tracks statistics related to Ethernet traffic to assist with troubleshooting and general performance monitoring. These statistics are aligned with the Remote Network Monitoring (RMON) convention, RFC 2819 (http://tools.ietf.org/html/rfc2819).

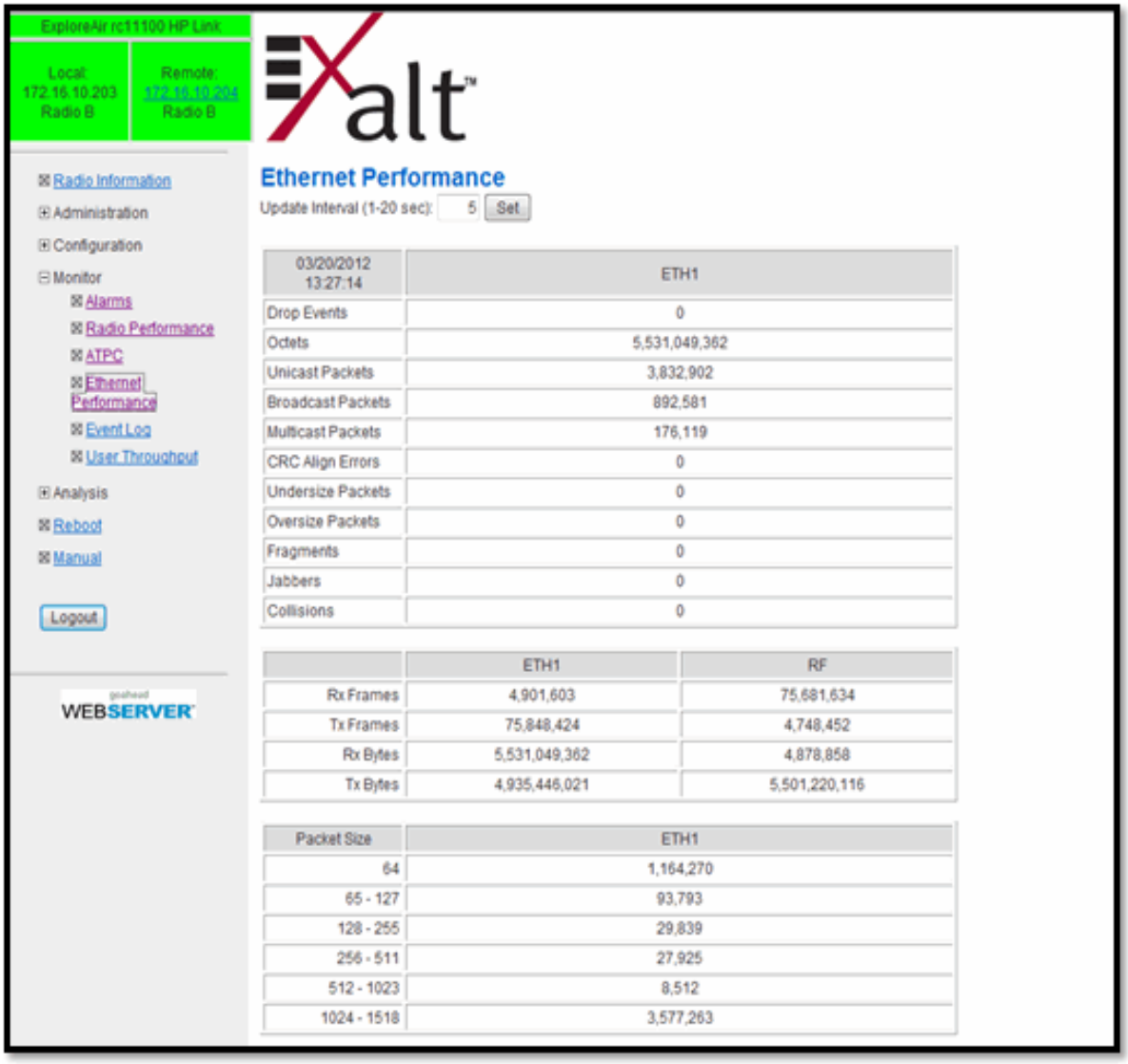


Figure 48 Ethernet Performance page–ExploreAir rc model

Event Log Page

Use this page to review a list of the events logged by the radio. The following items are listed in the event log:

- Alarms
- Alarms clearing (normal)
- Radio reboots
- XPIC link errors

Every event is tagged with the time that the event occurred, and a severity and type. The event log also allows filtering to limit the view of the log to only the level(s) of desired information.

The log contains the last 1000 events. Events are deleted on a FIFO basis.

The event log can be cleared and downloaded from the file transfer page (some models may require a software upgrade to enable this feature). A screen capture of the browser window can serve as a useful record.

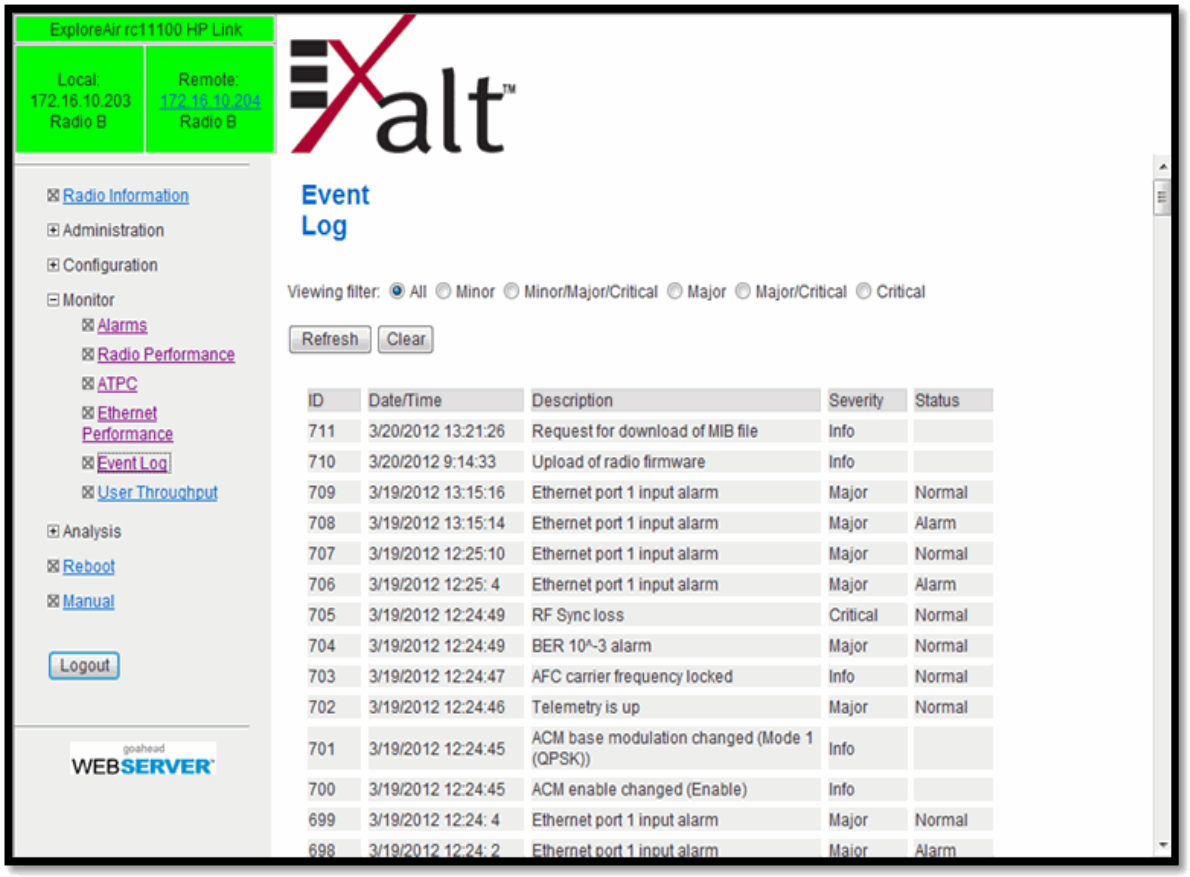


Figure 49 Event Log page–ExploreAir rc model

User Throughput Page

This page illustrates the user throughput of the radio, as configured.

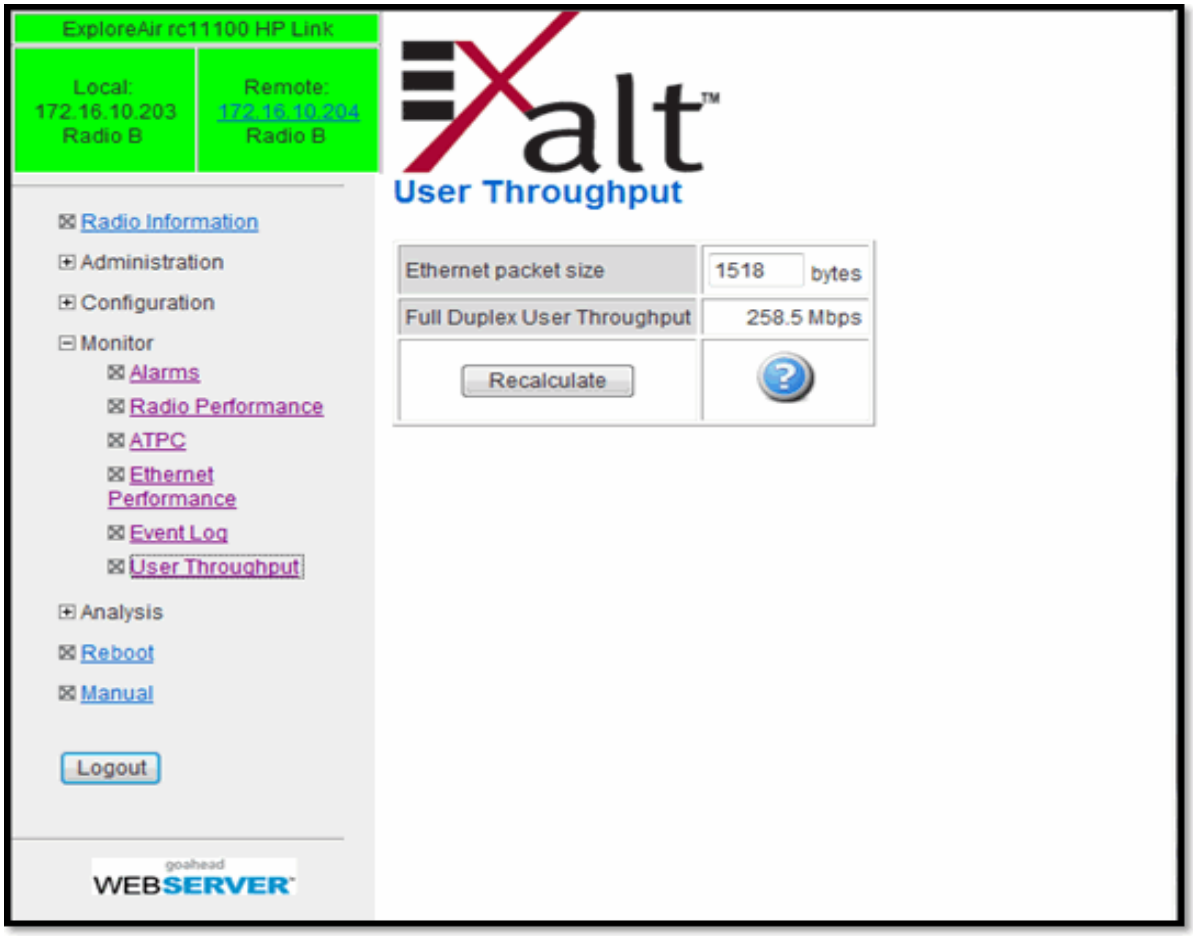


Figure 50 User Throughput page–ExploreAir rc model

Click the help icon ( ) to go to the page on how this information is determined (Figure 51)

Figure 51 User Throughput Help page–ExploreAir rc model

Diagnostic Charts Page

Use this page as an aid in troubleshooting. This page illustrates the historical (and current) performance for three parameters: RSL, Radio Temperature, and BER.

The horizontal scale illustrates 120 points of time measurement and is synchronized on all three graphs. The scale displays in minutes, hours, or days from the last two hours (120 minutes), five days (120 hours), or four months (120 days). All information is stored, so all of these periods are available for short- and long-term performance analysis. The right side of a graph represents the most recent measurement, and data 'marches' from the right-to-left at every interval.

The vertical scale of each chart independently scales to show the maximum resolution based on the maximum variation of the data over the selected time measurement.

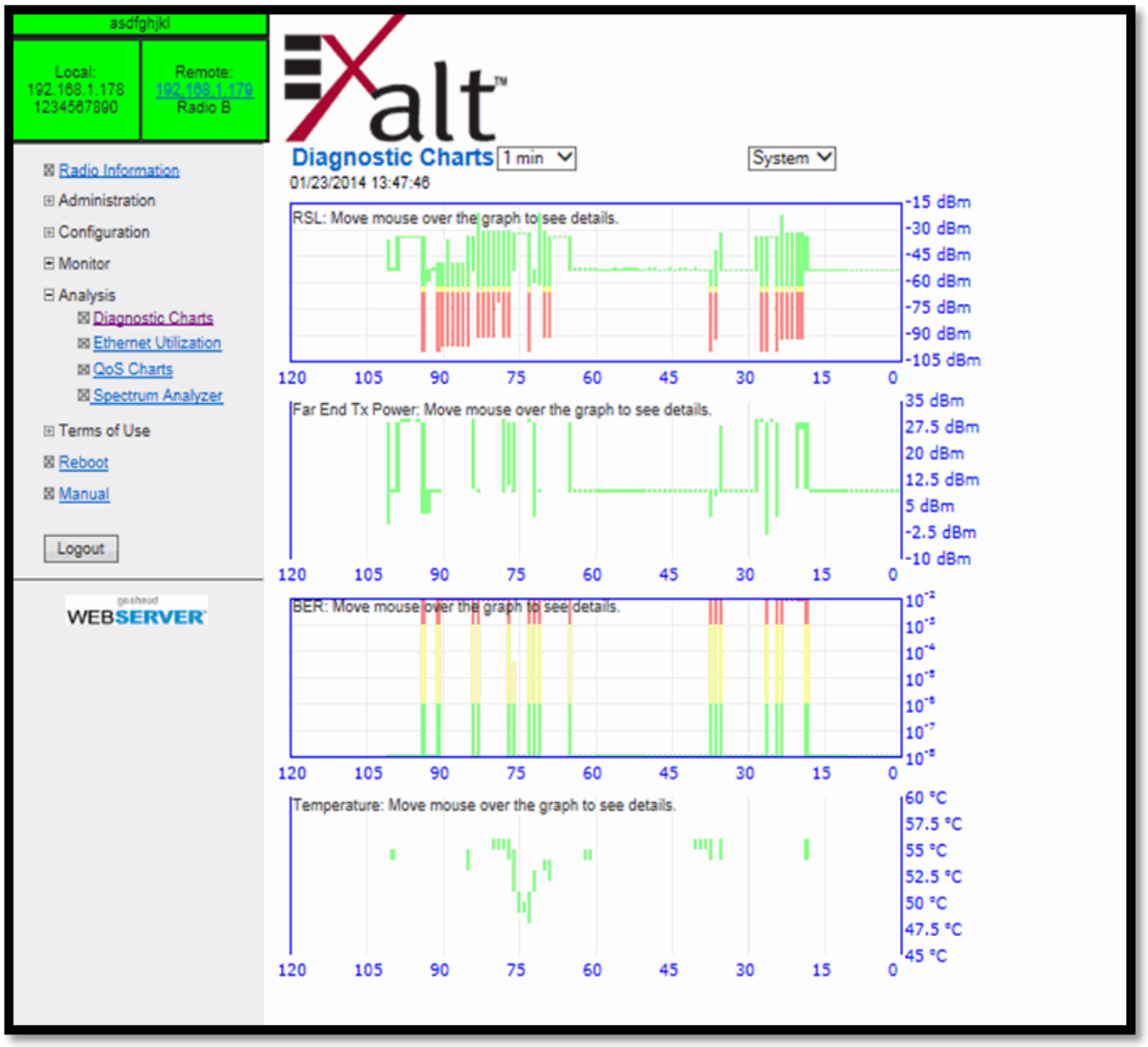


Figure 52 Diagnostic Charts page (ExploreAir model)

Note: ExtremeAir models have options to display V or H polarization, independently or combined. ExploreAir models do not have these options as they are configured for single-polarization.

Use the cursor to point to any spot on any chart, and in their upper-left corner all charts illustrate the measurements taken for that time interval. The time interval is indicated by T=(value). This is followed by the value of the measurement, listing the highest value, lowest value, and average value measured over that time interval. For example, if the displayed time interval is in minutes and the cursor is held at the T=17 mark on the horizontal axis, the measurements shown indicate performance from 17 minutes ago. The high/low/average values shown on each chart are measurements made across that specific one-minute interval.

The Far-End Transmit Power chart displays when any combination of ATPC or Receiver Overload Protection is enabled (see ATPC Configuration Page). This chart shows the far-end transmitter changes that are occurring relative to the provided RSL information. Since the far-end transmit power can change on links using ATPC or Receiver Overload Protection, this information is very useful for troubleshooting.

Changes in RSL often have an impact on BER, and this can be confirmed by looking for synchronized events. When BER events occur without corresponding changes in RSL, this normally indicates interference, atmospheric changes, transmission system issues (such as problems with cables, connectors, or antennas), or possibly radio hardware problems.

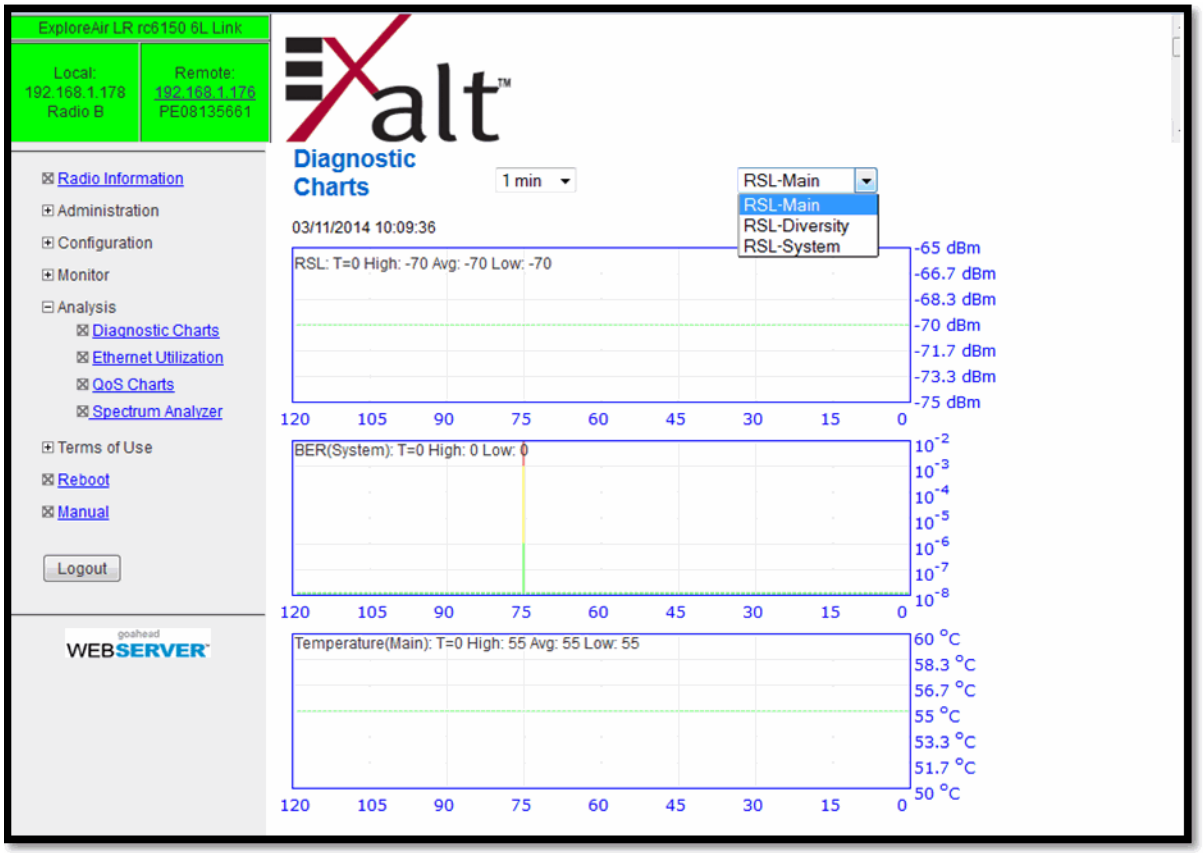


Figure 53 Diagnostic Charts page–ExploreAir LR Space Diversity models only

On ExploreAir LR models with Space Diversity configured, diagnostic charts of the Main radio allow the display of RSL for the Main, Diversity, or System radios. BER is always the System BER. The Diversity radio cannot show BER (only available on the Main radio).

Ethernet Utilization Page

This page shows a chart for each Ethernet interface to illustrate inbound and outbound packet utilization. This is shown as a percentage of the interface configuration (that is, if your interface is set for 100BaseT, then 100% represents 100Mbps. Compare offered load (inbound) to delivered load (outbound) to determine if radio capacity is a bottleneck for the data transfer. This chart can illustrate inbound and/or outbound utilization, and uses different colors for data entry. The legend can be hidden.

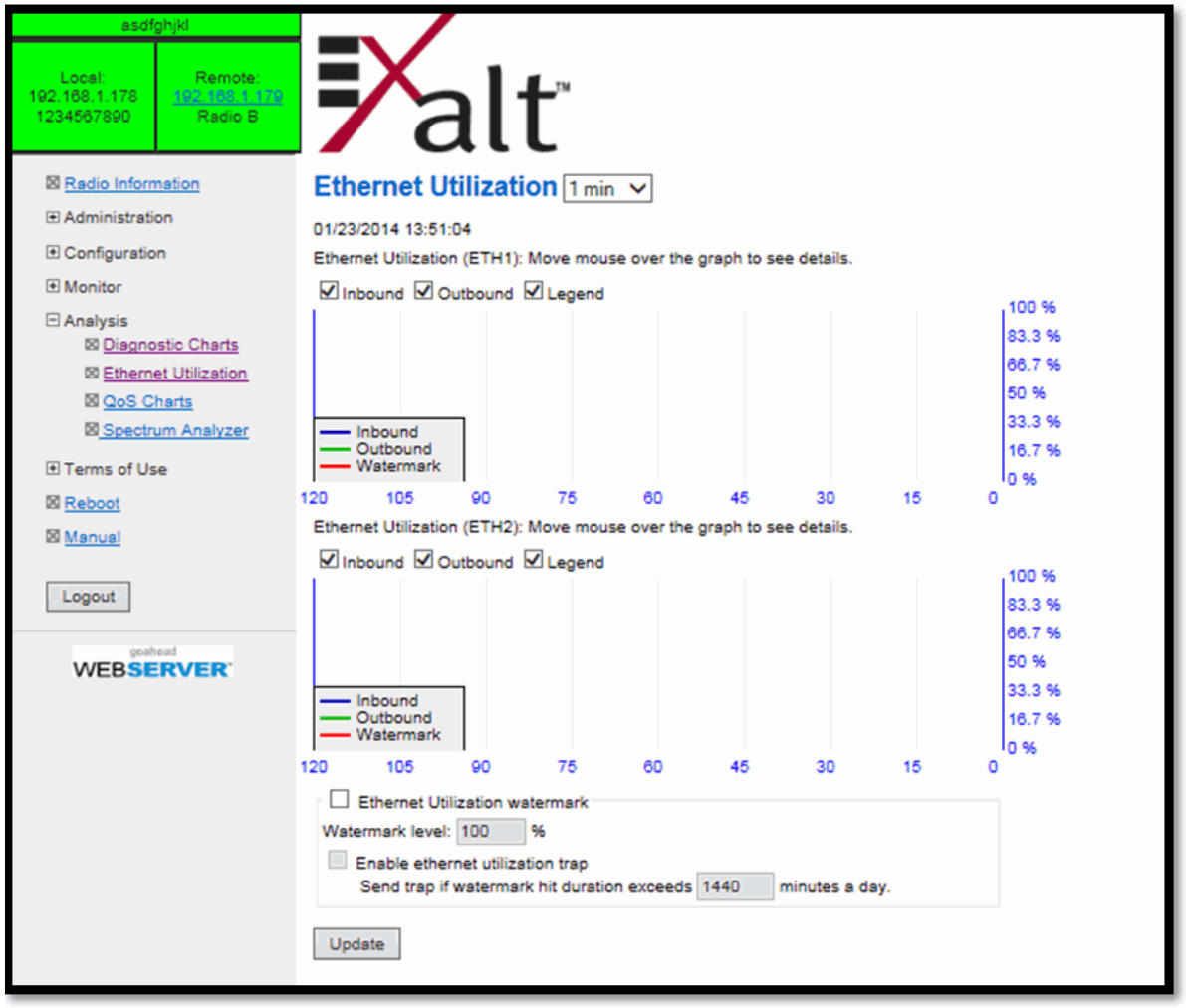


Figure 54 Ethernet Utilization page

Note that outbound utilization never exceeds the rate where a radio is configured. For example, if the radio is configured for a 55 Mbps capacity, outbound utilization will never exceed 55 Mbps at 100BaseT.

The Ethernet Utilization Watermark level function allows administrators to receive an SNMP trap when watermark conditions are exceeded. For example, if a radio is configured for 55 Mbps capacity, the administrator may wish to be warned if the radio exceeds 50 Mbps for more than 1 hour per day. In this case, set the Watermark level to 50% and the trap duration to 60 minutes. Traps must be enabled to activate this function.

When the watermark level function is enabled, a line on the chart appears for data comparison to the watermark.

QoS Charts Page

This page provides graphical analysis of the QoS function.

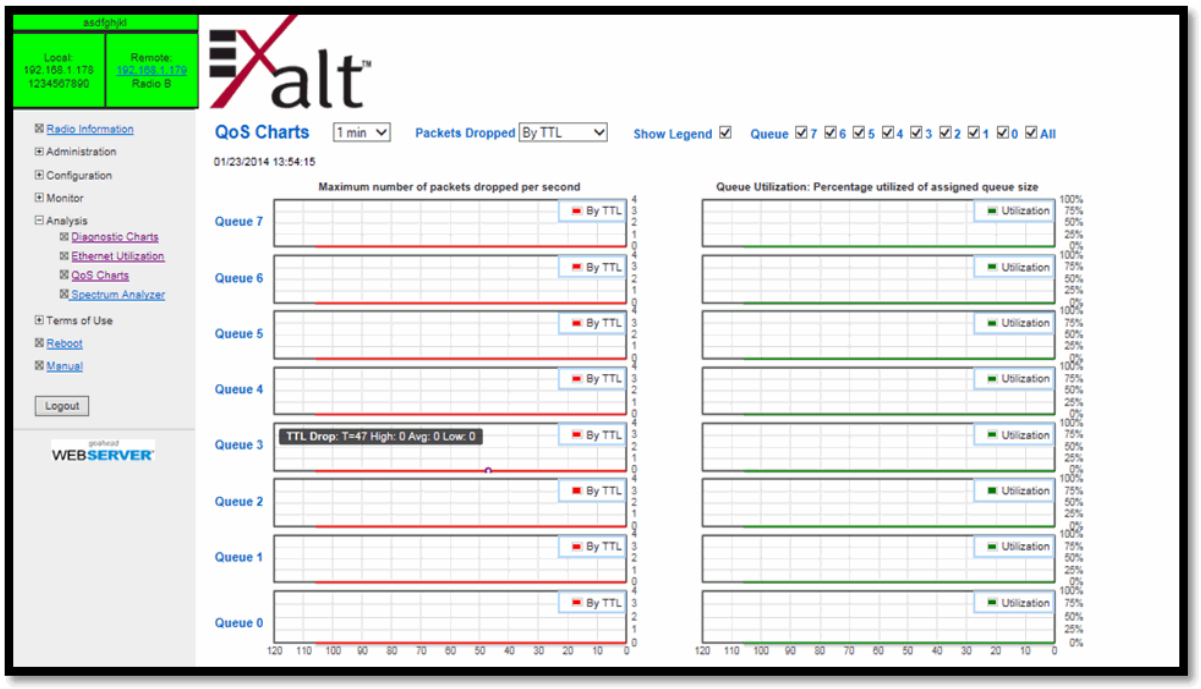


Figure 55 QoS Charts page

Four options are set above the charts:

- Period of time for the charts display (up to 120 minutes, or hours or days)
- Packets Dropped displays packets dropped by TTL, by Overflow, or both.
- Show Legend displays the legend in each chart (to illustrate colors assigned to different parameters in the chart)
- Queue displays all queues, selected queues only, or in any combination.

Packets dropped and queue utilization are measured every second. The Max, Min, and Average are computed for every time segment displayed. For example, there are 60 one-second measurements in a minute, so if Minute is the selected display, each vertical pixel group represents the maximum and minimum measurement during that minute, and averages the 60 measurements.

- If the left chart illustrates a high number of dropped packets due to overflow, increase the percentage of the queue assigned to overflowing queues, but be careful not to ‘starve’ high-priority queues to the point where they overflow. A few adjustments might be necessary to find the right balance between the typical traffic patterns of the network and the settings of this parameter per queue.
- If the left chart illustrates that there are a high number of dropped packets due to TTL, then it would generally be suggested to increase the TTL parameter for those queues. However, high TTL can result in higher latency, so for latency-sensitive applications, some monitoring may be necessary to assure that latency does not exceed tolerable levels. Again, several iterative adjustments may be necessary to find a good balance for this setting relative to the traffic patterns on the network.

The chart on the right is provided to aid in making decisions for the adjustments mentioned above. With this chart, during periods where high packet drops are occurring, the corresponding time frame can be viewed here to evaluate the actual utilization of each queue, helping you to determine which queues may be good candidates to reduce queue percentage and/or increase TTL. For example, if a particular queue has high overflow rate, the other queues could be reviewed to look for where there is no overflow and utilization is low.

Spectrum Analyzer Page –ExploreAir LR Models Only

The spectrum analyzer feature provides a useful pre-planning and troubleshooting tool. This feature is only available on radios with firmware supporting the spectrum analyzer. Perform a spectrum analysis after deployment and just before commissioning to maintain a record of the spectrum at the time of deployment. Figure 56 shows the Spectrum Analyzer page.

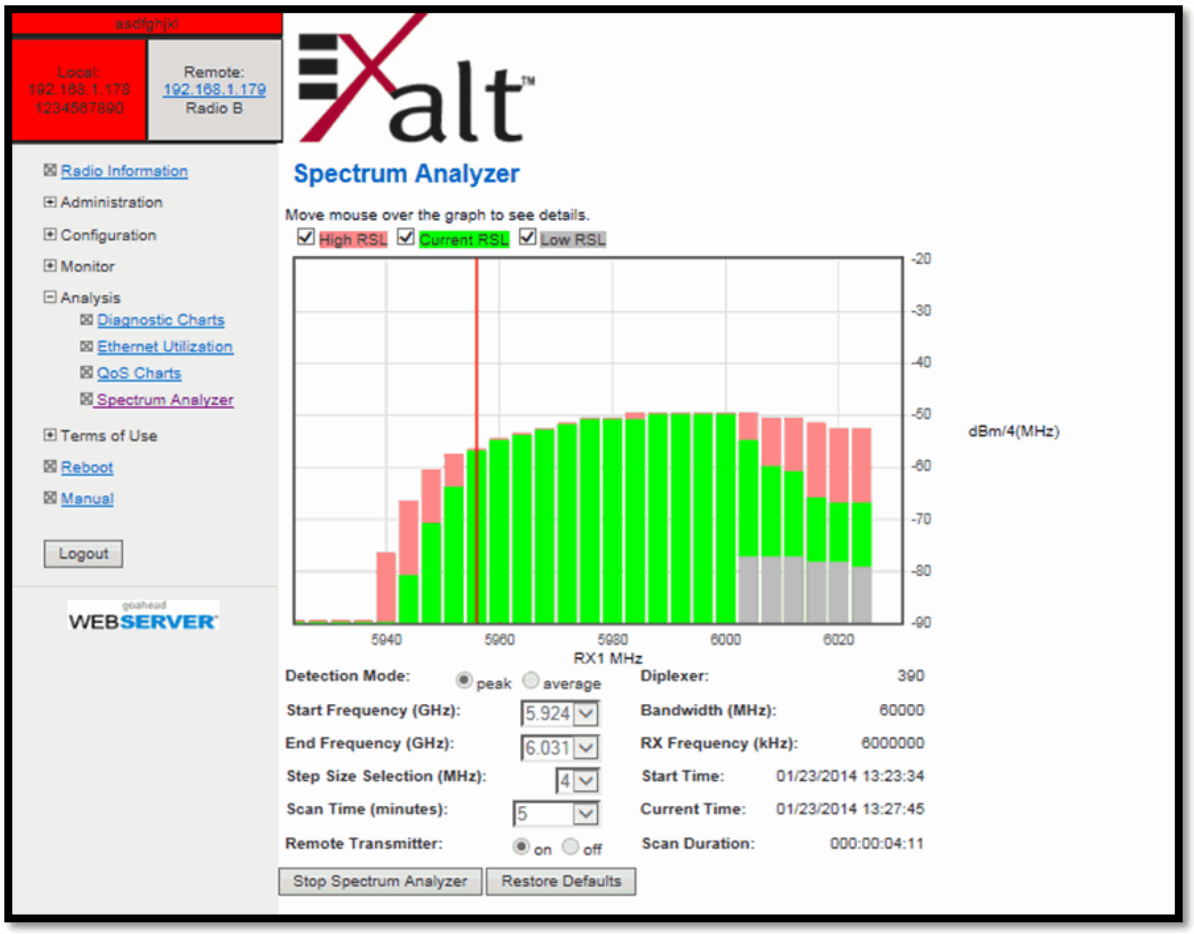


Figure 56 Spectrum Analyzer page

While a professional spectrum analyzer provides higher levels of control and precision for pre-planning, the Spectrum Analyzer page allows evaluation of the RF spectrum as seen at the radio's RF input port prior to deployment. This is useful for pre-planning the center frequency and occupied bandwidth, and to determine polarization and antenna type and mounting locations.

For troubleshooting, enable the spectrum analyzer to scan the desired segment or full band of the frequency range. Select the step size and set the remote radio transmitter ON or OFF. This allows viewing of the *clean* spectrum without the remote transmitter on and a comparison of the remote transmitter in the midst of other signals.

Note: Enabling the spectrum analyzer interrupts all radio traffic for the duration of the analysis. In addition, access to the radio's GUI may also be interrupted, depending on the location of the interfaced computer relative to the radio where the spectrum analysis is occurring. The GUI is available at the completion of the spectrum analysis.

Use the smallest step size to obtain the finest view of the spectrum. The spectrum analyzer can be set to match the start and stop frequency for a *dwell* mode. Peak and average detection modes are also available. Peak detection is helpful for capturing intermittent events such as pulsed emissions.

It is best to set the Scan Time option to a time value as opposed to using the 'infinity' setting. If your management computer is connected to the radio through the radio link, access to the GUI is interrupted during the duration of the analysis.

Note: The result of selecting infinity may be complete loss of contact to that radio and may require a physical visit to the radio location to disable the spectrum analyzer.

The spectrum analyzer graph displays received signals in red, green or gray (Figure 57), normalized in dBm to the resolution bandwidth of the analyzer. Red indicates a peak hold function. This is the highest level detected during the entire scan. Green indicates the last value measured at that frequency. Grey indicates the lowest value detected during the entire scan. Mouse over an area to view the details above the graph.

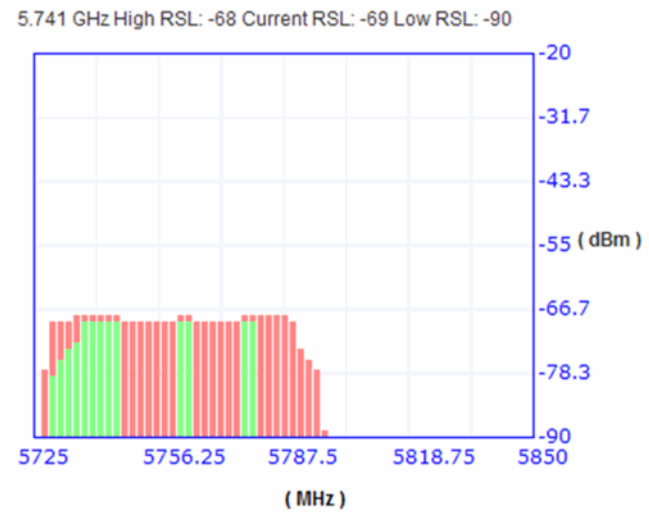


Figure 57 Spectrum analyzer graph example

A completely gray vertical box indicates that the signal maintained a steady level for the entire scan. A mostly green box indicates that the last scan measured at a strong or stronger level than the rest of the analysis. A completely red vertical box indicates that there was a signal at some point during the scan, but that the signal was not detected at the last scan. A graph displaying green on the lower part and red at the upper part indicates that at some time during the scan, a signal was detected at a higher level than was detected during the last scan.

The last spectrum analyzer scan performed displays in this page until the radio is rebooted. You can do a screen capture for record keeping and for comparison to future analyses. The time and date of the analysis displays on the page, which is handy as a reference in a screen capture.

Reboot Page

Use this page to reboot the radio. The function may never be required, but can be used in emergencies. All configurations that require a reboot automatically reboot on administrator confirmation.

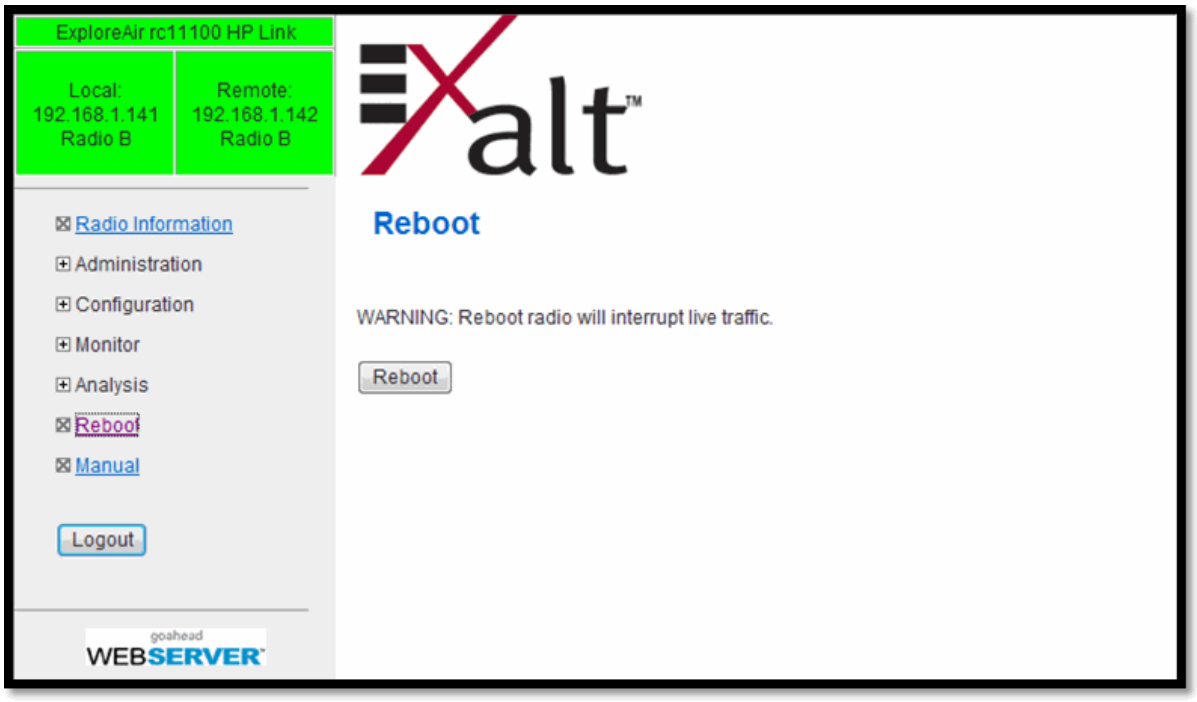


Figure 58 Reboot page

Manual Page

The manual (this document or the version that matches the installed firmware) is available within the GUI. Adobe Acrobat Reader 7.0 or higher is required (go to www.adobe.com to download Acrobat Reader). Click the Manual link to display the manual within the browser window. Once the manual displays, click the save button on the PDF toolbar to download the manual locally.

Figure 59 Manual page

Specifications–ExtremeAir Models

This section presents specifications for the ExtremeAir digital microwave radios.

Physical Specifications

Physical Configuration	Outdoor Unit (ODU)
Dimensions (HxWxD)	10.9 x 6.7 x 12.5 inches / 27.7 x 17 x 31.8 cm
Weight	17 lbs/7.7 kg
Operating Temperature	–40 to +149°F /–40 to +65°C
Altitude	15,000'/4.6 km
Humidity	100% condensing
Environmental	NEMA4/IP66

Common System Specifications

Power Control Step Size	0.5dB
Selectable Modulation Modes	QPSK, 16QAM, 64QAM, 128QAM, 256QAM
Maximum RSL	0dBm no damage QPSK: –25dBm error-free 16QAM and higher: –30dBm error-free

Throughput (Mbps full-duplex) Max system Layer 1/Max Ethernet Layer 2. Configured for dual-polarization (single-polarization throughput is ~50% of the values shown)

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
13.75/14MHz	54/44	108/88	134/108	162/130	198/152	216/174
27.5/28MHz	113/91	226/182	282/228	340/274	396/320	454/366
30MHz	115/93	229/185	286/231	344/278	401/324	459/371
40MHz	153/124	307/248	383/310	461/373	538/435	613/498
50MHz	192/155	385/311	482/390	579/468	672/546	750/624
55/56MHz	216/174	432/348	538/436	646/522	798/644	912/740
80MHz	319/258	636/516	777/645	954/775	965/904	1000/986

Ethernet Latency	<100µs typical
Error Floor	10^{-12}
Link Security	96-bit Security Code, optional NIST FIPS-197 compliant 128-bit or 256-bit AES encryption.

System Specifications, 11GHz FCC

Frequency Band	10700 to 11700GHz
Output Power (at full power)	+22dBm, +26dBm (HP), 16QAM +21dBm, +26dBm (HP), 32QAM +20dBm, +25dBm (HP), 64QAM +19dBm, +25dBm (HP), 128QAM +18dBm, +23dBm (HP), 256QAM
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	30MHz, 40MHz, and 80MHz

Receiver Threshold dBm (BER=10^{-6})

	16QAM	32QAM	64QAM	128QAM	256QAM
30MHz	–78	–74	–71	–68	–66
40MHz	–	–73	–70	–67	–64
80MHz	–	–70	–67	–64	–62

Emissions Designators

30MHz	30M0W7D
40MHz	40M0W7D
80MHz	80M0W7D

Sub-Bands

11GHz FCC (band edges)
TR 490/500/530MHz Lo/Hi
Band 1 (ID 501/502): 10.70–10.90GHz/11.20–11.40GHz
Band 2 (ID 503/504): 10.85-11.05GHz/11.35-11.55GHz
Band 3 (ID 505/506): 11.00–11.20GHz/11.50–11.70GHz
Band 4 (ID 535/536): 10.70-10.90GHz/11.2-11.4GHz
Band 5 (ID 537/538): 10.775-10.975GHz/11.275-11.475GHz
Band 6 (ID 539/540): 10.85-11.05GHz/11.35-11.55GHz
Band 7 (ID 541/542): 10.925-11.125GHz/11.425-11.625GHz
Band 8 (ID 543/544): 11.00-11.20GHz/11.50-11.70GHz

System Specifications, 18GHz FCC

Frequency Band	17700 to 19700GHz
Output Power (at full power)	+22dBm, QPSK +20dBm, 16QAM +19dBm, 32QAM +18dBm, 64QAM +17dBm, 128QAM +16dBm, 256QAM
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	30MHz, 40MHz, 50MHz, and 80MHz

Receiver Threshold dBm (BER=10^{-6})

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
30MHz	–84	–78	–75	–71	–68	–65
40MHz	–82	–76	–73	–69	–66	–63
50MHz	–81	–75	–72	–68	–65	–62
80MHz	–80	–74	–71	–67	–64	–61

Emissions Designators

30MHz	30M0W7D
40MHz	40M0W7D
50MHz	50M0W7D
80MHz	80M0W7D

Sub-Bands

18GHz FCC (band edges)
TR 1560MHz Lo/Hi
Band 1 (ID 507/508): 17.70–18.14GHz /19.26–19.70GHz

System Specifications, 23GHz FCC

Frequency Band	21200 to 23610GHz
Output Power (at full power)	+20dBm, QPSK +18dBm, 16QAM +17dBm, 32QAM +16dBm, 64QAM +15dBm, 128QAM +14dBm, 256QAM
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	30MHz, 40MHz, and 50MHz

Receiver Threshold dBm (BER=10^{-6})

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
30MHz	–82	–76	–73	–70	–67	–64
40MHz	–81	–75	–72	–69	–66	–63
50MHz	–79	–73	–70	–67	–64	–61

Emissions Designators

30MHz	30M0W7D
40MHz	40M0W7D
50MHz	50M0W7D

Sub-Bands

23GHz FCC (band edges)
TR 1200MHz Lo/Hi
Band 1 (ID 517/518): 21.20–21.62GHz /22.40–22.82GHz
Band 2 (ID 519/520): 21.59–22.01GHz /22.79–23.21GHz
Band 3 (ID 521/522): 21.98–22.40GHz /23.18–23.60GHz

System Specifications, 11GHz ITU/ETSI

Frequency Band	10700 to 11700GHz
Output Power (at full power)	+24dBm, +26dBm[a], QPSK +22dBm, +26dBm, 16QAM +21dBm, +26dBm, 32QAM +20dBm, +25dBm, 64QAM +19dBm, +25dBm, 128QAM +18dBm, +23dBm, 256QAM
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	27.5/28MHz, 40MHz, and 80MHz

Receiver Threshold dBm (BER=10^{-6})

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
27.5/28MHz	–84	–78	–74	–71	–68	–65
40MHz	–78	–	–73	–70	–67	–64
80MHz	–75	–73	–70	–67	–64	–61

Emissions Designators

27.5/28MHz	27M5W7D
40MHz	40M0W7D
80MHz	80M0W7D

a. The second output power reading is with the optional power upgrade.

Sub-Bands

11GHz ITU/ETSI Band Edges
TR 490/500/530MHz Lo/Hi
Band 1 (ID 501/502): 10.70–10.90GHz/11.20–11.40GHz
Band 2 (ID 503/504): 10.85-11.05GHz/11.35-11.55GHz
Band 3 (ID 505/506): 11.00–11.20GHz/11.50–11.70GHz
Band 4 (ID 535/536): 10.70-10.90GHz/11.2-11.4GHz
Band 5 (ID 537/538): 10.775-10.975GHz/11.275-11.475GHz
Band 6 (ID 539/540): 10.85-11.05GHz/11.35-11.55GHz
Band 7 (ID 541/542): 10.925-11.125GHz/11.425-11.625GHz
Band 8 (ID 543/544): 11.00-11.20GHz/11.50-11.70GHz

System Specifications, 15GHz ITU/ETSI (Preliminary)

Frequency Band	14400–15350GHz
Output Power (at full power)	+22dBm, QPSK +20dBm, 16QAM +20dBm, 32QAM +19dBm, 64QAM +18dBm, 128QAM +17dBm, 256QAM
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	13.75/14MHz, 27.5/28MHz, and 55/56MHz

Receiver Threshold dBm (BER=10^{-6})

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
13.75/14MHz	–87	–80	–77	–74	–71	–68
27.5/28MHz	–84	–77	–74	–71	–68	–65
55/56MHz	–80	–74	–71	–68	–65	–62

Emissions Designators

13.75/14MHz	13M7W7D
27.5/28MHz	27M5W7D
55/56MHz	55M0W7D

Sub-Bands

15GHz ITU/ETSI (band edges)		
TR 315MHz Hi/Lo (GHz)	**TR 420MHz Hi/Lo (GHz)**	**TR 490MHz Hi/Lo (GHz)**
Band 1: 14.94–15.05/14.63–14.73	Band 1: 14.92–15.03/14.50–14.61	Band 1: 14.89–15.01/14.40–14.52
Band 2: 15.04–15.16/14.73–14.84	Band 2: 15.03–15.15/14.61–14.73	Band 2: 15.01–15.12/14.52–14.63
Band 3: 15.14–15.24/14.82–14.93	Band 3: 15.14–15.26/14.72–14.84	Band 3: 15.12–15.24/14.63–14.75
	Band 4: 15.24–15.35/14.82–14.93	Band 4: 15.23–15.35/14.74–14.86

System Specifications, 18GHz ITU/ETSI

Frequency Band	17700–19700GHz
Output Power (at full power)	+22dBm, QPSK +20dBm, 16QAM +20dBm, 32QAM +19dBm, 64QAM +18dBm, 128QAM +17dBm, 256QAM
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	13.75/14MHz, 27.5/28MHz, 55/56MHz

Receiver Threshold dBm (BER=10^{-6})

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
13.75/14MHz	–86	–79	–76	–73	–70	–67
27.5/28MHz	–84	–78	–75	–70	–68	–65
55/56MHz	–80	–74	–71	–67	–64	–61

Emissions Designators

13.75/14MHz	13M7W7D
27.5/28MHz	27M5W7D
55/56MHz	55M0W7D

Sub-Bands

18GHz ITU/ETSI (band edges)
TR 1008/1010MHz Hi/Lo (GHz)
Band 1 (ID510/509): 18.7–19.0/17.69–17.99
Band 2 (ID 512/511): 18.94–19.24/17.93–18.23
Band 3 (ID 514/513): 19.19–19.49/18.18–18.48
Band 4 (ID 516/515): 19.41–19.71/18.40–18.70

System Specifications, 23GHz ITU/ETSI

Frequency Band	21200–23610GHz
Output Power (at full power)	+20dBm, QPSK +18dBm, 16QAM +17dBm, 32QAM +16dBm, 64QAM +15dBm, 128QAM +14dBm, 256QAM
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	13.75/14MHz, 27.5/28MHz, and 55/56MHz

Receiver Threshold dBm (BER=10^{-6})

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
13.75/14MHz	–85	–79	–76	–73	–70	–67
27.5/28MHz	–82	–76	–73	–70	–67	–64
55/56MHz	–79	–73	–70	–67	–64	–61

Emissions Designators

13.75/14MHz	13M7W7D
27.5/28MHz	27M5W7D
55/56MHz	55M0W7D

Sub-Bands

23GHz ITU/ETSI (band edges)	
TR 1232MHz Hi/Lo (GHz)	**TR 1008MHz Hi/Lo (GHz)**
Band 1 (ID 528/527): 22.432–22.852/21.2–21.62	Band 1 (ID 524/523): 23.008–23.322/22.00–22.314
Band 2 (ID 530/529): 22.81–23.23/21.578–21.998	Band 2 (ID 526/525): 23.294–23.608/22.286–22.60
Band 3 (ID 532/531): 23.188–23.608/21.956–22.376	

Interfaces

RF

Connector	Proprietary flange
Impedance	50 Ohms

Ethernet

Connectors	RJ48C/RJ45 Female x1 for xxx00 models x4 for xxx05 models 10/100/1000BaseT
Duplex	Half, full, auto
Compliance	802.3 with MDIX
VLAN	802.1q, transparent, trunk, and management only
QoS	8 priority levels, 8 queues; 802.1p, 802.1q (VLAN ID), source MAC address, destination MAC address
Ethernet Rate Limiting	Configurable per port
Maximum Packet Size	9728 bytes

Power — AC adapter/injector

Input	100–240VAC, 2.3A
Output	130W, 55VDC

Specifications–ExploreAir HP Models

This section presents specifications for the ExploreAir digital microwave radios.

Physical Specifications

Physical Configuration	Outdoor Unit (ODU)
Dimensions (HxWxD)	10.9 x 6.7 x 12.5 inches / 27.7 x 17 x 31.8 cm
Weight	17 lbs/7.7 kg
Operating Temperature	–40 to +140°F /–40 to +60°C
Altitude	15,000'/4.6 km
Humidity	100% condensing
Environmental	NEMA4/IP66

Common System Specifications

Power Control Step Size	0.5dB
Selectable Modulation Modes	16QAM, 32QAM, 64QAM, 128QAM, 256QAM
Adaptive Modulation	16QAM–256QAM fully configurable; errorless and jitterless

Full-Duplex User Capacity[a]

Mbps	16QAM	32QAM	64QAM	128QAM	256QAM
10MHz	–	–	58/47	–	77/62
30MHz	113/91	141/114	170/137	298/160	227/183
40MHZ	154/124	192/155	231/186	269/218	308/249
80MHz	315/258	394/323	473/387	533/452	633/517

Ethernet Latency	<100µs at full throughput GbE
TDM Latency	250µs typical
Error Floor	10^{-12}
Maximum RSL	0 dBm no damage 16QAM and higher: –30dBm error-free
Link Security	96-bit security key

Emissions Designators

10MHz	10M0W7D
30MHz	30M0W7D
40MHz	40M0W7D
80MHz	80M0W7D

a. Maximum layer 1 throughput as measured with 64-byte packets and maximum layer 2 Ethernet + TDM throughput as measured with 1536-byte packets. In both cases throughput includes source address, destination address and CRC overhead.

System Specifications, 11GHz

Frequency Band	10.70–11.70GHz
Output Power (at full power)	+29dBm, 16QAM +29dBm, 32QAM +29dBm, 64QAM +29dBm, 128QAM +28dBm, 256QAM
Output Power (at minimum power)	10dBm
Selectable Channel Bandwidths	10MHz, 30MHz, 40MHz, and 80MHz
Receiver Threshold (BER=10^{-6})	

dBm	16QAM	32QAM	64QAM	128QAM	256QAM
10MHz	–	–	–76	–73	–70
30MHz	–77	–74	–71	–68	–65
40MHz	–	–73	–70	–67	–64
80MHz	–	–70	–67	–64	–61

RF Diplexers

11GHz (band edges)
TR 490/500/530MHz Lo/Hi
Band 1 (ID 377/378): 10.70–10.90GHz /11.20–11.40GHz
Band 2 (ID 379/380): 10.85–11.05GHz /11.35–11.55GHz
Band 3 (ID 381/382): 11.00–11.20GHz /11.50–11.70GHz
Band 4 (ID 449/450): 10.70-10.90GHz/11.2-11.4GHz
Band 5 (ID 451/452): 10.775-10.975GHz/11.275-11.475GHz
Band 6 (ID 453/454): 10.85-11.05GHz/11.35-11.55GHz
Band 7 (ID 455/456): 10.925-11.125GHz/11.425-11.625GHz
Band 8 (ID 457/458): 11.00-11.20GHz/11.50-11.70GHz

Specifications–ExploreAir LR Models

This section presents specifications for the ExploreAir LR digital microwave radios.

Physical Specifications

Physical Configuration	Outdoor Unit (ODU)
Dimensions (HxWxD)	10.9 x 6.7 x 12.5 inches / 27.7 x 17 x 31.8 cm
Weight	17 lbs/7.7 kg
Operating Temperature	–40 to +149°F /–40 to +65°C
Altitude	15,000'/4.6 km
Humidity	100% condensing
Environmental	NEMA4/IP66

Common System Specifications

Power Control Step Size	0.5dB
Selectable Modulation Modes	QPSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM
Adaptive Modulation	QPSK–512QAM fully configurable; errorless and jitterless in max throughput mode

Full-Duplex User Capacity[a]

Mbps	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM
10MHz	20/16	39/32	49/39	58/47	67/54	79/64	89/72
12.5MHz	25/20	49/40	61/49	73/59	87/70	99/80	–
14MHz	28/23	56/46	71/57	85/69	99/80	113/91	–
25MHz	50/40	100/82	125/101	151/122	176/142	202/163	227/183
28MHz	57/46	113/92	142/114	170/137	199/160	227/184	256/207
29.65/30MHz	60/49	121/98	152/122	182/147	213/172	243/196	274/221
40MHZ	81/65	163/131	204/165	245/198	286/231	327/264	368/297
56MHz	115/93	230/185	287/232	344/278	402/324	460/371	517/417
60MHz	123/99	246/198	307/248	369/298	431/348	493/398	554/447
80MHz	164/132	329/265	412/332	494/399	577/465	659/532	742/599

Ethernet Latency	<100µs at full throughput GbE with AES encryption enabled
TDM Latency	250µs typical
Error Floor	10^{-12}
Maximum RSL	0 dBm no damage QPSK: –25dBm error-free 64QAM and higher: –30dBm error-free
Link Security	96-bit security key

Emissions Designators

10MHz	10M0W7D
12.5MHz	12M5W7D
25MHz	25M0W7D
30MHz	30M0W7D
40MHz	40M0W7D
60MHz	60M0W7D
80MHz	80M0W7D

a. Values shown are using the “Maximum Throughput and Minimum Latency” Performance Mode. Measurements shown indicate maximum layer 1 throughput as measured with 64-byte packets and maximum layer 2 Ethernet + TDM throughput as measured with 1536-byte packets. In both cases throughput includes source address, destination address and CRC overhead. Throughput is reduced approximately 10% from these figures for the Maximum System Gain or Balanced Performance modes. Consult product data sheet for details.

System Specifications, 6GHz Lower

Frequency Band	5.925–6.425GHz
Output Power (at full power)	+30dBm QPSK–256QAM, +27dBm 512QAM
Output Power (at minimum power)	10dBm
Selectable Channel Bandwidths	7, 10, 29.65/30, 40, and 60MHz

Receiver Threshold dBm (BER=10^{-6})[a]

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM
7MHz	–89						
10MHz	–88	–82	–79	–76	–73	–70	–66
29.65/30MHz	–83	–77	–74	–71	–68	–65	–61
40MHz	–82	–76	–73	–70	–67	–64	–60
60MHz	–80	–74	–71	–68	–65	–62	–58

a. Figures shown are for the “Maximum Throughput and Minimum Latency” setting of the radio. Maximum System Gain setting improves threshold 2.5dB. Balanced Performance setting improves by 2dB.

RF Diplexers

6GHz Lower (band edges)
TR 252.04MHz Hi/Lo
Band 1 (ID 389/390): 6177.02–6284.02MHz/5924.98–6031.98MHz
Band 2 (ID 391/392): 6249.02–6356.02MHz/5996.98–6103.98MHz
Band 3 (ID 393/394): 6321.02–6428.02MHz/6068.98–6175.98MHz
Band 4 (ID 445/446): 6212.02–6319.02MHz/5959.98–6066.98MHz
Band 5 (ID 537/538): 6286.02–6393.02MHz/6033.98–6140.98MHz

System Specifications, 6GHz Upper

Frequency Band	6.425–7.125GHz (ETSI/ITU model) 6.525–6.875GHz (FCC model)
Output Power (at full power)	+30dBm QPSK–256QAM +27dBm 512QAM
Output Power (at minimum power)	10dBm
Selectable Channel Bandwidths	28, 56, and 80MHz (ETSI/ITU model) 10 and 30MHz (FCC model)

Receiver Threshold dBm (BER=10^{-6})[a]

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM
10MHz	–88	–82	–79	–76	–73	–70	–66
28/30MHz	–83	–77	–74	–71	–68	–65	–61
56MHz	–80	–74	–71	–68	–65	–62	–58
80MHz	–79.0	–73	–70	–67	–64	–61	–57

a. Figures shown are for the “Maximum Throughput and Minimum Latency” setting of the radio. Maximum System Gain setting improves threshold 2.5dB. Balanced Performance setting improves by 2dB.

RF Diplexers

6GHz Upper ITU/ETSI (band edges)	
TR 340MHz Hi/Lo	**TR 350 MHz Hi/Lo**
Band 1: 6.765-6.880 GHz / 6.425-6.540 GHz	Band 1: 6.775-6.880 GHz / 6.425-6.530 GHz
Band 2: 6.860-6.970 GHz / 6.520-6.630 GHz	Band 2: 6.870-6.970 GHz / 6.520-6.620 GHz
Band 3: 6.940-7.050 GHz / 6.600-6.710 GHz	Band 3: 6.950-7.050 GHz / 6.600-6.700 GHz
Band 4: 7.010-7.125 GHz / 6.670-6.785 GHz	Band 4: 7.020-7.125 GHz / 6.670-6.775 GHz

6GHz Upper FCC (band edges)
TR 160MHz/TR 165MHz Hi/Lo
Band 1: 6.700-6.770 GHz / 6.535-6.605 GHz
Band 2: 6.750-6.820 GHz / 6.590-6.660 GHz
Band 3: 6.805-6.875 GHz / 6.645-6.715 GHz
Band 10: 6.700-6.770 GHz / 6.540-6.610 GHz
Band 11: 6.800-6.870 GHz / 6.640-6.710 GHz

System Specifications, 7GHz Lower FCC (Preliminary)

Frequency Band	6.875–7.125GHz
Output Power (at full power)	+30dBm, QPSK–128QAM +29dBm, 256QAM +27dBm, 512QAM
Output Power (at minimum power)	10dBm
Selectable Channel Bandwidths	12.5MHz and 25MHz
Receiver Threshold (BER=10^{-6})[a]	

dBm	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM
12.5MHz	–87	–80	–77	–74	–71	–68	–65
25MHz	–84	–77	–74	–71	–68	–65	–62

a. Figures shown are for the “Maximum Throughput and Minimum Latency” setting of the radio. Maximum System Gain setting improves threshold 2.5dB. Balanced Performance setting improves by 2dB.

RF Diplexers

7GHz FCC (band edges)
TR 150MHz Hi/Lo
Band 1 (ID 437/438): 7025–7050MHz / 6875–6900MHz
Band 2 (ID 439/440): 7050–7075MHz / 6900–6925MHz
Band 3 (ID 441-442): 7075–7100MHz / 6925–6950MHz
Band 4 (ID 443/444): 7100–7125MHz / 6950–6975MHz

System Specifications, 7GHz ITU/ETSI

Frequency Band	7.125–7.900GHz
Output Power (at full power)	QPSK–128QAM, +30dBm 256QAM, +29dBm 512QAM, +27dBm
Output Power (at minimum power)	10dBm
Selectable Channel Bandwidths	14MHz, 28MHz, and 56MHz
Receiver Threshold (BER=10^{-6})[a]	

dBm	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM
14MHz	–86.5	–80	–76.5	–73.5	–70.5	–67.5	–
28/29.65/30MHz	–83.5	–77	–73.5	–70.5	–67.5	–64.5	–61.5
56/60MHz	–80.5	–74	–70.5	–67.5	–64.5	–61.5	–58.5

a. Figures shown are for the “Maximum Throughput and Minimum Latency” setting of the radio. Maximum System Gain setting improves threshold 2.5dB. Balanced Performance setting improves by 2dB.

RF Diplexers

7GHz ITU/ETSI (band edges)	
TR 154MHz Hi/Lo	**TR 168 MHz Hi/Lo**
Band 1: 7.582–7.638 GHz /7.428–7.484 GHz	Band 1: 7.611–7.667 GHz/7.443–7.499 GHz
Band 2: 7.624–7.680 GHz /7.470–7.526 GHz	Band 2: 7.653–7.709 GHz/7.485–7.541 GHz
Band 3: 7.666–7.722 GHz /7.512–7.568 GHz	Band 3: 7.695–7.751 GHz/7.527–7.583 GHz
TR 161MHz Hi/Lo	**TR 196MHz Hi/Lo**
Band 1: 7.275–7.338 GHz /7.114–7.177 GHz	Band 1: 7.289–7.345 GHz/7.093–7.149 GHz
Band 2: 7.310–7.373 GHz /7.149–7.212 GHz	Band 2: 7.317–7.373 GHz/7.121–7.177 GHz
Band 3: 7.345–7.408 GHz /7.184–7.247 GHz	Band 3: 7.345–7.401 GHz/7.149–7.205 GHz
Band 4: 7.380–7.443 GHz /7.219–7.282 GHz	Band 4: 7.373–7.429 GHz/7.177–7.233 GHz
Band 5: 7.400–7.463 GHz /7.239–7.302 GHz	Band 5: 7.401–7.457 GHz/7.205–7.261 GHz
Band 6: 7.435–7.498 GHz /7.274–7.337 GHz	**TR 245MHz Hi/Lo**
Band 7: 7.470–7.533 GHz /7.309–7.372 GHz	Band 1: 7.645–7.729 GHz/7.400–7.484 GHz
Band 8: 7.505–7.568 GHz/7.344–7.407 GHz	Band 2: 7.729–7.813 GHz/7.484–7.568 GHz
Band 9: 7.575–7.638 GHz/7.414–7.477 GHz	Band 3: 7.813–7.897 GHz/7.568–7.652 GHz
Band 10: 7.610–7.673 GHz/7.449–7.512 GHz	
Band 11: 7.645–7.708 GHz/7.484–7.547 GHz	
Band 12: 7.680–7.743 GHz/7.519–7.582 GHz	
Band 13: 7.700–7.763 GHz/7.539–7.602 GHz	
Band 14: 7.735–7.798 GHz/7.574–7.637 GHz	
Band 15: 7.770–7.833 GHz/7.609–7.672 GHz	
Band 16: 7.805–7.868 GHz/7.644–7.707 GHz	

System Specifications, 8GHz ITU/ETSI – Preliminary

Frequency Band	7.725–8.500GHz
Output Power (at full power)	QPSK–128QAM, +30dBm 256QAM, +29dBm 512QAM, +27dBm
Output Power (at minimum power)	10dBm
Selectable Channel Bandwidths	14MHz, 28MHz, and 56MHz
Receiver Threshold (BER=10^{-6})[a]	

dBm	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM
14MHz	–86.5	–80	–76.5	–73.5	–70.5	–67.5	–
28/29.65/30MHz	–83.5	–77	–73.5	–70.5	–67.5	–64.5	–61.5
56/60MHz	–80.5	–74	–70.5	–67.5	–64.5	–61.5	–58.5

a. Figures shown are for the “Maximum Throughput and Minimum Latency” setting of the radio. Maximum System Gain setting improves threshold 2.5dB. Balanced Performance setting improves by 2dB.

RF Diplexers

8GHz ITU/ETSI (band edges)	
TR 119/126MHz Hi/Lo	**T/R 266MHz Hi/Lo**
Band 1 (ID 634/633): 8.398–8.426 GHz/8.279–8.307 GHz	Band 1 (ID 646/645): 8.171–8.290 GHz/7.905–8.024 GHz
Band 2 (ID 636/635): 8.412–8.440 GHz/8.293–8.321 GHz	Band 2 (ID 648/647): 8.283–8.402 GHz/8.017–8.136 GHz
Band 3 (ID 638/637): 8.426–8.454 GHz/8.307–8.335 GHz	**TR 311.32MHz Hi/Lo**
Band 4 (ID 640/639): 8.440–8.468 GHz/8.321–8.349 GHz	Band 1 (ID 650/649): 8.042–8.178 GHz/7.731–7.867 GHz
Band 5 (ID 642/641): 8.454–8.482 GHz/8.335–8.363 GHz	Band 2 (ID 652/651): 8.146–8.282 GHz/7.835–7.971 GHz
Band 6 (ID 644/643): 8.468–8.496 GHz/8.349–8.377 GHz	

System Specifications, 11GHz

Frequency Band	10.70–11.70GHz
Output Power (at full power)	+28dBm, QPSK–128QAM +27dBm, 256QAM +25dBm, 512QAM
Output Power (at minimum power)	10dBm
Selectable Channel Bandwidths	10MHz, 28/30MHz, 40MHz, and 80MHz[a]
Receiver Threshold dBm (BER=10^{-6})[b]	

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM
10MHz	–89	–82	–79	–76	–73	–	–
28/30MHz	–84	–77	–74	–71	–68	–65	–61
40MHz	–83	–76	–73	–70	–67	–64	–60
80MHz	–80	–73	–70	–67	–64	–61	–57

a. 80MHz channel operation is subject to FCC approval of proposed rulemaking allowing contiguous 2 x 40 MHz channels in the 11GHz Part 101 FCC band for broadband applications. Software upgrade is required.

b. Figures shown are for the “Maximum Throughput and Minimum Latency” setting of the radio. Maximum System Gain setting improves threshold 2.5dB. Balanced Performance setting improves by 2dB.

RF Diplexers

11GHz (band edges)
TR 490/500/530MHz Hi/Lo
Band 1: 11.195–11.415 GHz/10.685–10.905 GHz
Band 2: 11.270–11.490 GHz/10.760–10.980 GHz
Band 3: 11.345–11.565 GHz/10.835–11.055 GHz
Band 4: 11.420–11.640 GHz/10.910–11.130 GHz
Band 5: 11.495–11.715 GHz/10.985–11.205 GHz

Interfaces

RF

Connector	Waveguide flange: 6GHzL, 6GHzU, 7GHzL: Proprietary 11GHz: WR-75/UBR120
Impedance	50 Ohms

Ethernet

Connectors	RJ48C/RJ45 Female x1 for xxx00 and xxx50 models x4 for xxx05 models 10/100/1000BaseT
SFP (x1) for xxx50 models	1000BaseX (fiber only)
Duplex	Half, full, auto
Compliance	802.3 with MDIX
VLAN	802.1q, transparent, trunk, and management only
QoS	8 priority levels, 8 queues; 802.1p, 802.1q (VLAN ID), source MAC address, destination MAC address
Ethernet Rate Limiting	Configurable per port
Maximum Packet Size	9728 bytes (GbE)

T1/E1 (xxx10 models only)

	T1 (x4)	E1 (x4)
Connectors	RJ48C/RJ45 Female (x2)	
Impedance	100Ohms, Balanced	120 Ohms, balanced
Line Code	AMI, B8ZS, selectable per channel	HDB3
Data Rate	1.544 Mbps	2.048Mbps
Compliance	ANSI T1.102-1987; ITU-T; G823 GR-499-CORE	CEPT-1; G.703; ITU-T-G.703
Loopback Modes	Remote Internal, Remote External, Local Line	

Power — AC adapter/injector

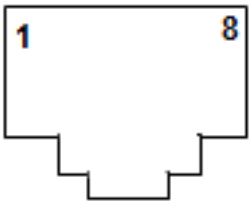
Input	100–240VAC, 2.3A
Output	130W, 55VDC

Interface Connections

This section provides the pin number assignment and wiring information for the connectors on the ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios. All connectors are shown as viewed from the radio front panel.

TDM Connections

On models with TDM connections, there are two connectors for TDM; each connector has two TDM circuits available. Figure 43 illustrates the pin orientation and functionality of these connectors. Figure 60 illustrates the pin orientation and functionality of these connectors.



Pin	Function
1	Tip Out (from radio) – Ch 1 & 2
2	Ring Out (from radio) – Ch 1 & 2
3	Tip Out (from radio) – Ch 3 & 4
4	Tip In (to radio) – Ch 1 & 2
5	Ring In (to radio) – Ch 1 & 2
6	Ring Out (from radio) – Ch 3 & 4
7	Tip In (to radio) – Ch 3 & 4
8	Ring In (to radio) – Ch 3 & 4

Figure 60 TDM connectors

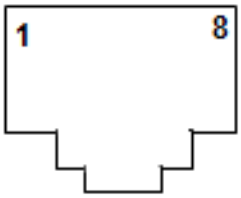
RSL Connector

A female BNC connector is provided on the front face of the radio chassis. This connector can be used during the antenna alignment process, to provide a received signal level (RSL) voltage to a voltmeter.

Power/Ethernet Connector

This connector is the primary connector on the radio, and must be connected to provide power to the radio, and primary Ethernet communications for traffic and Ethernet. Figure 45 illustrates the pin orientation and functionality for this connector.

Use a straight cable (wired as a standard Ethernet connection) for connection between the Power Injector and the PoE port of the radio. The wiring follows typical wiring for Power-over-Ethernet (PoE), however the power consumption requirement for the ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radio does not allow for 'standard' (802.3af) PoE, and only the Exalt power injector shall be used. In addition, the Exalt power injector provides critical reset and alarm capability that would not be available from a generic PoE injector, even if the power consumption requirement is met.



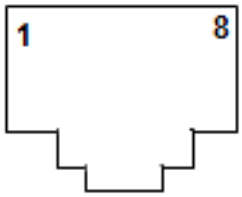
Pin	
1	Paired with Pin 2 (with 48VDC)
2	Paired with Pin 1 (with 48VDC)
3	Paired with Pin 6 (with 48VDC)
4	Paired with Pin 5 (with 48VDC)
5	Paired with Pin 4 (with 48VDC)
6	Paired with Pin 3 (with 48VDC)
7	Paired with Pin 8 (with 48VDC)
8	Paired with Pin 7 (with 48VDC)

Figure 61 Power/Ethernet connector

Note: Wire the CAT5e or CAT6 cable for the PoE connection as a 'straight-through' cable between the PoE injector and the radio. The cable connected to the injector for network access may be either straight-through or cross-connected. For xx005 models, the secondary Ethernet connections may be wired as straight-through or cross-connected and do not have power applied.

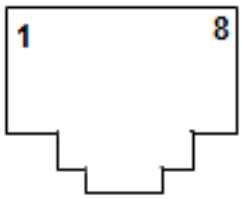
XPIC and SD Cabling – ExploreAir LR models only

XPIC and SD configurations require cabling between the two cabling between the XCON1 and XCON2 connections at each end.



Pin Side 1	Color	Pin Side 2
1	White/Green	3
2	Green	6
3	White/Orange	1
4	White/Brown	7
5	Brown	8
6	Orange	2
7	Blue	4
8	White/Blue	5

Figure 62 XCON1-to-XCON1 cable



Pin Side 1	Color	Pin Side 2
1	White/Orange	1
2	Orange	2
3	White/Green	3
4	Blue	5
5	White/Blue	4
6	Green	6
7	White/Brown	7
8	Brown	8

Figure 63 XCON2-to-XCON2 cable

Antennas

Table 9 lists direct-mount antennas for the ExtremeAir models. Table 10 lists direct-mount antennas for the ExploreAir models. Any standard waveguide-feed antenna can be used with a flexible or rigid waveguide between the radio and the antenna. Ensure that the waveguide flange type of the antenna and the radio match. If they do not match, a waveguide transition may be required (supplied separately).

Table 9 ExtremeAir supported direct-mount antennas

Frequency Band	Manufacturer	Model #	Description	Midband Gain (dBi)
11GHz	RadioWaves	HP2-11EXD	2-foot Parabolic	33.4
11GHz	RadioWaves	HP3-11EXD	3-foot Parabolic	36.9
11GHz	RadioWaves	HP4-11EXD	4-foot Parabolic	39.4
11GHz	RadioWaves	HP6-11EXD	6-foot Parabolic	42.9
18GHz	RadioWaves	HP2-18EXD	2-foot Parabolic	38.6
18GHz	RadioWaves	HP3-18EXD	3-foot Parabolic	42.0
18GHz	RadioWaves	HP4-18EXD	4-foot Parabolic	44.5
18GHz	RadioWaves	HP6-18EXD	6-foot Parabolic	48.0
23GHz	RadioWaves	HPCPE-23EXD	1-foot Parabolic	35.1
23GHz	RadioWaves	HP2-23EXD	2-foot Parabolic	40.2
23GHz	RadioWaves	HP3-23EXD	3-foot Parabolic	43.7
23GHz	RadioWaves	HP4-23EXD	4-foot Parabolic	46.2
23GHz	RadioWaves	HP6-23EXD	6-foot Parabolic	49.2

Table 10 ExploreAir HP and LR supported direct-mount antennas

Frequency Band	Manufacturer	Model #	Description	Midband Gain (dBi)
6GHz Lower	RadioWaves	HP6-59EX	6-foot Parabolic	39.0
6GHz Upper	TBD	TBD	TBD	TBD
7GHz Lower	TBD	TBD	TBD	TBD
11GHz	RadioWaves	HP2-11EX	2-foot Parabolic	33.4
11GHz	RadioWaves	HP3-11EX	3-foot Parabolic	36.9
11GHz	RadioWaves	HP4-11EX	4-foot Parabolic	39.4
11GHz	RadioWaves	HP6-11EX	6-foot Parabolic	42.9

XPIC–ExploreAir LR models only

ExploreAir LR dual-radio XPIC configurations use two approaches for antenna solutions:

- use a standard waveguide connected dual-polarized antenna and mount both radios using the remote mount solution, placing a flexible waveguide (and any tapered transitions necessary) mating the waveguide flanges to the antenna flanges.
- use a dual-polarized antenna with a circular waveguide feed, and implementing a custom Orthogonal Mode Transducer (OMT) to mount to the antenna to allow the connection to the two radio terminals. Consult Exalt regarding this approach, as only certain antennas can accept available OMT solutions.

Troubleshooting

This section provides information regarding troubleshooting of common issues and alarms on these radios. Exalt Digital Microwave Radio systems are designed by Exalt's expert engineers with extensive experience through multiple generations of microwave radio design. These new-generation systems contain extensive diagnostic tools, alarm indications, and troubleshooting aids. And, as compared to other systems in their class, are easier to install, maintain, and troubleshoot. The GUI provides information to aid in troubleshooting (see Diagnostic Charts Page).

Contact Exalt Customer Care for further assistance with issues with your Exalt radio and with suggestions on how the radio and documentation can be improved.

General Practices

Troubleshooting a microwave radio link can be a complex task. Approach troubleshooting as a process of elimination, and first determine which portions of the system are operating properly.

In a vast majority of cases, failures or poor performance of microwave links is attributed to something other than the microwave radio hardware. In this respect, the back-to-back bench test (see Back-to-back Bench Testing) is very important to determine if radio hardware is operating properly and eliminate many variables in the troubleshooting process.

If a back-to-back bench test fails, then the radio hardware is either broken or the radios are improperly configured. Upgrade the radio to the most current release of firmware, and/or reset the radio to its critical factory settings, following the quick start guide instructions and those in Configuration and Management, helps to confirm if configuration issues cause failure. The most common issues with microwave radio links are:

- An improperly terminated antenna or transmission system
- Multipath propagation
- RF interference
- Path obstruction
- Misaligned antenna
- Faulty antenna
- Improper grounding
- Insufficient link margin in the design/implementation
- Moisture in the transmission system (antenna feed and/or waveguide)

If the radio link has been operating without issues and is exhibiting new poor performance behavior or becomes completely inoperative, the troubleshooting process should pay close attention to any conditions that may have changed between the time when the system was working without issue and the time when the issues started.

Also, it can be helpful to compare some performance parameters of the system before and after the presence of issues. Often the source of the issues can be determined by thoughtful consideration of changes, such as:

- Changes in weather, including high winds
- Changes made to the radio equipment, transmission system, or connected equipment
- New radio systems or electronic equipment the nearby radio or transmission system

- New construction nearby either end of the link, or along the path
- Tree growth, flooded fields, or changes in rivers/lakes along the path

Verify that configurations are set as follows:

- Frequency pair matches (oppositely) at each end of the link
- Bandwidth matches at each end of the link
- Ethernet interfaces are enabled, as desired
- T1/E1 enabling matches at each end of the link
- Link security key matches at each end of the link
- Firmware version matches at both ends
- License key installed at both ends

Typical Indications of Issues

In many cases, microwave radio users do not notice changes or degradation to the radio system until the radio system fails completely or becomes highly errored or significantly intermittent. However, regular management of the radio system can help indicate changes in performance that have not yet impacted user performance, but may impact performance at a later date if left unchecked or unaddressed. The administrator can use this as an opportunity to be proactive and monitor the radio link performance regularly, watching for unexplained or unexpected changes in performance and trends in performance changes.

Most importantly, monitoring radio system RSL over time indicates the performance of the radio system. Address any long-term drop in RSL and erratic or unsteady RSL. Some RSL changes are expected and weather patterns and the related multipath can cause dramatic RSL changes resulting in system outage. However, that outage should not occur at a significantly greater rate than the designed long-term performance. Consult the path design engineer for more information about link reliability expectations and anticipated RSL deviation.

In addition, regular inspection of the transmission system (RF cables and antennas) and paying close attention to changes along the path, such as construction or tree height, or new microwave radio installations nearby, can be extremely helpful and proactive.

When link performance is very poor, alarms on the radio front panel and within the radio's management system indicates particular failures. Consult this manual for more information on the specific alarms and diagnostics, or contact Exalt Customer Care for assistance.

Exalt Customer Care is primarily motivated to determine if the radio hardware is faulty and require return for repair, and to help execute an effective and efficient repair and return process for radio terminals believed to be faulty. However, Exalt Customer Care provides advice regarding the total radio system and RF path engineering and environment, and advises on troubleshooting.

End users should first contact the installer and/or designer of the system. In many cases, an in-depth understanding of RF design is required, and on-site analysis and special test equipment, may be necessary. Compared to phone support from Exalt Customer Care, troubleshooting is much more expeditious if the professional installer and/or link designer examines the system and reviews the management information in the GUI. In turn, if the professional installer and/or link designer contacts Exalt Customer Care, the process to rectify the system is much more expedient due to the in-depth knowledge related to the implementation and the RF environment.

Improper Transmission System

Improper transmission system is a very common problem. In many cases, this is a problem that occurs during installation and is not a problem that suddenly appears. However, if waveguides are moved or flexed and radio errors, changes in RSL or other performance issues occur, this is a certain sign of this issue.

Another relatively easy method to test for this condition is to decrease the output power of the radio system (at each end, one end at a time). Poor RF termination may be reflecting too much RF energy back into the radio system, and reducing output power reduces the reflected energy at a faster rate than the transmitted energy towards the far end. Be careful not to reduce the output power to the point where the radio's threshold is reached. Typically, a reduction of just 3 to 6dB is enough to determine if this is the issue. If the reduction of output power clears the error condition, this is the likely cause.

Use a reflectometer or meter that can read VSWR at the operating frequency to identify poor terminations as well as poor antenna feeds.

Multipath Propagation

Multipath propagation is a term that encompasses changes to the RF path, such as reflections and/or refraction, causing partial or complete destruction of the radio signal, and thus excessive bit errors and/or system outages.

Rapid changes in temperature, inversion layers, humidity, air pressure, water evaporation, as well as standing water or moisture on objects along the path are all examples of changes that can cause multipath propagation. New building construction near either end of the path or along the path can cause new reflection characteristics.

If your system has been operating without issue and is suddenly experiencing issues that are symptomatic of a certain time of day or related to change in climatic events or some of the external factors listed above, this is likely the cause. Consult a professional RF path engineer in these cases. Often, minor repositioning of the antennas at either or both ends can reduce or eliminate these problems.

RF Interference

RF interference is usually indicative of another radio system nearby either end of your radio system or aimed towards one or both ends of your radio system – usually at or near the same frequency and usually with a similar signal level. This is less common for licensed systems, but still can occur.

Other forms of RF interference also exist, such as electronic equipment placed close to the radio chassis or transmitters that couple onto the cabling or grounding system of the radio. Microwave ovens and wireless communication devices used near the equipment or cabling are examples of electronic equipment interference.

RF interference, like most other causes of problems, is indicated by significant bit errors and/or system outages.

One means to determine presence of interference is the use of a spectrum analyzer that covers the same range as the radio system. A professional RF engineer can use a spectrum analyzer to locate sources of interference, measure these sources, and determine potential remedies to take to operate in the presence of interference.

If a spectrum analyzer is not available, the radio's RSL port can help determine RSL levels of interfering signals. By turning the far-end radio off, the residual RSL measured by the radio indicates the level of interference seen by the radio. It is possible that interference levels below that which can

be measured still have an impact on the radio system – especially if the radio system has low fade margin or is using a high order modulation.

Changes in frequency, bandwidth, antenna polarization, or antenna position may remedy an interference issue. However, if the system is licensed, these changes may not be allowed without re-licensing.

Path Obstruction

A path obstruction is defined as an object, such as a building or tree, impeding the proper path of the radio system. If the system design was proper at the time of installation and issues arise at a later date, an updated path profile and survey may be necessary to identify changes in path clearance.

Misaligned Antenna

At the time of initial installation, it is critical that the antennas at each end are properly aligned and that the designed RSL is achieved. However, antennas may become misaligned due to high winds, changes in the guy-wiring systems keeping the antenna mast stable, or loosening of the antenna mounting hardware. A reduction in the RSL of the link is symptomatic of this condition, but this condition is not the only condition that results in a reduction of RSL. However, if conditions occur where the antenna alignment may be suspected, the mechanics must be inspected and the antennas realigned.

Faulty Antenna

A faulty antenna is rare, but is still a possibility. In some cases, the mechanics of the antenna feed can get moisture inside, or a bad or weak connection in the pin and connector structure of the antenna may occur. A VSWR measurement of the antenna connection can be made to verify this condition.

Improper Grounding

In addition to being a potential human safety issue, improper system grounding is a somewhat common condition that can cause continuous bit errors or bit errors when metal objects come in contact with the radio, transmission system, or racking system. If touching the radio causes errors, grounding is the cause. It can be difficult to identify grounding problems, but a professional electrician can normally inspect a system and identify if there are deficiencies in the grounding system.

Insufficient Link Margin

Ideally, the link was designed with enough link margin (fade margin) to allow for multipath propagation and atmospheric fading and still remain reliable. In some cases, link margin is compromised by economic factors, such as using low-cost RF cabling or lower-cost antennas that have less gain or deficient performance compared to higher cost transmission system components. In some cases, there may be antenna size restrictions that forced the design to not have the desired amount of link margin.

If the link was designed with poor link margin, there are likely many cases of bit errors and outages. The antenna system and transmission line can be upgraded to help reduce this. If the link design was installed with sufficient margin, but RSL is reduced, the remaining link margin may no longer be enough to maintain a reliable link. The causes of RSL reduction were previously described, but are usually due to new path obstruction(s) or antenna misalignment due to wind or mechanical factors. The antenna height or location can be changed to overcome new obstructions. Realignment of the antenna, and/or improvement to mechanical structures can help overcome antenna misalignment.

Moisture in the Transmission System

If the connectors on cables and antennas and egress junctions are not properly weatherproofed, moisture can get into the transmission system and cause significant error conditions and erratic performance. In many cases, the transmission system must be replaced. A VSWR meter is one means to identify such issues. Conduct physical inspections often. If changes to the weatherproofing (such as cracking) are noticed, replace the weatherproofing before leakage occurs.

Back-to-back Bench Testing

Use back-to-back bench testing to test the radio before installation, pre-configure the radio and connected equipment before installation, or in the troubleshooting process to identify if the radio hardware is the source of a system issue. It is a critical process, and often required or highly desirable for any installation or troubleshooting exercise. This section describes how to properly configure the radio hardware and accessories for a proper back-to-back bench test.

For radio testing, there are two types of back-to-back configurations:

1 Basic test (test general operation)

2 Specification performance verification

Basic Test

The basic test is a simple test of radio functionality. It verifies that the radios are properly configured to communicate to one another, and verifies general radio performance as operational.

For the basic test, the following items are needed:

- Radio pair
- Powering source
- RF interconnect cable(s) (any length – short is best)
- Fixed or variable attenuation, between 60 and 90dB

Note: attenuation for basic test does not need to be calibrated or precise.

- Computer/terminal with either serial or Ethernet port

  If no computer is available, use the temporary hardware configuration key or DIP switch, depending on radio model (see Initial Configuration and Back-to-Back Bench Test)

Connect the items as follows:

1 Connect attenuation and (known-good) RF cable(s) between radio pair, shown in Figure 64.

2 Configure the frequencies of the radio to be the same pair, with opposite Tx and Rx orientation.

3 Power on radio pair

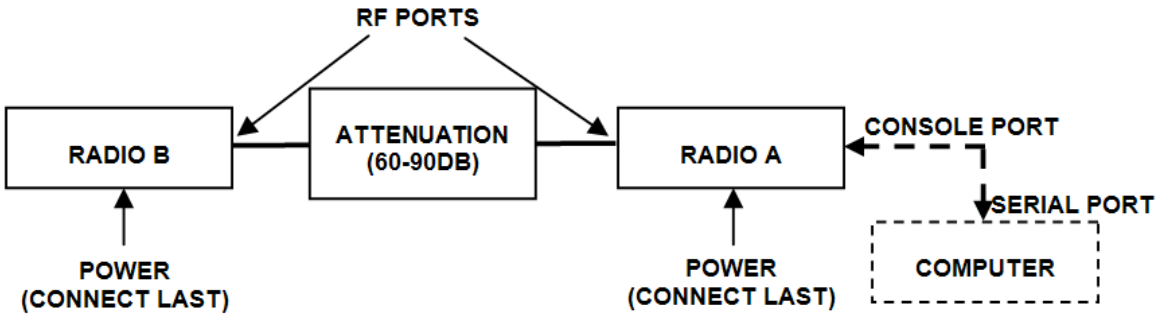


Figure 64 Basic back-to-back bench test configuration

After connecting and powering on and connecting a PC for GUI radio management, verify that the LINK and STATUS are green. If so, the radios are communicating and all radio-related alarm

conditions are normal. It can be beneficial to have a computer to verify configuration in case of red LEDs or to pre-configure the radio as desired for operation. Follow the instructions in Configuration and Management.

Specification Performance Verification

The specification performance verification is a more detailed test that allows you to verify that the radio's output power and threshold specifications are being met. This is typically a test that would only be performed in a troubleshooting scenario, but can be performed before installation to provide a detailed record or ensure radio performance before installation.

This test is identical to the basic test, but in place of the fixed attenuation, it requires the use of calibrated variable attenuation, or a set of calibrated fixed attenuators, or a combination of both, adding to a total attenuation value of 120dB, as measured at the operating frequency of the radio. In addition, a volt meter or computer is also required.

Connect the system as shown in Figure 64, using the combination of fixed and variable attenuation between the radio's RF ports. Connect the volt meter to either radio's RSL test point and associated reference ground connection.

In this test, it is desirable to use pre-tested RF cables, known to be good, and the insertion loss is known at the operating frequency. If the cables are short (6'/2m or less), you can estimate the loss, including connectors, to be less than 1dB each. The estimate of cable loss is critical to the overall confidence of the measurements made in this test.

There are two critical specifications that can be tested in this configuration:

- RF output power
- Radio receiver threshold

To measure transmitter output power, simply insert any value of attenuation between the radios between 60 and 90dB. Ensure that both RF output power settings are at maximum. Use the volt meter to measure RSL in both directions. The RSL measured value should match the appropriate value according to the inserted attenuation, such as:

$$RSL = RF\ Output\ Power - cabling\ losses - total\ attenuation$$

Verify output power by adjusting output power using the Exalt GUI (in administration mode) and evaluate the corresponding change to the RSL measurement.

For threshold testing, the key is to insert a measured amount of loss that is close to, but not exceeding the radio's specified system gain. System gain is the difference between RF output power and receiver threshold. At your selected modulation and bandwidth settings, determine the specified threshold performance, and choose a value of attenuation (including cable losses) that adds to roughly 5 to 15dB less than the system gain.

For example, if the threshold for your measurement is –85dBm, the output power is +27dBm, so the system gain is 112dB. Choose a value of total attenuation in the range of roughly 100–105dB. Once this attenuation is inserted, verify RSL readings as in the first step, and then, using the GUI, reduce radio output power in 1dB steps until the receiving radio (the one whose output power not being adjusted) Link LED turns from green to yellow. This indicates that threshold has been reached. At this point, verify the equation for system gain using the new output power level setting and verify that the threshold performance is meeting or exceeding the published specification.

Note: Due to the variation of measurements and accuracies involved in this test, you may read a measurement that is 1dB to as much as 2dB off of the expected value. It should be of no concern unless the value is more than 3dB worse than expected.

Once threshold is verified in this direction, repeat the process in the opposite direction by adjusting RF output power of the radio at the opposite end. Return the first radio to its original power setting before adjusting the second radio.

General Compliance and Safety

The usage of radio transmission devices is subject to specific regulatory requirements governed by regional legislation. In most cases, the specific device must be authorized for use in a given country and must be installed and adjusted in accordance with specific radio-frequency settings and in a manner that has been authorized specific to the device itself in accordance with the specific location of the device. Some users may be completely or partially restricted from use of the device. Please consult local governmental agency/agencies for regulatory requirements before use, or contact Exalt or your Exalt authorized dealer for assistance.

Do not modify this device in any way without the express written consent of Exalt. Modification voids the manufacturer warranty, and may also be illegal in accordance to government regulations. In addition, there are no user-serviceable parts or assemblies inside the product housing. There may also be voltages, signals, and mechanisms within the device that could be harmful to human safety.

The mounting of this device and associated peripherals and connections (inclusive of antenna mast, antenna, cabling, egress, lightning protection devices, grounding, power, and so on) may be subject to regional requirements for health and human safety. A qualified professional installer and an electrician are highly recommended, and may be required by law.

Regulatory Notices

This section presents the Regulatory Compliance Regulations for your country.

United States Compliance

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) product family operates under FCC Rule Parts 101 as a licensed device. They may only be used as a point-to-point transmission device for fixed or temporary-fixed (non-mobile) installations. The devices are subject to the following restrictions:

- Do not use external amplifiers to boost the power or overcome transmission system losses, unless the specific amplifier/cable/antenna combination has expressly been authorized by the FCC.
- Cross-border transmissions are expressly prohibited, except with written permission from both the FCC and the governing body of the neighboring country (Cofetel for Mexico; Industry Canada for Canada).
- Use only parabolic dish antennas. No other types of antennas (omni-directional, yagi, and so on) are authorized.

Federal Communications Commission (FCC), United States

The device is allowed to be used provided it does not cause interference to other devices. It is not guaranteed to provide protection against interference from other electronic and radio devices.

The system has been tested and found to comply with the limits of a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Shielded cables and I/O cords must be used for this equipment to comply with the relevant FCC regulations.

Changes or modifications not expressly approved in writing by Exalt may void the user’s authority to operate this equipment.

This device must be professionally installed.

To comply with regulations, the output power of this device may need to be adjusted in accordance to the associated transmission system. See RF Output Power Setting for details.

The antenna associated with ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios shall be mounted in a location that is at least 10 feet away from humans that may be subject to long-term or continuous exposure.

Canada Compliance

The ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios operate under Industry Canada regulations. Operation is subject to the following conditions, unless express permission is granted by Industry Canada to operate in a different manner:

- External amplifiers cannot be used to boost the power or to overcome transmission system losses, unless the specific amplifier/cable/antenna combination is expressly authorized by Industry Canada.
- Cross-border transmissions are expressly prohibited, except with written permission from both Industry Canada and the governing body of the neighboring country (FCC for USA)
- Only parabolic dish antennas may be used. No other types of antennas (omni-directional, yagi, and so on) are authorized

Industry Canada (IC), Canada

Operation is subject to the following two conditions:

1 this device may not cause interference, and

2 this device must accept any interference, including interference that may cause undesired operation of the device.

Regulatory Compliance

As of this printing, Exalt Communications, Inc. has approvals for the products that are covered by this manual, as indicated in Table 11. If your application or country is not listed, check with your Sales Representative for the current status.

Table 11 Product Approvals

Country	6GHz Lower	6GHz Upper	7GHz Lower	11GHz	18GHz	23GHz
Canada	TBD	TBD	TBD	✓	✓	✓
United States	✓	✓	✓	✓	✓	✓

Licensing

Frequency coordination for ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radios is normally required by local regulations. To obtain and maintain licensing, consult the licensing authorities.

Note: The professional installer is responsible to ensure that RF output power, channel assignment, bandwidth, and modulation are properly adjusted in accordance with local regulatory requirements and licensing, if any. Antenna models and polarization are usually specified within the licensing requirements.

United States

In the US frequency coordination is often conducted by a Certified Frequency Coordinator (CFC), who coordinates spectrum allocation for the Federal Communications Commission (FCC). CFCs assist applicants with licensing. Applicants can also apply using the FCC‘s Universal Licensing System (ULS) online at:

http://wireless.fcc.gov/uls/index.htm?job=home

You must first register with the FCC to use the on-line system, and obtain an FCC Registration Number (FRN). The FRN identifies you in all transactions to the FCC.

Exalt provides ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radio information to the following CFCs:

- Radio Dynamics (Radyn–www.radyn.com/)
- Comsearch (www.comsearch.com/)
- Micronet Communications, Inc. (www.micronetcom.com)

Upon request, ExtremeAir, ExploreAir HP, and ExploreAir LR rc-Series (FDD) radio information can be provided to any CFC.

Canada

In Canada frequency coordination is often conducted by a National Frequency Coordinator (NFC), who coordinates spectrum allocation for Industry Canada (IC). NFCs assist applicants in licensing. Applicants can also apply using the IC’s online system at:

http://sd.ic.gc.ca/engdoc/main.jsp#LicenceApplications

You must first register with the IC to use the online system.

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1 Exalt Limited Hardware Warranty

a. Exalt warrants solely to the original purchaser ("Purchaser") that the Exalt hardware product that this Agreement is provided with or for (the "Hardware Product") will substantially conform in all material respects to the relevant Exalt published specifications that apply at the time of manufacture of such Hardware Product for two (2) years from the date of purchase of Hardware Product by Purchaser (the "Warranty Period"). Proof-of-purchase in the form of an invoice, payment of invoice, or delivery waybill must be supplied, if requested by Exalt, in case of any dispute of warranty start date.

b. In the event Purchaser notifies Exalt during the Warranty Period of a defective Hardware Product (material nonconformance with the published specifications), Exalt shall within the Warranty Period, at its own option either: (A) use reasonable efforts to remedy any reproducible Hardware Product defect covered by this limited warranty within a reasonable period of time; (B) replace the defective Hardware Product with a functionally equivalent product (repair parts and products may be either reconditioned or new, but, if reconditioned, shall be of the same quality as new parts or products); or (C) if Exalt determines that it is unable to repair or replace such Hardware Product, Exalt (or its applicable reseller) will refund to Purchaser the amount actually paid by Purchaser for the applicable Hardware Product. All replaced parts and products become the property of Exalt.

c. The Exalt warranty does not cover any defective Hardware Product that (i) is subject to the exclusions set forth below in Section 3; (ii) cannot be demonstrated to have a defect of the types of defects covered by the Exalt warranty, or (iii) Purchaser is unable to provide adequate information describing how the Hardware Product failed that would allow Exalt to determine that the defect is covered by the Exalt warranty. Any Hardware Product that is returned by the Purchaser to Exalt and Exalt determines that such product is not covered by the Exalt warranty, will be, at Purchaser's option and expense (including any applicable shipping, handling, evaluation, repair, replacement and disposal fees), either be: (a) returned to Purchaser in the state received, (b) repaired or replaced, as applicable, and returned to Purchaser, or disposed of in accordance with Purchaser's instructions. Repaired or replaced Hardware Product will be warranted for the remainder of the original Warranty Period, but not less than ninety (90) days.

2 Warranty Registration

In order to facilitate warranty service and communication with Exalt, Exalt recommends that the Purchaser registers the Hardware Product with Exalt promptly following the Hardware Product purchase by providing to Exalt the requested registration information. [Product registration may be performed by completing and submitting the product registration form on www.exaltcom.com/ProductRegistration]

3 Limited Hardware Warranty Exclusions

This limited warranty will not apply to: (A) any Hardware Product that: (i) has been modified or altered by any party other than Exalt; (ii) has been subject to accident, misuse, neglect, or mistreatment; (iii) has been damaged during installation of the Hardware Product; (iv) has been damaged by failure of Purchaser or its agents to follow Exalt's instructions or specifications; (v) has been damaged by the equipment or system with which the Hardware Product is used; (vi) has sustained damage to the Hardware Products' interface or power connectors; (vii) is determined to be stolen; or (viii) has been damaged by water, fire, power changes, other hazards, or acts of God (including without limitation lightning); (B) any Software included in any such Hardware Product (see Software License below), or (C) any consumables. The warranty applies only to Hardware Products manufactured by or for Exalt and that can be identified by the Exalt trademark, trade name, serial number or logo affixed to them. Other products, including any third-party manufacturer products sold by Exalt on a resale basis, are subject to the applicable third-party manufacturer's warranty and end user agreement and are not warranted by Exalt. The Hardware Products covered by this warranty are not consumer products and are not intended for personal, family, or household purposes, nor are they intended for high-risk activities as described in Section 5 below.

4 Hardware Product RMA Procedure

A return material authorization (RMA) is required prior to returning Hardware Product to Exalt for in-warranty or out-of-warranty repair/evaluation. As such, Purchaser must use the then current Exalt RMA procedure. Such procedure is available on the Exalt website @ www.exaltcom.com/RMA.

PRODUCTS RETURNED WITHOUT A DULY ISSUED RMA NUMBER WILL BE RETURNED TO PURCHASER BY EXALT AT PURCHASER'S EXPENSE.

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