

ExtendAir® G2™ 24GHz

Digital Microwave Radios Installation and Management Guide



Models:
rc24020

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About this Document

This manual provides a complete description of the ExtendAir G2 24GHz 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	Description
2015-08-14	Initial release.
2015-09-09	Updated to include supported Antennas .

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 Wireless, 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.

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Website:	www.exaltcom.com
Sales e-mail:	sales@exaltcom.com
Customer Care e-mail:	support@exaltcom.com
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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://exaltcom.com/exalt-support.aspx>

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

The ExtendAir G2 24GHz Digital Microwave Radios

The Exalt ExtendAir G2 24GHz digital microwave radios are the most advanced carrier-class point-to-point terrestrial radio communications devices operating in the 24GHz frequency bands. The ExtendAir G2 24GHz radios are available with two Gigabit Ethernet PoE ports that are 10/100/1000BaseT (ETH1/PoE + ETH2).

The ExtendAir G2 24GHz radios connect 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 ExtendAir G2 24GHz digital microwave radio.



Figure 1 ExtendAir digital microwave radio without antenna, vertical diplexer

The ExtendAir G2 24GHz model number scheme uses the first two digits to define the general frequency band (in GHz) and the last three digits to define the connector and base configuration.

- ExtendAir G2 models have one 10/100/1000BaseT PoE port and one additional 10/100/1000BaseT port (see [Figure 5](#))
 - configured with 25Mbps of full-duplex Ethernet capacity

The ExtendAir G2 24GHz 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 ExtendAir G2 24GHz radios utilize radio frequencies that are considered ‘unlicensed’ in most countries. This means that the frequency plans and radio configuration are not coordinated with other users of the spectrum. Also, the frequency, channel-center frequencies, occupied bandwidth, and the Transmitter-to-Receiver frequency separation (also known as T/R spacing) are utilized to allow maximum use of the 24 GHz unlicensed band. 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 is a table of the configurations supported.

Table 1 Supported configurations

Band Name	Frequency Band Edges (GHz)	T/R Spacing (MHz)	Supported Channel Bandwidths (MHz)	# of Sub-Bands (diplexers)	Waveguide Flange Type
24GHz	24.000–24.250	80/100/112		1	0.219" diameter

In most cases, there are regulations or device-based conditions that limit the use of the device, such as minimum or maximum antenna gain, 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 ExtendAir G2 24GHz Digital Microwave Radios are intended for all-outdoor mounting and designed to be used with an indoor-mounted power injector.

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, thereby eliminating any RF cabling and associated losses.

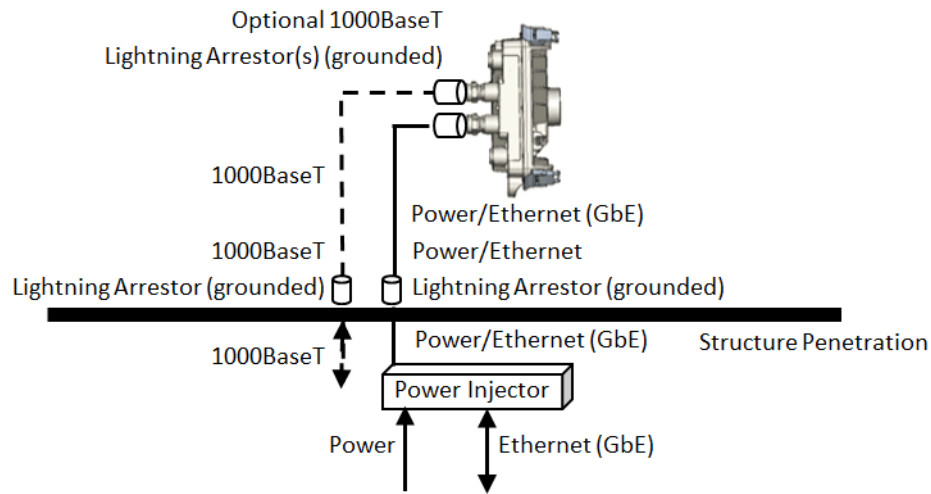


Figure 2 Cabling and surge suppression

The ExtendAir G2 24GHz radios provide connections for up to two Gigabit Ethernet data communication interfaces, and are powered by a combined Power/Ethernet cable, and associated power injector. The power injector provides 48VDC to the unit. The power injector and/or external power supply are sold separately.

The ExtendAir G2 24GHz radios 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, with field-interchangeable diplexers for low-cost sparing and easy capacity and frequency coordination
- 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. It is best to engage professional wireless engineering personnel 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 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

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 ExtendAir G2 24GHz Radios

The ExtendAir G2 24GHz radios utilize frequency division duplex (FDD) radio transmission. This means that the radio transmits on one center frequency in one direction while simultaneously receiving on a different center frequency in the opposite direction. This provides *full-duplex* configuration with equal capacity in both directions and minimal latency.

The radios are configured in Horizontal (TX-H) and Vertical pairs (TX-V), with alternate frequency settings for Transmit and Receive on the opposite ends of the link. The internal diplexers can be configured in the field (for example, to change a TX-H to a TX-V configuration) 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 11.0 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 TX-H and one TX-V—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
- Accessory kit (includes reset connector)
- Registration card
- Quick-start guide

Power solutions are sold separately. Power for the ExtendAir G2 models comply with the 802.3at Power-over-Ethernet (PoE) standard. Any 802.3at PoE device is compliant with these models.

You must mount the radio to the proper direct-mount antenna, therefore no mounting hardware is required.

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. See [Exalt Limited Hardware Warranty Software License and RMA Procedures Agreement](#).

Outdoor-rated and shielded CAT5e or CAT6 cable, such as Belden 1300A, with RJ-45 connectors is recommended for the Ethernet 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)
 - RF link connects in both directions
 - Traffic passes across the link
- Configure connected equipment and cabling
 - Test Ethernet (CAT5e) cabling, any auxiliary connector 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 easily 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 ExtendAir G2 24GHz 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 Ethernet throughput.

Use a professional link planning tool to determine optimum settings for the above parameters to meet the needs of your application.

Note the following generalizations regarding these factors:

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

Single IP Architecture

Exalt radios have a single IP architecture. The IP resides on the processor for management connectivity. If you are planning to use Out-of-Band management (see the [Ethernet Interface Configuration Page](#)), ensure that devices connected to the radio are properly configured. The management port (typically Ethernet 1) must be completely separate from the traffic (router or switch) ports. You can achieve this by using a separate switch or configuring a management-traffic specific VLAN for the radio management port.

Radio Default Configuration

Radios arrive from manufacture in default configuration configured as shown in Table 2.

Table 2 Factory default settings

Parameter	ExtendAir G2 24GHz
Frequency	Lowest frequency pair supported by software-configured diplexer
Transmit Power	-25 dBm or lowest power supported by frequency band
Bandwidth	Minimum value supported by model
Mode (modulation)	Minimum modulation supported by model (typically QPSK)
Link Security Key	000000000000
Administration Password	password
User Password	password
IP Address	10.0.0.1 (for TX-H); 10.0.0.2 (for TX-V)
IP Mask	255.0.0.0
IP Gateway	0.0.0.0
Ethernet Interfaces	Alarm Enabled, Auto-negotiate



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 steps particular to your radio model to perform a critical parameter reset.

The following configurations are reset on the radio when performing a reset:

- 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

Performing a Reset

To perform a radio reset, you must have a mechanism to connect the radio's RSL/BNC port between the center pin and the shield to provide a "short" between the two conductors. Common methods for this are:

- Using the BNC termination provided in the radio accessory kit.
- Using a standard voltmeter BNC cable, attach a jumper clip to the voltmeter end to short the two conductors.
- Using a BNC male connector assembly, connect or solder a wire or jumper to short the center pin and outer shield.

Once the RSL/BNC port shorting mechanism solution is identified, follow this procedure:

- 1 Remove the power source, preferably at the AC or PoE DC input.
- 2 Remove the RSL/BNC port cover on the radio.
- 3 Install the RSL/BNC port shorting mechanism chosen above.
- 4 Apply power.
- 5 Wait until the internal beeper sounds (approximately 1 minute). You can verify the reset by pinging the 10.0.0.1 default IP address.
- 6 Remove the RSL/BNC port shorting mechanism.
- 7 Replace the RSL/BNC port cover.

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/PoE 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 SSH 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. SNMPv1 and SNMPv2 are also supported.



Note: MIB files downloadable from the radio are listed on the [File Transfer Page](#). You can also find MIB files for your radio on exaltcom.com. MIBs for Exalt radios are model specific.

System Installation and Initiation Process

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

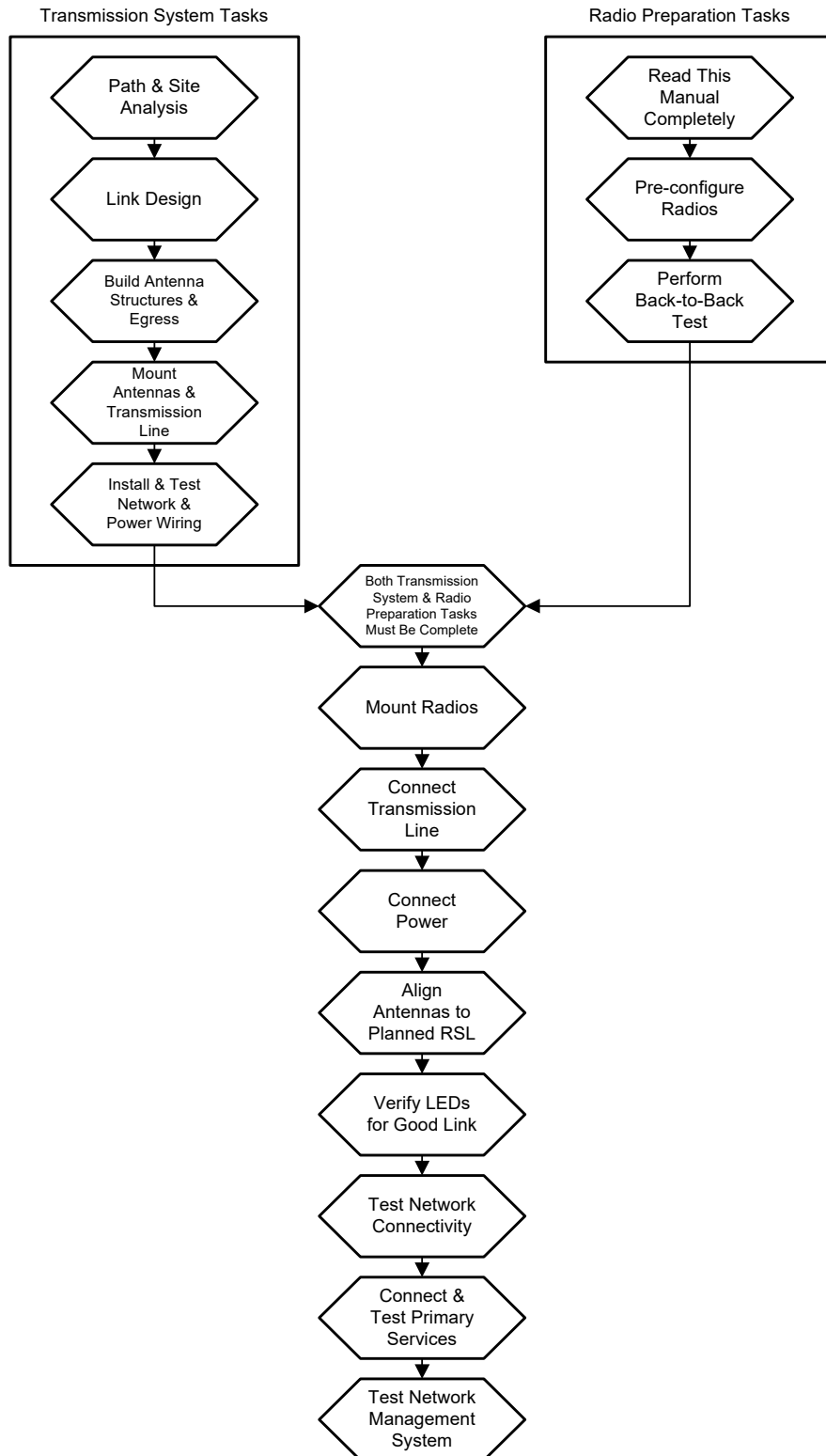


Figure 3 Radio installation tasks

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
- 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 ExtendAir G2 24GHz 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.



Note: Unless otherwise specified by the manufacturer, 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

You must mount this radio directly to the antenna. The antenna must be the proper type for this to be accomplished (see [Antennas](#)).

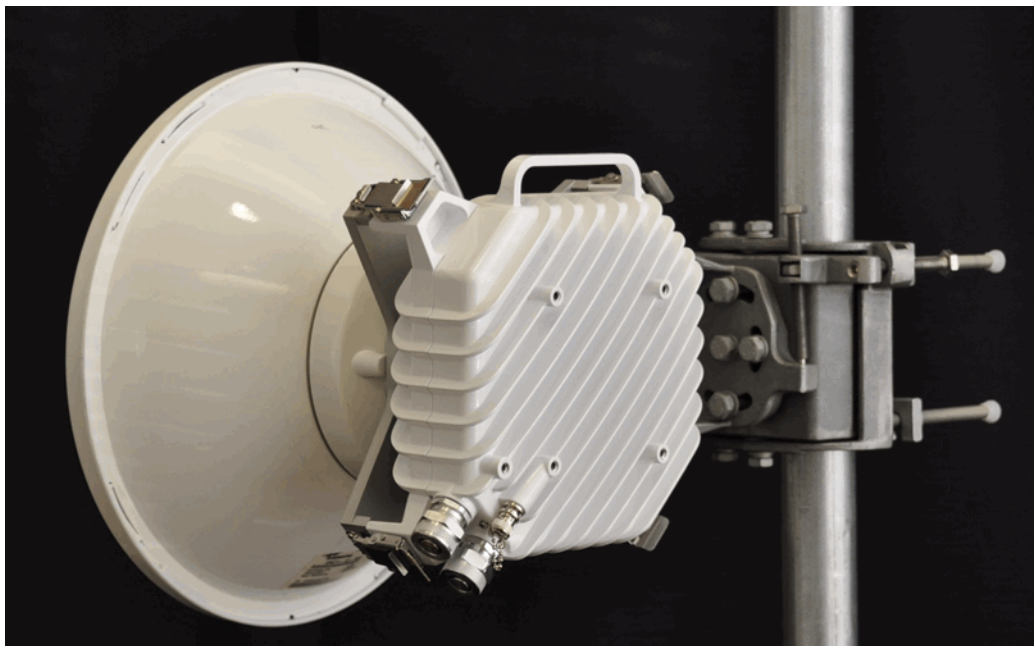


Figure 4 Direct-mount configuration

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.



Note: You must mount the ExtendAir G2 24GHz with the handle facing up (Figure 4). The system utilizes both polarizations of the antenna to achieve the full duplex link and cannot operate properly if the radios are oriented in any other manner.

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

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

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 5 shows the connectors on the ExtendAir G2 24GHz radios.

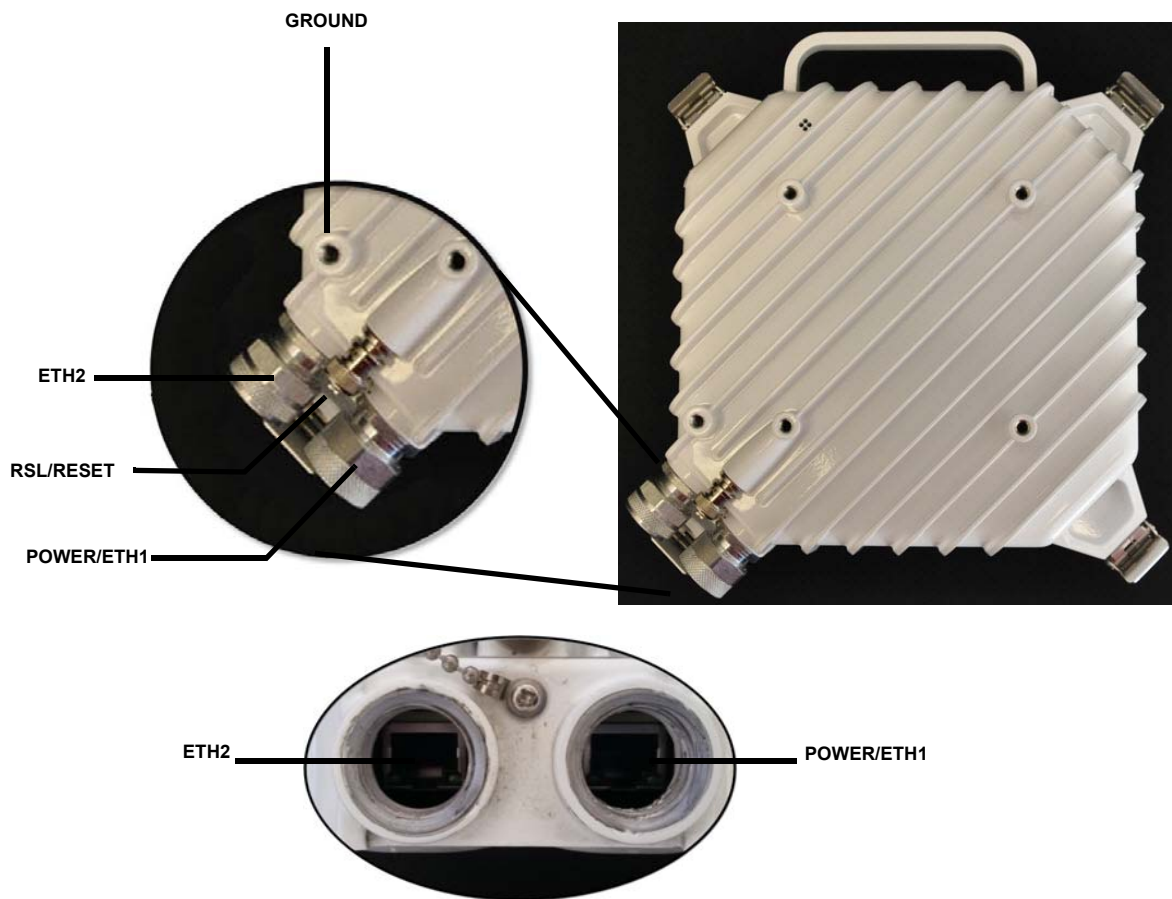


Figure 5 ExtendAir connectors

Connector Overview

The primary user interfaces are shown in Figure 5. [Table 3](#) provides details of the front panel connectors. Detailed pin structures for each connector are in [Interface Connections](#).

Table 3 Connectors

Connector	Description
RSL (BNC female)	Antenna alignment RSL voltage (during installation) Used for radio reset
Power/ETH1	Connected cables traverse to the power injector (Data+Power side), and provide the following functions: <ul style="list-style-type: none"> • Primary ports for user Ethernet data to traverse link (10/100/1000 BaseT) • DC power from power injector
ETH2	Port for an additional Ethernet connection; management and/or traffic.
⬇️ (Ground)	Threaded (M6) receptacle.



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

LED Indicators

Figure 6 shows the LED locations for the ETH connectors relative to the RJ-45 release tab.

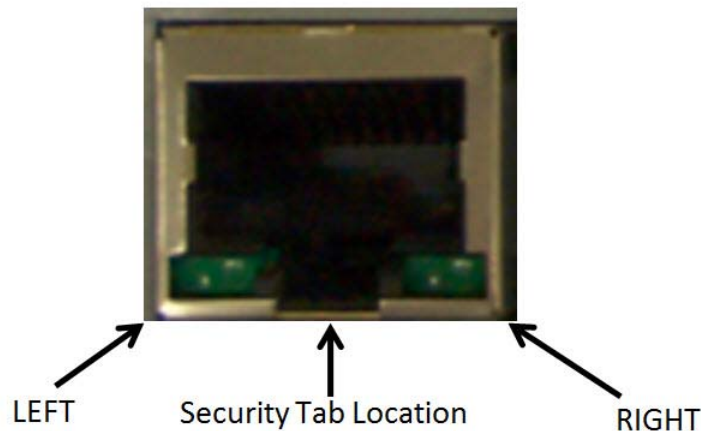


Figure 6 RJ-45 LED orientation

Table 4 provides details of the LED indicators on the ExtendAir G2 24GHz 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.

Table 4 LED indicators

Location/Label	Type	Function
ETH2 (LEFT)	Green LED	Solid = Ethernet link present.
ETH2 (RIGHT)	Green LED	Flash = Ethernet link present.
ETH1 (LEFT)	Green LED	Flash = Ethernet link present.

Table 4 LED indicators (Continued)

Location/Label	Type	Function
ETH1 (RIGHT)	Green LED	Solid = Ethernet link present.

Power

The radio requires a DC power source within specifications via a power-over-Ethernet (PoE) power injector (sold separately). Most PoE injectors take a DC voltage source input or use an AC adapter, or may be integral to a network switch or router.



Note: All injectors used with this product must be 802.3at compliant.

Read this section completely before applying power.

As an alternative to an off-the-shelf 802.3at injector, Exalt provides modular PoE solutions, including a multi-injector rack mount solution, that can properly power the ExtendAir G2 radio. These modular injectors (models A300505, A300501, and A300502) provide proper power to the radio, but the RESET button on these models does not reset the ExtendAir G2 24GHz radio. Pressing the RESET button has no effect on the radio and causes no harm.

Applying Power

Do not plug the injector into the main power source first. First, verify that the RF connector is properly terminated (see [Power](#)), and then plug in the radio-side connector from the injector to the radio. If the power source can be turned off using a switch, disable the power, plug the power supply side of the injector into the power source, and then enable power to the circuit. If the power source cannot be turned off, plug in to the power input side of the injector to apply power.



Do not apply power using a live RJ45 connector. Connect all RJ45 connectors first, and then apply power.

Exalt strongly recommends that the power supplies 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 power source is subject to significant spikes or variation, power conditioning is a worthwhile investment, as the quality of the power source 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 injector.

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 injector and the radio. Ensure that every connection to the device is wired in this manner.

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.

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. Surge protection for the radio protection is highly recommended in areas with any opportunity of lightning. Connect the surge protection using a CAT5e or CAT6 cable no longer than 6'/1m. Ensure that the surge protection device is properly grounded.



Note: Surge protection is not guaranteed to protect the radio equipment for high surges or direct lightning strikes.

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

Use the previously mentioned short CAT5e or CAT6 cable for the 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 RJ45 termination for the connection from the egress arrestor and power injector. The cabling between the radio, through all arrestors, and to the power injector must follow a straight-wired convention, maintaining standard Ethernet pairing.



Note: Use only outdoor-rated UV-resistant CAT5e or CAT6 cable. The cable that directly connects to the radio 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.

Diplexer (Channel Plan) Configuration

The ExtendAir G2 24GHz radio has a unique feature that allows field reconfiguration of the TX-H or TX-V Tx/Rx orientation. This allows a single spare unit for both TX-H and TX-V configurations.



CAUTION! Removal of the 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 Software License and RMA Procedures Agreement](#) may be void if damage to the radio occurs as a result of improper installation.

The transmitter (Tx) and receiver (Rx) tuning is determined by the ID number on the diplexer:

- ID #871 indicates that the Tx diplexer is in the horizontal orientation (customer part number E24F732-H).
- ID #872 indicates that the Tx diplexer is in the vertical orientation (customer part number E24F732-V).

Diplexer Flip Kit

The diplexer labels aid in determining configuration. With the radio handle at the top, diplexer ID #871 Tx/Rx port labels read normally. These labels read upside down for diplexer ID #872.



Note: These diplexers have the same frequency range.

- The **Port** label indicates the frequency range of the corresponding port (on the underside of the diplexer). One side is Tx and the other is Rx, depending on how it mounts to the radio.
- This label also displays the ID number to select on the [System Configuration Page](#).



Note: Since the diplexer cannot be seen without removing the front cover, it is critical that you change the external labeling if you change the diplexer. Labels are provided in the Diplexer Flip Kit.

To change the diplexer configuration:

- 1 On the antenna-mounting side of the radio chassis, use a 5mm Hex wrench to remove the four (4) chassis cover screws shown in the following photo.



- 2 Use a forceful back-and-forth motion to pivot the two halves of the chassis against each other until they separate.

Note that the gasket on the center nozzle of the RF section is a tight fit.



CAUTION! Do not place any object between the seams of the chassis to assist with separation—this will damage the outer diameter gasket.

The picture above shows the radio with the handle at the top. Use this orientation to determine diplexer orientation.

- 3 Use a 0.5mm hex wrench to remove the eight (8) screws shown below on the diplexer housing.



With the handle up, the labels on the diplexer housing indicate the Tx frequency (on the left side).



- 4 Turn the diplexer 180° or exchange the diplexer.
- 5 Re-mount the properly oriented assembly and secure it to the chassis using the eight (8) hex screws removed in Step 3.
- 6 Place a thin layer of silicone lubricant (provided) on the outer edge of the diplexer O-ring gasket.
- 7 Replace the cover and secure the four (4) Hex screws on the radio chassis,



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

8 Place new labeling on the radio chassis, as necessary.



Note: The chassis must have the right labels. You must also set the diplexer ID number on the [System Configuration Page](#).

Antenna/Transmission System

This section provides guidance to mounting and connecting the RF transmission system, which consists of the antenna, RF cabling, and RF lightning arrestors. 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 transmission line to the antenna connector as early in the process as possible, to reduce the opportunity for debris or moisture to enter either the antenna connector or the transmission line

connector. Use a connector cover or other temporary measures to ensure that the connector is kept clear. 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.

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 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 -60 dBm yields an RSL voltage measurement of 0.60VDC; an RSL of -45 dBm 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.

- 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 hand-held 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 for a Telnet session over a network connection.

SSH or Telnet into the Command Line Interface (CLI)

Use an SSH or 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 SSH or Telnet Session

Make the SSH or Telnet connection to the radio through the Ethernet 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-H radio or after default reset). **10.0.0.2** is the IP address for a new (from factory) TX-V radio.



Note: The accessing computer must be on the same IP subnet as the radio. The radio has a DHCP server (enabled by default). If the connecting computer is set to obtain its IP parameters from DHCP, the radio configures the accessing computer to 10.0.0.3 or 10.0.0.4. 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 changed to prevent unauthorized access.

Figure 7 shows the menu choices available after log in.

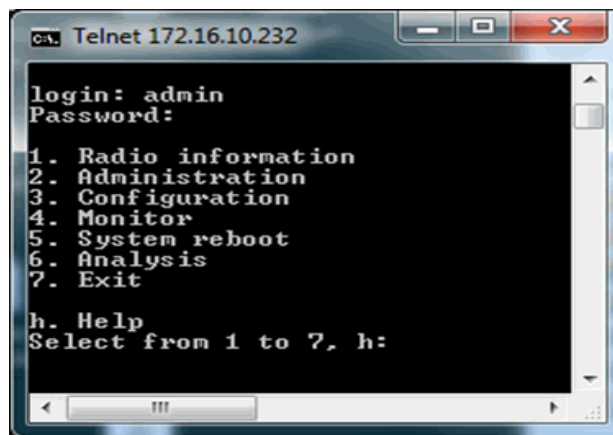


Figure 7 CLI root menu

The following selections can be made on all screens:

- 0 = back to previous screen
- h = 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. Google Chrome is the preferred browser. Netscape, Mozilla, Microsoft Internet Explorer, 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 Hi/Lo 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 [Radio Reset](#)).
- 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).

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.

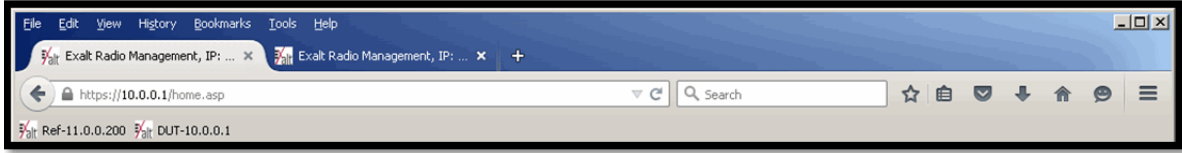


Figure 8 Initiating the browser connection

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



Figure 9 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 5 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.

The screenshot shows the Exalt web interface. At the top, it displays 'ExtendAir G2 Link' with local and remote radio information: Local 10.0.0.1 Radio A and Remote 11.0.0.200 Radio B. The Exalt logo is prominently displayed. A navigation menu on the left includes options like Radio Information, Administration, Configuration, Monitor, Analysis, Terms of Use, Reboot, Manual, and Logout. The main content area is titled 'Radio Information' and contains a table with the following data:

Model Name	ExtendAir G2 rc24020
Model Number	E24E732
Part Number	000000-000
Serial Number	PE47135599
Interface Type	2 x 10/100/1000BaseT
License Features	AES256, Max Capacity 360 Mbps
Boot Version	U-Boot 1.0.6.2 (Mar 26 2014)
Firmware Version	1.4.0 (Build #5, May 25 2015 - 13:04:02)
RF Transmit range	24.000 GHz to 24.250 GHz
RF Receive range	24.000 GHz to 24.250 GHz
Tx Band	TX High
Hardware ID number	b1e8211d1832e6cd
Support E-mail	support@exalt.com
Support Phone Number	Direct Dial: +1-408-740-3622 USA Toll-Free: +1-844-392-5801 (1-844-EXALT01)

Below the table, there is a disclaimer: 'Use of this product is subject to the terms of use and conditions of applicable end user and third party software license agreements accepted by or on behalf of the end-user.' with links to 'EULA' and 'Third party license agreement'.

Figure 10 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 that runs across the seam of the two halves of the chassis is missing or broken, the internal diplexer may have been adjusted since shipment. Check the label affixed to the chassis 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, disassemble the radio to inspect the orientation of the installed diplexer to ascertain the installed configuration. See [Diplexer \(Channel Plan\) 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](#))
- Modulation ([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, as shown in Figure 11:

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

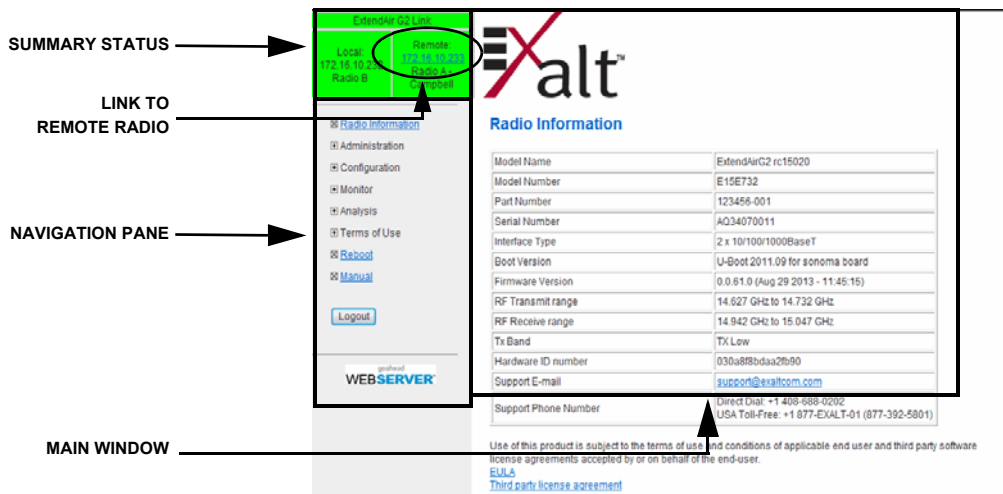


Figure 11 Exalt GUI window description

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 12, 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.

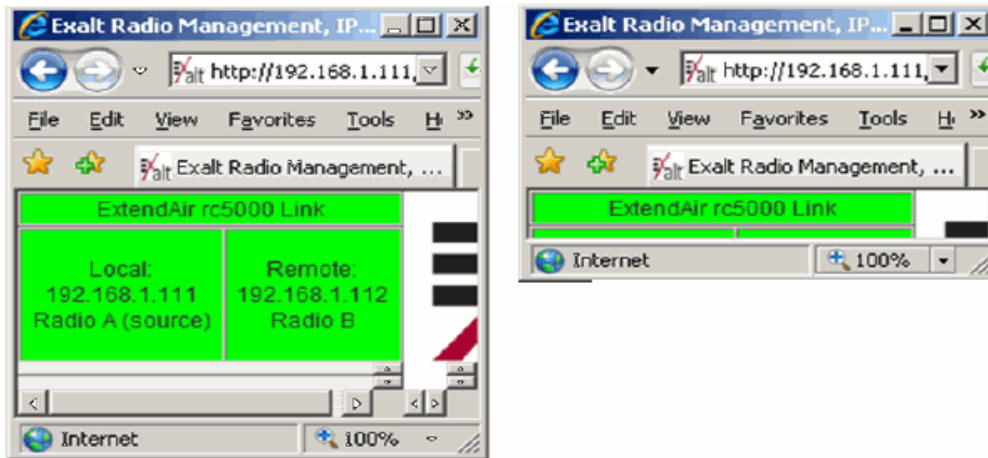


Figure 12 Summary status information

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 record keeping.

ExtendAir G2 Link

Local 10.0.0.1 Radio A	Remote 11.0.0.200 Radio B
------------------------------	---------------------------------

Exalt™

Radio Information

Model Name	ExtendAir G2 rc24020
Model Number	E24E732
Part Number	000000-000
Serial Number	PE47135599
Interface Type	2 x 10/100/1000BaseT
License Features	AES256, Max Capacity 360 Mbps
Boot Version	U-Boot 1.0.6.2 (Mar 26 2014)
Firmware Version	1.4.0 (Build #5, May 25 2015 - 13:04:02)
RF Transmit range	24.000 GHz to 24.250 GHz
RF Receive range	24.000 GHz to 24.250 GHz
Tx Band	TX High
Hardware ID number	b1e8211d1832e6cd
Support E-mail	support@exalt.com
Support Phone Number	Direct Dial: +1-408-740-3622 USA Toll-Free: +1-844-392-5801 (1-844-EXALT01)

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[EULA](#)
[Third party license agreement](#)

Figure 13 Radio Information page

- 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.
- 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 Zones Configurations Page

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

The screenshot shows the 'NTP and Time Zone Configurations' page in the Exalt web interface. The page has a sidebar on the left with a navigation menu and a main content area on the right. The sidebar includes options like 'Radio Information', 'Administration', 'Settings', 'NTP & Time Zone', 'SNMP', 'File Management', 'Configuration', 'Monitor', 'Analysis', 'Terms of Use', 'Reboot', and 'Manual'. The main content area features the Exalt logo, the title 'NTP and Time Zone Configurations', and an 'Update' button. Below the title is a table with three columns: 'Current Value' and 'New Value'. The table contains the following data:

	Current Value	New Value
NTP Client	Disable	Disable
NTP Server IP Address 1	64.147.116.229	64.147.116.229
NTP Server IP Address 2	132.163.4.101	132.163.4.101
NTP Server IP Address 3	208.66.175.36	208.66.175.36
NTP Server IP Address 4	64.90.182.55	64.90.182.55
Time Zone	UTC	(GMT) Coordinated Universal Time

Figure 15 NTP and Time Zones 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 16 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.

ExtendAir G2 24GHz 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.



Note: MIB files downloadable from the radio are listed on the [File Transfer Page](#). You can also find MIB files for your radio on exaltcom.com. MIBs for Exalt radios are model specific.

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 17).

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 designated for management 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.

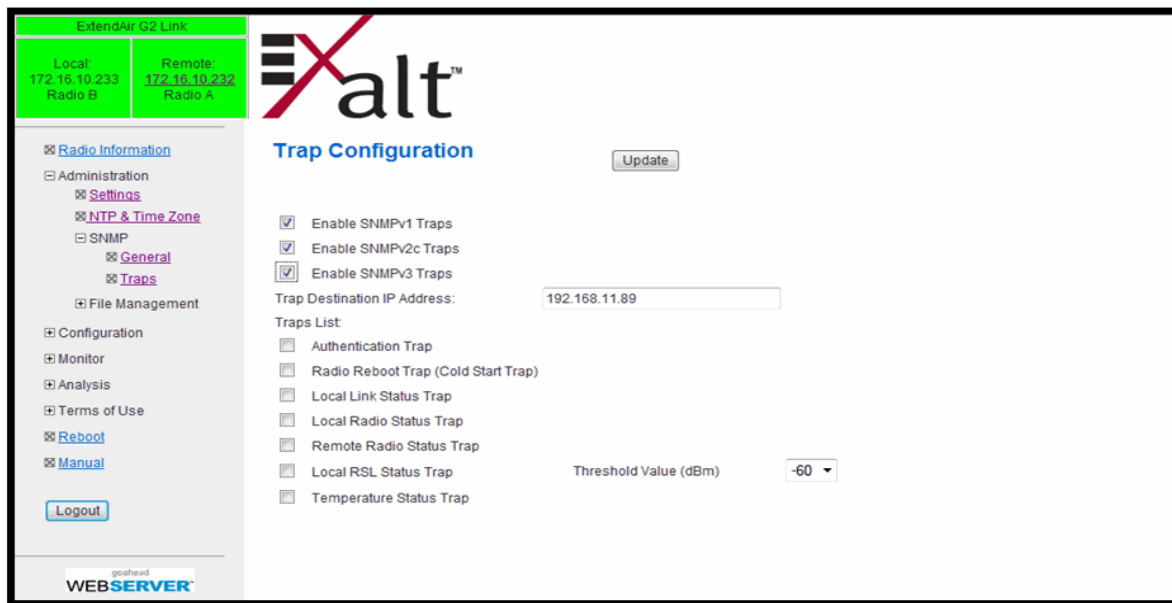


Figure 17 Trap Configuration page



Note: The **Update** button must be clicked to save any changes to this page.

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).
- **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.
- **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 if configuration changes require a 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](#)).

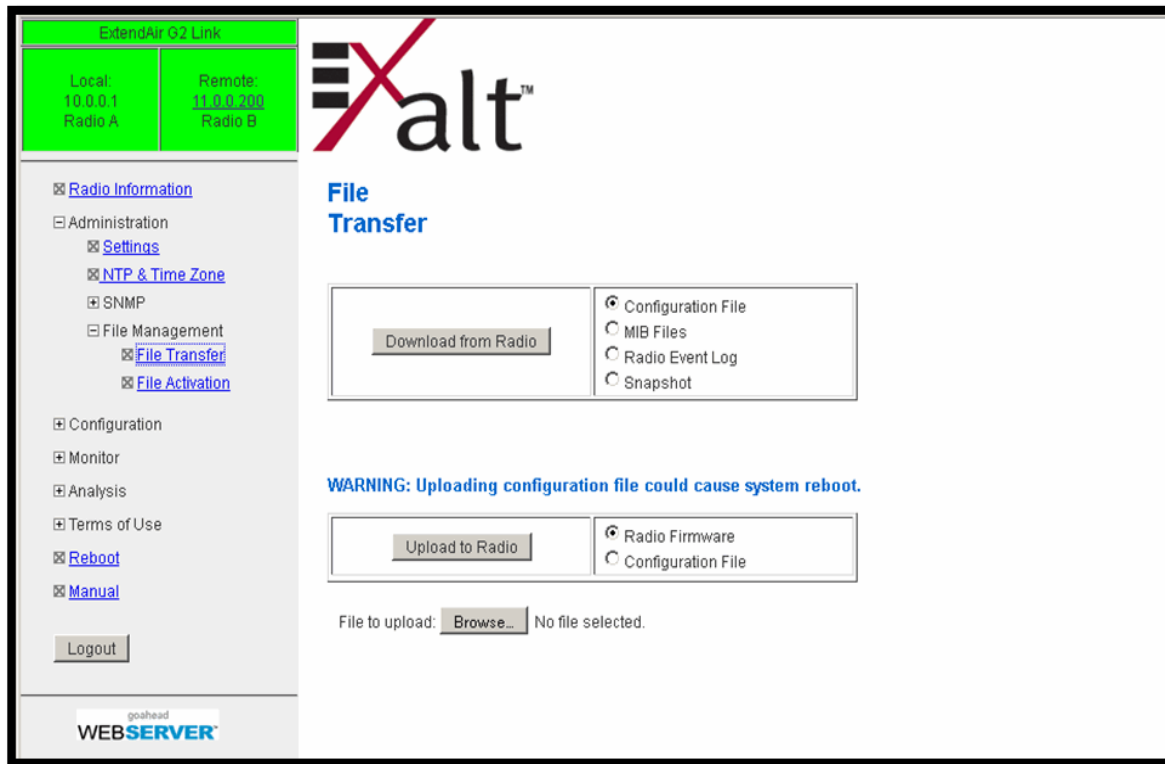


Figure 18 File Transfer page

These types of files can be downloaded: configuration, MIB, Snapshot, 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 upload a file:

- 1 Select the type of file to upload (Radio Firmware or Configuration).

- 2 Click **Browse** and choose the file to upload.

The file name being uploaded appears next to the **Choose File** button.

- 3 Click **Upload to Radio**.

The Uploading file progress bar displays (Figure 19).

File Transfer

<input type="button" value="Download from Radio"/>	<input checked="" type="radio"/> Configuration File <input type="radio"/> MIB Files <input type="radio"/> Radio Event Log <input type="radio"/> Snapshot
--	---

WARNING: Uploading configuration file could cause system reboot.

<input type="button" value="Upload to Radio"/>	<input checked="" type="radio"/> Radio Firmware <input type="radio"/> Configuration File
--	---

File to upload: ExtendAirG2...0150127.bin


Uploading file, please wait... 

Figure 19 File upload progress

Use the following steps to download a file:

- 1 Select the type of file to download (Configuration, MIB files, Event Log, or Snapshot).
- 2 Click the **Download from Radio** button and wait for the radio to prepare the file for download.
For some file downloads, a second page/link appears.



Figure 20 File Transfer page—download file link

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

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: Never 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

Consult the release notes for your release for firmware historical and upgrade paths.

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
- 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.

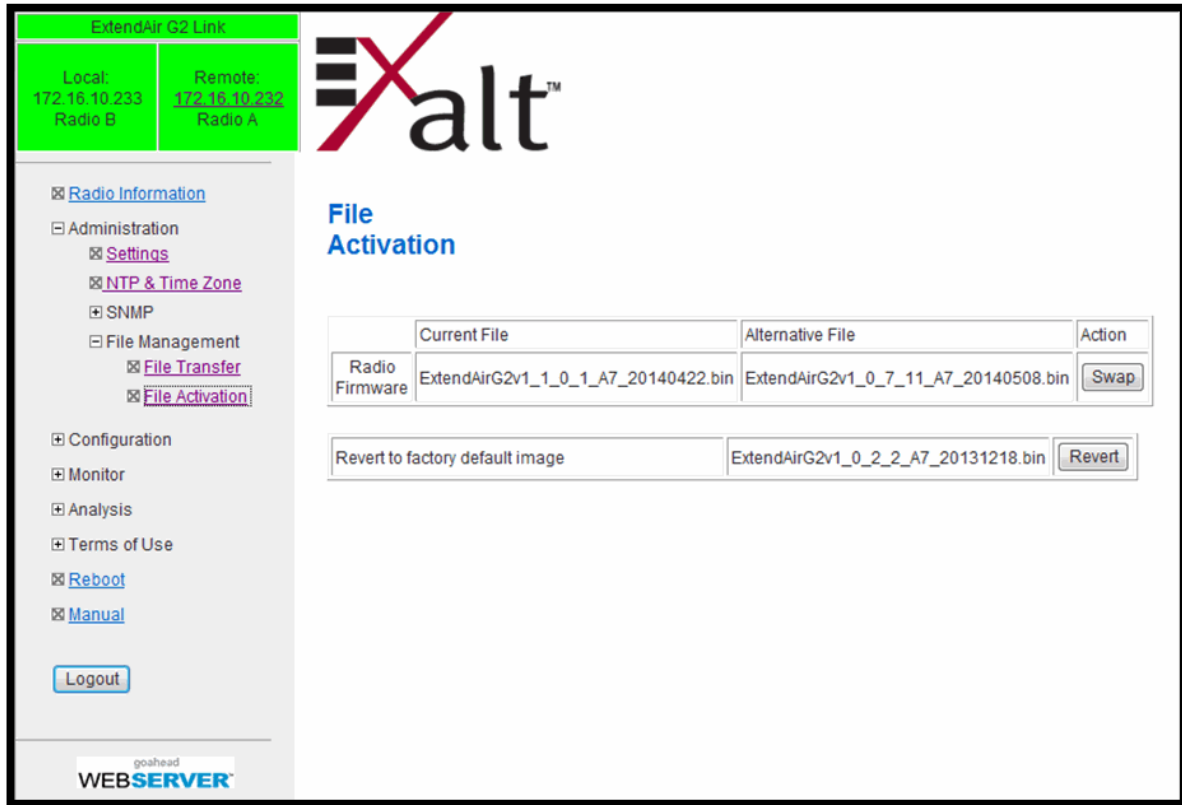


Figure 21 File Activation page

To load the original firmware that shipped with the radio, use the Revert function. Note that reverting may cause loss of some functionality, as the current firmware may support features not originally supported.



All other radio configurations are maintained. The radio does not return to factory settings, just the original factory firmware.

When reverting, the current file moves to an alternate file location and the original factory firmware becomes current. If you swap back to the original firmware and no new file has downloaded to the alternate file location, the original alternate file is restored to the alternate file location resulting in the configuration you started with before you reverted. New firmware always downloads to the alternate file location, and must be swapped to become the current firmware.



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.

The screenshot shows the 'System Configuration' page for an Exalt device. The page has a red header with 'ExtendAir G2 Link' and 'Local: 10.0.0.1 Radio B' and 'Remote: 0.0.0.0'. The Exalt logo is prominently displayed. A navigation sidebar on the left includes links for Radio Information, Administration, Configuration (with System selected), Interface, Advanced, Monitor, Analysis, Terms of Use, Reboot, and Manual, along with a Logout button. The main configuration area features an 'Update' button and a table of parameters. The table has three columns: 'Current Value' and 'New Value'. The 'New Value' column contains dropdown menus for most parameters, with some showing a list of options (e.g., 871, 872, OTHER for Diplexer/Filter Configuration). The TX and RX Frequency parameters include input fields for GHz, MHz, and kHz, along with a range in parentheses.

	Current Value	New Value
Diplexer/Filter Configuration	871	871
Radio Transmit Power (dBm)	-26	871 872 OTHER
Antenna Gain (dBi)	0	0
Calculated EIRP (dBm)	-27	-27
Bandwidth (MHz)	1.75	1.75
ACM Mode	Disable	Disable
Modulation	Mode 1 (QPSK)	Mode 1 (QPSK)
TX Frequency (MHz)	24,000.875	GHz: 24, MHz: 000, kHz: 875 (24,000.875 - 24,249.125)
TR Spacing (MHz)	80	80/100/112
RX Frequency (MHz)	24,080.875	GHz: 24, MHz: 080, kHz: 875 (24,000.875 - 24,249.125)
Buzzer Timeout (min)	off	Off
Full Duplex User Throughput	2.5 Mbps	2.5 Mbps

Figure 22 System Configuration page

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 \(Channel Plan\) Configuration](#)).



Note: The diplexer settings for both radios must match.

- 871–Use this setting for horizontally oriented diplexers.
- 872–Use this setting for vertically oriented diplexers.

These settings constrain the T/R spacing as follows:

Bandwidth	T/R
< 50 MHz	80 MHz.
= 50 MHz	100 MHz.
> 50 MHz	112 MHz.

- OTHER—Allows any T/R spacing (for example, for RF loopback support). This allows mis-setting parameters that can result in poor performance or no link. OTHER allows you to set the T/R spacing as needed to avoid interference.

Note: For optimum performance, base T/R spacings on the bandwidth in use and greater than or equal to those listed above.



For example, for any bandwidth, a T/R spacing of < 80 MHz results in degraded radio performance.

-
- Use this setting for frequency ranges not available with the diplexer ID.

Note: This setting has no validation process. You must ensure that the proper T/R spacing is maintained.



If the radio diplexer has never been changed from the manufacture configuration or the change was done following labeling directions in [Diplexer \(Channel Plan\) 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.



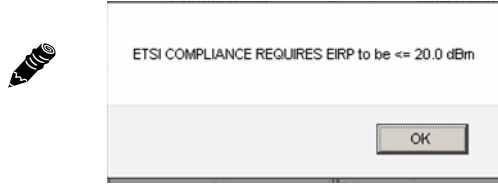
- Do not adjust the Radio Transmit Power parameter to a value higher than is legally allowed.
- Do not adjust the Radio Transmit Power parameter lower than the link budget and fade margin can afford.

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 Antenna Gain (dB) parameter to compute the Calculated EIRP (dBm).

Note: If you enter an invalid combination of Radio Transmit Power and Antenna Gain, a regulatory-specific warning appears (ETSI warning shown below) and the out-of-specs field is highlighted.



Click **OK** to change the values per regulatory requirements.

-
- The read-only Calculated EIRP (dBm) field displays the EIRP based on Radio Transmit Power and Antenna Gain (for regulatory compliance purposes).
 - Set the Bandwidth (MHz) parameter to the value 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 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 wider bandwidth has worse threshold performance and improved interference immunity, therefore if changing to a narrower 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.

-
- 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 (that is, the time-based dependence of a system's output on current and past inputs) 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.
- Set the Mode 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.

- Set the TX Frequency (GHz) parameter and Rx Frequency (GHz) parameter to the center frequencies. The frequencies must match the same pair at both ends of the link, but in opposite Tx/Rx orientation.



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.

- The Transmitter/Receiver (TR) frequency spacing is automatically determined based on the frequency settings and configured bandwidth in MHz. This is reported to verify the intended frequency settings, as a confirmation to proper input.
- 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.
- 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.

Ethernet Interface Configuration Page

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

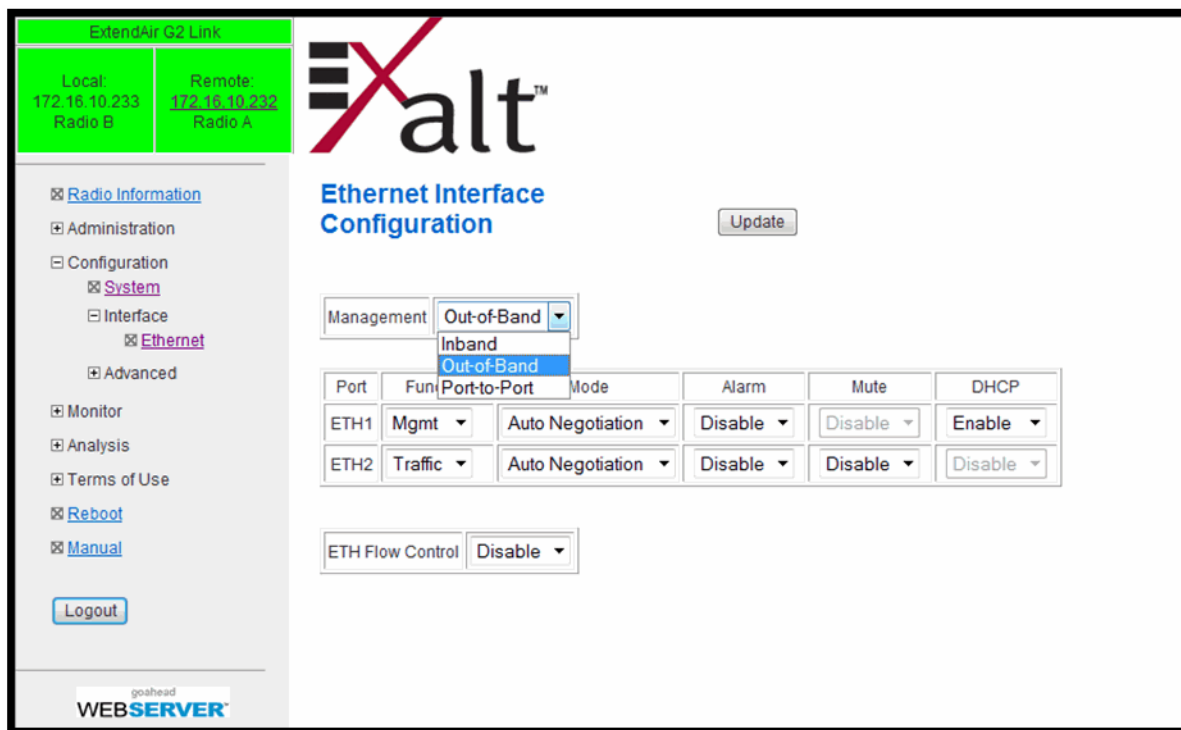


Figure 23 Ethernet Interface Configuration page

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.

The Management parameter allows determination of management information using the following management modes:

- Inband: Management traffic is carried over the air and is available from all connectors on either end of the link (Figure 24).
- Out-of-Band: Management traffic is not carried over the air and is only available from the port(s) configured for Management.



Note: The port configured for Management and the traffic ports must be logically separated by using VLANs or a separate switch (see [Single IP Architecture](#)).

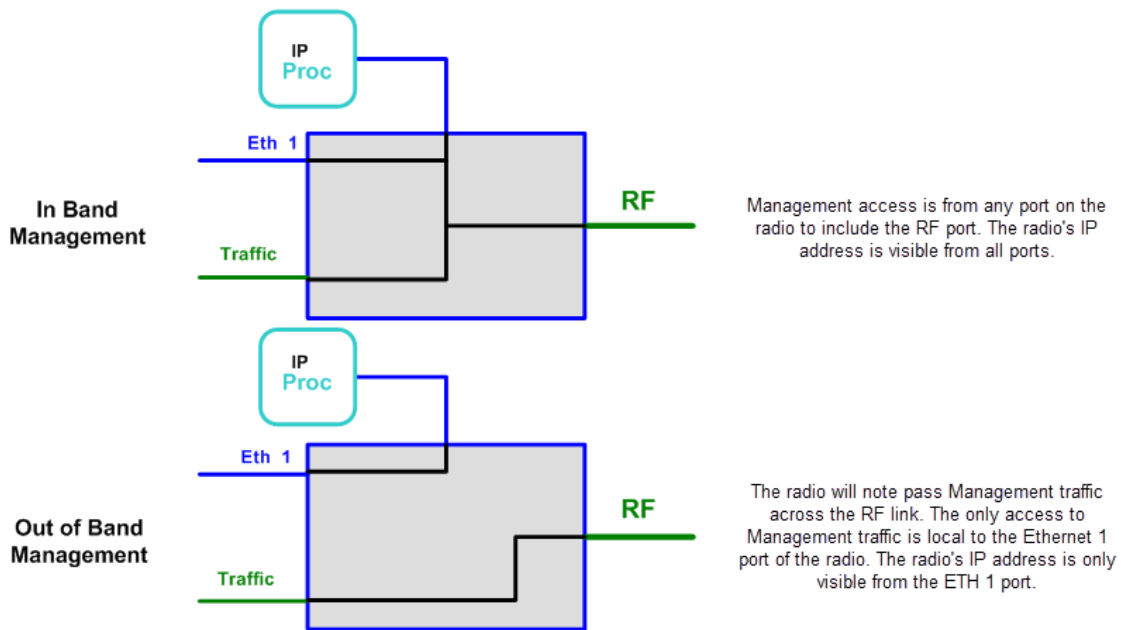


Figure 24 In-Band and Out-of-Band Management

- 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.
- The Flow Control setting allows the enabling of 802.3 Ethernet flow control. 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.
- The Alarm function can be enabled or disabled for each port. Generally, all constantly connected port alarms should be enabled, and unused or maintenance-only ports should have alarms disabled.
- The Mute setting allows signaling to connected network devices when the radio link is down such as for spanning tree protocol.
- When enabled, the DHCP feature provides a basic DHCP function to ease interfacing with a computer. DHCP is enabled by default. If the Ethernet port on the computer is set for DHCP addressing, on radio bootup (for up to 10 minutes) or when an Ethernet link is sensed for a management port, 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.

Auto-negotiation is recommended when connected to other 1000BaseT connections. It can also be hard set to match the connected network device, but in some cases, if it is set to 1000BaseT/Full, it may become impossible for the radio to communicate with a 100BaseT device.



Note: The 802.3 compliance standard requires auto-negotiation for 1000BASE-T Gigabit Ethernet over a twisted pair.

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.

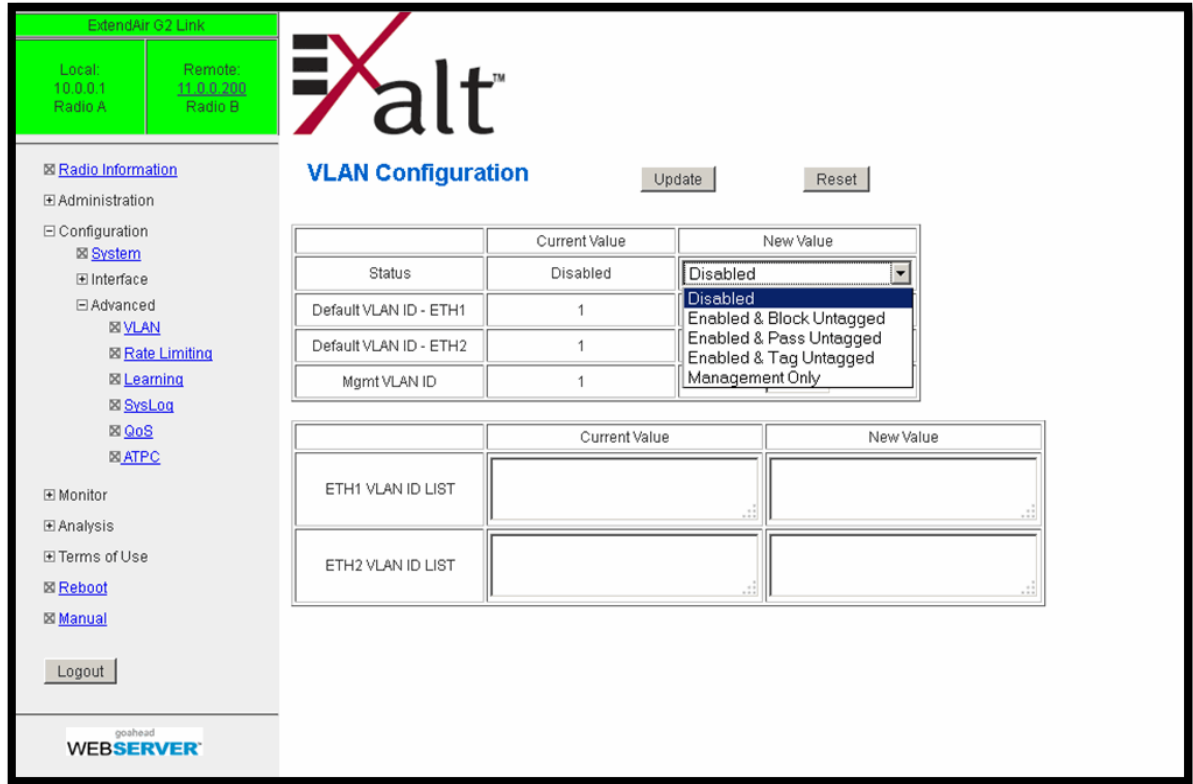


Figure 25 VLAN Configuration page



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.

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. Use the following methods to restore the management connection if a mistake was made assigning the management VLAN and access cannot be restored: Reset the radio to the critical factory defaults (see [Radio Reset](#)) and reconfigure the VLAN settings. ExtendAir G2 24GHz radios support filter lists of up to 4094 VLAN IDs.

Four VLAN configurations are provided:

- **Enabled & Block Untagged:** To pass desired VLANs across the radio, they must be listed in the lower tables per their respective interfaces. All other traffic, including untagged traffic, is not passed across the link. The radio must be managed on a VLAN whose ID is set in the upper table. This management VLAN ID is available to any interface IDs listed in this lower table.

- **Enabled & Pass Untagged:** To pass desired VLANs across the radio, they must be listed in the lower tables per their respective interfaces. All other VLAN traffic is not passed across the link, and untagged traffic is passed across the link with no changes. The radio must be managed on a VLAN whose ID is set in the upper table. This management VLAN ID is available to any interface IDs listed in this lower table.
- **Enabled & Tag Untagged:** To pass desired VLANs across the radio, they must be listed in the lower tables per their respective interfaces. All other VLAN traffic is not passed across the link, and untagged traffic is tagged with the programmed Default VLAN, per interface, as set in the upper table. Any interface requiring the default VLAN ID to pass must have the Default VLAN ID listed in the table below. The radio must be managed on a VLAN whose ID is set in the upper table. This management VLAN ID is available to any interface IDs listed in the lower table.
- **Management only:** All traffic is passed transparently, except the radio is managed on an assigned Management VLAN ID, as programmed in the upper table.

Ethernet Rate Limiting Page

This page enables radio Ethernet port rate limiting. 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.

Port	Current Value	New Value
ETH1	Disable 64 KBits	Rate Limit Options: Disable Select Rate Type: <input checked="" type="radio"/> KBit/s <input type="radio"/> MBit/s Select Rate: <input type="text"/>
ETH2	Disable 64 KBits	Rate Limit Options: Disable Select Rate Type: <input checked="" type="radio"/> KBit/s <input type="radio"/> MBit/s Select Rate: <input type="text"/>

Figure 26 Ethernet Rate Limiting page

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.

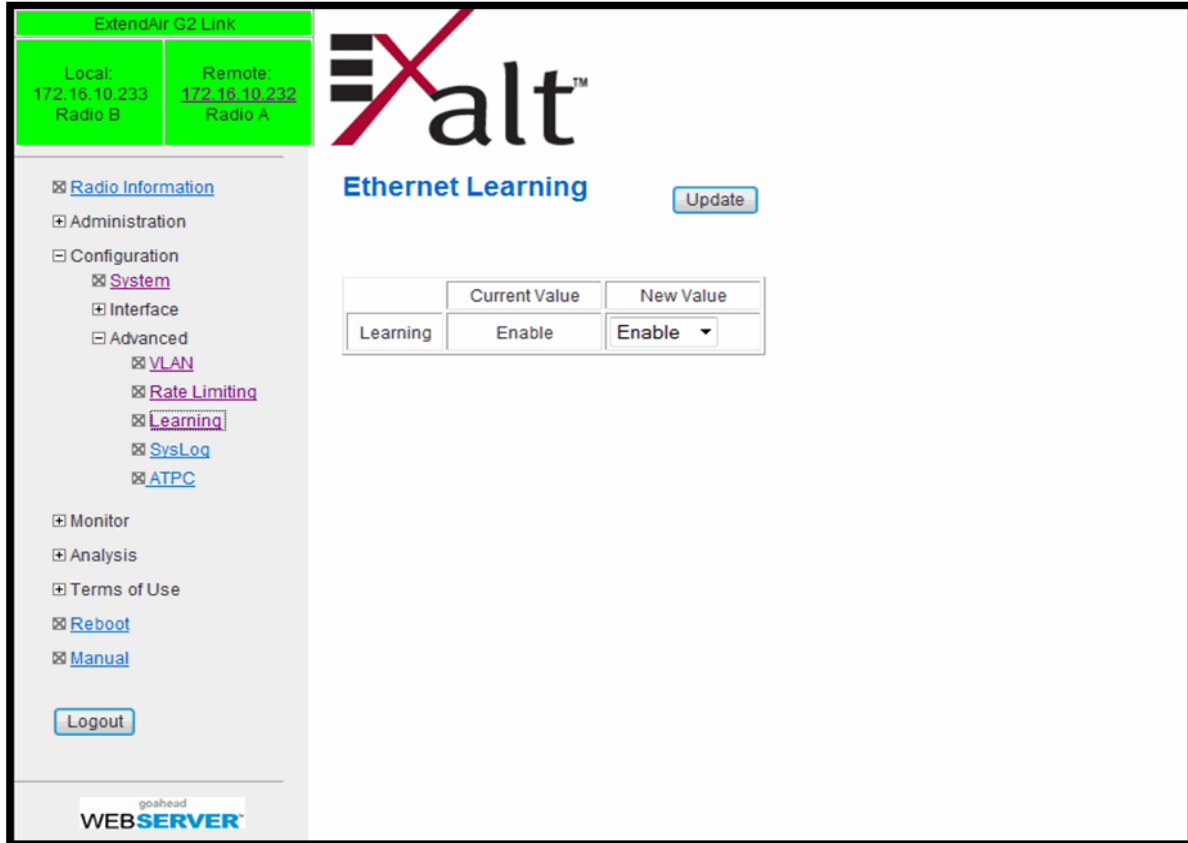


Figure 27 Ethernet Learning page

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

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

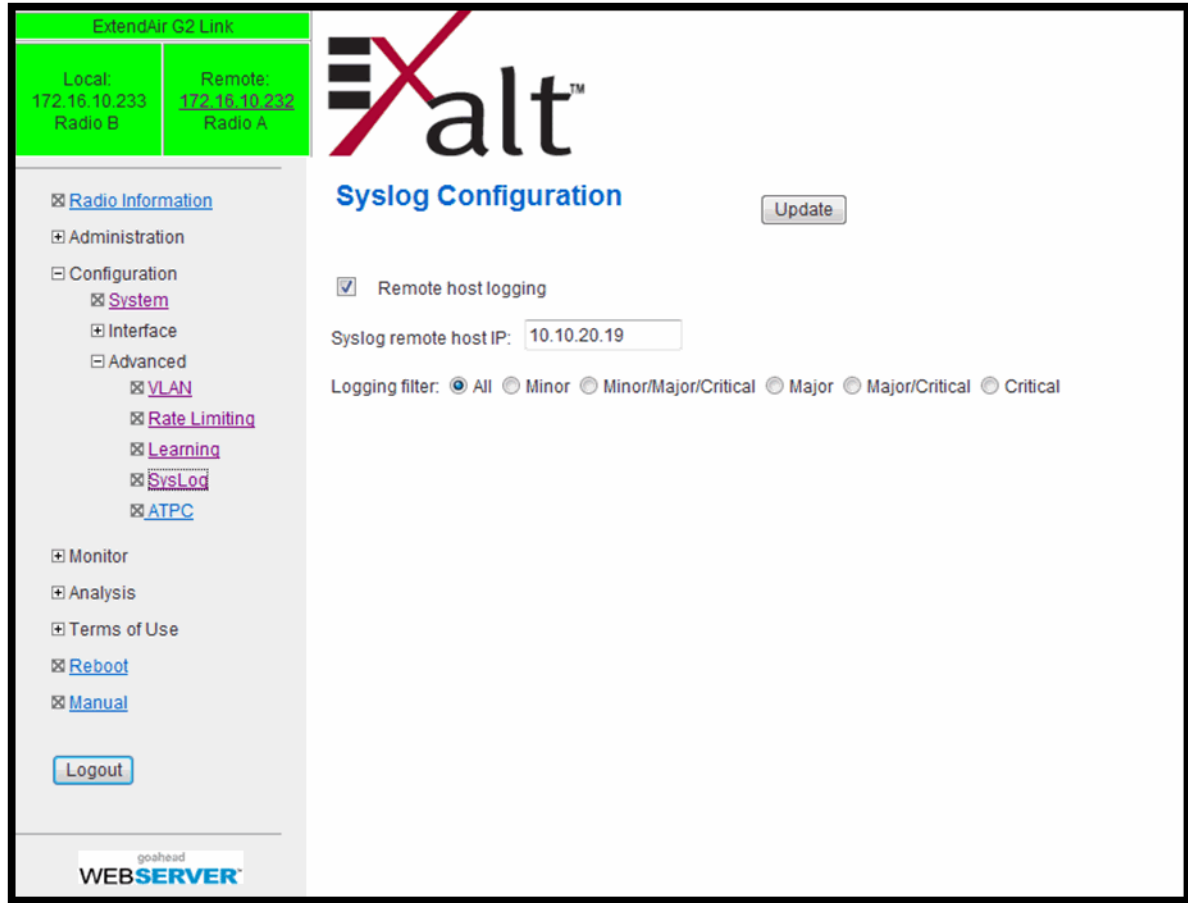


Figure 28 Syslog Configuration page

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.

ATPC Configuration Page

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.

	Current Value	New Value
Radio Transmit Power (dBm)	9	
ATPC Mode	Enable	<input type="radio"/> Disable <input checked="" type="radio"/> Enable
ATPC RSL Threshold (dBm)	-55.0	<input type="text"/>
ATPC Max TX Power (dBm)	20.0	<input type="text"/>
ATPC Timer Control	Enable	<input type="radio"/> Disable <input checked="" type="radio"/> Enable
Overload Protection	Enable	<input type="radio"/> Disable <input checked="" type="radio"/> Enable
Overload Protection RSL Threshold (dBm)	-38.0	<input type="text"/>
RSL High Watermark Event Trigger (dBm)	-36.0	<input type="text"/>

Figure 29 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 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.

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.

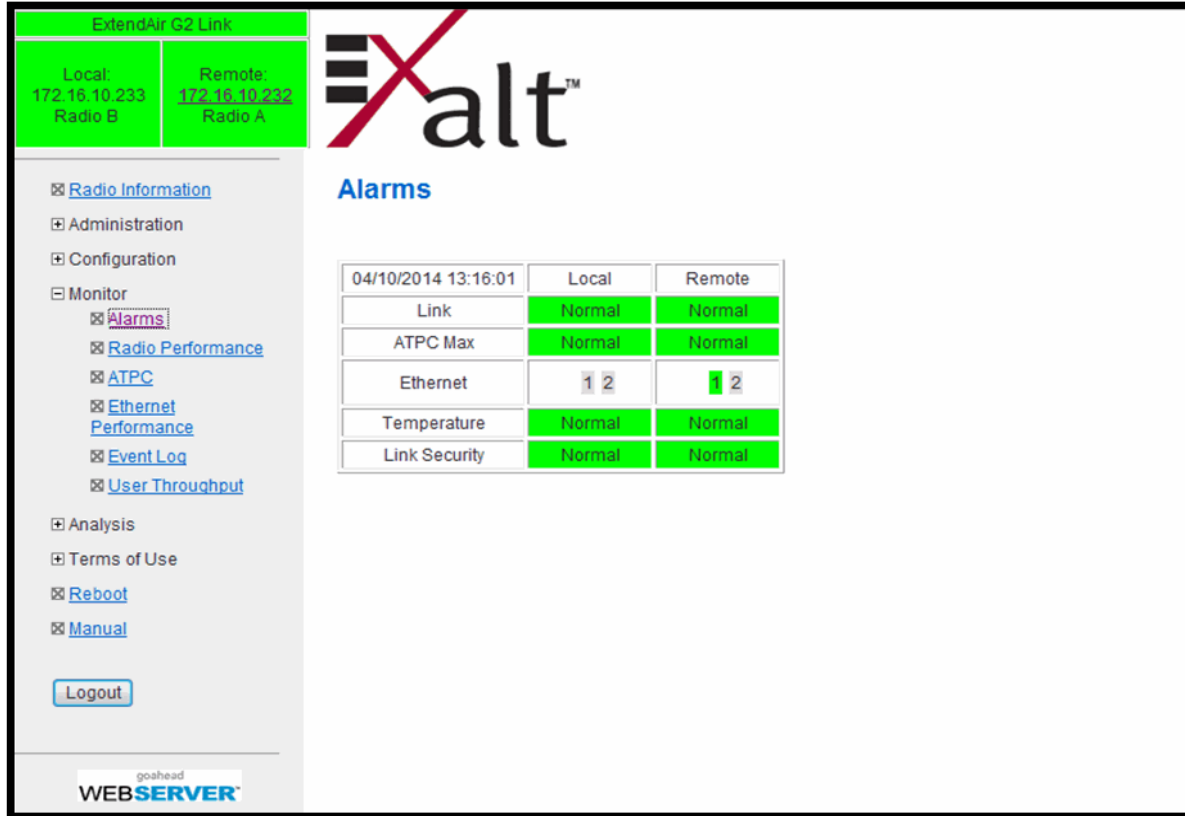


Figure 30 Alarms page

Table 6 lists alarm status conditions that appear on this page.

Table 6 Alarm status indicators

Label	Status
Link	Indicates RF link status: <ul style="list-style-type: none"> Green Solid = Error-free connection (BER<10e-6) Yellow Solid = Errored connection (10e-3>BER >10e-6) Red Solid = No link (BER>10e-3)
ATPC Max	(ATPC enabled) Indicates Automatic Transmitter Power Control maximum range status: <ul style="list-style-type: none"> 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
Ethernet	<ul style="list-style-type: none"> Green Solid = Alarm enabled and Ethernet link present Red = Alarm enabled and Ethernet link not present Grey = Alarm disabled

Table 6 Alarm status indicators (Continued)

Label	Status
Temperature	<ul style="list-style-type: none">• Green Solid = Normal temperature range• Yellow Solid = Exceeding normal temperature range <p>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 in service. In almost all cases, a temperature alarm is due to external causes.</p>
Link Security	<ul style="list-style-type: none">• Green = Security keys match• Red = Security keys do not match• Grey = Link is down

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.

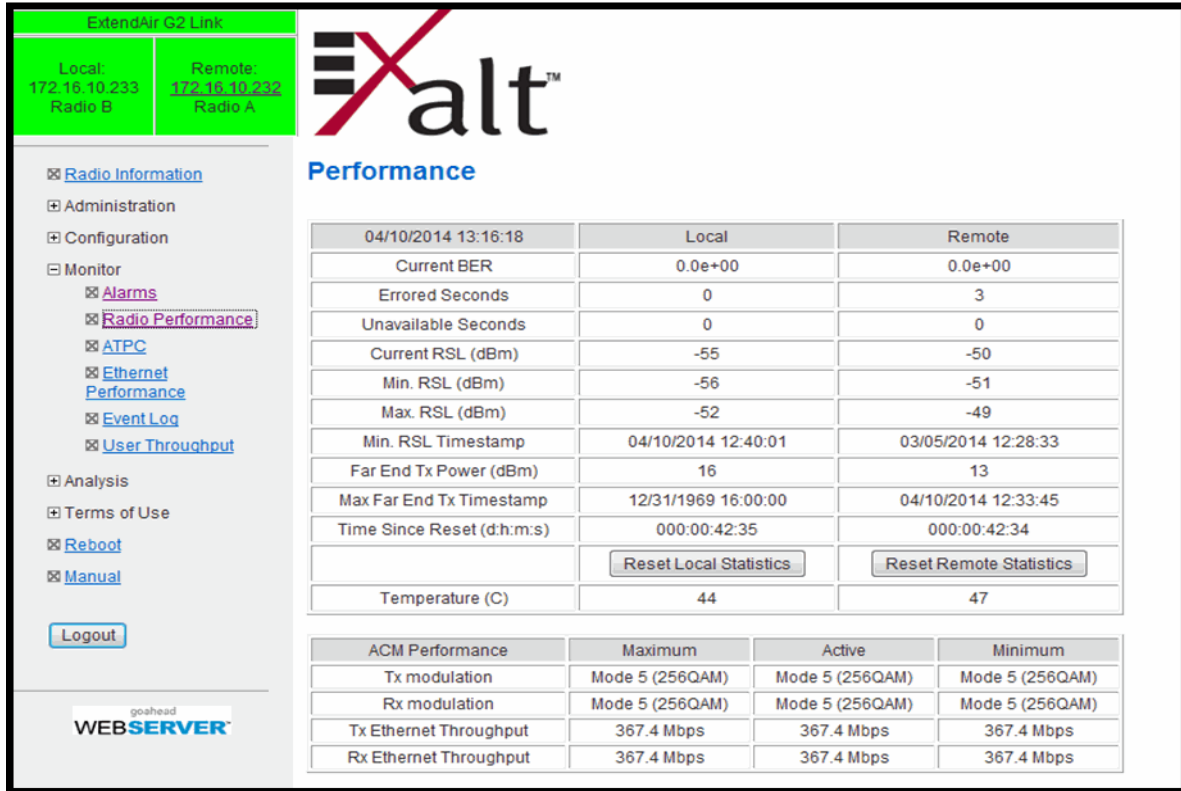


Figure 31 Radio Performance page

- 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 1×10^{-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 1×10^{-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. However, 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.

- 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 1×10^{-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.
- 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.
- 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.
- 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.
- 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 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.
- 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.

ATPC Statistics Page

Timers on this page provide 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).

ExtendAir G2 Link

Local 10.0.0.1 Radio A	Remote 11.0.0.200 Radio B
------------------------------	---------------------------------

alt™

ATPC Statistics

Current Time	06/04/2015 16:41:22
Elapsed Time at Max Power (d:h:m:s)	000:00:00:00
Elapsed Time ATPC Active (d:h:m:s)	000:00:00:00
Time Since Reset (d:h:m:s)	000:00:00:38

Near End Receiver Status:

ATPC RSL Threshold	-90.0 dBm
Overload Protection RSL Threshold	-35 dBm
Current RSL	-40.7 dBm

Far End Transmit Status:

Radio Transmit Power	-15.0 dBm
Current Transmit Power	-14.7 dBm
ATPC Max TX Power	0.0 dBm

Far End Receiver Status:

ATPC RSL Threshold	-90.0 dBm
Overload Protection RSL Threshold	-35 dBm
Current RSL	-39.2 dBm

Near End Transmit Status:

Radio Transmit Power	-15 dBm
Current Transmit Power	-15.0 dBm
ATPC Max TX Power	0.0 dBm

Figure 32 ATPC Statistics page

Ethernet Performance Page

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

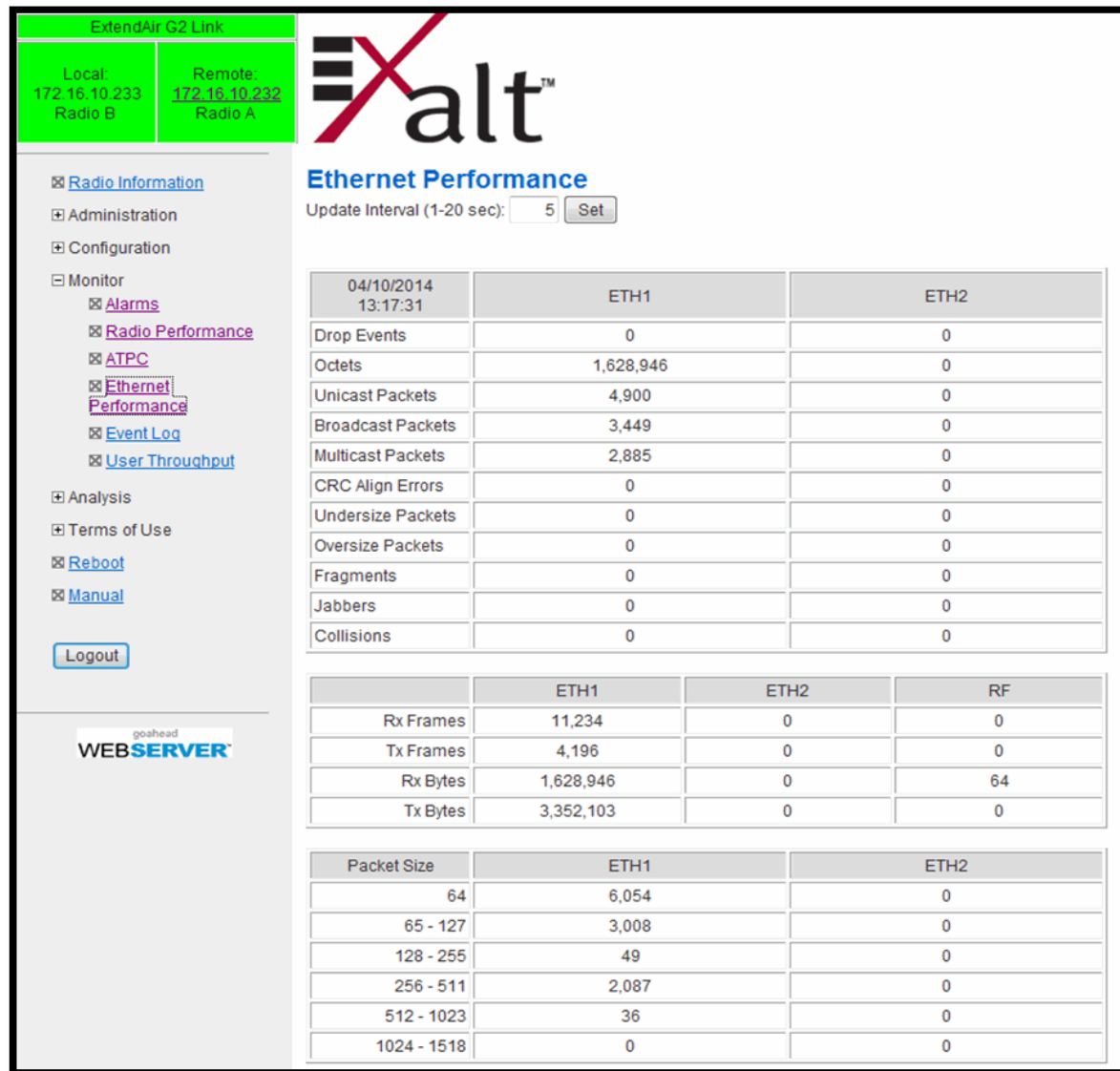


Figure 33 Ethernet Performance page

- The Update Interval field accepts entries from 1–20 sec.
- Drop Events field indicates the total number of packets dropped due to traffic exceeding Radio RF capacity.
- Octets
- Total Transmitted Packets fields indicate the total number of (Unicast, Broadcast, or Multicast) packets from the radio out toward the user equipment.
- CRC Align Errors indicates
- Undersize/Oversize Packets fields indicates the number of these packets received.

- Fragments
- Jabbers
- Collisions

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



Note: You must configure an NTP server or provide a timing source for the Event log to capture event time.

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 (first-in, first-out) 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). To maintain a record, copy and paste the log into a text file or take a screen capture of the browser window.

ID	Date/Time	Description	Severity	Status
668	4/10/2014 12:34:19	ATPC Max Range reached	Minor	Normal
667	4/10/2014 12:34:18	ATPC RSL Threshold reached	Minor	Alarm
666	4/10/2014 12:34: 5	ATPC RSL Threshold reached	Minor	Normal
665	4/10/2014 12:34: 5	ATPC Threshold changed to -55	Info	
664	4/10/2014 12:33:43	Reset statistics on local end	Info	
663	4/10/2014 12:33:29	Local channel RSL normal (-52 dBm) alarm	Info	Normal
662	4/10/2014 12:33:29	ATPC inactive	Minor	Normal
661	4/10/2014 12:33:25	ATPC RSL Threshold reached	Minor	Alarm
660	4/10/2014 12:33:25	ATPC Max Range reached	Minor	Alarm
659	4/10/2014 12:33:25	ATPC activated	Minor	Alarm
658	4/10/2014 12:33:23	RSL High Watermark Event Trigger Level changed to -36 dBm	Info	
657	4/10/2014 12:33:23	Overload Protection RSL changed to -38 dBm	Info	

Figure 34 Event Log page

User Throughput Page

This page illustrates the user throughput of the radio, as configured. This value is calculated based on the current configuration, not on a specific setting or the measured current throughput.

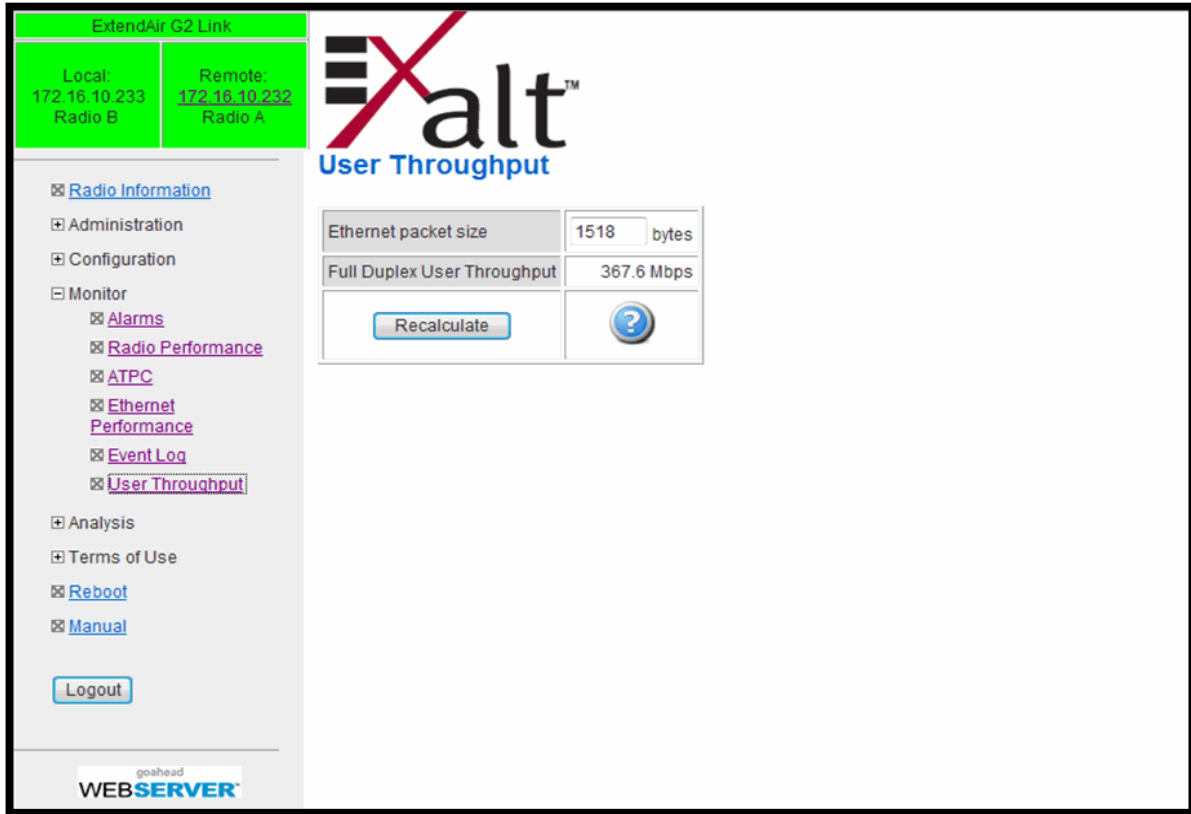



Figure 35 User Throughput page

Click the help icon () to go to the page on how this information is determined (Figure 36).

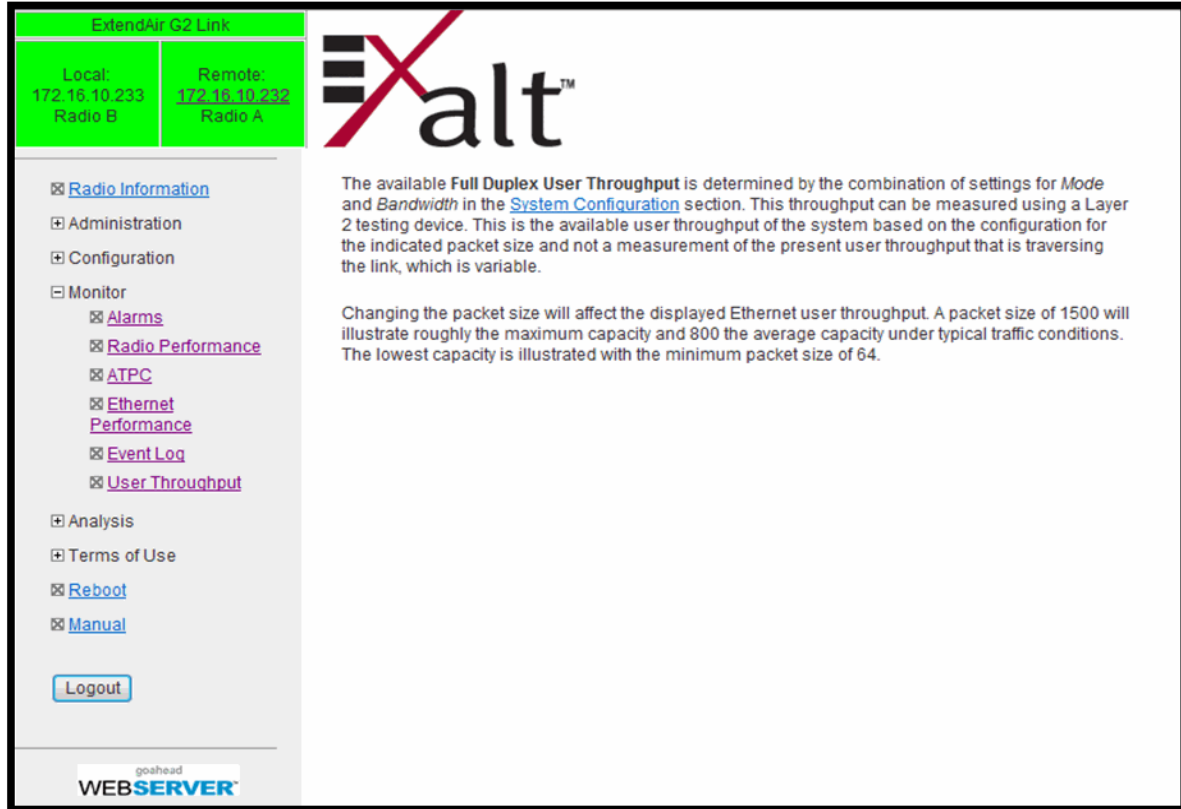


Figure 36 User Throughput Help page

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. This data is a current snapshot. Data is cleared on a radio power cycle or reload/reset.

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 37 Diagnostic Charts page

Use the cursor to point to any spot on any of the three charts, and all three charts illustrate the measurements taken for that time interval in the upper-left corner of each chart. 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 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.

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.

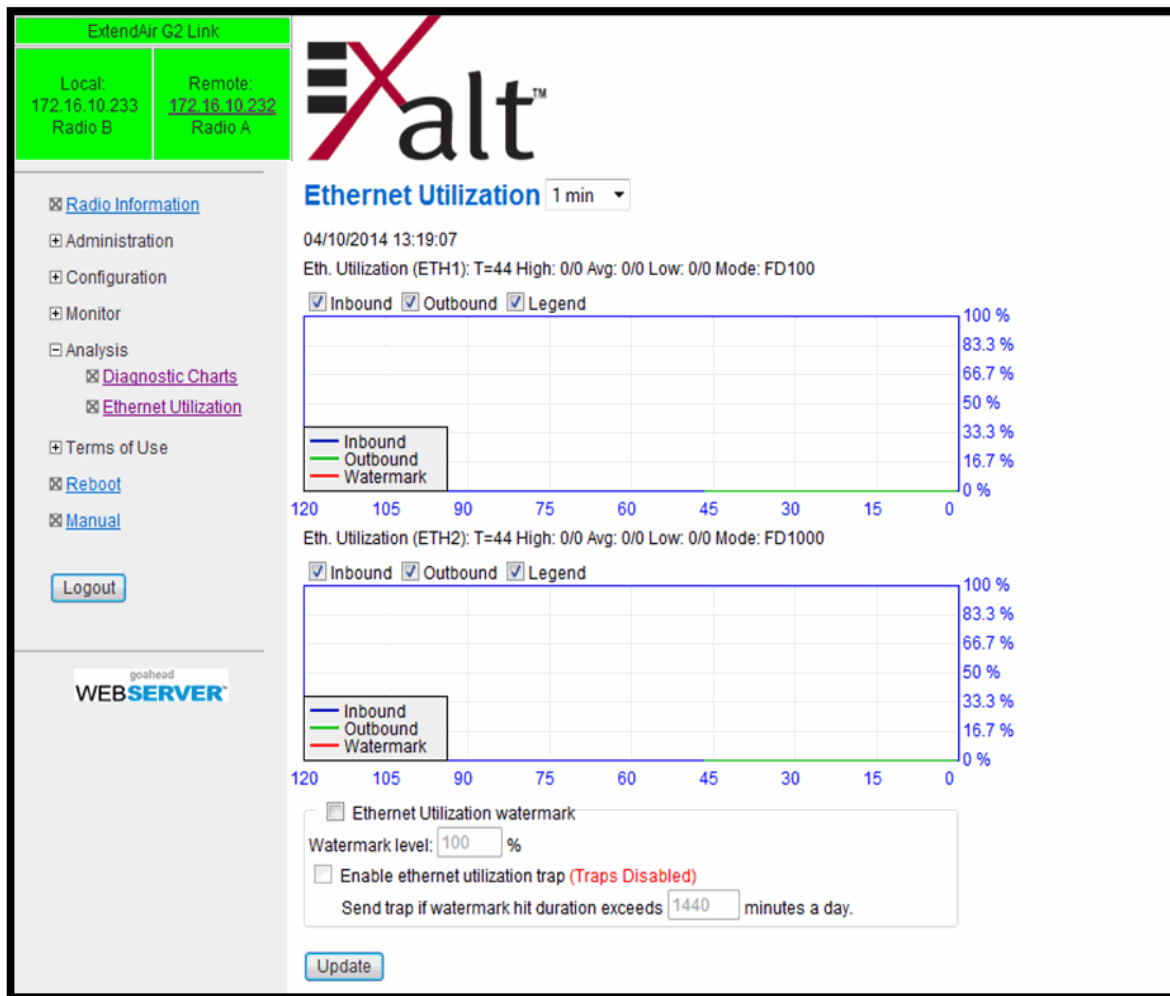


Figure 38 Ethernet Utilization page

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.

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 39 Reboot page

Manual Page

The manual (this document or the version that matches the installed firmware) is available within the GUI. Adobe Acrobat Reader 5.5 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.

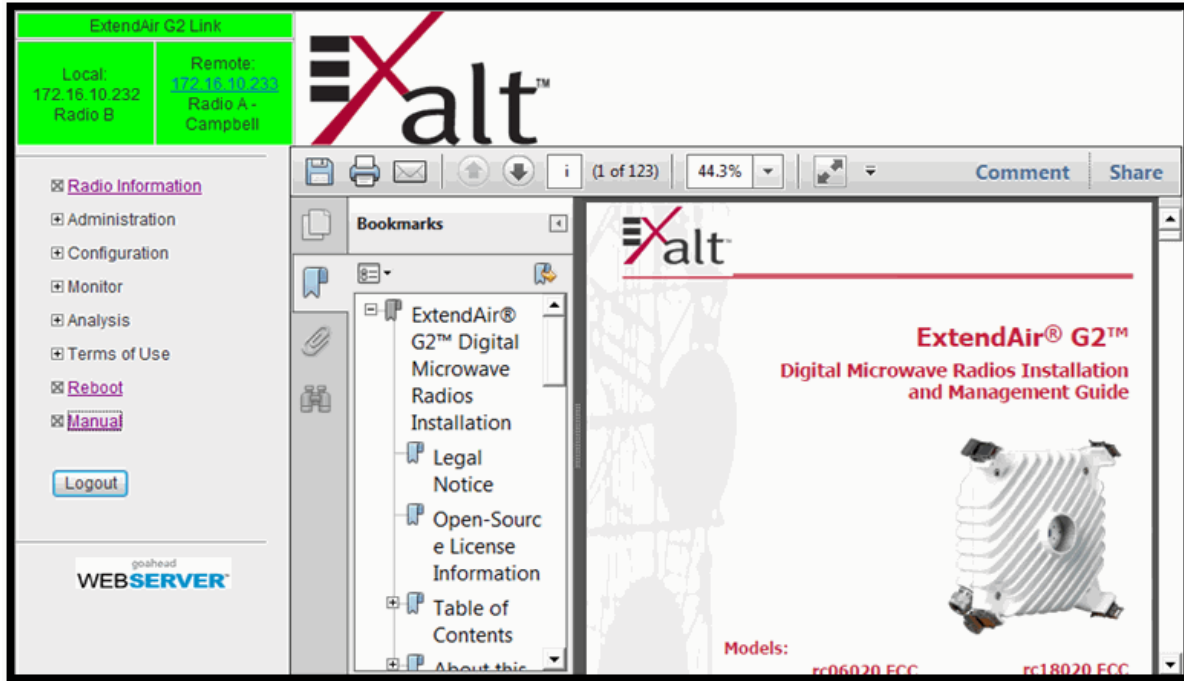


Figure 40 Manual page

Specifications

This section presents specifications for the ExtendAir G2 24GHz digital microwave radios.

Physical Specifications

Physical Configuration	Outdoor Unit (ODU)
Dimensions (HxWxD)	9.4 x 9.4 x 4.5 inches / 23.9 x 23.9 x 11.4 cm
Weight	9.5 lbs/4.3 kg
Operating Temperature	-40 to +149°F / -40 to +65°C
Altitude	15,000/4.6 km
Humidity	100% condensing
Environmental	NEMA4/IP-67

Common System Specifications

Power Control Step Size	0.5dB
Selectable Modulation Modes	QPSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM
Maximum RSL	0dBm no damage QPSK: -20dBm error-free 16QAM-256QAM: -25dBm error-free
Selectable Channel Bandwidths: z	3.5, 5, 7, 10, 13.75/14, 20, 25, 27.5/28, 29.65/30, 40, 50, 55/56/60/80 MHz
Full-Duplex User Capacity (Max system layer 1/Max Ethernet layer 2 ^a):	

Mbps	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
3.5MHz	6/5	13/10	16/13	20/16	-	-
5MHz	9/8	20/16	25/20	30/24	35/28	-
7MHz	13/11	27/22	34/27	41/33	48/38	-
10MHz	19/16	39/32	49/40	60/48	70/56	80/64
13.75/14MHz	28/22	56/45	70/56	84/68	98/79	112/90
20MHz	40/33	81/65	101/82	122/98	142/115	162/131
25MHz	48/40	98/80	123/100	150/120	175/140	200/160
27.5/28MHz	56/45	113/91	141/114	170/137	198/160	226/183
29.65/30MHz	60/48	121/98	151/122	182/147	212/171	243/196
40MHz	80/65	162/130	202/163	243/196	284/229	324/262
50MHz	95/80	195/160	245/200	300/240	350/280	400/320
55/56/60/80MHz	113/91	227/183	284/229	341/275	398/321	455/367

Ethernet Latency	40–125 μ s (<100 μ s typical) at full throughput (GigE) with AES encryption enabled
Error Floor	10 ⁻¹²
Link Security	96-bit Security Code, optional NIST FIPS-197 compliant 128-bit or 256-bit AES encryption.

a. Maximum layer 1 throughput as measured with 64-byte packets and maximum layer 2 Ethernet throughput as measured with 1522 byte packets. In both cases, throughput includes source address, destination address and CRC overhead. Base configurations start at 25 Mbps full-duplex with 50, 100, 200, 300, and 370 Mbps upgrades.

System Specifications, 24GHz

Frequency Band 24.000–24.250GHz
 Output Power (at minimum power) –25dBm
 Receiver Threshold dBm (BER=10⁻⁶)

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
3.5MHz	–92.5	–86.0	–82.5	–79.5	–	–
5MHz	–91.0	–84.5	–81.0	–78.0	–75.0	–
7MHz	–89.5	–83.0	–79.5	–76.5	–73.5	–
10MHz	–88.0	–81.5	–78.0	–75.0	–72.0	–69.0
13.75/14MHz	–86.5	–80.0	–76.5	–73.5	–70.5	–67.5
20MHz	–85.0	–78.5	–75.0	–72.0	–69.0	–66.0
25MHz	–84.0	–77.5	–74.0	–71.0	–68.0	–65.0
27.5/28MHz	–83.5	–77.0	–73.5	–70.5	–67.5	–64.5
29.65/30MHz	–83.0	–76.5	–73.0	–70.0	–67.0	–64.0
40MHz	–82.0	–75.5	–72.0	–69.0	–66.0	–63.0
50MHz	–81.5	–74.5	–71.0	–68.0	–65.0	–62.0
55/56/60MHz	–80.0	–73.5	–70.0	–67.0	–64.0	–61.0

Interfaces

RF

Connector	Waveguide flange:
	24GHz: 0.338" dia
Impedance	50 Ohms

Ethernet

Connectors	RJ-45, female, auto-MDIX
Interface Speed	10/100/1000 Mbps
Duplex	Half, full, auto, selectable
Compliance	802.3

Power

Input Voltage	48VDC
DC Consumption	30W

Interface Connections

This section provides the pin number assignment and wiring information for the connectors on the ExtendAir G2 24GHz radios. All connectors are shown as viewed from the radio front panel.

RSL Connector

A female BNC connector is provided on 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 the 802.3at standard for Power-over-Ethernet (PoE).



Pin	Function 100BaseT	Function GbE
1	Paired with Pin 2	Paired with Pin 2 (with 48VDC)
2	Paired with Pin 1	Paired with Pin 1 (with 48VDC)
3	Paired with Pin 6	Paired with Pin 6 (with 48VDC)
4	+DC Power (48V) In	Paired with Pin 5 (with 48VDC)
5	+DC Power (48V) In	Paired with Pin 4 (with 48VDC)
6	Paired with Pin 3	Paired with Pin 3 (with 48VDC)
7	-DC Power (48V) In	Paired with Pin 8 (with 48VDC)
8	-DC Power (48V) In	Paired with Pin 7 (with 48VDC)

Figure 41 Power/Ethernet connector



Note: Wire the CAT5e/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. The secondary Ethernet connection may be wired as straight-through or cross-connected and does not have power applied.

Antennas

Table 7 lists direct-mount antennas for the ExtendAir G2 24GHz models.

Table 7 Supported direct-mount antennas

Frequency Band	Manufacturer	Model #	Description	Midband Gain (dBi)
24GHz	Xi'an Putian	WTC03-240DAR-QOETB ¹	1-foot Parabolic	36.4
24GHz	Xi'an Putian	WTC06-240DAR-QOETB ¹	2-foot Parabolic	41.0

1 - or equivalent

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
- Link security key matches at each end of the link
- Firmware version matches 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 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, check the ground connection. Grounding problems can be difficult to diagnose, but a professional electrician can inspect a system and identify grounding deficiencies.

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 (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 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 42.
- 2 Configure the frequencies of the radio to be the same pair, with opposite Tx and Rx orientation.
- 3 Power on radio pair

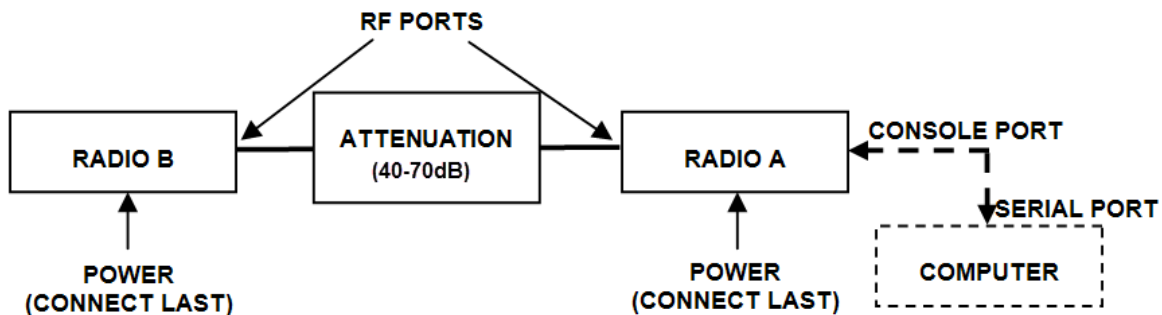


Figure 42 Basic back-to-back bench test configuration

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 42, 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:

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

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.

Safety Notices

- 1 Review this entire guide for important installation instructions BEFORE attempting to install this product.
- 2 This product is intended to be installed, used, and maintained by experienced telecommunications personnel only.
- 3 Employ a properly licensed or authorized electrician to install or evaluate/certify the installation of all power and grounding related to the use of this equipment and all connected devices.
- 4 The device(s) shall only be connected to AC power sources provided by the supplier or to DC sources within the device specifications. Use a separate breaker circuit at the power source.
- 5 Lightning, surge protection devices, and earth grounding are required for most installations to ensure human safety. Consult a qualified electrician.
- 6 Servicing of this device should be performed by authorized personnel only. Do not disassemble this device. By opening or removing any covers you may expose yourself to hazardous energy parts. Incorrect reassembly of this product can cause a malfunction, and/or electrical shock, when the unit is subsequently used.
- 7 Do not connect or disconnect the power connection to the device when the power supply is plugged into an AC outlet. To connect, first connect the power connection to the device, and then apply power (or plug in) at the outlet. To disconnect, disengage power at the outlet or unplug, and then disconnect the direct connection to the device.
- 8 Do not insert any object of any shape or size inside this product at any time, whether powered or not. Objects may contact hazardous energy components that could result in a risk of fire or personal injury.
- 9 Liquids shall not come in contact with, or enter the inside of the device at any time.
- 10 Proper ventilation and/or airflow shall be provided surrounding the equipment. Items shall not come in contact with heat-sinking materials. Ensure that ambient operational and storage temperature specifications are maintained at all times.
- 11 Equipment is suitable for mounting on noncombustible surfaces only.
- 12 Do not move or alter the marking labels.
- 13 A CSU or similar isolating device is necessary between the equipment and the public telecommunications network. The equipment has not been evaluated for direct connection to the public telecommunications network.

Regulatory Notices

This section presents the Regulatory Compliance Regulations for your country.

United States Compliance

The ExtendAir G2 24GHz product family operates under FCC Rule Parts 15.249 as a un-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.

This device complies with Part 15 of the FCC Rules. Operations is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Canada Compliance

The ExtendAir G2 24GHz radios operate under RSS-210 of 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

This device complies with RSS-210 of Industry Canada.

Cet appareil numérique de la RSS-210 respecte les exigences du Règlement sur le matériel brouilleur du 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes:

- 1 l'appareil ne doit pas produire de brouillage, et
- 2 l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Regulatory Compliance

As of this printing, Exalt Wireless, Inc. has approvals for the products that are covered by this manual, as indicated in Table 8. If your application or country is not listed, check with your Sales Representative for the current status.

Table 8 Product approvals

Country	24GHz
Canada	✓
United States	✓

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- 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.*

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