

ExtendAir® eMIMO™ Series

Digital Microwave Radios

Installation and Management Guide



**Models:
r5050 & rc5050 Series**

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About this Document

This manual provides a complete description of the ExtendAir eMIMO Series Digital Microwave Radios and related software. This manual provides planners, engineers, installers, system administrators, and technicians general and specific information related to the planning, installation, operation, management, and maintenance of these devices.

Revision History

Date	Products and Release code
2013-05-01	Draft for compliance submission

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



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

Introduction

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

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Related Documentation and Software

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

<http://login.exaltcom.com/>

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

The ExtendAir eMIMO Series Digital Microwave Radios

The Exalt ExtendAir eMIMO Series Digital Microwave Radios are the most advanced quad-band radios operating in the 4.9, 5.3, 5.4, and 5.8 GHz bands. The ExtendAir eMIMO Series 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 shows the ExtendAir eMIMO Series digital microwave radio.

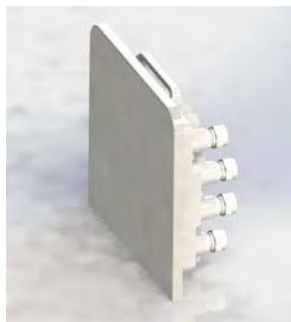


Figure 1 Exalt ExtendAir eMIMO Series Radio

The following ExtendAir eMIMO Series radios are covered in this manual:

- r5050 and rc5050
 - configured with 100 Mbps aggregate over-the-air capacity (1PoE port plus two Ethernet ports)
 - with license key upgrade for 250 Mbps aggregate capacity

The ExtendAir eMIMO Series radios allows operations in a near line-of-sight (nLOS) and non-line-of-sight (NLOS) conditions. Provide 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 management of the digital microwave radio, and assumes that path engineering and site planning has already been performed.

ExtendAir eMIMO Series radios utilize radio frequencies in the 4.90 to 4.94 GHz range. In most countries, this frequency band is allocated exclusively for Public Safety usage and specific restrictions for applications may apply. Licensing or registration may be required. Consult your country regulations to determine any restrictions that may apply and any process that must be followed to implement links in this band.

ExtendAir eMIMO Series radios utilize radio frequencies in the 5.250 to 5.875 GHz range. In most countries these frequency bands are considered as ‘license-exempt’ or ‘unlicensed.’ This means that virtually any user may use these frequencies freely, without paying for access, or any type of prenotification, post-notification or registration. As a result of this designation, users may also move or change these systems at any time, with significant flexibility to the location, orientation and configuration of the system. However, due also to this designation, there may be uncontrolled interference from other similar devices that occupy this spectrum. In these cases, it is up to engineering and maintenance personnel to design the system with existing and future interference sources in mind, recognizing that there is a chance that the interference conditions could be very dynamic, and outages may occur on the system as a result, and that, in some very rare cases, the system may cause interference into another system and may be required to be disengaged or modified/re-oriented to eliminate the interference.

If the spectrum in your country is designated as ‘license-exempt’ or similar, this does not infer that the installer may configure the system in any manner at any location. In most cases, there are regulations, or device-based conditions that limit the use of the device, such as maximum gain antenna, antenna types 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 certain countries, the spectrum for this product is NOT considered to be license-exempt. In these cases, there may be additional regulatory requirements concerning the location, frequency, power, orientation, configuration, and other aspects of the system, including, 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, either for license-exempt or other designation, 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

ExtendAir eMIMO Series Digital Microwave radios are intended for all-outdoor mounting and powered by a separately-purchased power injector. In some cases, the radio can be mounted indoors or in an enclosure. Depending on the configuration purchased, the associated antenna is either integrated as part of the unit or connected separately.

For the external antenna models, the unit is typically mounted very close to the external antenna to minimize RF cabling and associated losses. Alternatively, the unit can be mounted at an easily accessible location with longer RF cabling to the antenna. Proper lightning or surge suppression devices and associated grounding are required for all connections.

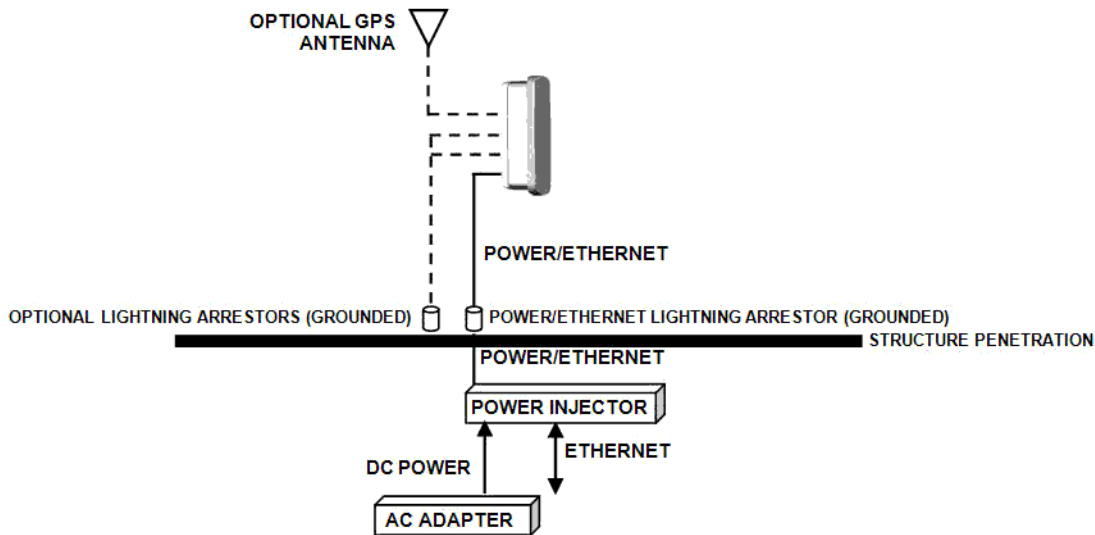


Figure 2 Cabling and mounting

For highest performance and reliability, it is advised to minimize the length of RF cable and associated transmission system losses between the antenna and the radio's antenna port.

The ExtendAir eMIMO Series radios provide connections for a combination of the following data communication interfaces:

- One 10/100/1000BaseT (PoE) port and two 10/100 ports

ExtendAir eMIMO Series radios 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 eMIMO Series radios provide the following primary features and benefits:

- Low-latency optimization and control for voice and data connections
- Very high throughput and flexible interface configurations with voice+data combinations
- High density collocation using ExaltSync™ (future feature release)
- Longer range with smaller antennas. Exalt provides the highest system gain advantage with higher transmit power while sustaining higher throughput levels when competitors must lower modulation levels to maintain the link.
- Space-Time Block Code (STBC) support: The space-time block code used in ExtendAir eMIMO Series radios is based on an Alamouti sequence and uses two antennas to transmit a single data

stream. This allows transmit diversity and power distribution, which reduces linearity requirements and improves the link budget by 3dB.

- Encryption for extreme wireless security
- VLAN tagging and QoS
- Easy-to-use management and configuration
- Flexible utilized channel bandwidth selection for interference avoidance 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

Pre-installation Tasks

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

Link Engineering and Site Planning

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

Exalt recommends using a link budget calculator and/or path planning tool to aid in the pre-planning and engineering required to determine following attributes:

- Antenna type gain at each end of the link
- Antenna mounting height/location for proper path clearance
- Antenna polarization orientation
- RF cabling type, length, connectors, route, and mounting
- Antenna system grounding
- Lightning arrestor type(s), location(s), and grounding
- Radio mounting location and mechanisms
- Radio grounding
- Radio transmitter output power setting
- Anticipated received signal level (RSL) at each end
- Anticipated fade margin and availability performance at each end
- Radio settings
- 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)
- Regulatory limitations on transmitter output power setting and antenna type/gain
- Noise/interference profile for the intended location

Familiarization with the ExtendAir eMIMO Series Radios

The ExtendAir eMIMO Series radios utilize time division duplex (TDD) radio transmission. This means that the transmitted signal in both directions uses the same center frequency and transmits in one direction for a period of time, and then in the opposite direction for another period of time. This total period of time is referred to as the *frame length* or *TDD frame length*, and is further discussed in [Time Division Duplex \(TDD\) Factors](#).

The two radio terminals are identical hardware, except for the TDD setting in software. When the radios are in their default state, both radios are configured as Radio B. **One end of the link must be configured as Radio A before the two ends of the radio system can communicate.**

It can be considered that Radio A is the primary radio in the link. Radio A provides the master clock and control to Radio B. For most applications, it is not important how the radio link is oriented, only that one end is configured for Radio A and the other for Radio B. For some applications (such as, multi-radio hub sites or repeaters), the orientation of the radio systems may be more critical. See [Link Orientation and Synchronization \(future feature\)](#) for details.

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

Shipping Box Contents

Two terminals are required to create a link. The terminal box contains the following items:

- Radio terminal (configured as Radio B)
- Mounting kit (for pole mounting)
- Accessory kit
 - Grounding screw/washers
 - Weather-sealing tape (required for RF connectors on the rc versions)
 - RSL adapter cable
- Registration card
- Quick-start guide

The power solution for ExtendAir eMIMO Series is sold separately. Any 802.3af compliant power-over-Ethernet solution may be used. 802.3at compatibility is also provided.

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.



Note: Register your system as soon as possible. A 2-year Warranty period applies to products registered within 90 days of purchase. The Warranty period is reduced to 1-year for unregistered products and products registered after the first 90 days.

Outdoor-rated and shielded CAT5e or CAT6 cable, such as Beldon 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)
 - Upgrade license key entry successful
 - RF link connects in both directions
 - Traffic passes across the link



Note: Some countries require Dynamic Frequency Selection (DFS) for certain frequency bands, which delays the transmitter turn-on time during the initial Channel Availability Check period of 1 minute. In accordance with these regulations, the radios boot up, and then wait for 1 minute before linking.

-
- Configure connected equipment and cabling
 - Test Ethernet (CAT5e or CAT6) cabling
 - 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 link distance and occupied channel bandwidth
 - 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 at the rear of this guide in the EIRP section for your region.

Time Division Duplex (TDD) Factors

The ExtendAir eMIMO Series 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:

- Link distance
- Bandwidth
- Mode (modulation)
- The setting of the above parameters determines the following performance factors:
- Ethernet throughput
- System latency (delay)

The following generalizations can be made with regards to these factors:

- The shorter the link distance, the lower the latency, the higher the throughput
- The higher the bandwidth, the higher the capacity
- The higher the mode, the higher the capacity

Link Orientation and Synchronization (future feature)

Link *orientation* refers to the Radio A and Radio B placement in your network. Link *synchronization* refers to using external or internal timing to coordinate multiple links.

For every link, one end of the radio link must be configured as Radio A, while the other end is configured as Radio B. In single-link systems, it does not matter which end of the system is mounted at which end of the link, and there is typically no requirement for any link synchronization.

Link orientation and synchronization are more important for networks with site(s) where there is more than one link of the same type or for sites using the same type of radio that are very close to each other at one or both ends.

Configure collocated radio terminals for the same link orientation. That is, configure all radios at the same location as Radio A or Radio B.

It can be advantageous to utilize link synchronization for collocated links. The radios allow the use of an optional GPS synchronization kit. This synchronization controls the transmitter and receiver frame timing so that collocated radios are transmitting at the same time and receiving at the same time. This can substantially reduce the opportunity for self-interference. Without synchronization, collocated radios may be transmitting and receiving at the same time, incurring near-end interference.



Note: It is not always necessary to synchronize collocated radios. If antennas are substantially separated or blocked from one another and/or frequency separation tuning is used, the opportunity for near-end interference can be eliminated.

When synchronization is required or desired, the following configurations are recommended:

- For a two-radio network without GPS, use Internal Sync and connect a single cable between the SYNC/RSL ports on both radios (see [RSL/Sync Connector](#) for wiring instructions).
- For a two-radio network using GPS sync, use two GPS kits or one GPS kit and the ExaltSync Collocation kit.



Note: Refer to the *ExaltSync Collocation Expansion Kit Quick Start Guide* for instructions.

- For a network of two or more radios using Internal Sync, connect using the ExaltSync Collocation kit.
- For a network of two or more radios using GPS Sync, connect using one GPS kit and the ExaltSync Collocation kit, or connect using one GPS kit per link.

Radio A/B Configuration

Use the Exalt GUI to configure the radio terminals for Radio A and Radio B orientation. Since many other parameters also need to be set, and the Exalt GUI is needed for these configurations, this is the best way to completely configure the radio terminals.

Radios arrive from manufacture in default configuration, orientated as Radio B and configured as shown in Table 1.

Table 1 Factory default settings

Parameter	ExtendAir eMIMO Series Radio Settings
Frequency	5GHz models: 5788 MHz (5600 or 5785 MHz if the regulatory domain does not allow 5788 MHz) 4.9GHz models: 4965 MHz
Transmit Power	+4dBm
Link Distance	<10 miles
Bandwidth	10 MHz

Table 1 Factory default settings (Continued)

Parameter	ExtendAir eMIMO Series Radio Settings
Mode	Mode 1
Link Security Key	000000000000
Administration Password	password
User Password	password
IP Address	10.0.0.1
IP Mask	255.0.0.0
IP Gateway	0.0.0.0
Ethernet Interfaces	Auto-negotiation



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 \(GUI\)](#) for details.

Radio Synchronization (future feature)

The radio synchronization feature improves the performance of Exalt radios operating in the same frequency band and that are collocated (such as in repeater and hub configurations). Radio synchronization ties radio systems together to operate off of a common clock system, ensuring that all radios simultaneously transmit and receive, and thus eliminating near-field interference issues and related radio system coupling.

Synchronization Modes

Synchronization can be implemented using either one or multiple GPS sources, or using the radios 'Internal' clocking signal. The following general configurations can be accommodated:

- GPS sync, using one GPS source (sold separately) per link. Ideal for links where the radios are not collocated on the same rooftop or tower.
- GPS sync, using one GPS source (sold separately) to drive timing to multiple collocated links, using one or more sync distribution accessories (sold separately). The ideal solution for networks that have multiple links at one location, but also have more nearby radio links that are not collocated, including repeaters and multi-link backbones.
- Internal sync, using one radio to synchronize another collocated link. This can be accomplished with a simple cable and proper radio configuration, and ideal when only 2 radios are collocated.
- Internal sync, using one radio to synchronize to multiple collocated links. This can be accomplished with one or more sync distribution accessories (sold separately). The ideal solution for networks that have multiple links at one location and do not have other nearby links or repeaters and multi-link backbones.

Virtually any combination of hubs and repeater sites, star configurations, and/or backbones can be implemented with synchronization. It is typically necessary or ideal in each configuration to match the following parameters on every radio in the network:

- Link Distance – Match to the longest distance link in the network.
- Frame Length – Match to the lowest frame length to optimize total system latency or match to a highest frame length to optimize user throughput. Choose an intermediate value to compromise between latency and throughput.
- Mode – It is desirable, but not always necessary, to match the mode for all collocated links.
- Bandwidth – It is desirable, but not always necessary, to match the bandwidth for all collocated links.

For complex networks, an Exalt engineer should review multi-link networks before deployment as several factors can optimize the network for desired performance.



Note: When GPS Sync is enabled, link initiation typically takes 1 to 3 minutes to allow for the radio to properly synchronize to the available GPS satellites.

Figure 3 illustrates two separate radios benefiting from synchronized GPS sources.

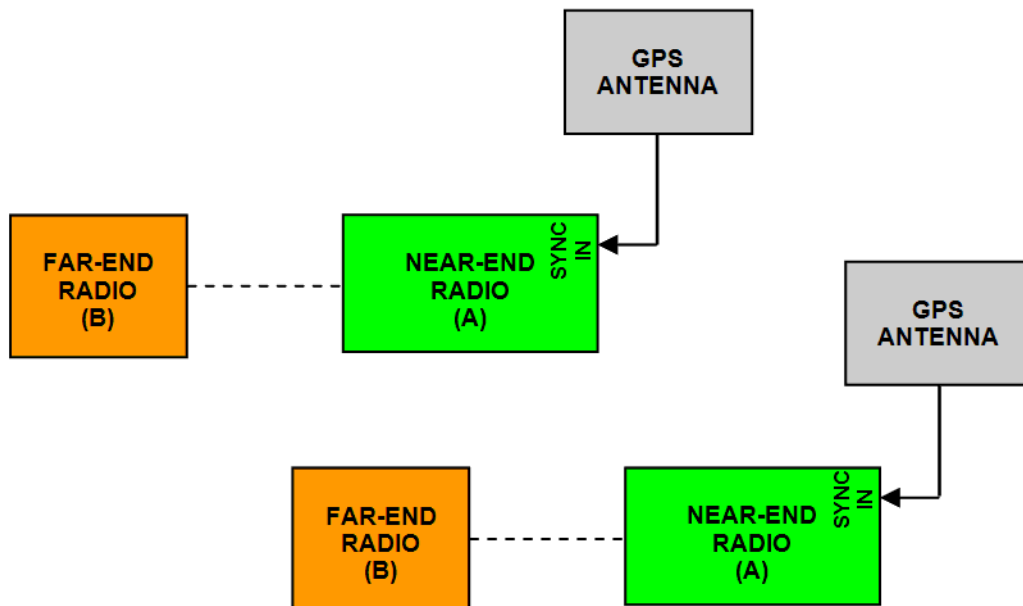


Figure 3 Synchronized GPS sources

Figure 4 illustrates the recommended synchronization method for two links that share a common site at one end of each link. Using internal sync, a cable can be connected between the two radios to accomplish sync. No GPS receiver is required. This approach cannot be used for more than two collocated radios.

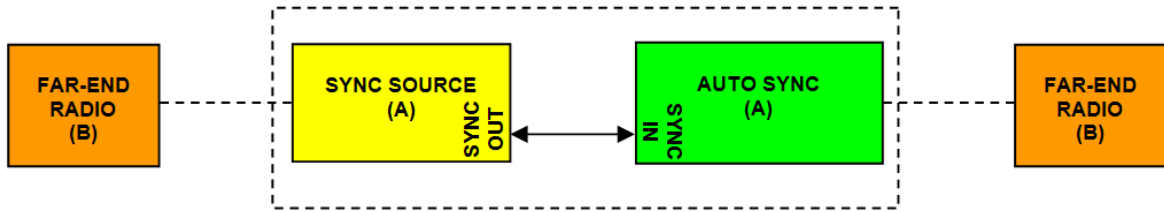


Figure 4 Internal Sync for two collocated radios

When more than two radio links terminate from the same site, use the sync distribution accessory, *ExaltSync Collocation Kit* (sold separately) to connect more links to the Internal Sync source, as shown in Figure 5. Use one kit to connect one Sync Source radio to up to three additional links. Each additional kit expands up to three additional links.

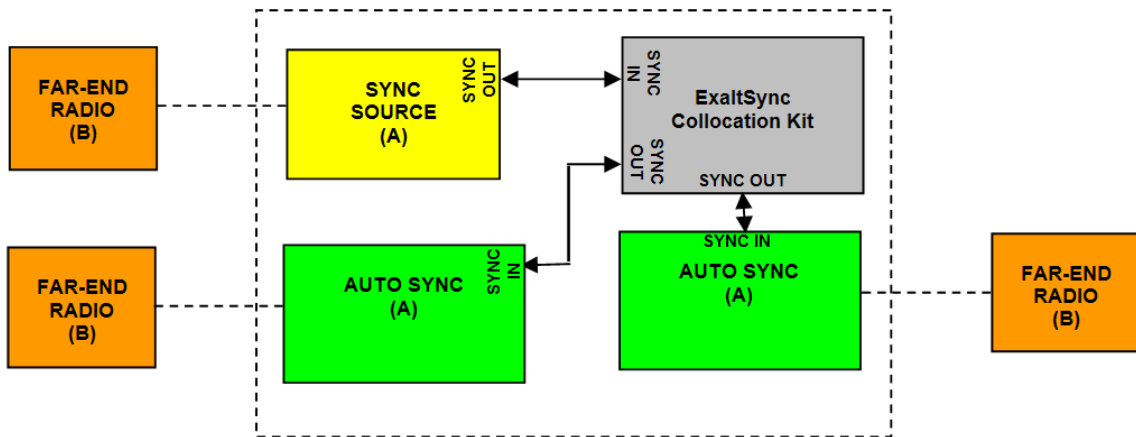


Figure 5 Internal Sync for more than two collocated radios

This approach can also be used using an Exalt GPS source for synchronization, instead of Internal Sync, as shown in Figure 6. This approach is recommended if there are other nearby sites that are not collocated or part of the connected network that need to be synchronized. Using one kit, a single GPS Antenna can synchronize up to 4 collocated links. This can be expanded 3 additional links per additional kit.

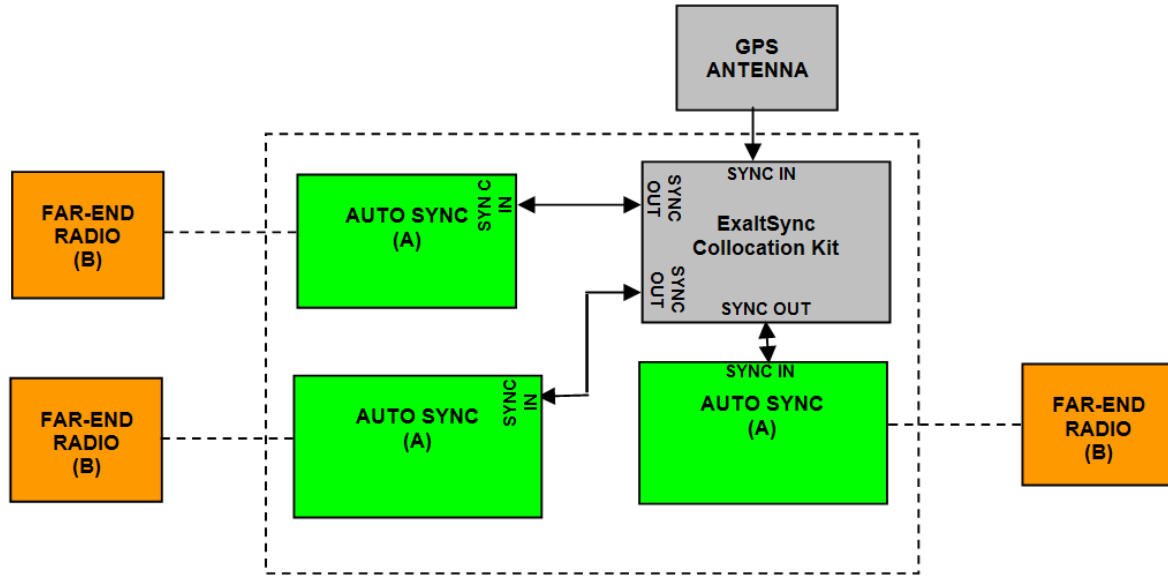


Figure 6 GPS Sync for more than one collocated radios

At the far end of a synchronized link, if there are additional links to synchronize, use the Sync Out port of the Radio B to drive synchronization to the collocated radios. If there is only one additional radio, connect a cable from Sync Out to the Sync In port of the next radio, which should be configured as Radio A. Set this radio in the chain to Sync Recipient, as shown in Figure 7. If more than one radio is located at the secondary location, to drive synchronization for multiple Radio A terminals connect a *ExaltSync Collocation Kit* driven from the Radio B Sync Out port.

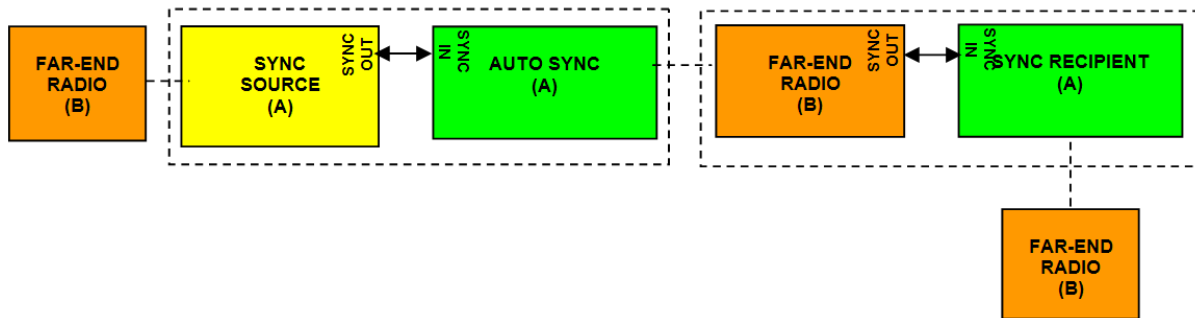


Figure 7 Synchronization for radios in a chain

Offset Timing

For GPS implementations, manual control of offset timing is also allowed. This provides a means to delay the synchronization signal using a user-defined offset. This is helpful when Exalt radios are near other devices operating in the same frequency band that also use a timing source, such as GPS. The timing source to the Exalt radios can be adjusted to match the other radio system timing source mechanism.

Offset timing can also optimize timing intervals for repeaters and backbones. As the distance of each link results in a unique factor for speed-of-light transmission of the radio signal, a subsequent radio can be delayed in timing so that the overall synchronization of radios is precisely maintained.

Offset timing can be adjusted in 1-ms intervals, from zero to the radio's frame length setting. For example, if using a 2-ms frame length, the offset timing can be set from zero up to 1999 ms.

When Sync is Lost

If the primary sync source (for example, the GPS source) signal is lost due to equipment failure, a disconnected sync cable, loss of satellite link, or other condition, the radio is said to be *flywheeling*. When flywheeling, the radio's clock is free-running off internal clocking and is no longer synchronized to any source. If the original sync source is restored to the flywheeling radio's configuration, it attempts to synchronize to this signal without causing transmission interruption.

When the flywheeling radio runs independently for long periods of time, the synchronization signal may be too far outside the capture range of the synchronization loop, and portions of transmission frames can be lost during this re-synchronization process. This condition is temporary and all interconnected radios will re-synchronize to the sync source, as necessary.

If the flywheeling period is exceeded, the radio will stop transmitting. There is a setting for infinite flywheeling; however, long periods of flywheeling can cause interference with collocated radios.

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.

Link Symmetry (future feature)

The default configuration of ExtendAir eMIMO Series radios provides 50/50 symmetrical throughput. The Tx/Rx Throughput Ratio setting enables programming different symmetry for applications where significantly higher throughput in one direction is anticipated such as for video broadcast, video aggregation, or remote server/storage WANs.

Exalt does not recommend placing two links with asymmetry back-to-back in a serial configuration due to the TDD cycle of the radios. This configuration requires that one radio transmits in an overlapping time period while another radio is receiving. Physical antenna isolation and/or frequency channel spacing may accommodate this configuration. Asymmetry is, however, ideal for single-hop, multi-link hub/spoke architectures, or simply single independent links.



Note: Asymmetry is only supported for a specific subset of system configurations that are optimized for typical asymmetric applications.

TDD frame sizes of 2ms and 5ms are supported. The 5ms configuration maximizes the aggregate throughput of the radio for every situation. The 2ms configuration reduces latency to meet latency-critical applications, especially for multi-link circuit support. The following RF BW/mode combinations are supported for these configurations:

- 5, 10, 20, and 40MHz in all bands

The following Tx/Rx ratios are supported for these configurations:

- 65/35 and 35/65

- 80/20 and 20/80



Note: GPS sync is supported with asymmetric settings, but in addition to the other requirements for sync, all radios tied to sync must be set with matching ratios.

Simple Network Management Protocol (SNMP) (future feature)

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

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

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

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

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

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



Note: MIB files can be downloaded on the [File Management Page](#).

System Installation and Initiation Process

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

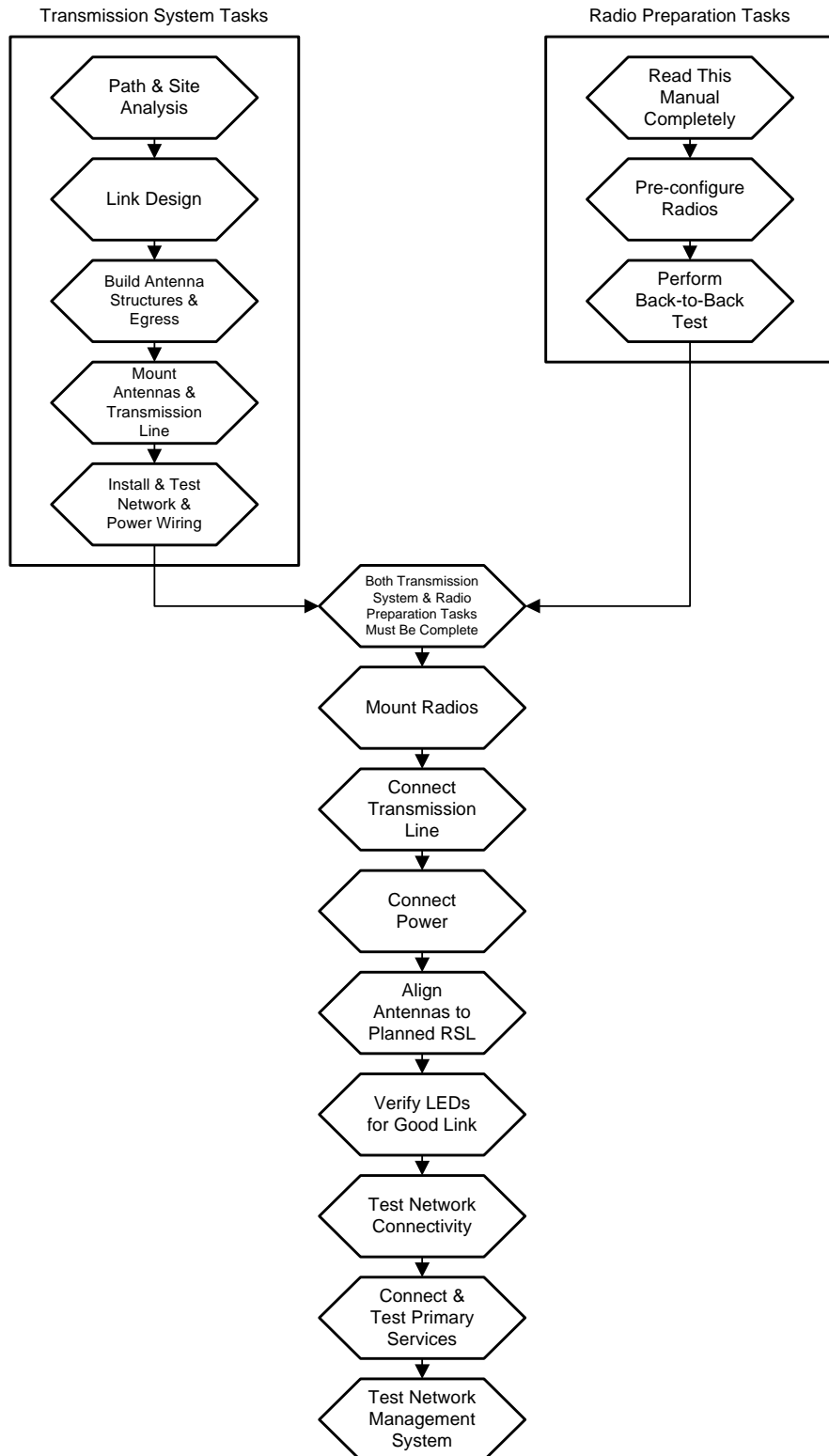


Figure 8 Radio installation tasks

Record Keeping

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

- GPS coordinates for antenna locations at each site
- Antenna heights above ground level (AGL), as mounted
- Antenna model numbers, serial numbers, and specifications
- Antenna polarization as mounted
- Length/type of primary transmission lines at each site
- Model number and serial number of RF lightning arrestors
- Length/type of secondary transmission line(s)
- 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
- Voltage standing wave ratio (VSWR)/return loss at radio's antenna connector 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 eMIMO Series radios are environmentally sealed units intended for deployment outdoors. The device must be deployed within an ambient temperature range as specified, and with non-restrictive airflow around the chassis. The rc models can also be mounted in an enclosure or indoors. The same airflow and temperature conditions apply. All integrated antenna models can be mounted behind a window if window losses are considered in the link budget calculation.



Note: Unless rated for outdoor use 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.

Note that for the rc models, the RF cable connector may require significant clearance for the bend radius of the coaxial cable assembly. All RF connectors, cables, and adapters must be rated for operation within the radio's frequency range. RF connector losses must be accounted for within the link engineering design and output power settings.

Mounting the System

Use the mounting system supplied with each terminal for wall or pole mounting (Figure 9). The pole mounting kit can accommodate a pole 2–5"/5–13cm in diameter. Install the mounting system first, and then affix the radio to the mount. The radio can also be affixed to the mount, and the entire assembly (including radio) mounted.

THESE PHOTOS WERE FROM THE SE TRAINING PPT



Figure 9 Pole-mount examples

For rc models, the mounting solution is a very simple single bracket, using the same pole-mounting band clamps with the same specifications.

For the integrated antenna model, it is critical to mount the entire device at the predetermined location for proper path clearance to the link end. Ensure that there is adequate space around the mounting system and the radio to allow for antenna alignment for both azimuth and elevation adjustments.



Note: Mount the rc models as close as possible to the antenna to minimize the length and associated losses of RF cabling.

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 10 shows the connectors on the ExtendAir eMIMO Series radios.


TBD

Figure 10 ExtendAir eMIMO Series connectors

Connector Overview

Table 2 provides details of the connectors. Detailed pin structures for each connector are in [Interface Connections](#).

Table 2 Connectors—TBD

Connector	Description
SYNC/RSL	(1) Sync In for TDD Synchronization (from Exalt GPS or second radio or ExaltSync Collocation Kit). (2) Sync Out for TDD Synchronization (to a second radio or through ExaltSync Collocation Kit to multiple radios). (3) Antenna alignment RSL voltage (during installation).
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 (10BaseT, 100BaseT, or 1000BaseT) to traverse link• DC power from power injector
ETH2 and ETH3	Ports for additional 10BaseT or 100BaseT Ethernet connections, management and/or traffic.
 (Ground)	Threaded (M5) receptacle.



Use a connector cover on all unused connectors for weatherproofing. The connector covers are included in the accessory kit. Use a safety ring on each connector to secure the connector covers.

LED Indicators—TBD

Table 3 provides details of the LED indicators on the ExtendAir eMIMO Series radios. Note that there are two LEDs, labeled top and bottom, associated with each connector.

Table 3 LED indicators–TBD

Location	Type	Function
GPS/RSL Top	Green LED	Solid when valid GPS connection is detected.
GPS/RSL Bottom	Green LED	Unused
ETH2 or ETH3 Top	Green LED	Unused
ETH2 or ETH3 Bottom	Green LED	Solid when valid when Ethernet Link is present. Blinking when Ethernet traffic is present.
Power/ETH1	Green LED	Solid when proper power is applied.
Power/ETH1 Bottom	Green LED	Solid when Ethernet link is established. Blinking when Ethernet traffic is present.

Power

The radio requires a 802.3af or 802.3at compliant PoE power source within specifications.



Note: Read this section completely before applying power.

Terminating the RF Connectors (rc models)

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

The following lists a few simple ways to achieve proper termination:

- Connect a 50-Ohm coaxial termination device to the RF port of the radio. The termination must be rated to 1W (or more). Example(s) include:
 - Broadwave Technologies P/N 552-200-002, or similar
- Connect the complete transmission system. That is, the RF cabling including the antenna. The cabled antenna provides a proper termination for the RF output.
- Connect a fixed (or a series of fixed) 50-Ohm attenuator(s) to the RF connector, either directly or at the end of an RF transmission line. The attenuator must be at least 30dB as specified at the operating frequency and rated for a minimum of 1W input power. Examples include:
 - Broadwave Technologies P/N 352-103-xxx
 - Bird 2-A-MFN-xx
 - JFW Industries 50FP-xxx-H6-N

Cover any unused connector with the connector cap and apply the weather-seal tape. Both cap and tape are included in the accessory kit.

Ethernet 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. Any Ethernet surge protection device used for the PoE port must be rated for 802.3af use, and for 1000BaseT operation. For the ETH2 and ETH3 connections, any 100BaseT rated surge protection device can be used.

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

If the radio arrester is deleted from the design, Exalt resellers can supply a longer cable with the proper weatherproof connector for the connection from the radio to the egress arrester.



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

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 [Table 7](#) and [Table 6](#) for lists 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. To comply with FCC and Industry Canada regulations, the minimum safe distance from the antenna for continuous human exposure is 10'/3m.

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.

Transmission Line from Antenna to Radio

Most installations use a very short length of coaxial transmission line for the connection between the antenna and the radio device. Coaxial transmission line can either have a solid or braided shield. Solid-shield cables are more resistant to external signal coupling and interference, but are generally stiffer than braided cables. Consult the path or site engineer(s) to ensure that the proper materials are chosen for the installation and that all factors were considered.

Generally, the larger the diameter of the transmission line, the lower the loss. So for longer runs of transmission line, larger diameter cables are highly advised. However, at every frequency, there is a maximum diameter cable that supports the operating frequency. Verify the specifications. This should be determined in the path and site planning process.

Table 4 lists representative samples of transmission line types recommended for the Exalt Digital Microwave Radio.

Table 4 Recommended transmission line

Manufacturer	Type	Description	Loss at 4.9GHz	Loss at 5.3GHz	Loss at 5.8GHz
Andrew	LDF4-50	1/2-inch solid shield	5.6dB/100'	5.7dB/100'	6.0dB/100'
Andrew	LDF4.5-50	5/8-inch solid shield	N/A	4.4dB/100'	4.7dB/100'
Times	LMR-600	1/2-inch braided shield	6.8dB/100'	6.9dB/100'	7.3dB/100'
Times	LMR-900	5/8-inch braided shield	N/A	4.6dB/100'	4.9dB/100'
RFS	LCF12-50J	1/2-inch solid shield	5.5dB/100'	5.6dB/100'	5.9dB/100'
RFS	LCF12-58J	5/8-inch solid shield	N/A	4.5dB/100'	4.8dB/100'

It is critical that the transmission line and antenna be capable of supporting the same type of connector, or easily adapted. It can be important to minimize the number of connectors and adapters, and it is ideal that they match directly without adaptation. In most cases, transmission line allows for N-type male connectors and antennas have N-type female connectors.

If possible, connect the primary transmission line directly to the antenna. It is desired to have the fewest possible pieces of transmission line in the system, to minimize losses and points of failure from connectors. The antenna can typically accommodate a direct connection if planned in advance. Use a 90° adapter for the connection to the antenna, if necessary, but confirm that all connectors and transmission lines are properly specified for the operating frequency with minimum loss, proper impedance (50 Ohm) and proper VSWR characteristics.

Transmission line connector termination is a critical element of the installation. Many 'factory built' RF transmission lines do not provide the proper characteristics for proper transmission, despite their published specifications, often due to the fully or semi-automated process of factory termination, which may not have considered the frequency of your system. When buying pre-terminated transmission line, it is strongly advised to obtain the documentation of test measurements on the connected transmission line showing that the loss characteristics and VSWR are within the specified limits specifically at your operating frequency. In addition to factory-built transmission line, self-terminated transmission line can suffer the same issues.



Caution: Always follow the manufacturer's termination process EXACTLY, and only use the manufacturer's authorized tools and connectors for a given transmission line type.

The manufacturers of transmission line typically offer instruction and certification for transmission line termination, and may also provide videos illustrating the process. There is no amount of extra care, education, precision, and effort that can be overstated for this process.

There is often a need for a small excess of transmission line near the antenna to accommodate both the need for extra slack as the antenna is loosened and moved for the alignment process, and to accommodate a drip loop for the transmission line and the initial transmission line securing hardware and grounding near the antenna. In addition, the transmission line is typically very stiff, and can provide undue pulling force on the antenna or radio connector. Take care to align the cable with the connector so that it does not provide any torque or strain on the connector.

Consult your transmission line manufacturer for the proper transportation, hoisting, securing, and grounding process. Always be very mindful of the entire length of transmission line to ensure that the transmission line is never twisted, kinked, or over-bent beyond the specified bend radius. Once a

transmission line is over-bent or kinked, it will likely never recover its specified characteristics, even after straightening, and will often be completely unusable.

The opposite end of this primary transmission line typically terminates at the radio connector. If using a long transmission line (in excess of 3'/1m), an RF lightning arrestor is recommended to protect the radio equipment.

As soon as practical, weatherproof the connected ends of the transmission line to the antenna and lightning arrestor and radio. This process should be delayed as long as possible to ensure that all systems are working properly before applying the weatherproofing. Once weatherproofing is applied, it may have to be removed for testing or installation modification. With this in mind, if the installation is occurring during inclement weather, take extra care at all times to ensure that no moisture enters any connector at any time. If moisture is suspected to have compromised the antenna or transmission line, it may render those devices useless without any means for remedy except for full replacement.

Cap and weatherproof the second antenna connector on the radio if using a single-polarity antenna.

Indoor Mounting

On rare occasions the antenna can be mounted indoors behind a window. In these cases, there would not be a need for drip loops or an RF lightning arrestor. Use a very short transmission line connected directly between the antenna and the radio mounted nearby. The weatherproofing process can also be omitted.

RF Lightning Arrestor

RF lightning arrestors provide a direct path to ground for lightning strikes that may couple to or directly hit the outdoor transmission system or antenna structure. The RF lightning arrestor prevents any associated voltage and current from entering the radio equipment, other equipment, or humans.

The following lightning arrestors are examples of proper devices for Exalt Digital Microwave Radios:

- Polyphaser AL-LSXM
- Citel PRC5800

Mount and ground the RF lightning arrestor in accordance to the manufacturer's recommendations. Place it as close as possible to the radio equipment. Minimize the distance to the radio to lessen the opportunity for lightning to couple to or strike the unprotected section of transmission line (if any). Consult a qualified electrician or installer in all cases of grounding and lightning arrestor implementation.

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*. The ExtendAir eMIMO Series radios have an integrated antenna.

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.

The following are the primary facilities when using the radio to align the antenna:

- RSL voltage connection using a volt meter (recommended)

Insert the included adapter into the GPS connector on the radio housing and the opposite end connected to a volt meter.

The RSL test point DC voltage is inversely proportional and numerically calibrated to the received signal level. The voltage rises as the antennas are less in alignment, and falls as antennas are more in alignment. The voltage measurement corresponds to the received signal level in measurements of dBm (a negative number for RSL measurements). For example, an RSL of -60dBm yields an RSL voltage measurement of 0.60VDC; an RSL of -45dBm measures 0.45VDC.

- Audio alignment buzzer

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

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



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



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

Configuration and Management

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

Telnet into the Command Line Interface (CLI) (future feature)

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

Connect to the Radio in a Telnet Session

Make the Telnet connection to the radio through the Ethernet port. Use Windows and perform the following steps:

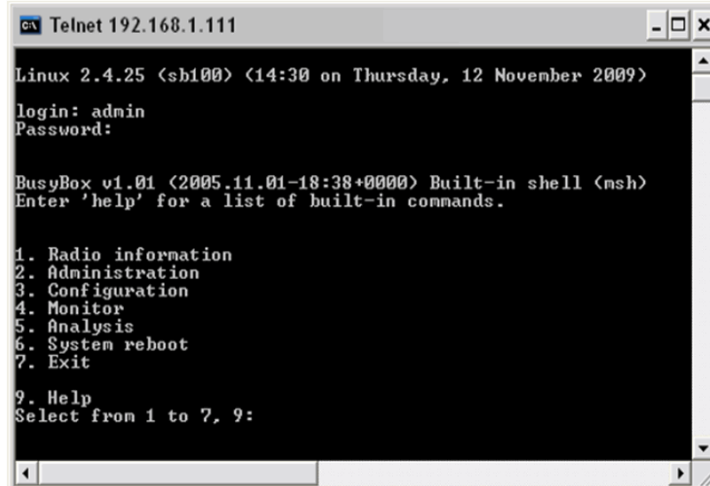
- 1 Open a command prompt or MS-DOS prompt (**Start>Run**).
- 2 Type `C:\>Telnet <IP Address>` at the command line:

The default IP address is **10.0.0.1**

Telnet

Use Telnet when prompted to enter the administration level login and password. The default administration login is *admin* and password is *password*. It is recommended that the default administration password be reset by performing a radio reset.

Figure 11 shows the three menu choices available after log in.



```
cx Telnet 192.168.1.111
Linux 2.4.25 (sb100) (14:30 on Thursday, 12 November 2009)
login: admin
Password:

BusyBox v1.01 (2005.11.01-18:38+0000) Built-in shell (msh)
Enter 'help' for a list of built-in commands.

1. Radio information
2. Administration
3. Configuration
4. Monitor
5. Analysis
6. System reboot
7. Exit

9. Help
Select from 1 to 7, 9:
```

Figure 11 CLI main menu

The following selections can be made on all screens:

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


Exalt Graphical User Interface (GUI)

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

Preparing to Connect

If the radios are new, both radios are preconfigured as Radio B, and have the same IP address. The initial priority is to configure one radio to Radio A and assign 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.
- 2 Connect to the GUI using the default IP address (10.0.0.1), 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).


To configure a radio as Radio A, connect to the GUI and change the configuration, as discussed in this section.

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](#)).

 **Note:** Do not connect the radios in a back-to-back configuration. If the radios are set to their factory default settings, both radios are configured as Radio B and cannot communicate. Both radios also have the same IP address, which causes IP address conflicts

 **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.

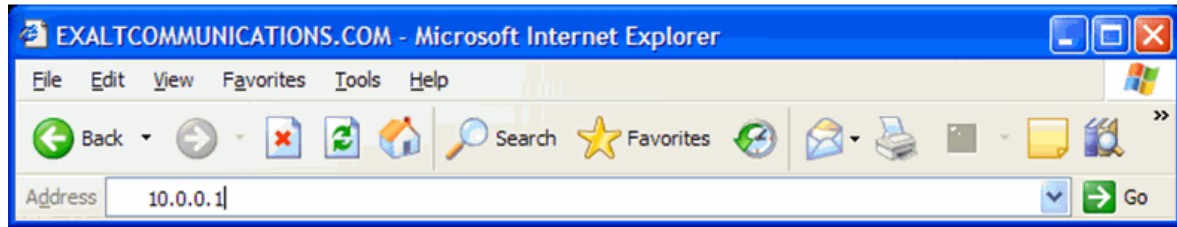


Figure 12 Initiating the browser connection

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



Figure 13 Browser Login screen

Login Privileges

There are two levels of login privileges:

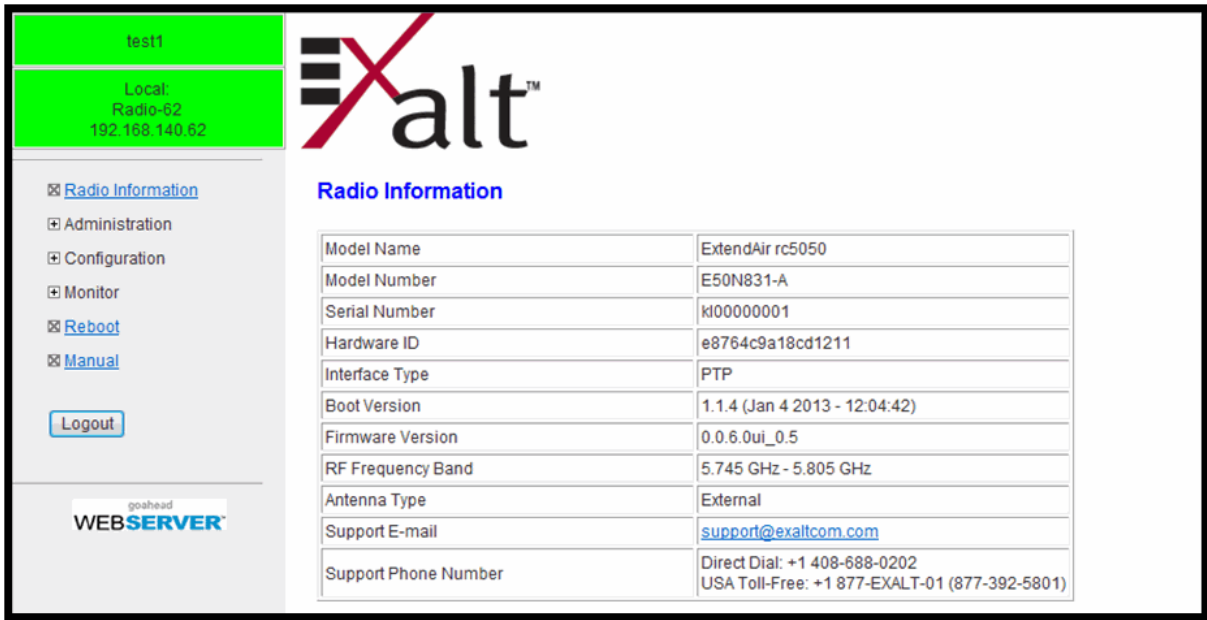
- Administrator (admin) – assigned complete permissions to view, edit, and configure
- User (user) – assigned limited, view-only permissions with no edit or configuration rights

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 left, there is a green header with 'test1' and 'Local Radio-62 192.168.140.62'. The Exalt logo is prominently displayed. A navigation menu on the left includes 'Radio Information', 'Administration', 'Configuration', 'Monitor', 'Reboot', and 'Manual', along with a 'Logout' button. The main content area is titled 'Radio Information' and contains a table with the following data:

Model Name	ExtendAir rc5050
Model Number	E50N831-A
Serial Number	k00000001
Hardware ID	e8764c9a18cd1211
Interface Type	PTP
Boot Version	1.1.4 (Jan 4 2013 - 12:04:42)
Firmware Version	0.0.6.0ui_0.5
RF Frequency Band	5.745 GHz - 5.805 GHz
Antenna Type	External
Support E-mail	support@exaltcom.com
Support Phone Number	Direct Dial: +1 408-688-0202 USA Toll-Free: +1 877-EXALT-01 (877-392-5801)

Figure 14 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](#).

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.



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

Most configuration parameter settings are intuitive. The following link parameters must match at both ends for the link to communicate:

- Encryption Key ([Administration Settings Page](#))
- Bandwidth ([System Configuration Page](#))
- Subnet Mask ([Administration Settings Page](#))



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. In the navigation pane, click the page link to access that page. There are two sections of the main GUI window:

- Navigation pane
- Main window

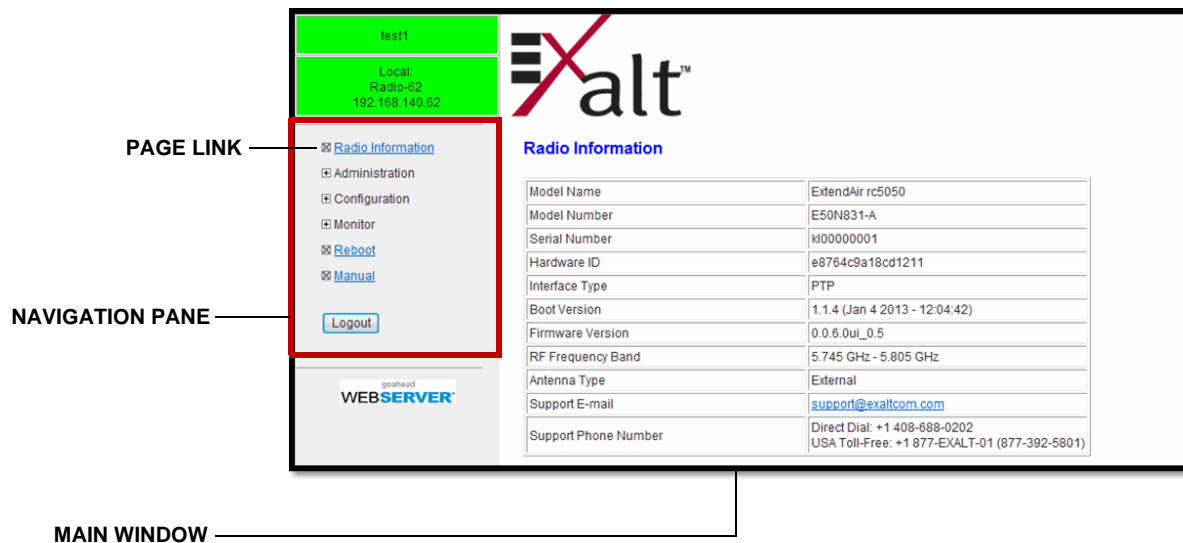
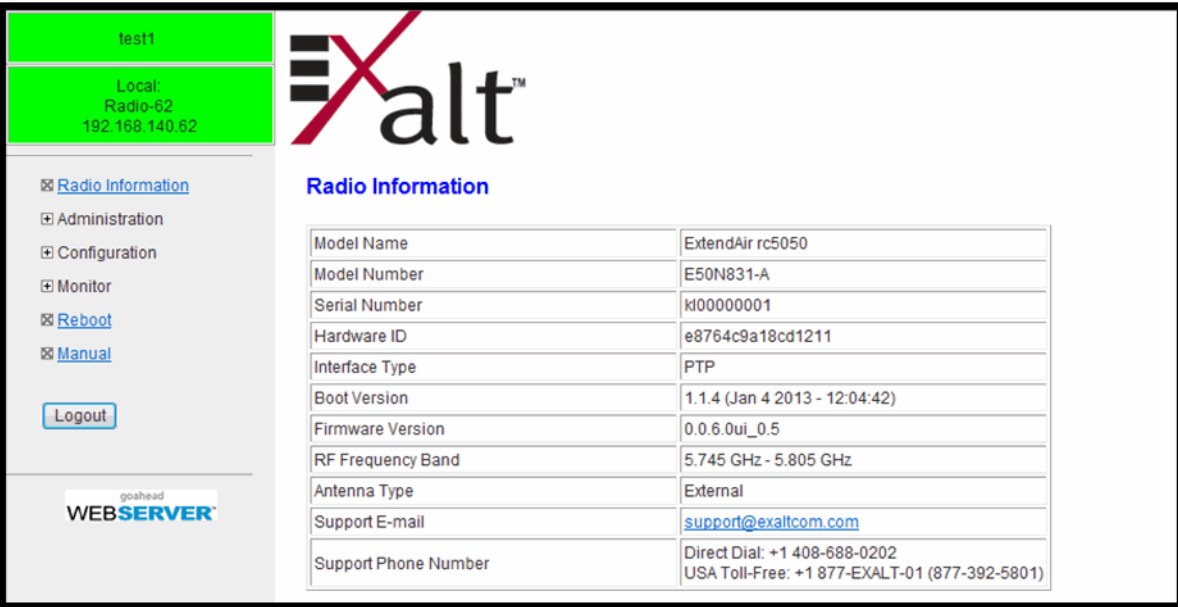


Figure 15 Exalt GUI window description

Radio Information Page

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



The screenshot shows the Exalt web interface. At the top left, there are two green boxes: one with 'test1' and another with 'Local: Radio-62 192.168.140.62'. The Exalt logo is prominently displayed. A sidebar on the left contains a menu with options: Radio Information (selected), Administration, Configuration, Monitor, Reboot, and Manual. Below the menu is a 'Logout' button and a 'goahead WEBSERVER' logo. The main content area is titled 'Radio Information' and contains a table with the following data:

Model Name	ExtendAir rc5050
Model Number	E50N831-A
Serial Number	k10000001
Hardware ID	e8764c9a18cd1211
Interface Type	PTP
Boot Version	1.1.4 (Jan 4 2013 - 12:04:42)
Firmware Version	0.0.6.0ui_0.5
RF Frequency Band	5.745 GHz - 5.805 GHz
Antenna Type	External
Support E-mail	support@exaltcom.com
Support Phone Number	Direct Dial: +1 408-688-0202 USA Toll-Free: +1 877-EXALT-01 (877-392-5801)

Figure 16 Radio Information page

Administration Settings Page

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

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

	Current Value	New Value
Date (mm/dd/yyyy)	01/01/1970	<input type="text"/>
Time (hh:mm:ss 24h)	11:08:52	<input type="text"/>
Radio Name	Radio-62	<input type="text" value="Radio-62"/>
Link Name	test1	<input type="text" value="test1"/>
Admin Password	*****	Enter Admin Password Twice: <input type="text"/> <input type="text"/>
User Password	*****	Enter User Password Twice: <input type="text"/> <input type="text"/>
IP Address	192.168.140.62	<input type="text" value="192.168.140.62"/>
IP Mask	255.255.255.0	<input type="text" value="255.255.255.0"/>
Default Gateway	192.168.140.1	<input type="text" value="192.168.140.1"/>
License Key	35XW#4MHKnZ7N6xDCbb03q9P	<input type="text" value="35XW#4MHKnZ7N6xDCbb03q9P"/>
Access List Filtering (Master only)	Enable	<input type="text" value="Enable"/>
Peer MAC Address	22:17:09:00:18:43	<input type="text" value="22:17:09:00:18:43"/>
Encryption	Open 123456789	<input type="text" value="Open"/> No Security Applied Encryption Key (8 to 64 digits): <input type="text" value="123456789"/>

Figure 17 Administration Settings page

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

- Radio Default: Resets ALL configurations to their default settings.



Note: On the far-end radio when you click the Radio Default button, the link to the radio is lost because the only configurations that are not reset are the IP addresses.

- Fill in the date and time fields as soon as practical. Events are captured with time/date stamps, which is valuable information for troubleshooting.
- Reset the admin and user passwords. These passwords should not match. If the admin password remains at the factory default setting, it provides an opportunity for random reassignment by a network-connected user.
 - The new password must be entered twice. If the passwords do not match and the Update button clicked, the password is not changed and remains set to the previous password.

- Enter the license key provided by Exalt to access extended features. Click Update to accept the changes and enable the new features. License keys are issued by radio serial number, so ensure that the license key used was issued for this particular radio.
- Access List Filtering: Enable this option to limit Radio A and Radio B connections to only provisioned radios (that is, those provisioned through the peer MAC address). For Radio B, access filtering is mandatory. Enable Access List Filtering for the Radio A to allow any Radio B to connect.
- Peer Mac Address: When Access List Filtering is enabled, Radio A only connects to the Radio B identified in the MAC address.
- Encryption: Not applicable when Open is selected. WPA2 (AES) is the available authentication protocol, which provides additional data security for the wireless link. This feature requires that both radios have a valid AES encryption key, simply insert a matching hexadecimal string on both terminals and enable the Access List Filtering option.

File Management Page

This page allows the administrator to upload and download files to and from the radio. The following types of files can be uploaded: configuration, license, and radio firmware. **When uploading Configuration Files, current configuration parameters are immediately overwritten, and the unit automatically reboots.** When uploading radio firmware files, the file is placed into reserve memory space.

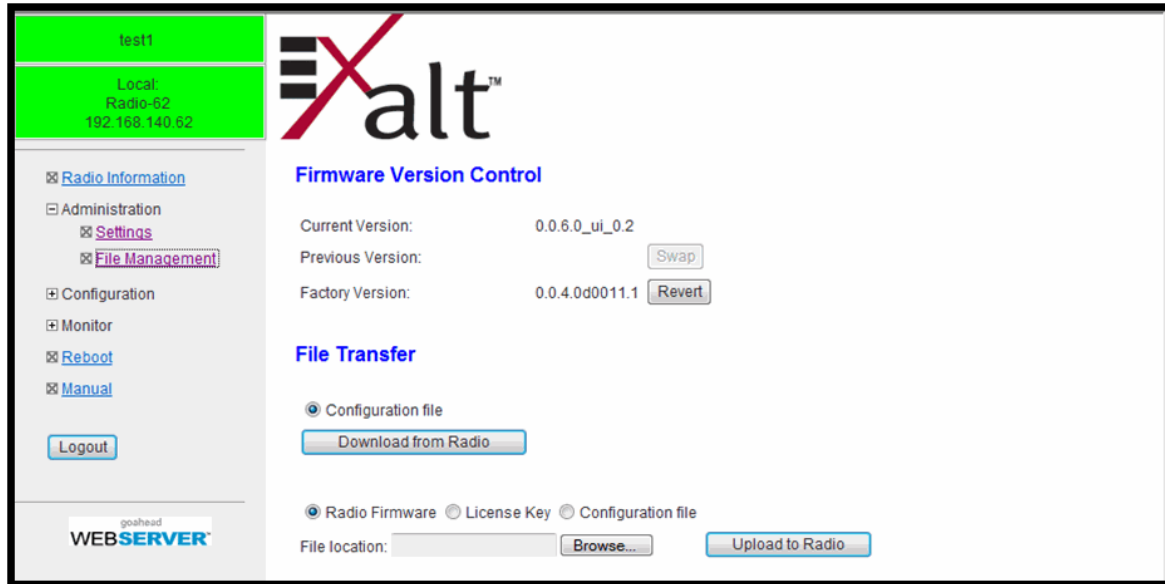


Figure 18 File Management page

The following types of files can be downloaded: radio firmware, configuration, and license key. Use the following steps to download a file.

- 1 Select the radio button for the type of file to download (Radio Firmware, License Key, or Configuration).
- 2 Browse to the file location, and select the file.
- 3 Click the Upload to Radio button and wait for the radio to prepare the file for download.

For some file downloads, a second page/link appears.

The 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: Do not change the name of any download file. The configuration file must be named config.nv. To keep track of multiple configuration files, use a folder naming system or temporarily rename the file, however, it must be named config.xml before it can be uploaded to a radio. Never change radio firmware file names under any circumstances.

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

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

- Link Name
- WPA2 (AES) License Key (although each link should be different)
- Admin and User passwords
- Bandwidth
- RF Frequency



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

System Configuration Page

This page contains several critical system parameters.

	Current Value	New Value
Radio Transmission Status	Enable	Enable ▾
Operational Mode	Client	Client ▾
Band	5 GHz ISM	<input checked="" type="radio"/> 5 GHz ISM
Channel	5.745 GHz	5.745 GHz ▾ 5.745 GHz 5.765 GHz 5.785 GHz 5.805 GHz Auto Select ISM
Channel Bandwidth	40 MHz	
Antenna Type	External	
Antenna Gain	9 dBi	
Transmit Power Limit	Disable 25 dBm	Disable ▾ Power Limit 25 dBm ▾
Range	20 Km	20 Km ▾

Figure 19 System Configuration page

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

- Disable the Radio Transmission Status parameter to stop transmitting to the far-end radio.
- Set the Endpoint Identifier parameter to either Radio A or Radio B.
- Select the Band 5 GHz ISM or 4.9GHz parameter radio button.



Note: 4.9GHz band operation is restricted in most countries to Government or Public Safety use. Consult with local regulatory restrictions prior to operating in this band.

- Select the Channel parameter with the value assigned to the radio license. For 5.8GHz ISM operation, select Auto Select ISM if desired to scan for the ISM frequency with the least noise or interference. The Radio B always searches for the Radio A. This parameter must match at both ends of the link.
- Select the Bandwidth parameter as determined in the design/engineering stage. This parameter must match at both ends of the link.



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

- Set the Antenna Type parameter as used in the installation.
- Set the Antenna Gain parameter to match the installed transmission system gain (that is, the gain of the antenna minus all losses between the radio and the antenna).
- Set the Radio Transmit Power Limit parameter to the designed level (dBm). 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 Link Distance parameter to optimize radio performance for the maximum link distance. Shorter distances provide better reaction times for error packet retransmissions, which allows better throughput (given the same RSL level).



Note: Do not select a range less than the actual link distance. This will cause failure and collisions on transmission between the radios.

VLAN Settings 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.

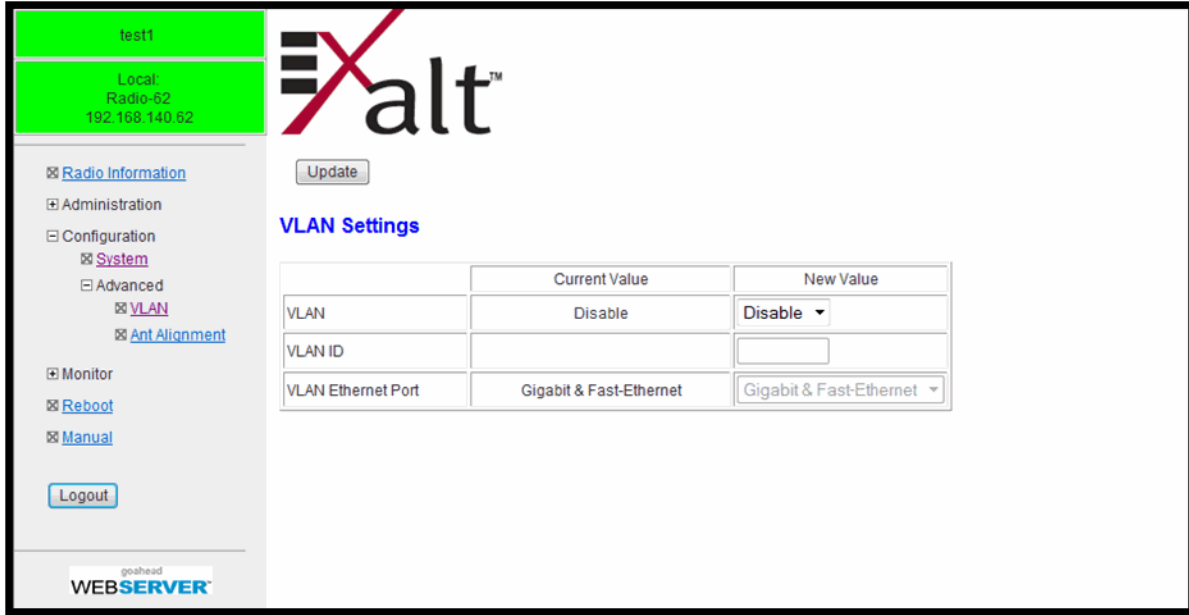


Figure 20 VLAN Configuration page



Note: Once a 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.

The following VLAN configurations are provided:

- Gigabit (PoE/ETH1)
- Fast-Ethernet (ETH2 and ETH3)

Antenna Alignment Page

This page aids with antenna alignment.

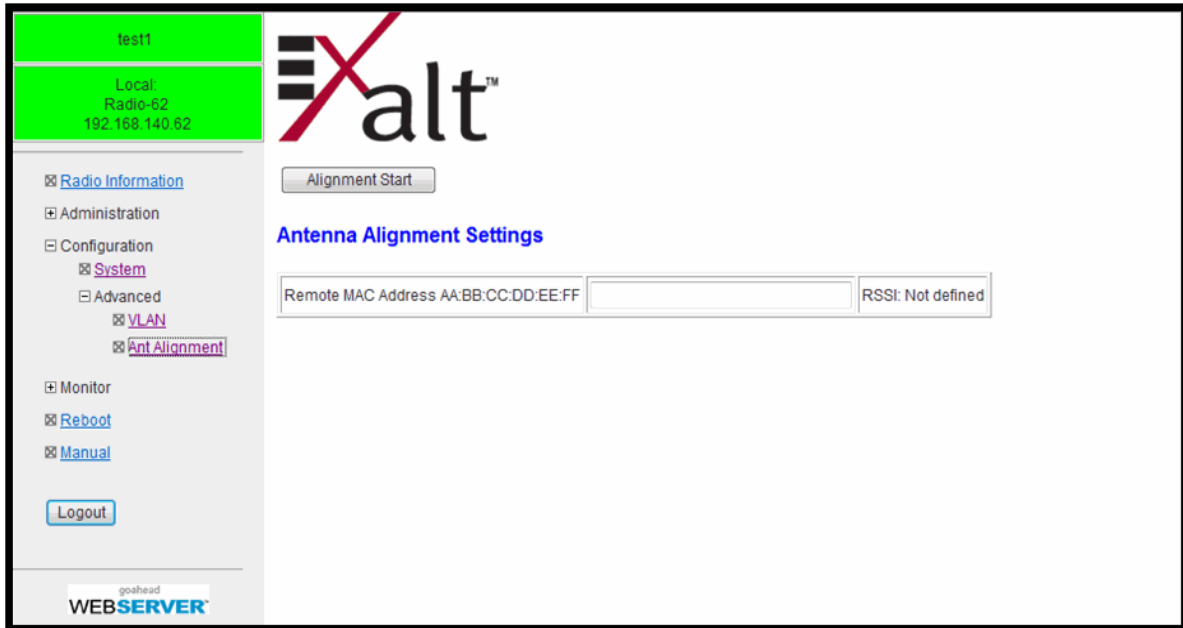
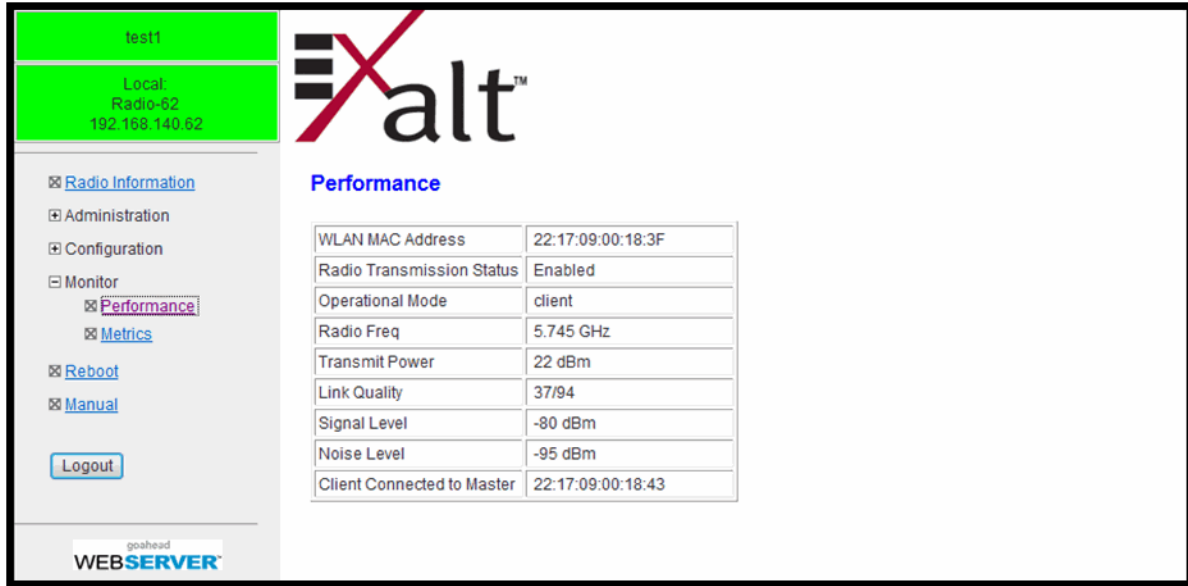


Figure 21 Antenna Alignment page

Input the MAC address of the peer radio. This is mandatory for Radio A and optional for Radio B. Click Alignment Start to initiate alignment. Audio beeps indicate the received signal level. The RSSI displays when alignment completes or when Alignment Stop is clicked. Click Alignment Stop when you are satisfied with antenna alignment.

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.



The screenshot shows the Exalt web interface. On the left is a navigation menu with options: Radio Information, Administration, Configuration, Monitor (with sub-options Performance and Metrics), Reboot, and Manual. A Logout button is at the bottom of the menu. The main content area features the Exalt logo and a 'Performance' section with a table of metrics.

Performance	
WLAN MAC Address	22:17:09:00:18:3F
Radio Transmission Status	Enabled
Operational Mode	client
Radio Freq	5.745 GHz
Transmit Power	22 dBm
Link Quality	37/94
Signal Level	-80 dBm
Noise Level	-95 dBm
Client Connected to Master	22:17:09:00:18:43

Figure 22 Performance page

- The WLAN MAC Address field indicates the local radio MAC address.
- The Radio Transmission Status field allows you to disable transmissions on this radio.
- The Operational Mode field indicates which mode the radio is in: master or client.
- The Radio Freq field 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 Transmit Power field lists the transmit signal quality (dBm).
- The Link Quality field indicates the strength of the link at both ends.
- The Signal Level field 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.
- The Noise Level field displays the noise interference (dBm) detected in the link.
- The Client Connected to Master field lists the address of Radio B that connected to this Radio A unit.

Metrics – Link Statistics and Radio Interface Statistics Page

The Metrics page lists link and radio interface statistics.

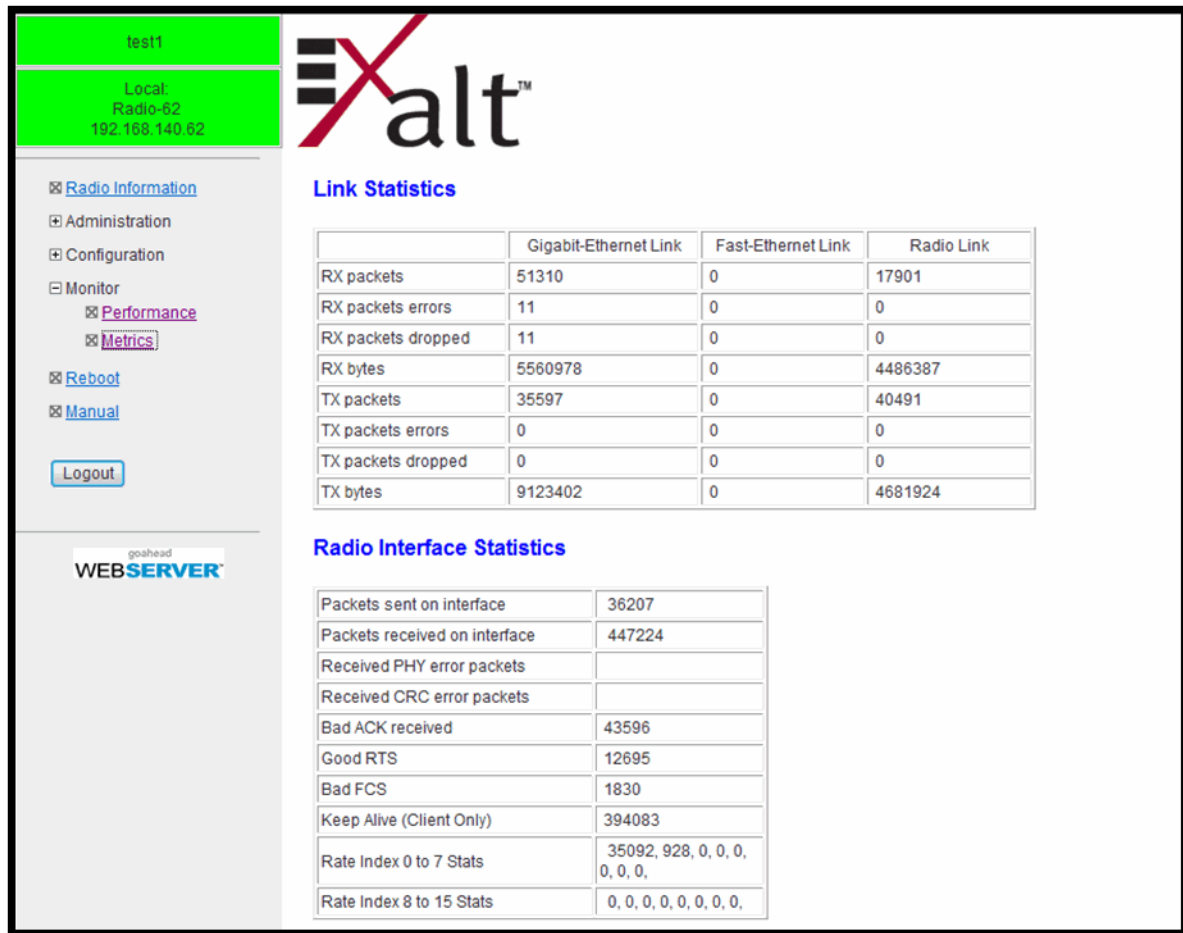


Figure 23 Metrics page

The link statistics listed are:

- Rx packets the number of data packets received
- Rx packets errors the number of data packet errors
- Rx packets dropped the number of data packets dropped
- Rx bytes the number of data bytes received
- Tx packets the number of data packets transmitted
- Tx packets errors the number of transmit data packet errors
- Tx packets dropped the number of transmit data packets dropped
- Tx bytes the number of data bytes transmitted

The radio interface statistics are:

- Packets sent on the interface
- Packets received on the interface

- Received PHY error packets
- Received CRC error packets
- Bad ACK received is a count of data unacknowledged frames. Note that the number of frames transmitted is not synonymous with ETH frames received from the external network. Data frames are different units of transmission. Non-zero values are not necessarily bad; it is normal to have these errors with resends and ACM involved.
- Good RTS
- Bad FCS
- Keep Alive (Radio B only)
- Rate index 0 to 15 stats indicates the modulation level. The higher the number the better modulation rate is achieved.

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.

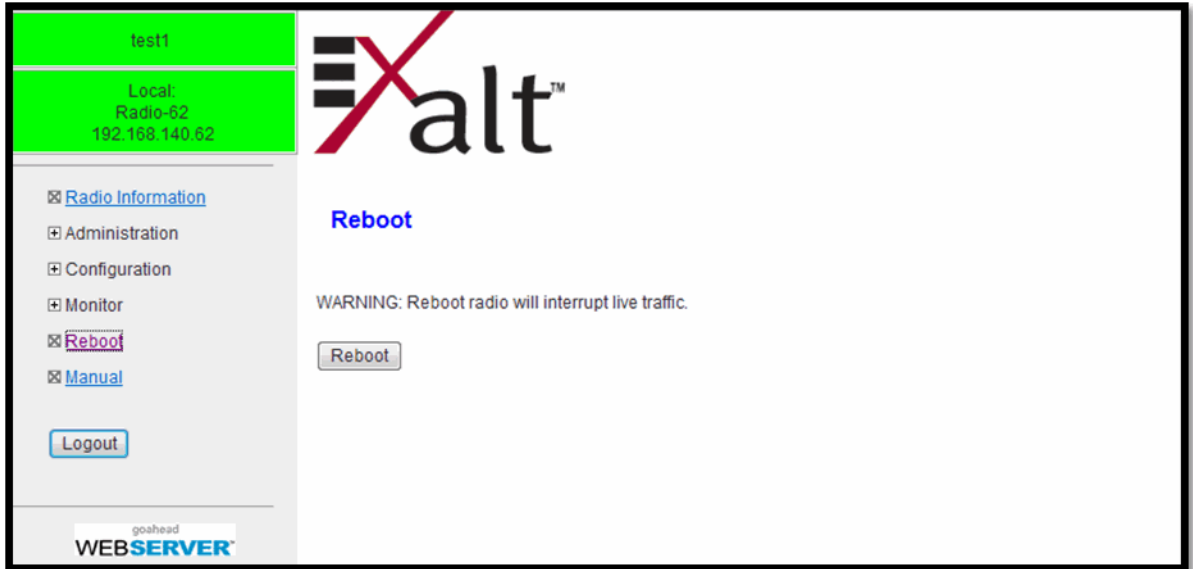


Figure 24 Reboot page

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 25 Manual page

Specifications

This section presents specifications for the ExtendAir eMIMO Series of Digital Microwave Radios.

Physical Specifications

Integrated Antenna Models

Physical Configuration	Outdoor unit (ODU)
Dimensions (H x W x D)	13.3 x 13.3 x 4.5 inches / 33.8 x 33.8 x 11.4 cm
Weight	7 lbs, 3.18 kg
Operating Temperature	-40 to +149°F / -40 to +65°C
Altitude	15,000'/4.6 km
Humidity	100% condensing
Environmental	IP-67

Connectorized Antenna Mode (rc models)

Physical Configuration	Outdoor unit (ODU)
Dimensions (H x W x D)	9.4 x 9.4 x 5.25 inches / 23.9 x 23.9 x 13.34 cm
Weight	6 lbs. 2.72 kg
Operating Temperature	-40 to +149°F / -40 to +65°C;
Altitude	15,000'/4.6 km
Humidity	100% condensing
Environmental	IP-67

Common System Specifications

Power Control Step Size 1.0dB
 Selectable Modulation Modes BPSK, QPSK, 16QAM, 64QAM
 Maximum RSL 0dBm no damage
 QPSK: -25dBm error-free
 64QAM: -30dBm error-free

Receiver Threshold (BER=10⁻⁶)

dBm	BPSK	QPSK	16QAM	64QAM
5MHz	-99	-94	-89	-83
10MHz	-96	-91	-86	-80
20MHz	-93	-88	-83	-77
40MHz	-90	-85	-80	-74

Maximum Aggregate Over-the-Air Capacity

Mbps	BPSK	QPSK	16QAM	64QAM
5MHz	2	4.5	9	13.5
10MHz	4.5	9	18	27
20MHz	13	39	78	130
40MHz	27	81	162	270

Maximum Range 120 km
 Link Latency <3 ms typical
 Error Floor 10⁻¹²
 Frequency Stability ±7 ppm
 Link Security 96-bit Security Code, over-the-air 128-bit AES encryption

System Specifications, 4.9GHz Band

Frequency Band	4940–4990MHz
Output Power (at full power)	+20dBm STBC ^a
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	5MHz, 10MHz, 20MHz, and 40MHz
Receiver Threshold (BER=10 ⁻⁶)	

dBm	BPSK	QPSK	16QAM	64QAM
5MHz	-99	-94	-89	-83
10MHz	-96	-91	-86	-80
20MHz	-93	-88	-83	-77
40MHz	-90	-85	-80	-74

Non-overlapping Channels^b

5MHz	10MHz	20MHz	40MHz
10	5	2	N/A

- Space-Time-Block Coding allows transmission out of both antennas simultaneously, even for single stream. Allows double the power for single-stream rates.
- Not all frequencies/channels are available in all regions.

System Specifications, 5.3GHz Band

Frequency Band	5250–5350MHz
Output Power (at full power)	+21dBm STBC ^a
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	5MHz, 10MHz, 20MHz, and 40MHz
Non-overlapping Channels ^b	

5MHz	10MHz	20MHz	40MHz
20	10	5	2

- a. Space-Time-Block Coding allows transmission out of both antennas simultaneously, even for single stream. Allows double the power for single-stream rates.
- b. Not all frequencies/channels are available in all regions.

System Specifications, 5.4GHz Band

Frequency Band	5470–5725MHz
Output Power (at full power)	+21dBm STBC ^a
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	5MHz, 10MHz, 20MHz, and 40MHz
Non-overlapping Channels ^b	

5MHz	10MHz	20MHz	40MHz
51	29	14	7

- a. Space-Time-Block Coding allows transmission out of both antennas simultaneously, even for single stream. Allows double the power for single-stream rates.
- b. Not all frequencies/channels are available in all regions.

System Specifications, 5.8GHz Band

Frequency Band	5725–5875MHz
Output Power (at full power)	+28dBm STBC ^a
Output Power (at minimum power)	0dBm
Selectable Channel Bandwidths	5MHz, 10MHz, 20MHz, and 40MHz
Non-overlapping Channels ^b	

5MHz	10MHz	20MHz	40MHz
26	18	9	4

- a. Space-Time-Block Coding allows transmission out of both antennas simultaneously, even for single stream. Allows double the power for single-stream rates.
- b. Not all frequencies/channels are available in all regions.

Interfaces

RF

Connector	N-type female (2, rc-model only)
Impedance	50 Ohms

Ethernet

Connectors	3x RJ48C/RJ-45, female
Interface Speed	1x 10/100/1000/BaseT 2x 10/100BaseT
Duplex	Half, full, auto
Compliance	802.3

Sync-In Sync-Out

Connector	RJ-45, female
-----------	---------------

Power — DC Power Injector (sold separately)

Connector	6-pin barrier strip
Input Voltage	48VDC (802.3af compliant, 802.3at compatible)
Consumption	<13 W

Interface Connections

This section provides the pin number assignment and wiring information for the connectors on the ExtendAir eMIMO Series radios. All connectors are shown as viewed from the radio rear panel, oriented with the PoE connector at the lower left corner.

RSL/Sync Connector

This connector can be used during the antenna alignment process, to provide a received signal level (RSL) voltage to a voltmeter. The connector is also used for connection to an optional Exalt GPS antenna for the purposes of GPS synchronization, or used to send or receive sync signals to a collocated radio, or to an ExaltSync Collocation Kit, for multiple radio sync. Figure 26 illustrates the pin orientation and functionality for this connector.

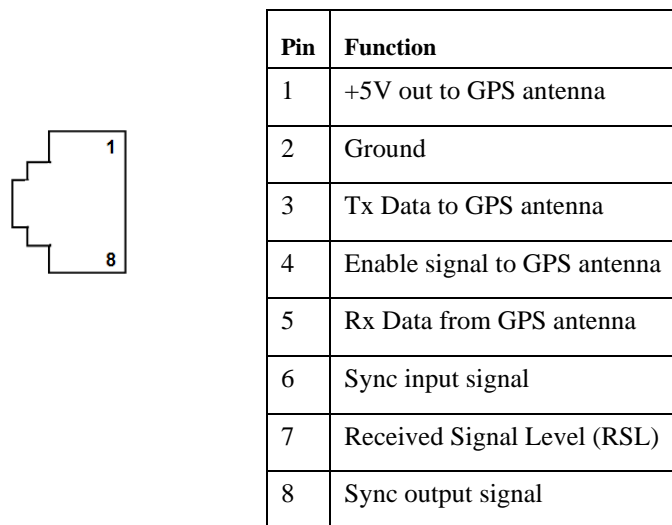


Figure 26 RSL & Sync In/Sync Out connector

Two Radio Internal Sync Out/In

If using the Internal Sync Out/In function between two radios only, connect Pin 8 from the Sync Out radio to Pin 6 of the Sync In radio and use a straight connection for Pin 2. Connect no other pins. To ease the need to keep track of which end of the cable is for In and Out, consider cross-connecting Pins 6 and 8, with a straight connection for Pin 2. Connect no other pins.

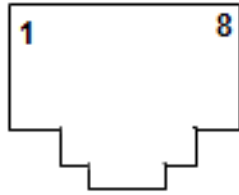
Sync Distribution Accessory

If using a sync distribution accessory (sold separately), connect CAT5e cabling straight from the radio Sync connector(s) to the accessory.

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 27 illustrates the pin orientation and functionality for this connector.

The Ethernet cable between the PoE injector must be wired as a straight connection. The wiring follows typical wiring for Power-over-Ethernet (PoE), and is 802.3af compliant and 802.3at compatible.



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

Figure 27 Power/Ethernet connector

Antennas

The ExtendAir eMIMO Series digital microwave radios are intended for use in the USA. In some countries, antennas exceeding a certain level of gain may be unlawful. Refer to [RF Output Power Setting](#) for details on regulatory limits.

ExtendAir eMIMO Series radios with integrated antennas have software selectable midband gain of 9, 17, or 23 dBi with a beamwidth of 3dB at 60, 20, and 10 degrees, respectively.

Table 6 lists dual-polarity antennas for the ExtendAir eMIMO Series radios.

Table 6 eMIMO Dual-polarity Antennas

Manufacturer	Model Number	Type	Diameter	Gain (dBi)	Band Support, GHz			
					4.9	5.3	5.5	5.8
MTI	MA-WC56-DP9	Panel	0.5 ft	9	X	X	X	X
Mars	MA-WE56-DP12	Panel	0.5 ft	12		X	X	X
Mars	MA-WD56-DP13	Panel	0.5 ft	13		X	X	X
MTI	MT-463012/NVH	Panel	1.5 ft	14	X	X	X	X
Mars	MA-WE56-DP15	Panel	1 ft	14.5		X	X	X
KBT	KBT65VH15-5158RT0	Panel	1 ft	15		X	X	X
MTI	MT-463013/NVH	Panel	1.5 ft	15.5	X	X	X	X
Mars	MA-WD55-DS16	Panel	1 ft	16	X	X	X	X
Mars	MA-WD56-DP16	Panel	1 ft	16	X	X	X	X
Mars	MA-WD56-DSV16	Panel	1 ft	16	X	X	X	X
Mars	MA-WD62-DS16	Panel	1 ft	16				X
Mars	MA-WD62-DP16	Panel	1 ft	16				X
MTI	MT-484052/NVH	Panel	0.5 ft	16	X	X	X	X
KBT	KBT65DP17-5158RT0	Panel	1 ft	17		X	X	X
Mars	MA-WC55-DS17	Panel	1 ft	17	X	X	X	X
Mars	MA-WC62-DP17	Panel	1 ft	17				X
KBT	TDJ-5158BKR×2	Panel	1 ft	18		X	X	X
Mars	MA-WC56-DP17	Panel	1 ft	18	X	X	X	X
MTI	MT-485005/VHN	Panel	0.5 ft	18		X	X	X
Mars	MA-WA56-DP19	Panel	0.5 ft	19	X	X	X	X
MTI	MA-WA56-DP19	Panel	0.5 ft	19	X	X	X	X

Table 6 eMIMO Dual-polarity Antennas (Continued)

Manufacturer	Model Number	Type	Diameter	Gain (dBi)	Band Support, GHz			
					4.9	5.3	5.5	5.8
MTI	MT-485053/NVH	Panel	0.5 ft	19.5		X	X	X
MTI	MA-WA56-DP20	Panel	1 ft	21	X	X	X	X
MTI	MT-465017/NVH	Panel	1 ft	22.5	X	X	X	X
MTI	MT-485025/ND	Panel	1 ft	23		X	X	X
MTI	MA-WA56-DP25N	Panel	1 ft	23.5	X	X	X	X
RadioWaves	FPD1-5-24	Panel	1 ft	23.8		X	X	X
ARC Wireless	PD5823B88	Panel	1 ft	24	X	X	X	X
Mars	MA-WA56-DP25N	Panel	1 ft	24	X	X	X	X
Mars	MA-WA62-DP24	Panel	1 ft	24				X
Wireless Beehive	5.8DP-26	Solid Parabolic	1.5 ft	26		X	X	(X)
General Dynamics	HQFD2-52	Solid Parabolic	2 ft	28.1		X	X	X
General Dynamics	QFD2-52	Solid Parabolic	2 ft	28.4		X	X	X
KBT	TDJ-4958P6AC×2	Panel	2 ft	28.5	X	X	X	X
L-Com	HG5158DP-29D	Solid Parabolic	2 ft	28.5		X	X	X
MTI	MA-QA56-DP28NB	Panel	2 ft	28.5	X	X	X	X
RadioWaves	HPD2-5.2	Solid Parabolic	2 ft	28.6		X	X	X
CommScope	HPX2F-52	Solid Parabolic	2 ft	29		X	X	X
Laird	HDDA5W-29-DP	Solid Parabolic	2 ft	29	X	X	X	X
Mars	MA-WA62-DP30	Panel	2 ft	29			X	X
RadioWaves	SPD2-5.2	Solid Parabolic	2 ft	29		X	X	X
Wireless Beehive	5.8DP-29	Solid Parabolic	2 ft	29		X	X	(X)
CommScope	PX2F-52	Solid Parabolic	2 ft	29.4		X	X	X
ARC Wireless	DA5830SD1	Solid Parabolic	2 ft	30	X	X	X	X
Wireless Beehive	5.8DP-31	Solid Parabolic	3 ft	31		X	X	(X)
General Dynamics	QFD2.5-52	Solid Parabolic	2.5 ft	31.1		X	X	X
RadioWaves	HPD3-5.2	Solid Parabolic	3 ft	31.1		X	X	X

Table 6 eMIMO Dual-polarity Antennas (Continued)

Manufacturer	Model Number	Type	Diameter	Gain (dBi)	Band Support, GHz			
					4.9	5.3	5.5	5.8
General Dynamics	HQFD2.5-52	Solid Parabolic	2.5 ft	31.2		X	X	X
Laird	HDDA5W-32-DP	Solid Parabolic	3 ft	32	X	X	X	X
L-Com	HG5158DP-32D	Solid Parabolic	3 ft	32		X	X	X
RadioWaves	SPD3-5.2	Solid Parabolic	3 ft	32.5		X	X	X
CommScope	PX3F-52	Solid Parabolic	3 ft	33.4		X	X	X
General Dynamics	QFD4-52	Solid Parabolic	4 ft	34.1		X	X	X
CommScope	HPX4F-52	Solid Parabolic	4 ft	34.5		X	X	X
General Dynamics	HQFD4-52	Solid Parabolic	4 ft	34.8		X	X	X
RadioWaves	HPD4-5.2	Solid Parabolic	4 ft	34.8		X	X	X
CommScope	PX4F-52	Solid Parabolic	4 ft	34.9		X	X	X
RadioWaves	SPD4-5.2	Solid Parabolic	4 ft	34.9		X	X	X
General Dynamics	QFD6-52	Solid Parabolic	6 ft	37.4		X	X	X
CommScope	PX6F-52	Solid Parabolic	6 ft	37.6		X	X	X
General Dynamics	HQFD6-52	Solid Parabolic	6 ft	37.8		X	X	X
CommScope	PARX6-59	Solid Parabolic	6 ft	37.9				X
RadioWaves	HPD6-5.2	Solid Parabolic	6 ft	37.9		X	X	X
RadioWaves	SPD6-5.2	Solid Parabolic	6 ft	37.9		X	X	X
Mars	MA-WA56-DP20	Panel	1 ft	22.5, 20.5	X	X	X	X
MTI	MT-485049/NVH	Panel	1 ft	23V/23H	X	X	X	X
MTI	MT-466010/NVH	Panel	2 ft	27.5, 28, 27	X	X	X	X
PC Tel	MPRD2449	Solid Parabolic	2 ft	27.5, 28.1, 29.4	X	X	X	X
MTI	MT-486013/NVH	Panel	2 ft	28, 29	X	X	X	X
L-Com	HG4958DP-30D	Solid Parabolic	2 ft	28, 30	X	X	X	X
Mars	MA-WA56-DP28N	Panel	2 ft	28.5, 29	X	X	X	X
PC Tel	MPRD3649	Solid Parabolic	3 ft	29.8, 31, 32	X	X	X	X
L-Com	HG4958DP-34D	Solid Parabolic	3 ft	31, 34	X	X	X	X

Table 7 lists single-polarity antennas for the ExtendAir eMIMO Series radios.

Table 7 eMIMO Single-polarity Antennas

Manufacturer	Model Number	Type	Diameter	Gain (dBi)	Bandwidth GHz			
					4.9	5.3	5.5	5.8
MTI	MT-462008/N/A	Panel	0.5 ft	9.5	X	X	X	X
MTI	MA-W55-10NH	Panel	1 ft	10	X	X	X	X
KBT	TDJ-5158BFA90-Y	Panel	0.5 ft	11		X	X	X
KBT	KBT120VP12-5158RT0	Panel	1 ft	12		X	X	X
KBT	KBT65VP15-5158RT0	Panel	1 ft	15		X	X	X
KBT	KBT120VP15-5158RT0	Panel	1 ft	15		X	X	X
MTI	MT-484034/NV/I	Panel	1.5 ft	15	X	X	X	X
KBT	KBT90VP16-5158RT0	Panel	1 ft	16		X	X	X
KBT	KBT65VP17-5158RT0	Panel	1 ft	17		X	X	X
KBT	KBT90VP17-5158RT0	Panel	2 ft	17		X	X	X
KBT	TDJ-5158BKC	Panel	1 ft	18		X	X	X
KBT	TDJ-5158BKR-C	Panel	1 ft	20		X	X	X
KBT	TDJ-5158BKR	Panel	1 ft	20		X	X	X
KBT	TDJ-5158BKB	Panel	1 ft	20		X	X	X
General Dynamics	EPD1-52	Panel	1 ft	23		X	X	X
KBT	TDJ-5158BKT-C	Panel	1 ft	23		X	X	X
KBT	TDJ-5158EB23	Panel	1 ft	23		X	X	X
KBT	TDJ-5158SPL4	Panel	1 ft	23.5		X	X	X
KBT	TDJ-5158P4	Panel	1 ft	24		X	X	X
Laird	PA58-24	Panel	1 ft	24		X	X	(X)
Laird	R2T58-24	Panel	1 ft	24	X	X	X	X
RadioWaves	FP1-5-24	Panel	1 ft	24.2		X	X	X
Laird	GD5W-25P	Grid Parabolic	2 ft	25	X	X	X	X
Laird	GD53-25	Grid Parabolic	2 ft	25		X		

Table 7 eMIMO Single-polarity Antennas (Continued)

Manufacturer	Model Number	Type	Diameter	Gain (dBi)	Bandwidth GHz			
					4.9	5.3	5.5	5.8
Laird	GD57-25	Grid Parabolic	2 ft	25			X	
Laird	HDGD58-26	Grid Parabolic	2 ft	26				X
Laird	GD58-26	Grid Parabolic	2 ft	26				X
KBT	TDJ-5158SPL6	Panel	2 ft	26.5		X	X	X
Commscope	28T-5801-1	Grid Parabolic	3 ft	27				X
CommScope	UBP600-4-1	Panel	2 ft	27.5	X	X	X	X
PC Tel	MPRC2449	Solid Parabolic	2 ft	27.7	X	X	X	X
General Dynamics	EPD2-52	Panel	2 ft	28		X	X	X
KBT	TDJ-5158P6	Panel	2 ft	28		X	X	X
Laird	GD53-28	Grid Parabolic	3 ft	28		X		
Laird	GD57-28	Grid Parabolic	3 ft	28			X	
Laird	GD5W-28P	Grid Parabolic	3 ft	28	X	X	X	X
RadioWaves	FP2-5-28	Panel	2 ft	28		X	X	X
CommScope	UBG600-4-1	Grid Parabolic	3 ft	28.5		X	X	X
General Dynamics	HQF2-52	Solid Parabolic	2 ft	28.5		X	X	X
General Dynamics	QF2-52	Solid Parabolic	2 ft	28.5		X	X	X
Laird	GD58-29	Grid Parabolic	3 ft	29		X	X	(X)
Laird	HDGD58-29	Grid Parabolic	3 ft	29				(X)
Laird	HDDA5W-29-SP	Solid Parabolic	2 ft	29	X	X	X	X
RadioWaves	SP2-5.2	Solid Parabolic	2 ft	29		X	X	X
CommScope	P2F-57W	Solid Parabolic	2 ft	29.3				X
CommScope	P2F-52	Solid Parabolic	2 ft	29.4		X	X	X
General Dynamics	QF2.5-52	Solid Parabolic	2.5 ft	31.1		X	X	X
RadioWaves	G3-5.2	Grid Parabolic	3 ft	31.1		X	X	X
RadioWaves	HP2-5.2	Solid Parabolic	2 ft	31.4		X	X	X

Table 7 eMIMO Single-polarity Antennas (Continued)

Manufacturer	Model Number	Type	Diameter	Gain (dBi)	Bandwidth GHz			
					4.9	5.3	5.5	5.8
RFS Cablewave	SPF3-52CN1S	Solid Parabolic	3 ft	31.4		X	X	X
Laird	HDDA5W-32	Solid Parabolic	3 ft	32	X	X	X	X
RadioWaves	HP3-5.2	Solid Parabolic	3 ft	32.5		X	X	X
RadioWaves	SP3-5.2	Solid Parabolic	3 ft	32.5		X	X	X
CommScope	P3F-52	Solid Parabolic	3 ft	33.5		X	X	X
RFS Cablewave	SDF4-52BN1S1	Solid Parabolic	4 ft	33.9		X	X	X
General Dynamics	SSP4-2357A	Solid Parabolic	4 ft	34.4				X
RFS Cablewave	SPF4-52CN1S1R	Solid Parabolic	4 ft	34.4		X	X	X
General Dynamics	HQF4-52	Solid Parabolic	4 ft	34.7		X	X	X
General Dynamics	QF4-52	Solid Parabolic	4 ft	34.8		X	X	X
CommScope	P4F-52	Solid Parabolic	4 ft	34.9		X	X	X
RadioWaves	SP4-5.2	Solid Parabolic	4 ft	34.9		X	X	X
RadioWaves	HP4-5.2	Solid Parabolic	4 ft	34.9		X	X	X
RFS Cablewave	DA4-W57BC1S1	Solid Parabolic	4 ft	35.5				X
RadioWaves	SP6-57	Solid Parabolic	6 ft	35.8				X
CommScope	P6F-52	Solid Parabolic	6 ft	37.6		X	X	X
General Dynamics	QF6-52	Solid Parabolic	6 ft	37.8		X	X	X
RadioWaves	HP6-5.2	Solid Parabolic	6 ft	37.9		X	X	X
RadioWaves	SP6-5.2	Solid Parabolic	6 ft	37.9		X	X	X
PC Tel	MPRC3649	Solid Parabolic	3 ft	30.4, 31.2, 32	X	X	X	X

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.

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 RF cable
- 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 RF cable)

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:

- RF matches at each end of the link
- Bandwidth matches at each end of the link
- Link distance matches at each end of the link
- TDD Frame Length matches at each end of the link
- Endpoint Identifier is different at each end of the link (one end Radio A, one end Radio B)
- Ethernet interfaces are enabled, as desired
- Link security key matches at each end of the link

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 RF Cable Termination

Improper RF cable termination 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 cables are moved or flexed, especially near the termination points, 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). A poor RF cable 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.



Note: The Praxsyst VSWR meter is an excellent tool for this purpose.

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.

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.



Note: Exalt Digital Microwave Radios operate in license-exempt bands. Microwave ovens, wireless Internet devices and cordless phone technology may also use this frequency band. It may be necessary to separate the radio chassis, cabling system and antenna from these devices.

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.

Exalt Digital Microwave Radios provides considerable flexibility to tune to different frequencies across the bands within which they operate. This is the easiest method to use to try to avoid existing interference. In addition, the occupied bandwidth of the radio can be reduced. This, along with re-tuning, can be very effective, however throughput is reduced.

Repositioning the antenna and/or changing polarization, or upgrading the antenna to a higher gain, and/or using a high-performance antenna, are all secondary means that can be used. It may be necessary to perform combinations of both radio changes (retuning, occupied bandwidth reduction) and antenna system changes (position, polarization, upgrade).

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 (connectorized antenna rc-models only)

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

Improper Grounding

In addition to being a potential human safety issue, improper system grounding is a somewhat common condition that can cause continuous bit errors or bit errors when metal objects come in

contact with the radio, transmission system, or racking system. If touching the radio causes errors, grounding is the cause. It can be difficult to identify grounding problems, but a professional electrician can normally inspect a system and identify if there are deficiencies in the grounding system.

Insufficient Link Margin

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

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

Moisture in the Transmission System

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

Back-to-back Bench Testing

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

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

- 1 Basic test (test general operation)
- 2 Specification performance verification

Basic Test

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

For the basic test, the following items are needed:

- Radio pair
- Powering source
- RF interconnect cable(s) (any length – short is best)
- Fixed or variable attenuation, between 60 and 90dB (note: attenuation for basic test does not to be calibrated or precise)
- Computer/terminal with either serial or Ethernet port (helpful, but not necessary)
 - 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 28.
- 2 Configure one radio as Radio A; the other as Radio B
- 3 Power on radio pair

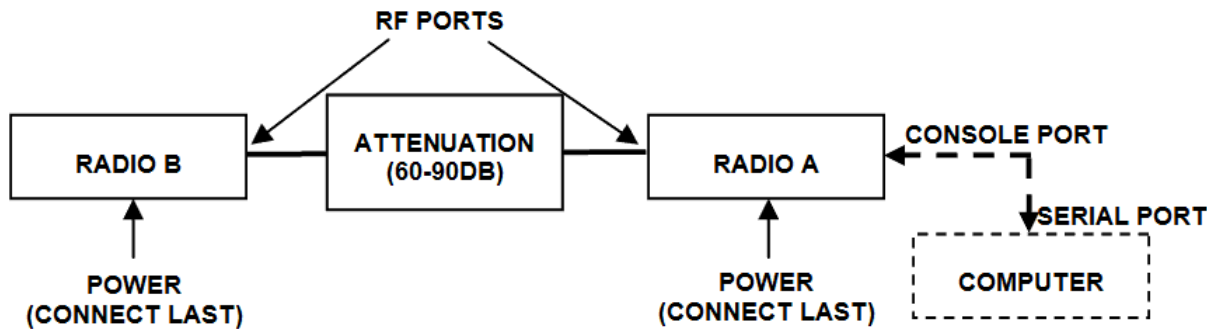


Figure 28 Basic back-to-back bench test configuration

After connecting and powering on, observe the front panel LEDs to verify that the LINK and STATUS LEDs 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 28, 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:

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

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.

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

United States Compliance

When operating in the 4940–4990 MHz band, the ExtendAir eMIMO models (regulatory model name/number eMIMO 100) are licensed-band products operating within Part 90 Subpart Y of the FCC regulations. This band is specifically reserved for Public Safety applications and related agencies, in accordance with these regulations.

Transmitter power reduction may be required, depending on transmission system gains and losses, in accordance with instructions found in this appendix.

When operating in the 5250-5850MHz bands, the ExtendAir eMIMO models (regulatory model name/number eMIMO 100) operate under FCC Rule Parts 15.247 and/or 15.407 as a license-exempt device. They may be used as a point-to-point or point-to-multipoint 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, directional flat-panel, or omni-directional antennas. No other types of antennas are authorized. Parabolic dishes of either grid or solid type are allowed.
- Antenna gains between 9dBi and 37.9dBi are permitted.

Federal Communications Commission (FCC), United States

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

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

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

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

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

This device must be professionally installed.

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

The antenna associated with this device shall be mounted in a location that is at least 10.5'/3.2m away from humans that may be subject to long-term or continuous exposure.

Canada Compliance

When operating in the 4940–4990 MHz band, the ExtendAir eMIMO models (regulatory model name/number eMIMO 100) are licensed-band products operating within RSS-111 of Industry Canada regulations. This band is specifically reserved for Public Safety applications and related agencies, in accordance with these regulations.

Transmitter power reduction may be required, depending on transmission system gains and losses, in accordance with instructions found in this appendix.

When operating in the 5250-5850MHz bands, the ExtendAir eMIMO models (regulatory model name/number eMIMO 100) 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, directional flat-panel, or omni-directional antennas may be used. No other types of antennas are authorized. Parabolic dishes of either grid or solid type are allowed.
- Antenna gains between 9dBi and 37.9dBi are permitted.

Industry Canada (IC), Canada

This Class B Digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte les exigences du Règlement sur le matériel brouilleur du Canada.

This device complies with RSS-210 of Industry 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.

Antennas Supported in Canada

The ExtendAir eMIMO models (regulatory model name/number eMIMO 100) are designed to operate with the antennas listed in [Table 7](#) and [Table 6](#), which have a maximum gain of 37.9dBi. Antennas not included in the list or having a gain greater than 37.9dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

Europe and ITU Country Compliance

All of these permitted devices must be professionally installed. They can only be used as a point-to-point or point-to-multipoint transmission device for fixed or temporary-fixed (non-mobile) installations.



Note: 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 specific country regulations. The output power must never exceed that specified in [Specifications](#).

The ExtendAir eMIMO Series 50xx models operate under EN 301 893 and EN 302 502 rules as a license-exempt device.

The ExtendAir eMIMO Series 50xx models comply with ETS 301 893 for the 5.3 and 5.47 GHz bands for license-exempt use for most countries recognizing ETSI or ITU band assignments. This band is not yet harmonized for all countries recognizing ETSI or ITU band assignments. These bands require Dynamic Frequency Selection (DFS) and Transmitter Power Control (TPC) for radar-detection and avoidance. There is a +30dBm EIRP limit applied to this band. Transmitter power must be adjusted accordingly with respect to the RF cabling losses and antenna gains associated with each terminal.

The ExtendAir eMIMO Series 50xx models comply with ETS 302 502 for the 5.8 GHz band. This band is not yet harmonized for all countries recognizing ETSI or ITU band assignments. Consult the individual country regulations or your Exalt Communications representative for details. This band requires DFS and TPC for radar-detection and avoidance. There is a +33dBm EIRP limit for use of the 10 MHz BW setting, and a +36dBm EIRP limit for use of the 20 MHz BW setting. Some countries limit the EIRP to +5dBm for all bandwidths in this band.

All models comply with the requirements for CE Mark (EN 60950-1 and IEC 60950-1) and EMC (EN 301 489-17). No substitutions shall be made, and all wiring and grounding instructions contained in this manual must be followed to ensure safety in accordance to the standards and local rules.

Regulatory Compliance–TBD

As of this printing, Exalt Communications, 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.

Notations are as follows: ✓ indicates approved; (✓) indicates in-process; * indicates consult Exalt Communications for availability.

Table 8 Product Approvals (Exalt)

Country	4.9GHz	5.3GHz	5.4GHz	5.8GHz
Austria				
Australia				
Belgium				
Brazil				
Bulgaria				
Canada				
Cyprus				
Czech Republic				
Denmark				
Estonia				
Finland				
France				
Germany				
Great Britain				
Greece				
Hungary				
Iceland				
Ireland				
Italy				
Latvia				
Liechtenstein				
Lithuania				
Luxembourg				
Malta				
Mexico				

Table 8 Product Approvals (Exalt) (Continued)

Country	4.9GHz	5.3GHz	5.4GHz	5.8GHz
Netherlands				
Norway				
Philippines				
Poland				
Portugal				
Romania				
Slovak Republic				
Slovenia				
Spain				
Sweden				
Switzerland				
Thailand				
UAE				
United States				

EIRP Limits for the United States and Canada



Note: The professional installer is responsible to ensure that RF output power is properly adjusted to not exceed the regulatory limit.

EIRP for the USA and Canada

4940–4990 MHz Band

For ExtendAir eMIMO Series (regulatory model name/number eMIMO 100) operating within the 4940–4990 MHz band, the maximum EIRP allowed is +46dBm. The maximum output power of the radio shall never exceed +20dBm.

The transmit power must be reduced from maximum by 1 dB for every 1dB that the antenna gain exceeds 26dBi (including transmission system losses)

5250–5350 MHz Band

For operation within the 5250–5350 MHz band, the maximum EIRP is 30 dBm. The maximum output of the radio is +21 dBm.

$$P = 30 - G + L$$

where:

- $P =$ Maximum transmitter output power of radio, in dBm.
- $G =$ Specified gain of antenna, in dBi, from 5250 to 5350 MHz.
- $L =$ Total transmission system losses of all elements between the radio's RF connector and the antenna's RF connector (all cables, connectors, lightning suppressors), in dB, as specified or measured between 5250 and 5350 MHz.

5470–5725 MHz Band

For operation within the 5470–5725 MHz band, the maximum EIRP allowed is 30 dBm. The maximum output power of the radio is +21 dBm.

$$P = 30 - G + L$$

where:

- $P =$ Maximum transmitter output power of radio, in dBm.
- $G =$ Specified gain of antenna, in dBi, from 5470 to 5725 MHz.
- $L =$ Total transmission system losses of all elements between the radio's RF connector and the antenna's RF connector (all cables, connectors, lightning suppressors), in dB, as specified or measured between 5470 and 5725 MHz.

5725–5850 MHz Band

For operation within the 5725–5850 MHz band, the maximum EIRP allowed is 61.9 dBm. The maximum output power of the radio is +28 dBm

$$P = 61.9 - G + L$$

where:

- $P =$ Maximum transmitter output power of radio, in dBm.
- $G =$ Specified gain of antenna, in dBi, from 5725 to 5850 MHz.
- $L =$ Total transmission system losses of all elements between the radio's RF connector and the antenna's RF connector (all cables, connectors, lightning suppressors), in dB, as specified or measured between 5725 and 5850 MHz.

EIRP Limits for Australia



Note: The professional installer is responsible to ensure that RF output power is properly adjusted to not exceed the regulatory limit.

5470–5725 MHz Band



Note: Australian regulations have a no-transmit band from 5600–5650 MHz, adjust the transmitter to avoid this range.

For ExtendAir eMIMO Series (regulatory model name/number eMIMO 100) models within the 5470–5725 MHz band, the maximum EIRP allowed is 30 dBm. The maximum output power of the radio is +21 dBm.

$$P = 30 - G + L$$

where:

- $P =$ Maximum transmitter output power of radio, in dBm.
- $G =$ Specified gain of antenna, in dBi, from 5470 to 5725 MHz.
- $L =$ Total transmission system losses of all elements between the radio's RF connector and the antenna's RF connector (all cables, connectors, lightning suppressors), in dB, as specified or measured between 5470 and 5725 MHz.

5725–5850 MHz Band

For ExtendAir eMIMO Series (regulatory model name/number eMIMO 100) models within the 5725–5850 MHz band, the maximum EIRP allowed is 36 dBm. The maximum output power of the radio is +28 dBm.

$$P = 36 - G + L$$

where:

- $P =$ Maximum transmitter output power of radio, in dBm.
- $G =$ Specified gain of antenna, in dBi, from 5725 to 5850 MHz.
- $L =$ Total transmission system losses of all elements between the radio's RF connector and the antenna's RF connector (all cables, connectors, lightning suppressors), in dB, as specified or measured between 5725 and 5850 MHz.

EIRP Limits for the European Union and ITU Countries

The countries that are covered by this Regulatory Domain are: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ghana, Great Britain, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Netherlands, Switzerland, and Turkey.



Note: The professional installer is responsible to ensure that RF output power is properly adjusted to not exceed the regulatory limit.

- Use only parabolic dish antennas, directional flat-panel, or omni-directional antennas. No other types of antennas are authorized. Parabolic dishes of either grid or solid type are allowed.
- Antenna gains between 9dBi and 37.9dBi are permitted.

50xx Series EIRP

Table 9 summarizes the maximum power by band and country for ExtendAir eMIMO Series radios.

5250–5350 MHz band

For all models within the 5250–5350 MHz band, the maximum EIRP is specified in Table 9. The maximum output of the radio is +21 dBm.

$$P = ME - G + L$$

where:

- P = Maximum transmitter output power of radio, in dBm.
- ME = Maximum EIRP, as specified in Table 9.
- G = Specified gain of antenna, in dBi, from 5250 to 5350 MHz.
- L = Total transmission system losses of all elements between the radio's RF connector and the antenna's RF connector (all cables, connectors, lightning suppressors), in dB, as specified or measured between 5250 and 5350 MHz.

5470–5725 MHz band

For all models within the 5470–5725 MHz band, the maximum EIRP allowed is specified in Table 9. The maximum output power of the radio is +21 dBm.

$$P = ME - G + L$$

where:

- P = Maximum transmitter output power of radio, in dBm.
- ME = Maximum EIRP, as specified in Table 9.
- G = Specified gain of antenna, in dBi, from 5470 to 5725 MHz.
- L = Total transmission system losses of all elements between the radio's RF connector and the antenna's RF connector (all cables, connectors, lightning suppressors), in dB, as specified or measured between 5470 and 5725 MHz.

5725–5850 MHz band

For all models within the 5725–5850 MHz band, the maximum transmit power with respect to specific country EIRP regulations is determined based on the channel bandwidth. The EIRP power limit is specified in Table 9. The ExtendAir eMIMO Series radios (regulatory model name/number eMIMO 100) maximum transmitter conducted power is +28 dBm. Use the following equation to determine the maximum transmitter power for the radio:

$$P = ME - G + L$$

where:

- P = Maximum transmitter output power of radio, in dBm.
- ME = Maximum EIRP, as specified in Table 9.
- G = Specified gain of antenna, in dBi, from 5725 to 5850 MHz.
- L = Total transmission system losses of all elements between the radio's RF connector and the antenna's RF connector (all cables, connectors, lightning suppressors), in dB, as specified or measured between 5725 and 5850 MHz.

Table 9 EU and ITU Country Specific EIRP Levels

Country	Maximum EIRP 5.3 GHz band	Maximum EIRP 5.4 GHz band	Maximum EIRP 5.8 GHz band (BW dependent)^a
Austria	23 dBm	30 dBm	5 dBm
Belgium		30 dBm	
Cyprus	23 dBm	30 dBm	
Czech	23 dBm	30 dBm	33/36 dBm
Denmark	23 dBm	30 dBm	33/36 dBm
Estonia	23 dBm	30 dBm	
Finland	23 dBm	30 dBm	
France	23 dBm	30 dBm	33/36 dBm
Germany	23 dBm	30 dBm	33/36 dBm
Ghana	23 dBm	30 dBm	33/36 dBm
Great	23 dBm	30 dBm	33/36 dBm
Hungary	23 dBm	30 dBm	33/36 dBm
Iceland	23 dBm	30 dBm	33/36 dBm
Ireland	23 dBm	30 dBm	33/36 dBm
Italy	23 dBm	30 dBm	33/36 dBm
Liechtens	23 dBm	30 dBm	5 dBm
Lithuania	23 dBm	30 dBm	33/36 dBm
Luxembo	23 dBm	30 dBm	
Netherla	23 dBm	30 dBm	33/36 dBm
Norway	23 dBm	30 dBm	33/36 dBm
Poland	23 dBm	30 dBm	33/36 dBm
Portugal	23 dBm	30 dBm	5 dBm
Romania	23 dBm	30 dBm	33/36 dBm
Slovak	23 dBm	30 dBm	5 dBm
Slovenia	23 dBm	30 dBm	
Spain	23 dBm	30 dBm	33/36 dBm
Sweden	23 dBm	30 dBm	33/36 dBm
Switzerla	23 dBm	30 dBm	5 dBm
Turkey	23 dBm	30 dBm	33/36 dBm

a. If the output power is designated as 33/36 dBm, the EIRP is limited to 33 dBm for 10 MHz bandwidth transmissions and 36 dBm for 20 MHz bandwidth transmissions.

Declaration of Conformity to the R&TTE Directive 1999/5/EC

English:	This equipment is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Deutsch:	Dieses Gerät entspricht den grundlegenden Anforderungen und den weiteren entsprechenden Vorgaben der Richtlinie 1999/5/EU.
Dansk:	Denne udstyr er i overensstemmelse med de væsentlige krav og andre relevante bestemmelser i Direktiv 1999/5/EF.
Español:	Este equipo cumple con los requisitos esenciales así como con otras disposiciones de la Directiva 1999/5/EC.
Ελληνικά:	Αυτός ο εξοπλισμός είναι σε συμμόρφωση με τις ουσιώδεις απαιτήσεις και άλλες σχετικές διατάξεις της Οδηγίας 1999/5/EC.
Français:	Cet appareil est conforme aux exigences essentielles et aux autres dispositions pertinentes de la Directive 1999/5/EC.
Íslenska:	Þessi búnaður samrýmist lögboðnum kröfum og öðrum ákvæðum tilskipunar 1999/5/ESB.
Italiano:	Questo apparato é conforme ai requisiti essenziali ed agli altri principi sanciti dalla Direttiva 1999/5/EC.
Nederlands:	Deze apparatuur voldoet aan de belangrijkste eisen en andere voorzieningen van richtlijn 1999/5/EC.
Norsk:	Denne utstyret er i samsvar med de grunnleggende krav og andre relevante bestemmelser i EU-direktiv 1999/5/EC.
Português:	Este equipamento satisfaz os requisitos essenciais e outras provisões da Directiva 1999/5/EC.
Suomalainen:	Tämä laite täyttää direktiivin 1999/5/EY oleelliset vaatimukset ja on siinä asetettujen muidenkin ehtojen mukainen.
Svenska:	Denna utrustning är i överensstämmelse med de väsentliga kraven och andra relevanta bestämmelser i Direktiv 1999/5/EC.

For 5 GHz radios, the following standards were applied:

- Radio: EN 301 893, EN 302 502
- EMC: EN 301 489-1, EN 301 489-17
- Safety: EN 60950-1, IEC 60950-1

The following CE mark is affixed to the product:



EU WEEE

Exalt is committed to meeting the requirements of the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive. The Directives require producers of electrical and electronic equipment to finance the take-back for re-use or recycling of their products placed on the EU market after 13 August 2005.

Exalt products that are within the scope of the Directives are labeled with a crossed-out "wheelie-bin" symbol as required by the Directives. This indicates that the product was placed on the market after 13 August 2005 and that end-users should segregate the product from other wastes at end-of-life.

The WEEE Directives are being implemented in each of the 28 EU and European Economic Area (EAA) countries through national legislation. This has resulted in considerable variation in the detailed requirements across the EU, many of which require presence in the EU. As a result, Exalt's WEEE compliance approach is to require the distributors and/or resellers in the EU to comply with each country's national legislation by registration of the distributor or reseller as the producer and for the reseller/distributor to carry out and fulfill the legislative requirements of each national compliance scheme.

Below is the crossed out wheelie bin symbol as required by the WEEE Directive.



EU RoHS

RoHS is the acronym used to refer to the European Union (EU) Directive 2002/95/EC on the Restriction of the use of certain hazardous substances in electrical and electronic equipment. Hazardous materials are those chemicals and substances that are legislatively, market, or customer banned or restricted for use in products and/or manufacturing. There are six (6) RoHS substances: lead (Pb), cadmium (Cd), mercury (Hg), hexavalent chromium (Cr+6), polybrominated biphenyls (PBB) and polybrominated diphenylethers (PBDE). Other countries may be introducing legislation that results in similar restrictions of hazardous substances. Many Exalt products will continue to use lead-based solder under the exemption allowed for network infrastructure equipment. Small amounts of lead, cadmium, mercury, hexavalent chromium, PBB, and PBDE can also be found in a few electrical and electrical components.

Exalt Limited Hardware Warranty Software License and RMA Procedures Agreement

THIS IS AN AGREEMENT BETWEEN YOU AND EXALT COMMUNICATIONS, INC. ("EXALT"). BY EXECUTING OR OTHERWISE ACCEPTING THIS AGREEMENT OR BY USING THE EXALT PRODUCT WITH OR FOR WHICH THIS AGREEMENT IS PROVIDED ("PRODUCT"), YOU ARE AGREEING TO ALL OF THE BELOW TERMS AND CONDITIONS. IF YOU DO NOT AGREE WITH THESE TERMS AND CONDITIONS, YOU SHOULD NOT USE THE PRODUCT AND RETURN IT TO YOUR PLACE OF PURCHASE. "YOU" MEANS THE LEGAL (END USER) ENTITY THAT PURCHASED THE PRODUCT.

1 Exalt Limited Hardware Warranty

- a. Exalt warrants solely to the original purchaser ("Purchaser") that the Exalt hardware product that this Agreement is provided with or for (the "Hardware Product") will substantially conform in all material respects to the relevant Exalt published specifications that apply at the time of manufacture of such Hardware Product for one (1) year from the date of purchase of Hardware Product by Purchaser (the "Warranty Period"). Purchaser may elect to extend the Warranty Period by one additional year as set forth below. 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.
- c. All replaced parts become the property of Exalt. Exalt may, at its sole option, refuse to accept as defective any Hardware Product that (i) is subject to the exclusions set forth below; or (ii) cannot be demonstrated to be defective by Exalt and Purchaser is unable to provide adequate information describing how the Hardware Product failed. Such Hardware Product will, at Purchaser's option and expense, either be: (a) returned to Purchaser in the state received, or (b) repaired and returned to Purchaser. Repaired or replaced Hardware Product will be warranted for the remainder of the original Warranty Period, but not less than ninety (90) days.

2 Timely Registration May Extend Limited Hardware Warranty Period

Purchaser may elect to extend the one (1) year Warranty Period to a two (2) year Warranty Period by registering the Hardware Product with Exalt within ninety (90) days of Hardware Product purchase (all requested registration information must be provided in clear and accurate form within such 90 day period). [Product registration may be performed by completing and submitting the product registration form on www.exaltcom.com/ProductRegistration]

3 Limited Hardware Warranty Exclusions

This limited warranty will not apply to: (A) any Hardware Product that: (i) has been modified or altered by any party other than Exalt; (ii) has been subject to accident, misuse, abnormal wear and tear, neglect, or mistreatment; (iii) has been damaged during installation of the Hardware Product;

(iv) has been damaged by the equipment or system with which the Hardware Product is used; (v) has sustained damage to the Hardware Products' interface or power connectors; (vi) is determined to be stolen; or (vii) has been damaged by fire, power changes, other hazards, or acts of God (including without limitation lightning); or (B) any Software included in any such Hardware Product (see Software License below). The warranty applies only to Hardware Products that can be identified by the Exalt trademark, trade name, serial number or logo affixed to them. Exalt does not warrant any Hardware Product that is not manufactured by, for, or with permission from Exalt. The Hardware Products covered by this warranty are not consumer products and are not intended for personal, family, or household purposes, nor are they intended for high-risk activities as described in Section 5 below.

4 Hardware Product RMA Procedures

A return material authorization (RMA) is required prior to returning Hardware Product to Exalt for warranty or out-of-warranty repair/evaluation. As such, Purchaser must use the following procedure:

- a. Contact Exalt Customer Care, by phone at +1 408-688-0202 or USA Toll-Free at +1 877-EXALT-01 (392-5801), or by e-mail at support@exaltcom.com, and request an RMA number. Please be prepared to provide the serial number of the Hardware Product, the date of purchase, and a description of the failure that is as complete as possible.
- b. Pack the Hardware Product in its original container and packing or an equivalent.
- c. Write the RMA number CLEARLY on the outside of the shipping box.
- d. Cost of shipment to Exalt's authorized service center, taxes, duty, tariffs, risk of loss and insurance charges to Exalt shall be borne by the Purchaser. During the Warranty Period, for service of defects covered by this limited warranty, cost of return shipment and insurance charges shall be borne by Exalt. For return shipment outside of the U.S., Purchaser shall be responsible for duty, tariffs and any other re-importation costs. Exalt will select the carrier and method/schedule of shipment. Purchaser may expedite return shipments, upon request, at its own expense.

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

5 PRODUCT WARRANTY DISCLAIMER AND LIMITATION OF LIABILITY

- a. THE ABOVE EXPRESS LIMITED WARRANTY FOR THE HARDWARE PRODUCT, THE CONDITIONS AND OTHER TERMS SET FORTH IN THIS AGREEMENT ARE IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS AND OTHER TERMS WHETHER EXPRESS, IMPLIED OR STATUTORY, REGARDING THE PRODUCT (HARDWARE PRODUCT AND SOFTWARE) AND ANY SERVICES PROVIDED BY EXALT, AND EXALT, ITS SUPPLIERS AND LICENSORS HEREBY EXPRESSLY DISCLAIM, TO THE EXTENT ALLOWED BY APPLICABLE LAW, ANY AND ALL SUCH EXPRESS, IMPLIED AND STATUTORY WARRANTIES, CONDITIONS AND OTHER TERMS, INCLUDING WITHOUT LIMITATION ANY AND ALL IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE, TITLE, INTERFERENCE WITH QUIET ENJOYMENT, NON-INFRINGEMENT OF THIRD-PARTY RIGHTS AND MERCHANTABILITY. FURTHER, EXALT DOES NOT WARRANT RESULTS OF USE OR THAT YOUR USE OF THE PRODUCT WILL BE UNINTERRUPTED OR ERROR FREE. NO WARRANTIES ARE MADE BY EXALT'S SUPPLIERS OR LICENSORS. EXCEPT FOR THE ABOVE EXPRESS LIMITED WARRANTY FOR THE HARDWARE PRODUCT, THE CONDITIONS AND OTHER TERMS STATED HEREIN, THE

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