EXALT Communications

EX-2.4i
2.4GHz Digital Microwave Radio

Installation and Maintenance Manual

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Legal Notice

Y2K Statement: All imbedded or external software/firmware supplied by Exalt adhere to the four-digit year nomenclature as required for Year 2000 compliance.

About this Document

This manual provides a complete description of the Exalt EX-2.4i Digital Microwave Radio and related software. The purpose of this manual is to provide the planner, engineer, installer, system administrator, and technician with general and specific information related to the planning, installation, operation, management and maintenance of the device.

Revision History

Revision	Date	Detail
001	2005-12-01	Initial release.

Icons

Throughout this document, the following icons are used to denote specific types of information as described here.

(Warning) Denotes information pertaining to potential danger to human life.

(Caution) Denotes information pertaining to potential danger to property.

(Note) Denotes information that may be particularly useful or unique

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 your governmental agency/agencies for regulatory requirements before use, or contact Exalt or your dealer for assistance.

This device may not be modified in any way without the express written consent of Exalt. Modification will not only void the manufacturer warranty, but may also be expressly 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, etc.) 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. For example, within the USA, this device must be professionally installed.

Exalt cannot warrant the device or be found liable for any unauthorized use or installation of the device.

Regulatory Notices

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 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.

In order to comply with regulations, the output power of this device may need to be adjusted in accordance to the associated transmission system. See section 2 of this manual for details.

The antenna associated with this device shall be mounted in a location that is at least 10 feet away from humans that may be subject to long-term or continuous exposure.

Industry Canada (IC), 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.

This device has been designed to operate with the antennas, as listed below, and having a maximum gain of 30.3dBi. Antennas not included in the list or having a gain greater than 30.3dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Manufacturer	Model #	Description	Gain (dBi)
Andrew	19T-2440-1	16-inch Solid Parabolic Dish	19
Andrew	21T-2441-1	24-inch Solid Parabolic Dish	21
Andrew	18T-2400-1	Semi-parabolic Grid	17
Andrew	26T-2400-1	Semi-parabolic Grid	23
Andrew	P2F-23	2-foot Solid Parabolic Dish	21.6
Andrew	P4F-23	4-foot Solid Parabolic Dish	27.3
Andrew	KP3F-23	3-foot Grid Parabolic Dish	25.1
Andrew	KP4F-23	4-foot Grid Parabolic Dish	27.5
Andrew	KPR3F-23	2-foot Grid Parabolic Dish	23.6
Andrew	KPR4F-23	4-foot Grid Parabolic Dish	27.3
Andrew	QD-2402	11-inch Panel	16
Gabriel	DFPS.5-23	6-inch Panel	10.3
Gabriel	DFPS1-23	1-foot Panel	16.5
Gabriel	P-24A36	3-foot Grid Parabolic Dish	25.7

Gabriel	P-24A48	4-foot Grid Parabolic Dish	27.7
Gabriel	SSP2-23	2-foot Solid Parabolic Dish	20.7
Gabriel	SSP4-23	4-foot Solid Parabolic Dish	26.7
Gabriel	SSP6-23	6-foot Solid Parabolic Dish	30.3
Gabriel	HSSP2-23	2-foot Solid HP Parabolic Dish	20.5
Gabriel	HSSP4-23	4-foot Solid HP Parabolic Dish	26.3
Gabriel	HSSP6-23	6-foot Solid HP Parabolic Dish	30.0
RadioWaves	SP1-2.4	1-foot Solid Parabolic Dish	14
RadioWaves	SP2-2.4	2-foot Solid Parabolic Dish	21.3
RadioWaves	SP3-2.4	3-foot Solid Parabolic Dish	24.3
RadioWaves	SP4-2.4	4-foot Solid Parabolic Dish	27.2
RadioWaves	SP6-2.4	6-foot Solid Parabolic Dish	30.3
RadioWaves	G3-2.4	3-foot Grid Parabolic Dish	24.5
RadioWaves	G4-2.4	4-foot Grid Parabolic Dish	27
RadioWaves	G6-2.4	6-foot Grid Parabolic Dish	30.3
RFS	MGAR2-23	2-foot Grid Parabolic Dish	20.8
RFS	MGAR3-23	3-foot Grid Parabolic Dish	24.2
RFS	MGAR4-23	4-foot Grid Parabolic Dish	27.2
RFS	SPF2-23	2-foot Solid Parabolic Dish	20.5
RFS	SPF3-23	3-foot Solid Parabolic Dish	24.2
RFS	SPF4-23	4-foot Solid Parabolic Dish	27.1
SuperPass	SPAPG20	14x15.5-inch Panel	20.5

The antenna associated with this device shall be mounted in a location that is at least 10 feet away from humans that may be subject to long-term or continuous exposure.

Safety Notices

- Review this guide in it's entirety for important installation instructions BEFORE you attempt to install this product.
- This product is intended to be installed, used, and maintained by experience telecommunications personnel only.
- A properly licensed or authorized electrician should be employed to install or evaluate/certify the installation of all power and grounding related to the use of this equipment and all connected devices.
- The device(s) shall only be connected to AC power sources provided by the supplier or to DC sources within the device's specifications. A separate breaker circuit shall be employed at the power source.
- Lightning, surge protection devices and earth grounding are required for most installations to ensure human safety. Consult your qualified electrician.
- 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.
- 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, then apply power (or plug in) at the outlet. To disconnect, disengage power at the outlet or unplug, then disconnect the direct connection to the device.
- Do not insert any object of any shape or size inside this product at any time, weather powered or not. Objects may contact hazardous energy parts that could result in a risk of fire or personal injury.
- Liquids shall not come in contact with, or enter the inside of the device at any time.

- Proper ventilation and/or airflow shall be provided surrounding the equipment. Do not block any intake or exhaust vents. Items shall not come in contact with heat-sinking materials. Assure that ambient operational and storage temperature specifications are maintained at all times.
- Equipment is suitable for mounting on noncombustible surfaces only.
- Do not move or alter the marking labels.

Warranty

Exalt standard hardware warranty is for two year from the date of shipment from Exalt or their authorized Distributor. Exalt warrants that hardware will conform to the current relevant specifications, or specifications that applied at the time of original manufacture, and will be free from defects in material and workmanship under normal use and service. Exalt shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty ending date but not less than thirty (30) days. A return material authorization (RMA) is required prior to returning equipment to Exalt for warranty or out-of-warranty repair/evaluation.

Exalt shall not be responsible for warranty of products which have been subjected to neglect, accident or improper use or installation.

UNLESS SPECIFICALLY EXCLUDED BY LAW, IN NO EVENT SHALL EXALT BE LIABLE TO YOU OR ANY OTHER PARTY FOR ANY DIRECT, INDIRECT, GENERAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR OTHER DAMAGE RISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION OR ANY OTHER PECUNIARY LOSS, OR FROM ANY BREACH OF WARRANTY), EVEN IF EXALT HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

IN NO CASE SHALL EXALT'S LIABILITY EXCEED THE AMOUNT YOU PAID FOR THE PRODUCT.

This warranty shall extend to the original equipment purchaser only, and is in lieu of all other warranties, expressed or implied, including the implied warranties of fitness for a particular purpose and merchantability. CUSTOMERS ARE REQUIRED TO REGISTER THEIR PRODUCTS FOR FULL WARRANTY SUPPORT in accordance with documentation supplied with the original delivered product(s). Unregistered products will receive a warranty period of one (1) year. Proof-of-purchase in the form of an invoice, payment of invoice, or delivery waybill must be supplied, if requested, to establish original date of shipment in case of any dispute of warranty start date.

For warranty returns, cost of shipment to Exalt's authorized service center shall be borne by the customer. Cost of return shipment shall be borne by Exalt and will be made by Exalt's choice of carrier and method/schedule of shipment. Customers may expedite return shipments, upon request, at their own expense.

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Section 1 - Introduction

1.0 Introduction to Exalt Communications

Exalt Communications Inc. wishes to thank you for your purchase of the EX-2.4i Digital Microwave Radio. Our charter is to build the highest quality, highest reliability products that meet or exceed all of your expectations. This commitment to quality and reliability extends to our employees and partners as well. We expect that your experience with our employees and partners during any sales or support engagement to be a positive experience that meets all of your needs. We appreciate your feedback about our products, our employees and our support. Our company succeeds when you succeed. Please feel free to comment to us at any time, including any enhancements that you consider for both our products and our support.

Direct-Dial Telephone: +1 (408) 871-1804
Website: www.exaltcommunications.com
Sales Email: sales@exaltcommunications.com
Support Email: support@exaltcommunications.com

Mailing Address: Exalt Communications Inc.
580 Division St.
Campbell, CA 95008
USA

1.1 The EX-2.4i Digital Microwave Radio

The EX-2.4i Digital Microwave Radio is a point-to-point terrestrial communications device. In most cases, the device is used to connect voice and/or digital data from one location to another, relieving the need for copper or fiber connectivity, or enhancing existing connectivity by providing a redundancy solution, a primary solution and/or additional capacity.

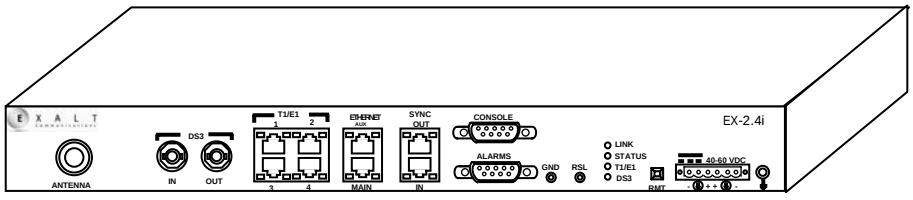

Figure 1-1: EX-2.4i Digital Microwave Radio

Generally, the EX-2.4i requires clear line-of-sight and proper path clearance to achieve a high-performance, reliable connection. Detailed path engineering and site planning should be

performed BEFORE the purchase of this equipment. This document primarily focuses on the installation and maintenance of the device, assuming that path engineering and site planning has already been performed. Please refer to Exalt's document "Exalt Communications: Guidance for Engineering and Site Planning of Terrestrial Wireless Links" for detailed information on these activities.

The EX-2.4i utilizes radio frequencies in the range of 2400 to 2483.5MHz. In most countries this frequency band is 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 pre-notification, 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 users as well as other devices that occupy this spectrum. In these cases, it is up to the engineering and maintenance personnel to design around existing and future interference sources, recognizing that there is a chance that the interference conditions could be a very dynamic condition, 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 must be disengaged or modified 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, maximum output power, application, limited geography of use, and other such regulations. The engineer or user is encouraged to determine these limitations and engineer/install the system within the confines of all local regulations. This guidance is extended to the peripheral equipment, installation and cabling of the system, which may be regulated for human safety, electrical code, air-traffic control, and other such entities.

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. Please consult your local regulatory organization(s) to determine the 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 dealer for information pertaining to your country.

1.2 EX-2.4i Basic Features

The EX-2.4i Digital Microwave Radio is a one-piece radio device that is intended for all-indoor or radio enclosure-based mounting. The associated antenna is typically mounted on a tower or mast structure on a rooftop, with RF cabling running from the antenna location, with an egress through the structure or radio enclosure, with proper lightning suppression and grounding, to the

RF connector of the EX-2.4i. In turn, the communications interfaces and power connections are directly applied to the EX-2.4i, or in some cases, also with an egress through the structure or radio enclosure with proper lightning or surge suppression devices and associated grounding.

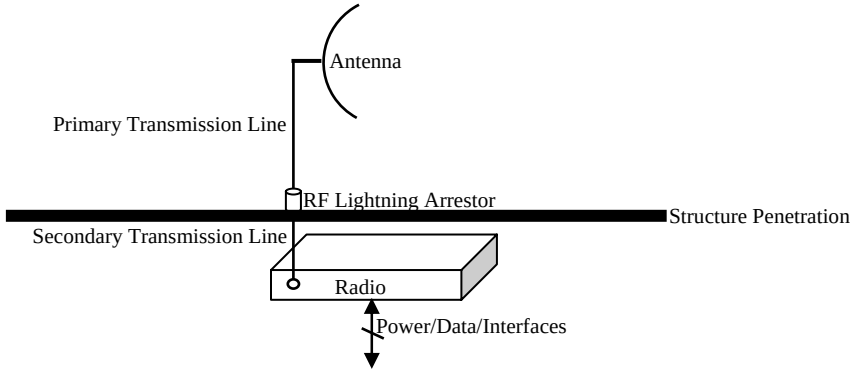

Figure 1-2: Indoor Radio Mount Interconnection

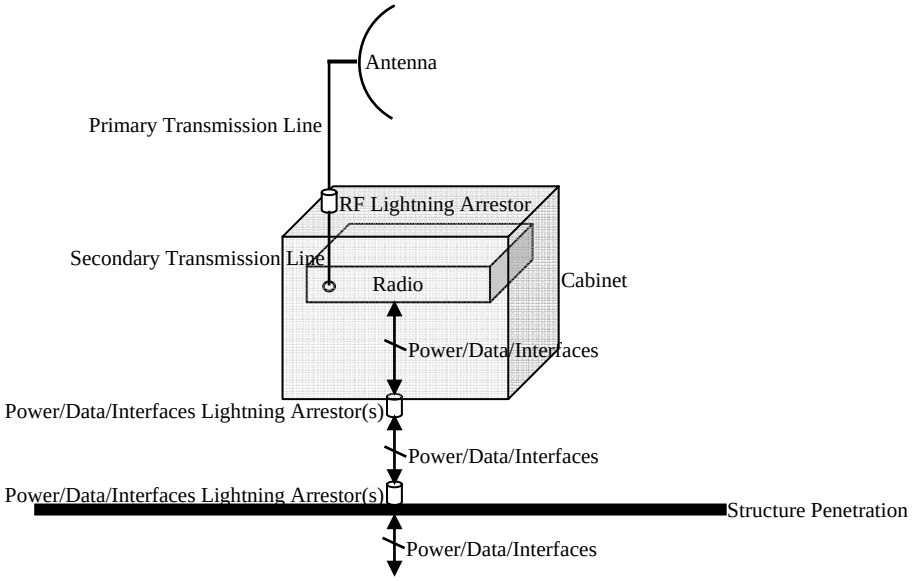

Figure 1-3: Cabinet Radio Mount Interconnection

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 RF port.

The EX-2.4i provides connection for any of the following data communication interfaces, or a combination thereof:

- 100BaseT Fast Ethernet, up to line-speed (100Mbps full-duplex user Ethernet data rate)
- 1-4xT1/E1 interfaces for synchronous voice traffic
- DS-3 interfaces for synchronous voice traffic

The EX-2.4i is powered by a direct DC connection (48V) or by an optional external AC adaptor (sold separately).

The EX-2.4i provides the following features and benefits:

- Computer-free link initiation for fast system initiation
- Low-latency optimization for voice and data connections
- Very high throughput and flexible interface configuration with voice+data combinations
- Encryption for extreme wireless security
- Secure and easy-to-use management and configuration
- Flexible utilized channel bandwidth selection for interference avoidance and frequency coordination
- Agile center frequency tuning, including dynamic frequency selection for interference avoidance and frequency coordination
- Adaptive or selectable modulation/capacity for continuous connection during adverse RF conditions or interference

Section 2 – Before Installation

2.0 Link Engineering and Site Planning

Any terrestrial wireless link should be designed prior to purchase and installation. Generally, professional wireless engineering personnel are engaged to determine the viability and requirements for a well-engineered link that will meet the user's needs for reliability.

The reader is referred to the document "Exalt Communications: Guidance for Engineering and Site Planning of Terrestrial Wireless Links." This document describes all of the pre-planning and engineering that is required to determine the following parameters:

- 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 output power setting
- Radio grounding
- Anticipated Received Signal Level (RSL) at each end

With respect to radio path and site planning, the EX-2.4i is generally identical to any other microwave terrestrial wireless system. Engineering of these systems may not require significant specific knowledge about the EX-2.4i itself. The most important parameters being:

- RF specifications (output power, threshold, occupied bandwidth, carrier-to-interference tolerance)
- Regulatory limitations on output power setting and antenna type/gain

2.1 Laboratory Back-to-Back Test

It is strongly advised to perform a back-to-back test, in a controlled environment, prior to installation. This will allow you to perform several tasks which can be much more difficult to perform once the radio link endpoints are distant from one another. Most importantly, a back-to-back test will provide confidence that the radio link is operational and configured properly **prior** to installation, so that if troubleshooting is necessary, the radio hardware and configuration settings are eliminated from the troubleshooting process.

- Confirm that the radio system is generally operational
    - Radios power-up with planned power and wiring solutions

  - RF link can connect in both directions
  - Traffic can be passed across the link
- Configure connected equipment and cabling
  - Test Ethernet (CAT5) cabling, and/or T1/E1/DS3 cabling, any auxiliary connector cabling and configure all interfaces
  - Configure IP settings for configuration and management
  - Configure passwords and security modes
  - Become familiar with the configuration and management interfaces, including the web-based GUI interface, the SNMP interface and/or the CLI/Telnet interface.
- Configure radio parameters
  - Set output power to engineered or allowed level (see section 2.2)
  - Set operating center frequency and dynamic frequency setting (DFS) parameters
  - Set occupied bandwidth/capacity/modulation parameters
- Make detailed radio performance measurements
  - Measure output power
  - Measure receiver threshold
  - Confirm error-free performance

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

Detailed performance measurements are typically not required for pre-installation, but they can typically 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 test should be performed to re-verify many or all of the items above, 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/replacement.

Detailed instructions for back-to-back testing are included in Appendix B.

2.2 RF Output Power Setting

The maximum RF output power is bounded by one of the following criteria (in order from highest to lowest):

- Maximum RF output power setting of the radio device
- Maximum RF output power allowed/authorized by the local government regulations and for this specific device
- Maximum EIRP (effective isotropic radiated power) 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

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 be found in this section (below) and in section 5.

The following information pertains to specific regulatory requirements based on up-to-date information for countries where the EX-2.4i is authorized. A list of recommended antennas can be found in section 4.3.

2.2.1 United States

The EX-2.4i operates under FCC Rule Parts 15.247 as a license-exempt device, and must be professionally installed. It may only be used as a point-to-point transmission device for fixed or temporary-fixed (non-mobile) installations. The device is subject to the following restrictions:

- External amplifiers may not be used to boost the power, or to overcome transmission system losses, unless the specific amplifier/cable/antenna combination has expressly been authorized by the FCC. The output power must never exceed +30dBm.
- 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)
- Only parabolic dish antennas or directional flat-panel antennas may be used. No other types of antennas (omni-directional, yagi, etc.) are authorized. Parabolic dishes of either grid or solid type are allowed. Maximum gain of each type of antenna certified is:
    - Parabolic Dish: 30.3 dBi (6-foot diameter)
    - Directional Flat Panel: 20.5 dBi (~2-foot square)
- Maximum transmit power with respect to FCC (USA) EIRP regulations is determined with the following equation:

$$P = 30 - [(G - 6)/3] + L$$

Where:

P = Maximum output power of radio, in dBm

G = Specified gain of antenna, in dBi, from 2400 to 2483.5 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 2400 and 2483.5MHz

The maximum EIRP allowed for this device is 52.2 dBm. The maximum RF output power is +30dBm.

The professional installer is responsible to assure that RF output power has been properly adjusted so that it does not exceed the regulatory limit, per these conditions.

2.2.2 Canada

The EX-2.4i operates 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 may not be used to boost the power, or to overcome transmission system losses, unless the specific amplifier/cable/antenna combination has expressly been 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 or directional flat-panel antennas may be used. No other types of antennas (omni-directional, yagi, etc.) are authorized. Parabolic dishes of either grid or solid type are allowed. Maximum gain of each type of antenna allowed is:
    - Parabolic Dish: 30.3 dBi (6-foot diameter)
    - Directional Flat Panel: 20.5 dBi (~2-foot square)

  A complete list of allowed antennas can be found within the Industry Canada regulatory statement at the front section of this manual.
- Maximum transmit power (Pmax) based on Industry Canada EIRP regulations is unlimited.

Section 3 - System Installation and Initiation Process

This section briefly describes the process for system initiation and turn-up.

3.1 Outline of Tasks

The process of radio installation and initiation is outlined here.

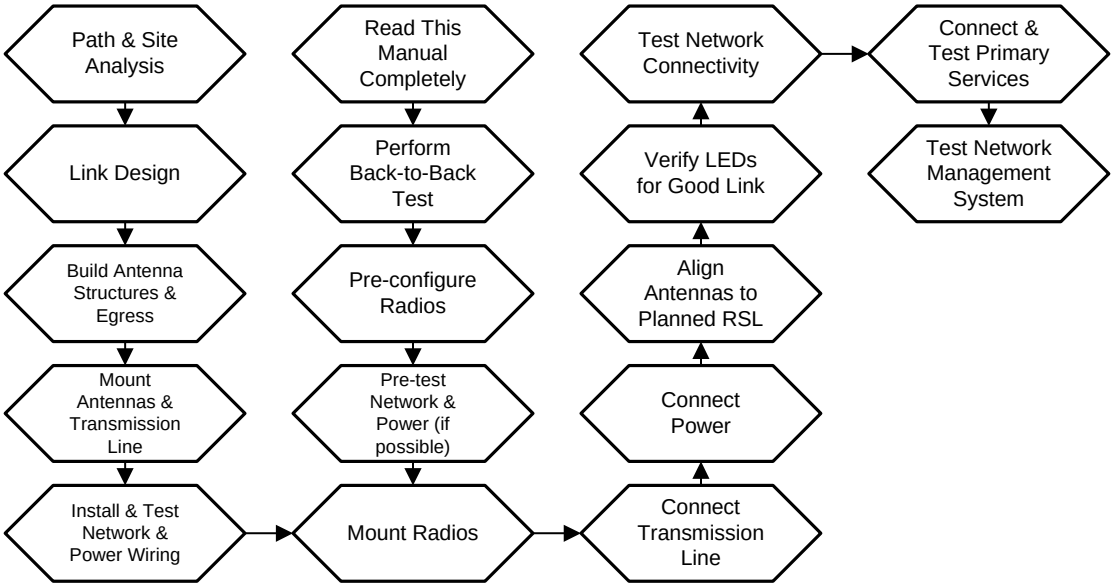

Figure 3-1: Radio Installation Flowchart

3.2 Record Keeping

After installation, it is advised that the following items are recorded for the sake of ongoing maintenance and any future troubleshooting. A record should be kept for each end of the radio link. It is advised to store a copy of these records at the radio location, at the opposite end radio location, and a central record-keeping storage location.

- GPS coordinates for antenna locations at each end
- Antenna heights (AGL) as mounted
- Antenna model numbers, serial numbers and specifications
- Antenna polarization as mounted
- Length/type of primary transmission line
- Model number and serial number of RF lightning arrestor used
- Length/type of secondary transmission line(s)
- Transmitter output power setting as installed
- RSL as measured after antenna alignment

- Designed RSL per original design
- RSL reading with far-end power off
- Spectrum analyzer plot with far end off
- VSWR/Return Loss at Radio's antenna connector
- Radio's network management IP address
- Radio's Network Management Gateway address
- Radio's transmitter and receiver frequency

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

- Security codes (should be kept in a secure place or memorized)
- Photographs of complete installation
- Customer sign-off/acceptance document (if any)

Section 4 - Installation and Configuration

4.0 Mechanical Configuration and Mounting

The EX-2.4i is a one-piece radio design intended for deployment in a telecom equipment rack indoors or in an appropriate environmental enclosure. The device must be deployed within an ambient temperature range as specified and properly ventilated with no obstructions to the air intake and exhaust. The radio occupies 1 rack unit (1.75”) in a typical telecom rack.

In most cases, additional racked equipment can be placed directly above and/or below the device with no empty spaces in the rack. However, depending on the power consumption and ventilation for those adjoining devices, they may pass heat to the device and render the radio unable to cool properly, which can lead to device failure. Likewise, heat dissipation from the radio may cause adjoining devices a similar condition. With this in mind, it is desired to have some air space above and below the device, where possible. Where this is not possible, a thermal analysis may be required by a professional engineer to determine the impact of thermal transfer between all adjoining units.

It is also possible to mount the device on a wall or a table.

With respect to the connections, proper clearance shall be provided for all cables and connectors that affix to the device. Most notably, the RF cable connector may require significant clearance for the bend radius of the coaxial cable assembly. If desired, a properly-specified 90-degree RF connector may be used on this connector to minimize clearance requirements, such as may be necessary in an enclosure implementation. All RF connectors, cables and adapters must be rated for operation over 2400 to 2483.5 MHz and their losses must be accounted for within the link engineering design and output power settings.

4.0.1 Rack Mounting the System

Rack mounting hardware for a standard 19-inch or 23-inch rack is included in the Accessory kit. Affix the rack mounting brackets to the sides of the unit with the screws supplied. The radio may be flush mounted or projection mounted at a variety of depths. Rack screws are not provided, use the appropriate screw type matching your equipment rack.

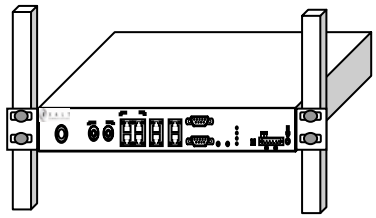

Figure 4-1: 19-inch Rack Mount

If mounting in a 23-inch rack, the rack mount extensions must be affixed to the standard rack brackets. Simply attach these extensions using the screws supplied.

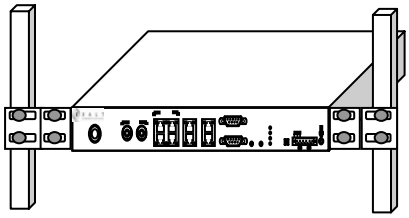

Figure 4-2: 23-inch Rack Mount

4.0.2 Wall Mounting the System

If mounting on a wall, a wall-mount kit is required. The brackets from the wall-mount kit can be affixed so that the mounting holes are oriented towards the bottom of the radio. It is advised that the brackets be mounted in the most central mounting location to the chassis, as shown.

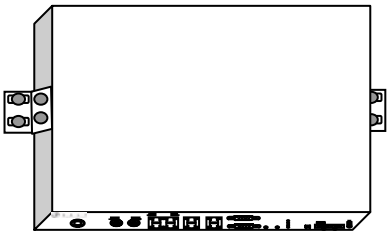

Figure 4-3: Wall Mount

4.0.3 Table or Rack Shelf Mounting the System

If mounting on a table or a rack shelf, it is advised to affix the rubber feet that are included in the accessory kit. Simply remove the adhesive cover from the rubber feet, and affix the feet to the bottom of the unit near the corners. These feet will help keep the radio stable on a wooden or metal surface to keep it from sliding.

In many areas, it is necessary to strap the equipment to a table or rack shelf if mounting in this manner. In case of earthquake or other shock or vibration, or an accidental pull of a cable, the unit should be secured from falling.

4.1 User Interfaces

This section is intended to provide a brief familiarization of the connectors, controls and indicators on the device. More details about each item are found in other sections of this document.

The EX-2.4i front panel is shown here:

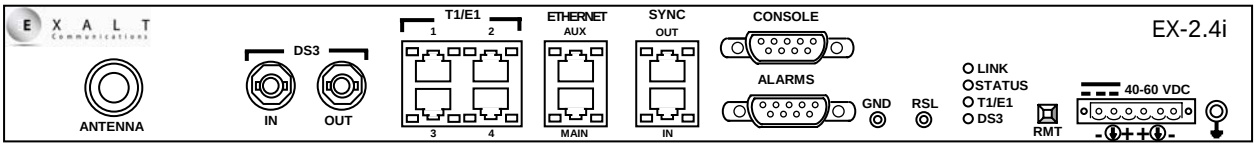

Figure 4-4: Front Panel

4.1.1 Connector Overview

The following table provides detail of the connectors on the front panel of the EX-2.4i.

Label	Type	Gender	Function
Antenna	N	F	Transmission line connection to antenna
DS3 (In/Out)	BNC	F	Primary ports for User DS3 circuits to traverse link
T1/E1 (1-4)	RJ-48C	F	Primary ports for User T1 or E1 circuits to traverse link
Ethernet (Main/Aux)	CAT5	F	Primary ports for user Ethernet and/or management data (10BaseT or 100BaseT) to traverse link
Sync (In/Out)	CAT5	F	External radio synchronizing source (e.g. GPS) input and output
Console	9-pin sub-D	F	Management port (serial) for PC/PDA for Command Line Interface (CLI) communications
Alarms	9-pin sub-D	F	External alarm inputs and outputs
GND (Ground)	Bantam	F	Common (return) voltmeter port for measuring received signal level
RSL	Bantam	F	Voltmeter port for measuring received signal level
40-60VDC	6-pin Modular	M	DC power input from DC source or AC adaptor
⏚ (Ground)	Threaded (M5) Receptacle	F	Chassis ground connection (M5 x 0.8 thread)

Table 4-1: Connectors

4.1.2 Indicator Overview

The following table provides detail of the indicators on the EX-2.4i.

Location/Label	Type	Function
Link	3-color LED	**Indicates RF link status:** Green Solid = Error-free connection (BER<10e-6) Yellow Solid = Errored connection (10e-3>BER >10e-6) Red Solid = No link (BER>10e-3)

		Red Blink = No remote information available Off = System is not properly powered/system failure
Status	3-color LED	**Indicates system status:** Green Solid = No alarm conditions (normal operation) Yellow Solid = Alarm conditions, not traffic effecting Yellow Blink Slow = In loopback (from this end) Yellow Blink Fast = In loopback (at this end) Red Solid = Alarm conditions, traffic effecting Red Blink = No remote information available Off = System is not properly powered/system failure
T1/E1	3-color LED	**Indicates T1/E1 support:** Green Solid = T1/E1 interfaces supported Yellow Solid = T1/E1 interfaces supported, but disabled Off = T1/E1 support not alarmed; System is not properly powered/system failure
DS3	3-color LED	**Indicates DS3 support:** Green Solid = DS3 interface is supported Yellow Solid = DS3 interface supported, but disabled Off = DS3 support not alarmed; System is not properly powered/system failure
Left Corner Data	Green LED	Solid = Negotiated @ 100Mbps Blink = Negotiated @ 10Mbps Off = No connection negotiated
Right Corner Data	Green LED	Solid/Blinking = Data is present Off = No data present
Left Corner T1/E1	Green LED	Solid = Connection present (clocking confirmed) Blink Fast = Connection present, coding/clock problem Blink Slow = Connection present but unexpected Off = No connection/clock
Right Corner T1/E1	Yellow LED	Solid = Loopback Blink Fast = AIS Off = No loopback, No AIS
Remote End Button	Amber LED	Off = Remote end Link & Status LEDs are both green Solid = There is no remote end status available Blink = There are alarm conditions (Link and/or Status LEDs are non-green) at the remote end
Sync In Left Corner	Green LED	On = Sync input connected Off = Sync input not connected
Sync In Right Corner	Green LED	Unused
Sync Out Left Corner	Green LED	On = Sync output connected Off = Sync output not connected
Sync Out Right Corner	Green LED	Unused
Summary (Rear Panel)	3-color LED	**Indicates overall status (from the rear panel):** Green = Link and Status are both green

		Yellow = Link and/or Status are in a yellow state Red = Link and/or Status are in a red state Off = System is not properly powered/system failure

Table 4-2: Indicators

4.1.3 Control Overview

There is only one external control on the EX-2.4i, a button labeled "RMT" (Remote). This button allows the user to easily and quickly evaluate the status of the remote end radio. Press and hold the button and, while held, all local end status LEDs (Link, Status, T1/E1, DS3) represent the status of the LEDs on the remote end radio. In addition, the RSL Voltage also represents the voltage that is present at the remote end.

When the amber LED that is embedded in the RMT is flashing, this is an alert that the remote end has an alarm condition, and the button should be pressed to determine the alarm conditions.

When the RMT button is pressed and held, and all local LEDs flash, there is no far end information available. This indicates that the remote radio is either not powered, is booting, or is not linked in the direction towards the local radio, or the local radio is receiving excessive errors in this direction. It could also indicate a serious failure of the local or remote radio. Examining local end LEDs (when this button is not pressed) in combination with the remote end information (from a technician located at the far end, and/or when the button is pressed) can aid in troubleshooting analysis.

4.2 Applying Power

The radio requires a DC power source within specifications, as stated. The DC may be provided from a DC battery source, central lab/rack supply or from Exalt's AC adaptor (sold separately).

4.2.1 Terminating the RF Connector

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

There are a few simple means to accommodate this proper termination:

- Connect a 50-ohm coaxial termination device to the RF port of the radio. The termination needs to 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 should be at least 20dB as specified at 2400 MHz, and rated for a minimum of 1W input power.
    - Broadwave Technologies P/N 352-103-xxx
    - Bird 2-A-MFN-xx
    - JFW Industries 50FP-xxx-H6-N

4.2.2 AC Power

The optional AC adaptor (sold separately) comes equipped for easy direct connection to the device. The AC rating of the adaptor accepts most worldwide standard voltages and frequencies. Please refer to the input voltage requirements stated on the label that is affixed to the adaptor to assure that the adaptor may be used with your AC mains supply. The AC plug outlet provided with the adaptor may need to be replaced to match your country configuration. The adaptor cable uses a standard connector for this cable so that you can simply use a pre-wired cable that is appropriate to your outlet configuration. If that type of cable is not available, the existing AC plug end can be severed and a replacement plug affixed. Consult a qualified electrician for this activity.

Do not plug the adaptor into your mains power. First, verify that the RF connector is properly terminated (per section 4.2.1 above) and then plug in the radio-side connector from the AC adaptor to the radio. If your AC mains can be turned off by a switch, disable the power first, plug the AC side of the adaptor into the AC mains socket, and then enable power to the circuit. If your AC mains cannot be turned off, simply plug into the AC main socket to apply power. Verify radio is active by observing LED activity. All LEDs will flash at initial power cycle, for the user to verify that all LEDs are operational.

It is strongly encouraged that the AC Mains supply be fused or on a breaker to ensure against over-voltage and/or over-current situations to provide some form of protection to the radio electronics and other devices that may be connected to the same supply. In addition, if your AC power is subject to significant spikes or variation, power conditioning is a worthwhile investment, as the quality of mains power may have a direct impact on the device operation, performance and/or reliability. Many users will deploy an Uninterruptible Power Source (UPS) or other form of battery-backed system, to protect against brown-out and black-out conditions, as well as to condition the power being presented to the adaptor.

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

The above statement is similarly true for every wired connection to the device. While the configuration for surge suppression or line conditioning is of a different type for each kind of signal interface, the opportunity for damage to the device, loss of communications and property

can be significant. In some cases, there can also be a risk to human life by not protecting against lightning entering a building through wiring or improper grounding. If you do not have experience in this type of installation practice, it is strongly suggested that a qualified electrician and/or telecoms professional is consulted during the installation of the equipment and wiring.

4.2.3 DC Power

The device accepts direct DC power within the voltage specifications stated (48 Volts, nominal) and with enough current delivery capacity, also per the specifications stated. The DC power may be connected as a positive or negative voltage supply, and may be referenced to ground or may be 'floating' (differential voltage). There are different system grounding considerations depending on the nature of the DC supply grounding, and your qualified electrician or telecoms professional should be consulted on the proper wiring and grounding process.

To connect a DC source, with the power disabled on the DC supply, connect proper gauge wiring to your DC supply. For most (short) power cable runs, 18awg or 24awg wire can be typically used. Strip the ends just long enough for enclosure to the DC radio connector, approximately 0.25 inches (6mm). If using stranded wire, the stripped ends that will be inserted into the DC terminal connector should be solder-tipped. If using solid wire, a solder-tip is not necessary. Make sure that the power wiring is long enough to neatly traverse, when properly dressed, between the supply and the radio mounting location. If DC wires will be exposed to outdoor environments, use wire that is in a proper weather-proof wiring jacket. For longer runs of DC wiring, you may need to use higher gauge wire and/or a higher current source supply to overcome the additional resistance of the DC wiring. However, the DC connector for the radio may not be able to accept a very high diameter wire, so you may need to transition to thinner gauge, if necessary, near the end of the wiring run, or simply use the maximum diameter wire for the entire wiring run, so long as it meets the powering requirements considering the total resistance of the wiring and the power source current load capacity.

Insert the wiring ends into the DC mating connector (supplied). The mating connector should NOT be connected to the radio system, and the power system should be disabled. Pay close attention to the polarization of the DC signals coming from the DC supply and the ground conductor (if any), and ensure that you have connected them to the proper pins of the DC mating connector. The connector mate on the radio is clearly marked for proper polarization and for ground connection.

It is recommended that you wire across the plus (+) and minus (-) terminals from the DC supply, and place a separate jumper between the proper terminal and the ground terminal if you wish to reference one side of the power supply line to the radio chassis ground. In most cases, your DC system would be floating and this is not necessary, but some configurations may require one side to be grounded for proper electrical safety.

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

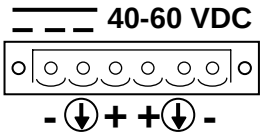

Figure 4-5: DC Connection

Once the wires are connected to the mating connector, do not connect to the radio and first test the DC connection to the connector from the DC supply. Engage power on the DC supply, and use a volt meter to verify proper voltage level and polarization.

Verify that the RF connector is properly terminated, per section 4.2.1 above. Disengage power once again on the DC source, and connect the mating connector to the radio device. Engage power on the DC source. Verify radio is active by observing LED activity. All LEDs will flash at initial power cycle, for the user to verify that all LEDs are operational.

Refer to the previous section (4.2.2) regarding fusing, breakers, lightning protection, surge protection and power conditioning. These recommendations should also be followed for a DC supply.

4.2.4 Backup or Emergency Power

In addition to traditional backup power systems, such as battery supply, UPS or generator-driven central supply, the EX-2.4i is designed to accommodate a multi-source DC supply, if desired, for backup power source connection. If your primary source of power is not backed up directly, you can alternatively connect a second source of power supply to a second set of pins on the DC connector. These pins are properly bridged and rectified to isolate the two DC power sources from one another, and draw from either or both of the supplies, as necessary.

For example, some users identify the AC adaptor as a critical path assembly for overall system reliability, and connect redundant AC adaptors accordingly. Or, they may have AC supply as primary, and a secondary DC system that engages in case of AC power failure. Likewise, this redundancy can be wired into the DC connector accordingly. Virtually any redundant power system can be accommodated with this dual-input structure, as desired.

4.3 The Antenna/Transmission System

This section provides general guidance to the mounting and connecting of the RF transmission system, consisting of the antenna, RF cabling and RF lightning arrestors. Manufacturer's instructions for proper mounting, grounding and wiring of these devices should be consulted for definitive direction, and those instructions supersede any of the information in this section.

The following list of antennas is recommended in conjunction with this product. In some countries, antennas exceeding a certain level of gain may be unlawful. Refer to section 2.2 for details on regulatory limits.

Manufacturer	Model #	Description	Gain (dBi)	3dB (Az/El) Beamwidth (degrees)
Andrew	19T-2440-1	16-inch Solid Parabolic Dish	19	16/17
Andrew	21T-2441-1	24-inch Solid Parabolic Dish	21	10/11
Andrew	18T-2400-1	Semi-parabolic Grid	17	14/13
Andrew	26T-2400-1	Semi-parabolic Grid	23	7.5/10
Andrew	P2F-23	2-foot Solid Parabolic Dish	21.6	12/13.3
Andrew	P4F-23	4-foot Solid Parabolic Dish	27.3	6.9
Andrew	KP3F-23	3-foot Grid Parabolic Dish	25.1	8.1
Andrew	KP4F-23	4-foot Grid Parabolic Dish	27.5	6.9
Andrew	KPR3F-23	2-foot Grid Parabolic Dish	23.6	7.9/8.7
Andrew	KPR4F-23	4-foot Grid Parabolic Dish	27.3	6.2/6.7
Andrew	QD-2402	11-inch Panel	16	27
Gabriel	DFPS.5-23	6-inch Panel	10.3	35/53
Gabriel	DFPS1-23	1-foot Panel	16.5	36
Gabriel	P-24A36	3-foot Grid Parabolic Dish	25.7	8.4
Gabriel	P-24A48	4-foot Grid Parabolic Dish	27.7	6.5
Gabriel	SSP2-23	2-foot Solid Parabolic Dish	20.7	14.5
Gabriel	SSP4-23	4-foot Solid Parabolic Dish	26.7	7.2
Gabriel	SSP6-23	6-foot Solid Parabolic Dish	30.3	4.8
Gabriel	HSSP2-23	2-foot Solid HP Parabolic Dish	20.5	14.5
Gabriel	HSSP4-23	4-foot Solid HP Parabolic Dish	26.3	7.2
Gabriel	HSSP6-23	6-foot Solid HP Parabolic Dish	30.0	4.8
RadioWaves	SP1-2.4	1-foot Solid Parabolic Dish	14	28
RadioWaves	SP2-2.4	2-foot Solid Parabolic Dish	21.3	14
RadioWaves	SP3-2.4	3-foot Solid Parabolic Dish	24.3	9.5
RadioWaves	SP4-2.4	4-foot Solid Parabolic Dish	27.2	7.3
RadioWaves	SP6-2.4	6-foot Solid Parabolic Dish	30.3	4.8
RadioWaves	G3-2.4	3-foot Grid Parabolic Dish	24.5	9.2
RadioWaves	G4-2.4	4-foot Grid Parabolic Dish	27	7.1
RadioWaves	G6-2.4	6-foot Grid Parabolic Dish	30.3	4.6
RFS	MGAR2-23	2-foot Grid Parabolic Dish	20.8	13.7
RFS	MGAR3-23	3-foot Grid Parabolic Dish	24.2	8.6
RFS	MGAR4-23	4-foot Grid Parabolic Dish	27.2	7
RFS	SPF2-23	2-foot Solid Parabolic Dish	20.5	13.8
RFS	SPF3-23	3-foot Solid Parabolic Dish	24.2	9.2
RFS	SPF4-23	4-foot Solid Parabolic Dish	27.1	6.9
SuperPass	SPAPG20	14x15.5-inch Panel	20.5	15/16

Table 4-3: Recommended Antennas

4.3.1 Initial Antenna Mounting

The antenna should be the exact model recommended by the path and site planning engineer(s). The antenna should be mounted at the proper height, mast/mounting location and polarization orientation also 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 co-located systems operating in or near the same frequency band.

The antenna shall be mounted in a restricted area and in a manner which prevents 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 feet (3 meters).

The antenna structure must be secure and safe with respect to the mounting of the antenna, transmission system weight, 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 that may be affixed to the structure.

If additional objects may be 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 you have mounted, cabled and aligned the antenna, your goal will be to never require modification, so this prior planning can be important in the path and site planning stage, and the construction of the antenna structure.

Follow the antenna manufacturer’s instructions for mechanical mounting of the antenna. Make sure that there will be enough room around the antenna to allow 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 to prepare for 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, so as to reduce the opportunity for debris or moisture to enter either the antenna connector or the transmission line connector. Otherwise, a connector cover or other temporary

measures can be taken to keep the connector clear. Extra care must be taken if the antenna is installed during inclement weather to be certain that no moisture gets inside the antenna connector at any time.

The antenna may be aimed at this point in the general direction required for the link. Using a compass, a reference bearing, binoculars or any other similar device, you may point the antenna in the right direction (generally), and slightly tighten the azimuth and elevation adjustments enough so that the antenna maintains its general position and is safe to be left without additional securing.

4.3.2 Transmission Line from Antenna to Egress

Most installations use coaxial transmission line for the connection between the antenna and the radio device. Coaxial transmission line may be either solid-shield or braided-shield variety. Solid-shield cables are more resistant to external signal coupling and interference, but are generally stiffer than braided cables. The path or site engineer(s) should be consulted to assure that the proper materials were chosen for the installation with all factors considered.

Generally, the thicker the transmission line, the lower the loss. So for longer runs of transmission line, thicker cables are highly advised. However, at every frequency, there is a maximum diameter cable that will support the operating frequency, so be certain to verify the specifications. This should have all been determined during the path and site planning process.

In some cases, the choice of transmission line will not be coaxial cable, but instead will be air-dielectric waveguide. This is an expensive solution and is generally not necessary, but may be required for very long transmission line runs and/or for very long link distances and/or for systems that require extremely high reliability.

The following is a representative sample of transmission line types that are recommended for this radio:

- Andrew Heliax® LDF4-50, 1/2-inch solid copper shielded coaxial cable, 3.3dB/100ft.
- Andrew Heliax® LDF4.5-50, 5/8-inch solid copper shielded coaxial cable, 2.5dB/100ft.
- Times LMR-600, 1/2-inch braided coaxial cable, 4.3dB/100ft.
- Times LMR-900, 5/8-inch braided coaxial cable, 2.9dB/100ft.
- RFS LCF12-50J 1/2-inch solid copper shielded coaxial cable, 3.5dB/100ft.
- RFS LCF12-58J 5/8-inch solid copper shielded coaxial cable, 2.8dB/100ft.

For extremely long transmission lines and/or extremely long radio paths, it may be necessary to use waveguide transmission line instead of coaxial transmission line.

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

connectors. For waveguide, the waveguide flange can typically accommodate a direct adapter to an N connector, or alternatively, the antenna can be purchased with a direct waveguide connection. But often a flexible coaxial jumper is needed to connect between the waveguide to the antenna, as waveguide is generally inflexible and can be mechanically challenging to align to the exact antenna connector location.

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, and the antenna can typically accommodate a direct connection if planned in advance. You may use a 90-degree adaptor for the connection to the antenna, if necessary – but be certain to confirm that all connectors and transmission lines are properly specified for the operating frequency (2400 to 2483.5MHz, in this case) with minimum loss, proper impedance (50 ohm) and proper Voltage Standing Wave Ratio (VSWR) characteristics.

Transmission line connector termination is perhaps the most critical element of the installation. Many 'factory built' RF transmission lines may actually 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 receive documentation of the test measurements on the connected transmission line showing that the loss characteristics and VSWR are within specified limits specifically at your operating frequency. In addition to factory-built transmission line, self-terminated transmission line can suffer the same issues. 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 manufacturer's 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.

Once the transmission line is connected to the antenna, traverse the exact route provided by the site planner. 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, as well as 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 connector. Take care to align the cable with the connector in a manner that does not provide any torque or strain on the connector.

Consult your transmission line manufacturer for proper transportation, hoisting, securing and grounding process. Always be very mindful to the entire length of transmission line to assure that the transmission line is never twisted or kinked or over-bent past the specified bend radius. Once a transmission line is over-bent, it may never recover its specified characteristics, even after straightening.

The opposite end of this primary transmission line will typically terminate at the building or enclosure egress point. This is the location where the RF lightning arrestor shall be located. A proper termination to the connector-type of the lightning arrestor shall be made at this location.

Once again, a drip loop may be required, and proper securing hardware and grounding needs to be accommodated.

As soon as practical, the connected ends of the transmission line to the antenna and lightning arrestor should be weatherproofed. Generally this process should be delayed as long as possible to be certain that all systems are working properly before weatherproofing is applied, as once weatherproofing is applied, you may be required to remove it if any tests or changes are needed before installation is complete. However, if the installation is occurring during inclement weather, extra care must be taken at all times to assure 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.

It bears mention that on rare occasion, the antenna might be mounted indoors and behind a window or other barrier. In these cases, there would not be a need for drip loops or an RF lightning arrestor. In cases such as these, a very short transmission line can typically be connected directly between the antenna and the radio mounted nearby. In these cases, the weatherproofing process can also be omitted.

4.3.3 RF Lightning Arrestor

The purpose of the RF lightning arrestor is to provide a direct path to ground for any lightning strike that may couple to or directly hit the outdoor transmission system or antenna structure. As such, the RF lightning arrestor prevents the associated voltage and current from entering the building or enclosure, where it might harm the radio equipment, other equipment, or humans.

The following lightning arrestors are examples of proper devices for this model:

- Polyphaser AL-LSXM
- Andrew BB-BNFNFE-26

The RF lightning arrestor shall be mounted and grounded in accordance to the manufacturer's recommendations. It shall be placed as close as possible to the egress point where the next piece of transmission line enters the building or enclosure. Minimize the distance to the egress to the opportunity for lightning to couple to or strike the section of transmission line that is unprotected (if any). Where possible, a bulkhead connector should be used to eliminate any opportunity for this risk. If cable lengths behind the arrestor and into the egress are kept substantially short (less than 1m), this is typically considered safe practice. Your qualified electrician or installer shall be consulted in all cases of grounding and lightning arrestor implementation.

4.3.4 Transmission Line from Egress to Radio

Once again, it is desired to have a single transmission line section from the egress to the radio RF connection. Minimize the number of connectors and adaptors. For indoor runs, a cable ladder or tray may be needed to properly secure the cable. In some cases, a short flexible jumper may be

needed to allow for ease of connection to the radio's RF connector. A properly specified 90-degree connector can often eliminate this need. Or an installation with space accommodated around the radio for a gentle bend radius of the transmission line can also accommodate a direct connection. In all cases, be certain that the transmission line is not providing any pulling force onto the RF connector of the radio. Transmission lines can be very stiff, and can damage the connector if not dressed properly. Also, follow the transmission line manufacturer's instructions for proper cable securing devices.

4.4 Antenna Alignment

Antennas must be installed at both ends of the planned link to commence precision alignment.

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

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

Using these devices can be extremely advantageous compared to using the radio, as they employ many unique facilities to aid in this process. In addition, using these tools makes it possible to align the antennas before the radio equipment is delivered on site. However, many installers routinely use the radios as the means for antenna alignment, and they have much success with this method as well.

The radio includes four facilities to aid in antenna alignment:

- Received Signal Level (RSL) voltage port
    - The RSL port voltage is inversely proportional and numerically calibrated to the received signal level. The voltage will rise as the antennas are less in alignment, and fall 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 0.60V; an RSL of -45dBm measures 0.45V.
- Built-in alignment beeper
- LED flashing mode
- Web interface
- Scrolling CLI display through serial port
- Scrolling CLI display through Telnet access

Aligning the antennas using the radio can be accommodated in a number of ways:

- Radio near/at antenna location

  - Temporarily connect the radio to the antenna using a short piece of transmission line, so that the radio is very close to the antenna location
    - Run wires, as necessary, from RSL port to voltmeter so that antenna installer can view the voltmeter directly
    - Connect headphones or speaker to RSL port for audio alignment by the antenna installer
    - Listen for the radio internal beeper

Note: The final RSL readings during alignment will likely be different (better) than the planned RSL, due to the short RF transmission line. Determine ideal RSL in this temporary configuration to assure proper ideal alignment.

- Run separate wires from radio mounted location to antenna location
  - Temporarily connect a set of wires from the RSL port of the radio up to the antenna location, for the radio installer to use a local voltmeter or headphone/speaker

Note: Due to the resistance of the cable, the RSL readings might be impacted. Use the thickest wiring possible in this configuration, where possible. You may test the impact of the voltage reading due to the wiring by comparing a direct measurement at the RSL port versus at the end of the wiring, if necessary.

- RF/DC coupler
  - Install a temporary DC coupling device at the radio antenna port and at the antenna connector. Connect the RSL port to the radio antenna port coupler, and the voltmeter to the antenna connector coupler. See Appendix C for more information.

- Verbal relay/Walkie-talkie/Mobile radio/Cell phone
  - A person located at the radio front panel may use a short-range communication device or verbal relay to communicate to the antenna installer, reading off RSL voltage measurements continuously.

4.5 Configuration Using the Command Line Interface (CLI)

The EX-2.4i utilizes a CLI as the primary user interface for configuration and management of the system. The Console port may be used for serial devices, or the Ethernet MAIN or AUX ports may be used for a Telnet session over a network connection.

4.5.1 Connecting to the Radio

For serial interface to the Console port, on your PC, PDA, Terminal or any other device that has a serial interface and text-input capability, the following settings are needed on your device:

Baud rate:	9600 bps
Parity:	No
Data bits:	8
Stop bit:	1
Flow Control:	No
Terminal Emulation:	VT100

A standard serial cable (not a null modem cable) is required for connection between your device and the Console port. See Appendix X for wiring detail.

Once connected and configured, press the return/enter key to get to a prompt. At the prompt, enter 'help' or '?' or '9' or 'menu' to get to the root menu.

For a Telnet connection to the radio through either of the Ethernet ports, using Windows OS, perform the following steps:

- Open a Command Prompt, or MS-DOS prompt (Start…Run..cmd)
- Enter the following at the command line of the command prompt window:
  C:\>Telnet <*IP Address*>
  Note: The default IP address of the EX-2.4i is 10.0.0.1
  Note: You may reset the default address through serial CLI or by radio reset (as described in section 4.1.3)
  After entering this command, your command window should indicate: Connecting to 10.0.0.1 . . .
- When prompted, enter the administration level password
  Note: The default administration password is 'admin' (no quotes, case sensitive)
  Note: You may reset to the default administration password by radio reset (as described in Section 4.1.3)
- At the prompt, enter 'help' or '?' or '9' or 'menu' to get to the root menu

4.5.2 CLI construction

The EX-2.4i utilizes three different methods for commands:

(1) Menu-driven structure
(2) Direct CLI command strings
(3) Direct CLI number sequences

The Menu-driven structure is easy-to-use, where simply typing a return/enter key, help or the number 9, a display is provided, prompting the user with the acceptable commands at that point in the menu structure.

The CLI command string is intended for users that become familiar with the CLI command string, and this avoids the need to go through any menu structure, where direct commands can be typed.

The CLI number sequence is not often used, but can be helpful for writing command scripts to pre-configure radios, or get a series of values from the device for management or monitoring.

In the following paragraphs, the CLI structure is presented in a format that illustrates all of these nomenclatures simultaneously. For example, an entry such as:

Set Subnet Mask, 1.2.4, [setmask *xxx.xxx.xxx.xxx*]

Illustrates that 'Set Subnet Mask' would be seen in the menu tree, the number sequence for this command is 1.2.4, and direct input can be made by typing *setmask* followed by numeric entries for the subnet mask IP address. Such as *setmask 255.255.000.000*.
When there is a particular choice of what to type in the CLI field, the choices are shown following the command such as:

Set Main Ethernet Duplex, 1.4.1.1.2, [setmainduplex *full:half:auto*]

Where the choices are full, half or auto, in this case. So the user would type the command, such as:

setmainduplex full
or
1.4.1.1.1 full

In some cases, there are several entries that follow a single command. Such as with T1 interface line code. Since there are four T1 inputs, the configuration for all four are done with a single command. Such as:

Set Line Code (per channel), 1.4.1.3.3.3, [setcode A:B A:B A:B A:B] (A=AIS, B=B8ZS)

Where, if the user wanted AIS for channels one and two, and B8ZS for channels three and four, the user would type:

setcode A A B B
or
1.4.1.3.3.3 A A B B

As can be seen in this last example, the choices are shown within the menu tree structure, such as A=AIS and B=B8ZS.

4.5.2.1 The root menu

At the CLI root menu, you are presented with four choices:

1. Configuration/Status
2. Exit

9. Help

4.5.2.2 The Configuration menu

The following list is an illustration of the tree structure of the configuration menu.

1. Configuration/Status <menu>
    1. Configuration wizard, 1.1, <configwiz>
    2. IP setting 1.2, <IPconfig>
        1. Display IP address, 1.2.1, <dispIP>
        2. Set IP address, 1.2.2, [setip *xxx.xxx.xxx.xxx*]
        3. Display Subnet Mask, 1.2.3, <dispmask>
        4. Set Subnet Mask, 1.2.4, [setmask *xxx.xxx.xxx.xxx*]
        5. Display NMS Gateway IP address, 1.2.5, <dispgate>
        6. Set NMS Gateway IP address, 1.2.6, [setgate *xxx.xxx.xxx.xxx*]
        7. Display all IP Configuration, 1.2.7, <dispIPall>
    3. Configuration File Load/Save, 1.3, <configfile>
        1. Load Configuration From File, 1.3.1, [configload *c:\filename.cfg*]
        2. Save Configuration To File, 1.3.2, [configsave *c:\filename.cfg*]
    4. Detailed Configuration Parameters, 1.4, <config>
        1. Interface Configuration, 1.4.1, <configintfc>
            1. Main Ethernet Configuration, 1.4.1.1, <configmain>
                1. Display Main Ethernet Configuration, 1.4.1.1.1, <dispmain>
                2. Set Main Ethernet Duplex, 1.4.1.1.2, [setmainduplex *full:half:auto*]
                3. Set Main Ethernet Speed, 1.4.1.1.3, [setmainspeed 10:100]
            2. Aux Ethernet Configuration, 1.4.1.2, <configaux>
                1. Display Aux Ethernet Configuration, 1.4.1.2.1, <dispaux>
                2. Set Aux Ethernet Duplex, 1.4.1.2.2, [setauxduplex full:half:auto]
                3. Set Aux Ethernet Speed, 1.4.1.2.3, [setauxspeed 10:100]
            3. T1/E1 Configuration, 1.4.1.3, <configTE>
                1. Display T1/E1 Configuration, 1.4.1.3.1, <dispTE>
                2. Set T1/E1 Mode, 1.4.1.3.2, [setTE T:E]
                3. Configure T1, 1.4.1.3.3, <configT>
                    1. Set AIS (per channel), 1.4.1.3.3.1, [setAIS Y:N Y:N Y:N Y:N] (Y=AIS on, N=AIS off)
                    2. Set LBO (per channel), 1.4.1.3.3.2, [setTLBO 1:2:3:4:5 1:2:3:4:5 1:2:3:4:5 1:2:3:4:5] (1=0-133 ft., 2=133-266 ft., 3=266-399 ft., 4=399-533 ft., 5=533-655 ft.)
                    3. Set T1 Line Code (per channel), 1.4.1.3.3.3, [setTcode A:B A:B A:B A:B] (A=AIS, B=B8ZS)
                4. DS3 Configuration, 1.4.1.4, <configDS3>
                    1. Display DS3 Configuration, 1.4.1.4.1, <dispDS3>
                    2. Set DS3 Mode, 1.4.1.4.2, [setDS3 On:Off]
                    3. Set DS3 LBO, 1.4.1.4.3, [setDS3LBO 1:2] (1=0-450 ft., 2=450-900 ft.)

4. Set DS3 Line Code, 1.4.1.4.4, [setDS3code A:B:H] (A=AMI, B=B3ZS, H=HDB3)
5. Display All Interface Configuration, 1.4.1.5 <dispconfigall>

2. System Configuration, 1.4.2, <configsys>
    1. Transmit Power, 1.4.2.1, <pwr>
        1. Display Transmit Power, 1.4.2.1.1, <disppwr>
        2. Set Transmit Power, 1.4.2.1.2, [setpwr xx] (power in dBm)
    2. RF frequency, 1.4.2.2, <freq>
        1. Display Frequency, 1.4.2.2.1, <dispfreq>
        2. Set Frequency, 1.4.2.2.2, [setfreq xxxx] (frequency in MHz)
    3. RF Bandwidth, 1.4.2.3, <bw>
        1. Display RF Bandwidth, 1.4.2.3.1, <dispbw>
        2. Set RF Bandwidth, 1.4.2.3.2, [setbw xx] (bw in MHz)
    4. Modulation, 1.4.2.4 <mod>
        1. Display Modulation, 1.4.2.4.1, <dispmod>
        2. Set Modulation, 1.4.2.4.2, [setmod 1:2:3] (1=QPSK, 2=16QAM, 3=64QAM)
    5. External Synchronization, 1.4.2.5, <sync>
        1. Display External Sync Status, 1.4.2.5.1, <dispsync>
        2. Enable External Sync, 1.4.2.5.2, [setsync on:off]
    6. TDD Frame Size, 1.4.2.6, <frame>
        1. Display Frame Size, 1.4.2.6.1, <dispframe>
        2. Set Frame Size, 1.4.2.6.2, [setframe 1:2:3:4]
    7. Link Security Code, 1.4.2.7, <code>
        1. Display Link Security Code, 1.4.2.7.1, <dispcode>
        2. Set Link Security Code, 1.4.2.7.2, [setcode xxxxxxxx]
    8. External Input Alarm, 1.4.2.8, <alarm>
        1. Display External Input Alarm, 1.4.2.8.1, <dispalarm>
        2. Set External Input Alarm, 1.4.2.8.2, [setalarm Y:N O:C] (Y= enable external alarm, N=disable external alarm, O=normally open, C=normally closed)
    9. Display All System Configuration, 1.4.2.9, <dispconfigsysall>
3. Administration, 1.4.3, <admin>
    1. System Time and Date, 1.4.3.1, <time>
        1. Display Time and Date, 1.4.3.1.1, <disptime>
        2. Set Time and Date, 1.4.3.1.2, [settime yyyy mm dd hh mm ss]
    2. Password, 1.4.3.2, <pw>
        1. Monitoring Password, 1.4.3.2.1, <monpw>
            1. Display Monitor Password, 1.4.3.2.1.1, <dispmonpw>
            2. Set Monitor Password, 1.4.3.2.1.2, [setmonpw xxxxxxxx]
        2. Administration Password, 1.4.3.2.2, <adminpw>
            1. Display Admin Password, 1.4.3.2.2.1, <dispadminpw>
            2. Set Admin Password, 1.4.3.2.2.2, [setadminpw xxxxxxxx]

3. File Transfer, 1.4.3.3 <file>
    1. Download Configuration File from Radio, 1.4.3.3.1, [downloadconfig c:\\directory\filename.cfg]
    2. Upload Radio Boot Software to Radio, 1.4.3.3.2, [uploadboot c:\\directory\filename.bot]
    3. Upload Radio Application Software to Radio, 1.4.3.3.3, [uploadapp c:\\directory\filename.app]
    5. Upload Radio FPGA Firmware to Radio, 1.4.3.3.4, [uploadfirm c:\\directory\filname.frm]
9. Help on Configuration

Appendix A – Specifications

A-1 Physical Specifications

Physical Configuration	Single-piece Indoor Unit (IDU)
Dimensions (H x W x D)	1RU: 1.75 x 17 x 14 inches; 4.5 x 43.2 x 35.6 cm
Weight	8 pounds; 3.6 kg
Operating Temperature	-4 to +140 degrees F; -20 to +60 degrees C
Altitude	15,000 feet; 4.6 km
Humidity	95% non-condensing

A-2 System Specifications

Frequency Band	2400 to 2483.5MHz
Tunable Range	2406 to 2468MHz
Tuning Resolution	1MHz
Output Power	+27dBm (0.5W), at full power
Output Power Attenuation Range	25dB
Attenuation Resolution	0.5dB
Selectable Modulation Modes	QPSK, 16QAM, 64QAM
Selectable Channel Bandwidths	8MHz, 16MHz, 32MHz, 64MHz

Receiver Threshold (BER=10e-6)

(dBm)	**QPSK**	**16QAM**	**64QAM**
8MHz	-88	-80	-74
16MHz	-85	-77	-71
32MHz	-82	-74	-68
64MHz	-79	-71	-65

Maximum RSL	-20dBm error-free; +10dBm no damage
Non-overlapping channels	8MHz: 8; 16MHz: 4; 32MHz: 2; 64MHz: 1

Aggregate User Capacity

(Mbps)	**QPSK**	**16QAM**	**64QAM**
8MHz	12.8	25.5	38.3
16MHz	25.5	51.0	76.5
32MHz	51.0	102.0	153.0
64MHz	102.0	204.0	306.0

Error Floor	10e-12
Frequency Stability	±7ppm
Link Security	64-bit Security Code
Regulatory Compliance	FCC 15.247; IC RSS-210
FCC ID	TTM-102P40I

IC ID 6254A-102P40I

Emission Designator(s)

	QPSK	16QAM	64QAM
8MHz	10M2W7D	9M9W7D	10M2W7D
16MHz	17M3W7D	19M0W7D	20M2W7D
32MHz	34M7W7D	36M0W7D	38M1W7D
64MHz	60M7W7D	61M3W7D	61M7W7D

A-3 Interfaces

RF

Connector	N-type Female
Impedance	50 ohms

T1/E1 (x4)

Connector	RJ-45 (RJ48C), Female
T1 Impedance	100 Ohms, balanced
E1 Impedance	120 Ohms, balanced
T1 Line Codes	AMI, B8ZS, selectable
E1 Line Codes	HDB3
T1 LBO Settings (in ft.)	0-133, 133-266, 266-399, 399-533, 533-655
Loopback Modes	Remote Internal, Remote External, Local Line
T1 Clocking Speed	1.544Mbps
E1 Clocking Speed	2.048Mbps
T1 Compliance	ANSI T1.102-1987; ITU-T; G.823; GR-49T-CORE
E1 Compliance	CEPT-1; G.703; ITU-T-G703

DS3

Connectors	BNC Female
Impedance	75 ohms
Line Codes	AMI, B3ZS, HDB3, selectable
DS3 LBO Settings (in ft.)	0-450, 450-900
Loopback Modes	Remote Internal, Remote External, Local Line
DS3 Clocking Speed	44.736Mbps
Compliance	ANSI T1.102-1993; T1.107

Ethernet

Connectors	RJ-45, Female, auto-MDIX
Interface Speed	10, 100 or 1000BaseT
Duplex	Half, Full, Auto, selectable
Compliance	802.3

Console (Serial)

Connector	9-pin Sub-D, Female
Interface Speed	9600 bps
Compliance	EIA-574 DTE (RS-232)

Alarm

Connector	9-pin Sub-D, Female
Inputs	(2) TTL
Outputs	(2) Relay (Form C)

Sync (In and Out)	
Connector	RJ45, Female
Signal	1pps (GPS)
Power	
Connector	6-pin barrier strip
Input Voltage	40-60Vdc
Consumption	<0.7A @ 48V (<34 Watts)

Appendix B - Back-to-back Testing

B-1 Introduction

Back-to-back testing is used to bench test the radio before installation, pre-configure the radio and connected equipment before installation, or in the trouble-shooting 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 test.

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

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

B-2 Basic Test

The basic test is a simple test of radio functionality. It verifies that the radios are configured properly to communicate to one another, and verifies general radio performance to be 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 at 2400MHz (note: attenuation for basic test does not to be calibrated or precise)
- Computer/Terminal with either Serial or Ethernet port (helpful, but not necessary)

Connect the items as follows:

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

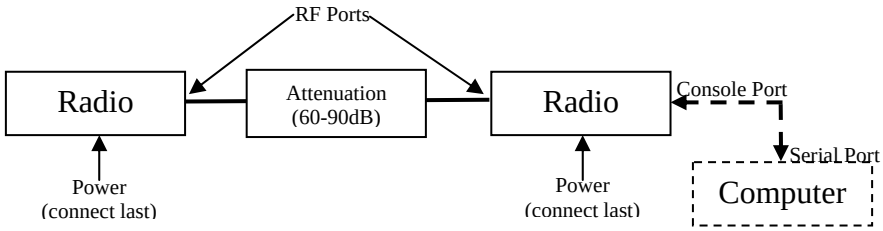

Figure B-1: Basic Back-to-Back Test Configuration

After connecting and powering one, the front panel LEDs can be observed to verify that the Link and Status LEDs are both green. If they are green, 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 from the product manual on how to connect the computer and configure the radio.

Alternatively, you may reset the radios to factory default configuration, which is performed by holding the RMT button down while powering up. Hold the button down for approximately 5 seconds while applying power, and the radio is reset to factory default configurations. Perform the reset for both ends, and the system should be operational in it's default state. At this point, you may reconfigure the radio, as necessary.

Note: If you have pre-configured the radios, the factory reset procedure will reset the majority of your configurations. Do not reset the radios unless you have a record of the desired configuration, or have downloaded the configuration file from the radio first.

B-3 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 if you wish to have a detailed record or be extremely certain of the 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 (roughly 2.4 GHz, in this case). In addition, a voltmeter or computer is also required.

Connect the system as in figure B-1, using the combination of fixed and variable attenuation in between the radio's RF ports. Connect the voltmeter to either radio's RSL measurement port and the associated reference ground connection.

In this test, it is highly desirable to RF cables that are pre-tested, known good and known loss at the operating frequency. If the cables are short (in the range of 6 feet 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 output power, simply insert any value of attenuation between the radios between 60 and 90dB. Make sure that both of the radio's RF output power settings are at maximum. Using the voltmeter, measure RSL in both directions. The RSL measured value should match the appropriate value in accordance to the inserted attenuation. Such as:

RSL = RF Output Power – cabling losses – total attenuation

You can further verify output power by adjusting output power using your computer (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 your computer, adjust radio output power attenuation in 1dB steps until the receiving radio (the one whose output power you are not adjusting) Link LED turns from green to yellow. This would indicate 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 the published specification.

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

Once threshold is verified in this direction, you may repeat the process in the opposite direction by adjusting RF output power of the other radio.

You may wish to perform threshold measurement tests for all combinations of bandwidth and modulation that you are using – especially if testing for the purposes of troubleshooting. It should not be necessary to vary center frequency, as this does not typically have any impact on

system gain performance – however, any combination of settings may be tried to gain confidence in the radio performance parameters.

Appendix C - DC Coupler for Antenna Alignment

C-1 Introduction

One challenge associated with an all-indoors radio construction is the alignment of the antennas. It can sometimes be challenging to place the radio near the antenna alignment personnel, and can also be challenging to run a separate set of wires for the voltmeter to be in view of the alignment personnel. If any of the conventional methods that have been mentioned in the manual are difficult to achieve, one of the simplest methods to use is to employ the use of a DC coupling system as a temporary test configuration exclusively for the use of aligning the antennas.

This type of system simply couples the DC voltage associated with RSL measurement at the radio location, over the RF transmission line, up to the antenna port.

You must remove all DC-blocked lightning arrestors in the transmission system prior to applying the DC coupler system. Failure to do so can result in electric shock and/or damage the lightning arrestors and/or other equipment.

C-2 Items Required

The following items are needed for the DC coupling system, per radio end (double the quantities of these items for a complete link for simultaneous use at both ends):

- 2ea DC Couplers: Mini-Circuits ZNBT-60-1W
- 1ea BNC male-male extension cable: Pomona 2249
- 1ea BNC Female to Mini Bantam (stackable Pin-tip plugs): Pomona 3221
- 1ea BNC Female to Banana Male: Pomona 5268*
- 1ea Digital Volt Meter

*This type of plug is typical for most professional hand-held Digital Volt Meters (DVM). However, verify that your DVM can accept this type of Banana connector. If not, you may need a different part number or adapter to connect to your DVM.

C-3 Interconnection

Connect the items as shown in Figure C-1. For the coupler installation, make certain that the DC side of the coupler is facing away from the radio and away from the antenna – towards the RF transmission line system. Using the BNC adaptors and cables, attach the radio end DC coupler to the RSL port on the radio, and the antenna end DC coupler to the DVM that the antenna alignment personnel will use.

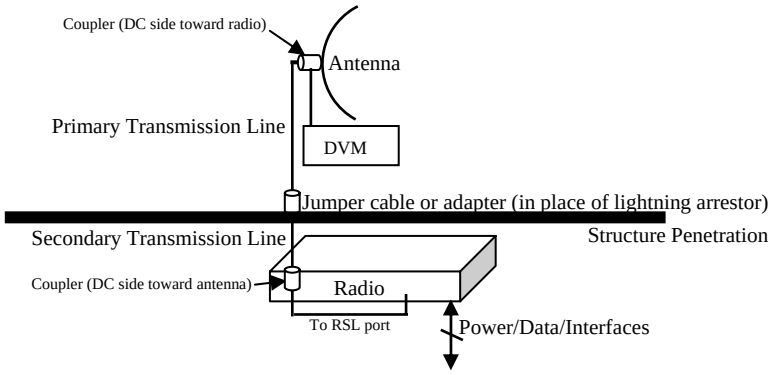

Figure C-1: DC Coupler Interconnection

The DC voltage from the RSL port is now coupled to the transmission line system between the radio and the antenna, and is available at the antenna location. This allows the antenna alignment personnel to view the DVM output directly while adjusting the antenna.

Always remove the DC couplers and associated wiring, at both the radio end and the antenna end, after antenna alignment is complete.