Moseley

EVENT-HD

Installation & Reference Manual

Document Number: **602-14886-01**, Rev. B

Date: MAY, 2008

Notice of Disclaimer: The information and specifications provided in this document are subject to change without notice. Moseley, Inc. reserves the right to make changes in design or components as progress in engineering and manufacturing may warrant.

The Warranty(s) that accompany Moseley products are set forth in the sales agreement/contract between Moseley and its customer. Please consult the sales agreement for the terms and conditions of the Warranty(s) provided by Moseley. To obtain a copy of the Warranty(s), contact you Moseley Sales Representative at 1-805-968-9621 or 1-805-685-9638 (FAX).

The information provided in this document is provided “as is” without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Some jurisdictions do not allow the exclusion of implied warranties, so the above exclusion may not apply to you.

In no event shall Moseley, Inc. be liable for any damages whatsoever – including special, indirect, consequential or incidental damages or damages for loss of profits, revenue, use, or data whether brought in contract or tort, arising out of or connected with any Moseley, Inc., document or the use, reliance upon or performance of any material contained in or accessed from this document. Moseley’s license agreement may be provided upon request. Additional Terms and Conditions will be finalized upon negotiation or a purchase.

The above information shall not be constructed to imply any additional warranties for Moseley, Inc. equipment including, but not limited to, warranties of merchantability or fitness for an intended use.

Trademark Information

Software Defined Indoor Unit™ (SDIDU™) is a product and trademark of Moseley Inc.

Java™ is a trademark of Sun Microsystems Inc.

Windows® is a registered trademark of Microsoft Corporation

All other brand or product names are trademarks or registered trademarks of their respective companies or organizations.

EVENT-HD Installation & Reference Manual
Document Number: 602-14886-01
Revision Levels:

SECTION	DWG	REV	REVISED / RELEASED
N/A	N/A	A	February, 2008
C	N/A	B	May, 2008

Blank Page

Table of Contents

List of Illustrations

List of Tables

1. Safety Precautions

PLEASE READ THESE SAFETY PRECAUTIONS!

1.1 RF Energy Health Hazard

This symbol indicates a risk of personal injury due to radio frequency exposure.

The radio equipment described in this guide uses radio frequency transmitters. Do not allow people to come in close proximity to the front of the antenna while the transmitter is operating. The antenna will be professionally installed on fixed-mounted outdoor permanent structures to provide separation from any other antenna and all persons.

WARNING: RF Energy Exposure Limits and Applicable Rules for 6-38 GHz. It is recommended that the radio equipment operator refer to the RF exposure rules and precaution for each frequency band and other applicable rules and precautions with respect to transmitters, facilities, and operations that may affect the environment due to RF emissions for each radio equipment deployment site.

Appropriate warning signs must be properly placed and posted at the equipment site and access entries.

1.2 Protection from Lightning

Article 810 of the US National Electric Department of Energy Handbook 1996 specifies that radio and television lead-in cables must have adequate surge protection at or near the point of entry to the building. The code specifies that any shielded cable from an external antenna must have the shield directly connected to a 10 AWG wire that connects to the building ground electrode.

Do not turn on power before reading Moseley's product documentation. This device has a 48 VDC direct current input.

1.3 Protection from RF Burns

It is hazardous to look into or stand in front of an active antenna aperture. Do not stand in front of or look into an antenna without first ensuring the associated transmitter or transmitters are switched off. Do not look into the waveguide port of an ODU (if applicable) when the radio is active.

1.4 Risk of Personal Injury from Fiber Optics

DANGER: Invisible laser radiation. Avoid direct eye exposure to the end of a fiber, fiber cord, or fiber pigtail. The infrared light used in fiber optics systems is invisible, but can cause serious injury to the eye.

WARNING: Never touch exposed fiber with any part of your body. Fiber fragments can enter the skin and are difficult to detect and remove.

1.5 Warning – This is a Class A product

WARNING: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

1.6 Warning – Turn off all power before servicing

WARNING: Turn off all power before servicing.

1.7 Safety Requirements

Safety requirements require a switch be employed between the Indoor Unit's (IDU) external power supply and the IDU power supplies.

1.8 Proper Disposal

The manufacture of the equipment described herein has required the extraction and use of natural resources. Improper disposal may contaminate the environment and present a health risk due to the release of hazardous substances contained within. To avoid dissemination of these substances into our environment, and to lessen the demand on natural resources, we encourage you to use the appropriate recycling systems for disposal. These systems will reuse or recycle most of the materials found in this equipment in a sound way. Please contact Moseley or your supplier for more information on the proper disposal of this equipment.

2. System Description

This manual is written for those who are involved in the “hands-on” installation of the EVENT-HD in a microwave point-to-point link, such as installation technicians, site evaluators, project managers, and network engineers. It assumes the reader has a basic understanding of how to install hardware, use Windows® based software, and operate test equipment.

2.1 Introduction

The Moseley family of digital radios provides high capacity transmission, flexibility, features, and convenience for wireless digital communications networks. The Moseley digital point-to-point radios represent a new microwave architecture that is designed to address universal applications for video, audio, data, PDH and SDH platforms. This advanced technology platform is designed to provide the flexibility to customers for their current and future network needs.

The Moseley EVENT-HD is a digital microwave radio terminal composed of a Software Defined Indoor Unit (IDU) and Outdoor Unit (ODU). The IDU is common to all product lines. The ODU, the radio transceiver unit which establishes the frequency of operation, is selected by application and model. The ODU is fully interchangeable covering the licensed 2, 7, 13, 18, and 23 GHz bands as well as the unlicensed 5.3 and 5.8 GHz ISM bands. Some applications are described below.

The EVENT-HD can be used for Broadcast STL (Studio-to-Transmitter Link) and BAS (Broadcast Auxiliary Service) licensed half-duplex applications, FCC part 74.602, for data rates to 150 Mbps:

- 2 GHz band between 1990 to 2110 MHz in 12 MHz and 17 MHz channels.
- 6.5 GHz band between 6425 to 6525 MHz in 25 MHz channels.
- 7 GHz band between 6825 to 7125 MHz in 25 MHz channels.
- 13 GHz band between 12.7 to 13.25 GHz in 25 MHz channels.

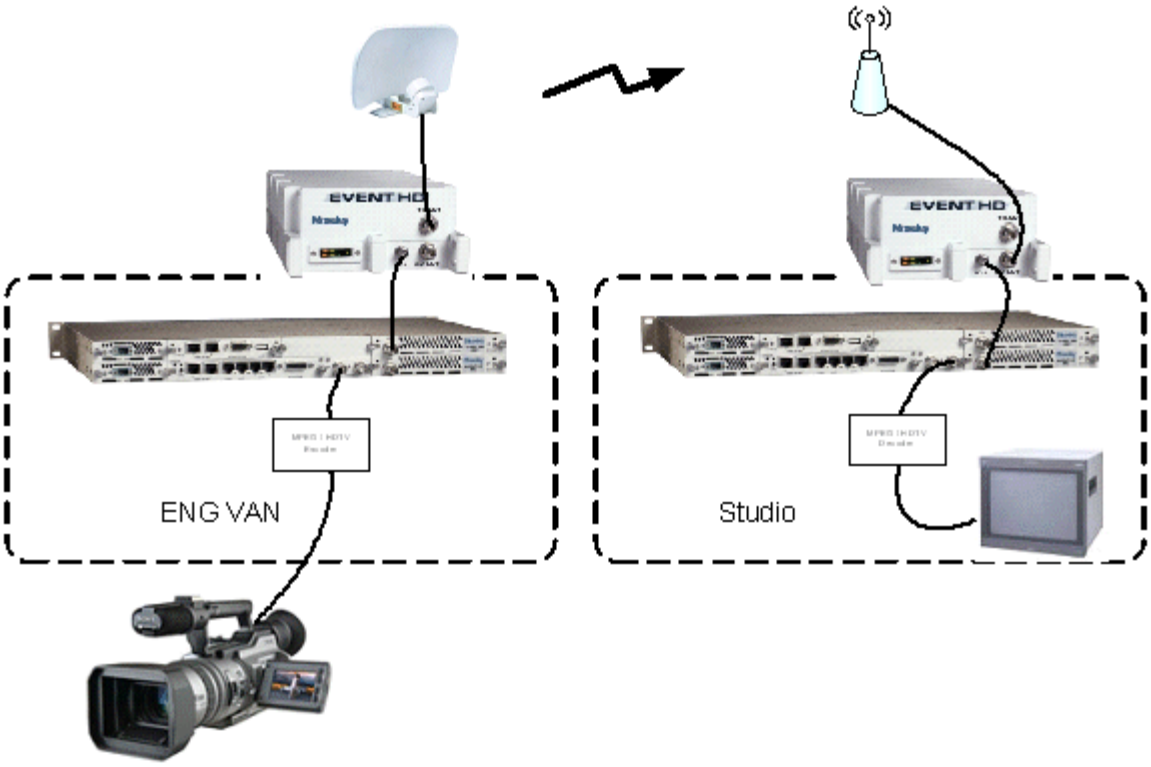


Figure 2-1. Typical Broadcast ENG Application

The EVENT-HD can be used for unlicensed high-capacity full-duplex data and broadcast applications for data rates to 100 Mbps:

- 5.3 GHz band between 5.25 to 5.35 GHz for U-NII in 13, 20, and 30 MHz channels.
- 5.8 GHz band between 5.725 to 5.850 GHz for ISM in 12.5, 16.7, 25, and 30 MHz channels.

The EVENT-HD can be used for licensed high-capacity full-duplex data and broadcast applications for data rates to 100 Mbps:

- 2/2.2 GHz band, Canada and Australia.
- 6.8 GHz band, FCC part 101.147, in 10 MHz channels.
- 6 GHz lower and upper, and 7 GHz ETSI.
- 18 and 23 GHz, US part 101.

EVENT-HD digital radios support diversity, 1+0, and 1+1 protection and ring architectures in a single 1 RU chassis. The modem and power supply functions are supported using easily replaceable plug-in modules. An additional feature of the IDU is provision for a second plug-in modem/IF module to provide diversity, repeater or east/west network configurations.

The EVENT-HD includes integrated Operations, Administration, Maintenance, and Provisioning (OAM&P) functionality and design features enabling simple commissioning when the radio network is initially set up in the field at the customer's premises. Furthermore, a highlight of the EVENT-HD is scalability and the capability to support a ring-type architecture. This ring or consecutive point radio architecture is self-healing in

the event of an outage in the link and automatically re-routes data traffic, thereby ensuring that service to the end user is not interrupted.

EVENT-HD digital radios enable network operators (mobile and private), government and access service providers to offer a portfolio of secure, scalable wireless applications for data, video, and Voice over IP (VoIP). The split mount architecture consists of a single 1RU rack mount IDU with a cable connecting to an ODU with an external antenna.

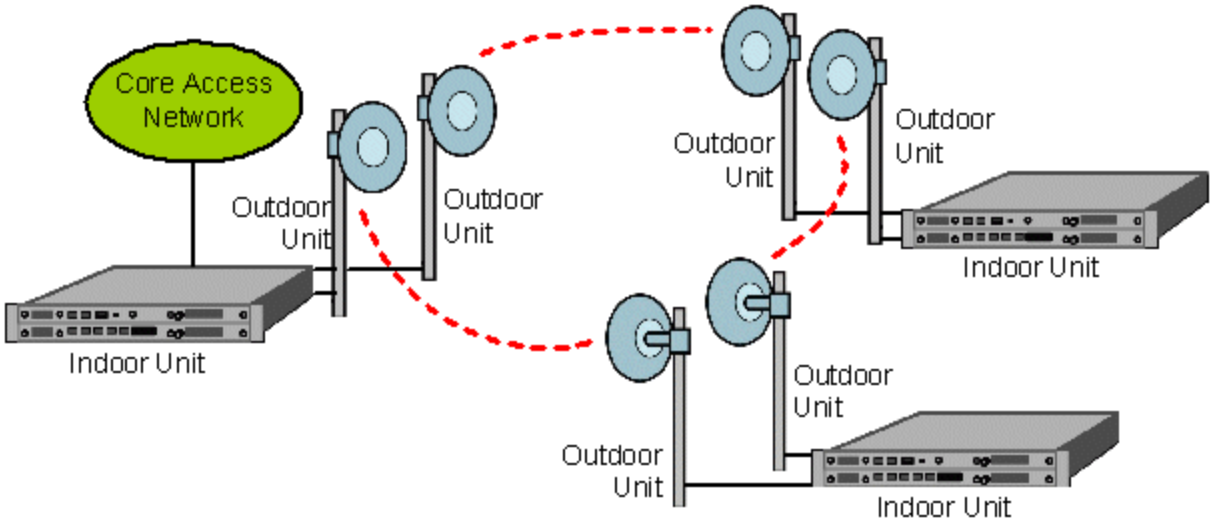


Figure 2-2. Microwave Split Mount Architecture

Table 2-1 shows key features that Moseley technology offers to those involved in the design, deployment and support of broadband fixed wireless networks.

Table 2-1. Key Benefits/Advantages of EVENT-HD Radios

Component/Feature	Benefits	Advantages to Providers/Customers
IDU	Universal signal processing platform	Enables easy network interface options and network capacity growth in the future.
	Advanced Single Chip Modem ASIC	Cost effective solution; simplifying product logistics and overall product life cycle costs. The flexibility reduces capital and operating expenditures commonly associated with field installation, maintenance, training and spares.
	Integrated Forward Error Correction (FEC)	Frequency independent and Scalable.
	Powerful adaptive equalizer	Software defined flexibility enables selective modulation for spectral efficiency and adherence to worldwide regulatory emissions guidelines.
Easy to install units	Straightforward modular system enables fast deployment and activation.	Fast return on investment.
	Carrier-class reliability.	No monthly leased line fees.
Complete support of payload capacity with additional voice orderwire	Aggregate capacity beyond basic network payload.	Increases available bandwidth of network.
	Scalable and spectrally efficient system.	Allows customer full use of revenue-generating payload channel.

Component/Feature	Benefits	Advantages to Providers/Customers
	Separate networks for radio overhead/management and user payload.	Lowers total cost of ownership.
Ring Architecture	Supports a ring (consecutive point) configuration, thus creating a self-healing redundancy that is more reliable than traditional point-to-point networks.	Enables network scalability.
	In the event of an outage, traffic is automatically rerouted via another part of the ring without service interruption.	Increases deployment scenarios for initial deployment as well as network expansion with reduced line-of-sight issues.
	Ring/consecutive point networks can overcome line-of-sight issues and reach more buildings than other traditional wireless networks.	Increases network reliability due to self-healing redundancy of the network.
	Networks can be expanded by adding more IDUs or more rings, without interruption of service.	Minimizes total cost of ownership and maintenance of the network.
	A separate management channel allows for a dedicated maintenance ring with connections to each IDU on the ring.	Allows for mass deployment.
Adaptive Power Control	Automatically adjusts transmit power in discrete increments in response to RF interference.	Enables dense deployment. Simplifies deployment and network management.
Comprehensive Link/Network Management Software	A web interface offers security, configuration, fault, and performance management via standard craft interfaces.	Simplifies management of radio network and minimizes resources as entire network can be centrally managed out of any location.
	Suite of SNMP-compatible network management tools that provide robust local and remote management capabilities.	Simplifies troubleshooting of single radios, links, or entire networks. Simplifies network upgrades with remote software upgrades. Allows for mass deployment.

2.2 System Features

- Selectable Rates and Interfaces
  - DVB-ASI interface application scalable from 10 to 100 Mbps.
  - PDH Options
    - Up to 16 x E1/T1
    - 100BaseTX/Ethernet: Scalable 1-100 Mbps
    - DS-3/E-3/STS-1
  - Super PDH Options
    - Up to 32 x E1/T1
    - 100 BaseTX/Ethernet: Scalable 1-100 Mbps
  - SDH Options: 1-2 x SDH STM-1/OC-3 SONET

- Support for multiple configurations for both PDH and SDH
  - 1+0, 1+1 protection/diversity
  - Hot Standby
  - East/West Repeater (2 + 0)
- Selectable Spectral Efficiency of 0.8 to 6.25 bits/Hz (including FEC and spectral shaping effects)
- QPSK, 16 –256 QAM Modulation
- Powerful Trellis Coded Modulation concatenated with Reed-Solomon Error Correction
- Built-in Adaptive Equalizer
- Support of Voice Orderwire Channels
- Adaptive Power Control
- Standard high-power feature at antenna port
  - 5W (37 dBm in QPSK mode) in 2 GHz bands
  - 1W (30 dBm) in 5.8, 7, and 13 GHz bands
- Built-in Network Management System (NMS)
- Consecutive Point ring architecture
- Built-in Bit Error Rate (BER) performance monitoring
- Integrated Crosspoint switch: allows a total of 160 E1s (200 T1s) to be mapped any-to-any between front-panel ports and RF link(s).

2.3 Physical Description

The following section details the physical features of the EVENT-HD digital radios.

- Model Types
- Front and rear panel configurations
- LED and I/O descriptions

2.3.1 Model Types

The following model types are available with associated ODU configuration:

Product Name	Band	Primary Data Interfaces	Primary Throughput	ODU
1. Event 2200	1990-2110	*ASI*	*10-100 Mbps*	 *ODU2200*
		Ethernet	*2 Mbps*	
2. Event 2200 FD	2025-2150	*16xE1/T1*	*up to 100 Mbps*	 *ODU2200FD*
		2xEthernet		
	2200-2300	*16xE1/T1*	*up to 100 Mbps*	
		2xEthernet		

Product Name	Band	Primary Data Interfaces	Primary Throughput	ODU
3. Event 2500	2450-2500	*ASI* *Ethernet*	*10-100 Mbps* *2 Mbps*	 *ODU2500*
4. Event 5300	5250-5350	*16xE1/T1* *2xEthernet*	*up to 100 Mbps*	 *ODU5300*
5. Event 5800	5725-5850	*16xE1/T1* *2xEthernet*	*up to 100 Mbps*	 *ODU5800*
6. Event 6500	6425-6525	*ASI* *Ethernet*	*10-150 Mbps* *2 Mbps*	 *ODU6500*
7. Event 6800	6525-6875	*16xE1/T1* *2xEthernet*	*up to 100 Mbps*	 *ODU6800*
8. Event 7200	6875-7125	*ASI* *Ethernet*	*10-150 Mbps* *2 Mbps*	 *ODU7200*
9. Event 13G	*12700-13250*	*ASI* *Ethernet*	*10-150 Mbps* *2 Mbps*	 *ODU13G/18G/23G*

2.3.2 Front Panel

All models of the EVENT-HD are available with an optional front panel to perform primary configuration functions such as change frequency and monitor receiver status and radio health parameters.

Figure 2-3. Optional Front Panel

See the EVENT-HD User Interface Guide (Moseley Document #602-15038-01) for Front Panel installation and operating information.

2.3.3 Rear Panel Indicators

All models of the EVENT-HD support a variety of rear panel configurations that depend on the network interface and capacity configurations. Figure 2-4 shows an example of the EVENT-HD 1+0 configuration and the associated LEDs on the IDU rear panel. The controller, standard I/O, and each modem card have a status LED.

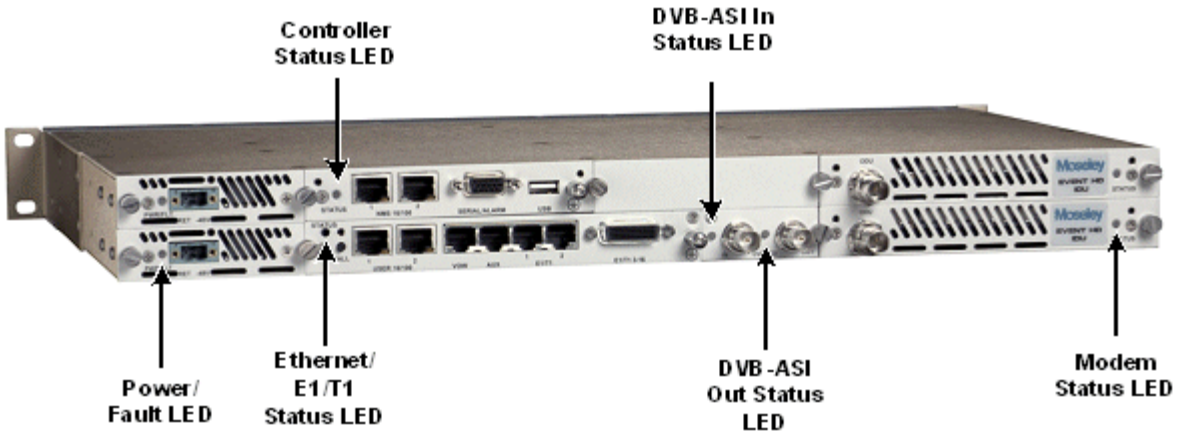


Figure 2-4. IDU LEDs: Rear Panel Configuration for IDU, 1+0 Configuration

The modem status LED indicates the modem status as described in Table 2-2.

Table 2-2. Modem Status LED.

LED	STATUS
GREEN	Active Locked Link
ORANGE	Standby Locked Link (1+1 Non-Diversity Only)
Flashing GREEN	Low SNR
Flashing ORANGE	Unlocked

Table 2-3. DVB-ASI Input Status LED.

LED	STATUS
GREEN	Good ASI input
RED	No ASI input
Alternating YELLOW/GRN	ASI exceeds radio bit rate (FIFO overflow)
Flashing RED	Loss-of-Frame
Flashing GRN	No ASI data

Table 2-4. DVB-ASI Output Status LED

LED	STATUS
GREEN	Active Locked ASI Link
Alternating RED/GREEN	No ASI, loss-of-frame
GREEN, occasionally flashing YELLOW	Locked ASI link with errors (yellow flashes)

The controller status LED is the primary rear panel indicator of alarms. An alarm is generated when a specific condition is identified and is cleared when the specified condition is no longer detected. When an alarm is posted,

1) The controller status LED turns orange for 5 seconds

2) The controller status LED turns off for 5 seconds

3) The controller status LED flashes orange the number of times specified by the first digit of the alarm code

4) The controller status LED turns off for 3 seconds

5) The controller status LED flashes orange the number of times specified by the second digit of the alarm code

Steps 2-5 are repeated for each alarm posted. The entire process is repeated as long as the alarms are still posted.

The standard I/O and modem status LEDs are set to red when certain alarms are posted. Alarms are also shown in the Web Interface, Command Line Interface (CLI), and optional Front Panel. See the EVENT-HD User Interface Guide (Moseley Document #602-15038-01).

2.3.4 Rear Panel Connections

Refer to the Figure 2-5 for an example of an IDU rear panel followed by a description of the connections.

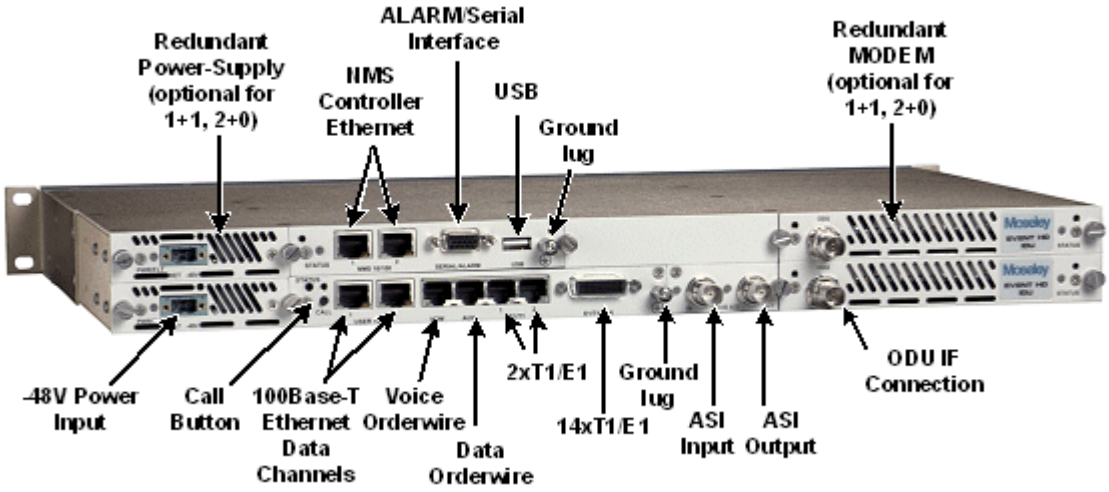


Figure 2-5. IDU-SB, 1+1 Protection: IDU Rear Panel Connections

Power Supply Input DC Input -48 VDC: 48v (Isolated Input); 2-pin captive power connector. The IDU requires an input of 48 volts dc ±10% at the rear panel DC Input connector. The total required power is dependent on the option cards and protection configuration (1+0, 1+1). The IDU rear panel power connector pin numbering is 1 through 2, from left to right, when facing the unit rear panel. Pin 1 is the power supply return and is connected to unit chassis ground internally. Pin 2 should be supplied with a nominal 48 V dc, with respect to the unit chassis (ground). A ground-isolated supply may be used, provided it will tolerate grounding of its most positive output.

The recommended power input is 44 to 52 V dc at 2 Amps minimum. It is recommended that any power supply used be able to supply a minimum of 100 W to the IDU.

A mating power cable connector is supplied with the IDU. It is a 2-pin plug, 5 mm pitch, manufactured by Phoenix Contact, P/N 17 86 83 1 (connector type MSTB 2,5/2-STF). This connector has screw clamp terminals that accommodate 24 AWG to 12 AWG wire. The power cable wire should be selected to provide the appropriate current with minimal voltage drop, based on the power supply voltage and length of cable required. The

recommended wire size for power cables under 10 feet in length supplying 48 Vdc is 18 AWG.

The IDU supplies the ODU with all required power via the ODU/IDU Interconnect cable. The IDU does not have a power on/off switch. When DC power is connected to the IDU, the digital radio powers up and is operational. There can be up to 320 mW of RF power present at the antenna port (external antenna version). The antenna should be directed safely when power is applied.

Alarm/Serial Interface: DB-15HD female connector for two Form-C relay alarm outputs (rated load: 1A @ 24 VDC), two TTL alarm outputs, four TTL alarm inputs, and Serial Console. The two Form-C relay alarm outputs can be configured to emulate TTL alarm outputs.

USB Interface: USB connector, reserved.

Voice Orderwire Connector

- **Call Button**: The voice orderwire provides a PTP connection via a PTT handset and buzzer. The call button initiates a ring. Only the IDU's link partner will receive the ring. Voice Orderwire does not ring all nodes or support party line calls.
- **Connector**: RJ-45 modular port connector for voice orderwire interface.

Data Orderwire Connector: RJ-45 modular port connector for RS422/RS-232 data at 64 kbps.

NMS 10/100 Network Management System Connections

- **NMS 10/100 1**: 10/100Base-TX RJ-45 modular local port connector for access to the Network Management System (SNMP) and Web Interface.
- **NMS 10/100 2**: 10/100BaseTX RJ-45 modular remote port connector for access to the Network Management System (SNMP). This port to be used for consecutive point networks.

100/Ethernet Models: Ethernet 100BaseT Connections

- **USER 10/100 1**: 100Base-TX RJ-45 modular port connector for the local Fast Ethernet interface.
- **USER 10/100 2**: 100Base-TX RJ-45 modular port connector. This port to be used for consecutive point networks.

T1 Channels

- **T1 1-2**: Two T1/E1 (RJ-48C) interface connections.
- **T1 3-8/16**: Single Molex 60-pin connector containing 14 T1/E1 connections.

DVB/ASI, DS-3, E-3, and STS-1 Connection (Optional Mini IO)

- **DVB/ASI Out**: BNC connector for the DVB/ASI digital video and DS-3, E-3, and STS-1 interface.
- **DVB/ASI In**: BNC connector for the DVB/ASI digital video and DS-3, E-3, and STS-1 interface.

OC-3 Connection (Optional Mini IO)

- **OC-3 Out**: OC-3 type SC connectors for the OC-3 interface.
- **OC-3 In**: OC-3 type SC connectors for the OC-3 interface.

STM-1 Connection (Optional Mini IO)

- **STM-1 Out**: BNC connector for the STM-1 interface.
- **STM-1 In**: BNC connector for the STM-1 interface.

ODU/IDU Interconnect

- **To ODU**: TNC female connector. Used to connect the ODU to the IDU. Provides –48VDC and 350 MHz Transmit IF to the ODU and receives 140 MHz Receive IF from the ODU.

Ground Connection

- **Ground Lug**: Two ground lugs are provided on the rear panel. Either may be used to connect the IDU to ground.

2.3.5 ODU LED Indicators

The ODU 2200, 6500, and 7200 have an externally visible LED meter that provides both RSL (Receive Signal Level) and transmit power. For full-duplex operation the ODU meter displays RSL on the top bar and transmit level on the bottom bar as shown in Figure 2-6.

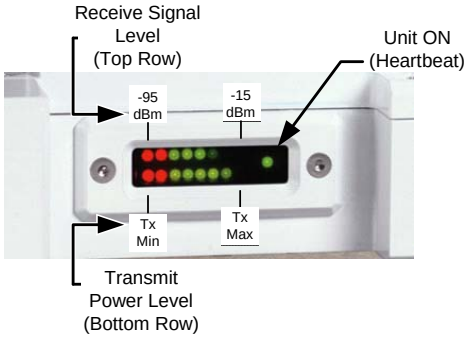


Figure 2-6. ODU 2200 RSSI Output vs. Received Signal.

The upper RSL LED meter is calibrated to represent exactly 10 dB for each LED, going from -95 dBm at the far left (red) to -15 dBm at the far right (green). The brightness of each LED is modulated for levels between 0 to 10 dB such that the far left LED will be fully extinguished at -95 dBm and the far right LED will be fully illuminated at -15 dBm. When the RSL is in the red region (<-75 dBm) the signal level is approaching or has reached threshold (depends on modulation type).

The transmit LED indicates full power will all 8 LEDs illuminated to minimum power with 1 LED illuminated. For simplex applications, both rows indicate either RSL or transmit power.

2.4 System Description

The EVENT-HD architecture consists of a single 1RU rack mount IDU with a cable connecting to an ODU. The IF signal between the IDU and ODU operates at a relatively low frequency compared with the RF signal allowing for extensive cable runs in excess of 250m with inexpensive coaxial cable with no degradation in radio performance.

The EVENT-HD ODU is mounted to a fixed or telescoping antenna mast near the desired antenna location providing a short cable run between the ODU and antenna at the RF frequency. This IDU/ODU architecture is advantageous when compared to a single IDU (no ODU) with external mount antenna as operating at these RF frequencies from the

IDU rack to the antenna will result in significant signal degradation and require expensive low-loss coaxial cable or waveguide.

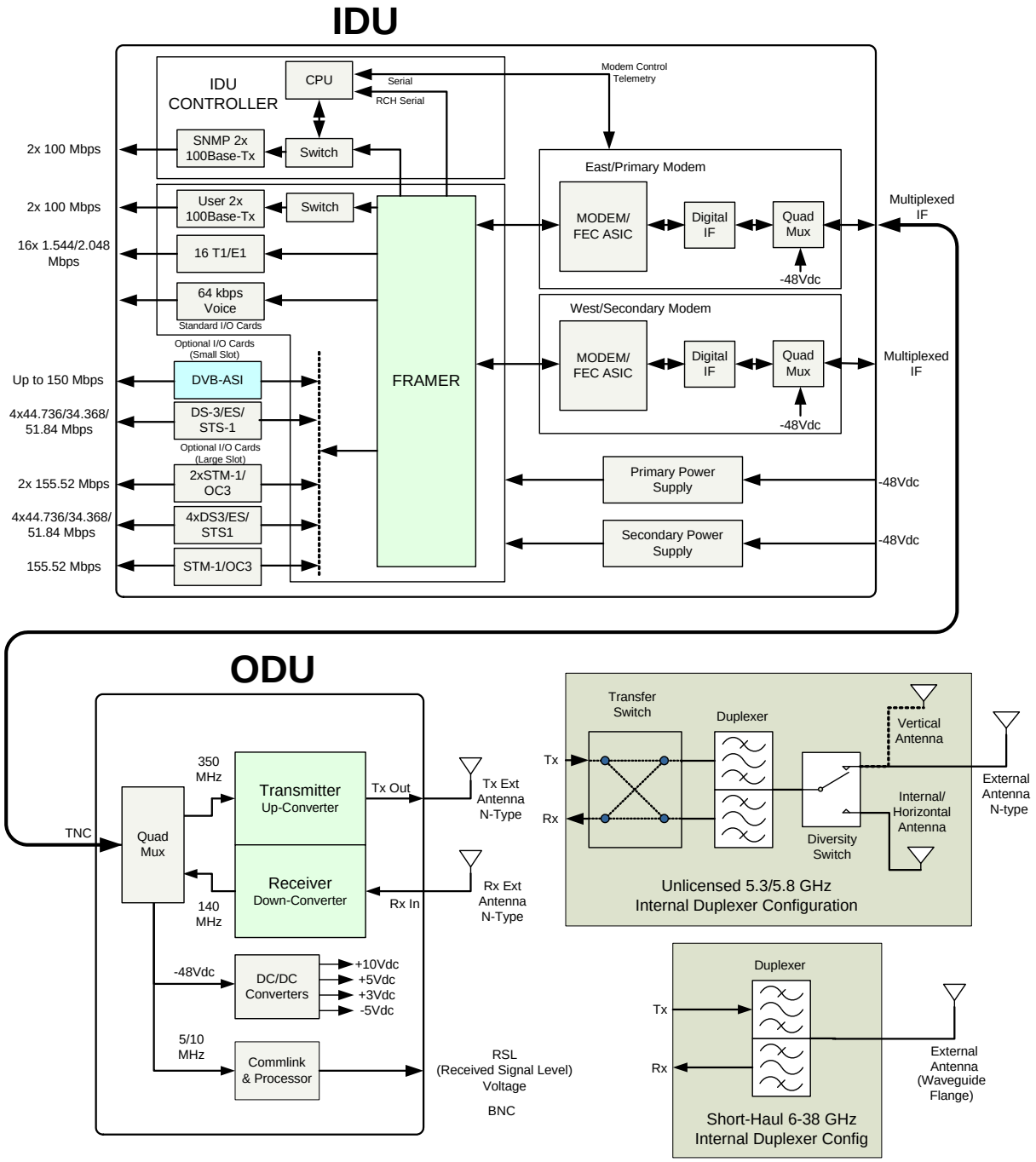


Figure 2-7. EVENT-HD Block Diagram

Figure 2-7 shows the EVENT-HD digital radio and interfaces from a functional point of view. The functional partitions for the I/O, Modem/IF, power supply modules, up/down converters, and internal RF duplexing partition are shown. The IDU comes with the standard I/O capability which can be upgraded. The Modem/IF function is modular allowing the addition of a second Modem to support protection or ring architectures. The power supply is similarly modular. In addition, the ODUs are interchangeable allowing

use of a single IDU in licensed, unlicensed, and short-haul applications by swapping the RF component.

The EVENT-HD ODU RF Up/Down Converter provides the interface to the antenna. The transmit section up converts and amplifies the modulated Intermediate Frequency (IF) of 350 MHz from the IF Processor and provides additional filtering. The receive section down converts the received signal, provides additional filtering, and outputs an IF of 140 MHz to the IF Processor.

The EVENT-HD digital radio modem performs QPSK, 16-QAM, 32-QAM, 64-QAM, and 128-QAM modulation and demodulation of the payload and forward error correction using advanced modulation and coding techniques. Using all-digital processing, the IF Modem uses robust modulation and forward error correction coding to minimize the number of bit errors and optimize the radio and network performance. The IF Modem also scrambles, descrambles and interleaves/deinterleaves the data stream in accordance with Intelsat standards to ensure modulation efficiency and resilience to sustained burst errors. The modulation will vary by application, data rate, and frequency spectrum. The highest order modulation mode supported is 128 Quadrature Amplitude Modulation (QAM). Table 2-5 summarizes the TCM/convolutional code rates for each modulation type supported by the EVENT-HD.

Table 2-5. EVENT-HD TCM/Convolutional Code Rates

Modulation Type	Available Code Rates
QPSK	1/2, 3/4, 7/8
16-QAM	3/4, 7/8,
32-QAM	4/5, 9/10
64-QAM	5/6, 11/12
128-QAM	11/12

The major functions of the IDU can be summarized as follows:

- **I/O Processing** – The EVENT-HD digital radio comes with a standard I/O capability that includes support for up to 16xT1/E1 and 2x100Base-TX user payloads, 2x100Base-TX for SNMP, and voice orderwire. In addition, option cards for DVB-ASI, DS-3/E3/STS-1, 1-2 x STM-1/OC-3, and 4xDS-3/E3/STS-1 may be added. The EVENT-HD architecture is flexible and allows for the addition of other I/O types in the future.
- **Switch/Framing** – The EVENT-HD digital radio includes an Ethernet Switch and a proprietary Framer that are designed to support 1+1 protection switching, ring architecture routing, and overall network control functions.
- **Network Processor** – The EVENT-HD digital radio includes a Network Processor which performs SNMP and Network Management functions.
- **Modem/IF** – The EVENT-HD digital radio modem performs forward-error-correction (FEC) encoding, PSK/QAM modulation and demodulation, equalization, and FEC decoding functions. The IF chain provides a 350 MHz carrier and receives a 140 MHz carrier. The multiplexer function is built into an appliqué that resides in the Modem/IF Module. Two modems can be used for 1+1 protection or ring architectures.
- **Power Supply** – The EVENT-HD power supply accepts 48 Vdc and supplies the IDU and ODU with power. A second redundant power supply may be added as an optional module.

The Modem Processor and its associated RAM, ROM, and peripherals control the digital and analog operation. It also provides configuration and control for both the IF and I/O cards. The IDU interfaces with the ODU to receive and provide modulated transmit and receive waveforms.

The EVENT-HD digital radio also provides the physical interface for the user payload and network management. In transmit mode, the Framer merges user payload (OC-3 or Fast Ethernet) with radio overhead-encapsulated network management data. This combined data stream is transmitted without any loss of user bandwidth. In the receive mode, the Framer separates the combined data stream received from the 256-QAM Modem. The IDU supports Scalable Ethernet data rates, such as 25 or 50 Mbps via the 100BaseT data interface port. The IDU provides network management data on 10 Mbps ports accessible via the 10/100BaseTX port. The Central Processor Unit (CPU) provides the embedded control and network element functionality of the OAM&P. The CPU also communicates with other functions within the IDU for configuration, control, and status monitoring. The CPU passes appropriate status information to the IDU rear panel display.

The power supply converts -48 Vdc to the DC voltage levels required by each component in the system.

2.5 Consecutive Point Architecture

The consecutive point network architecture is based on the proven SONET/SDH ring. Telecommunications service providers traditionally use the SONET/SDH ring architecture to implement their access networks. A typical SONET/SDH network consists of the service provider's Point of Presence (POP) site and several customer sites with fiber optic cables connecting these sites in a ring configuration (see Figure 2-8). This architecture lets providers deliver high bandwidth with high availability to their customers.

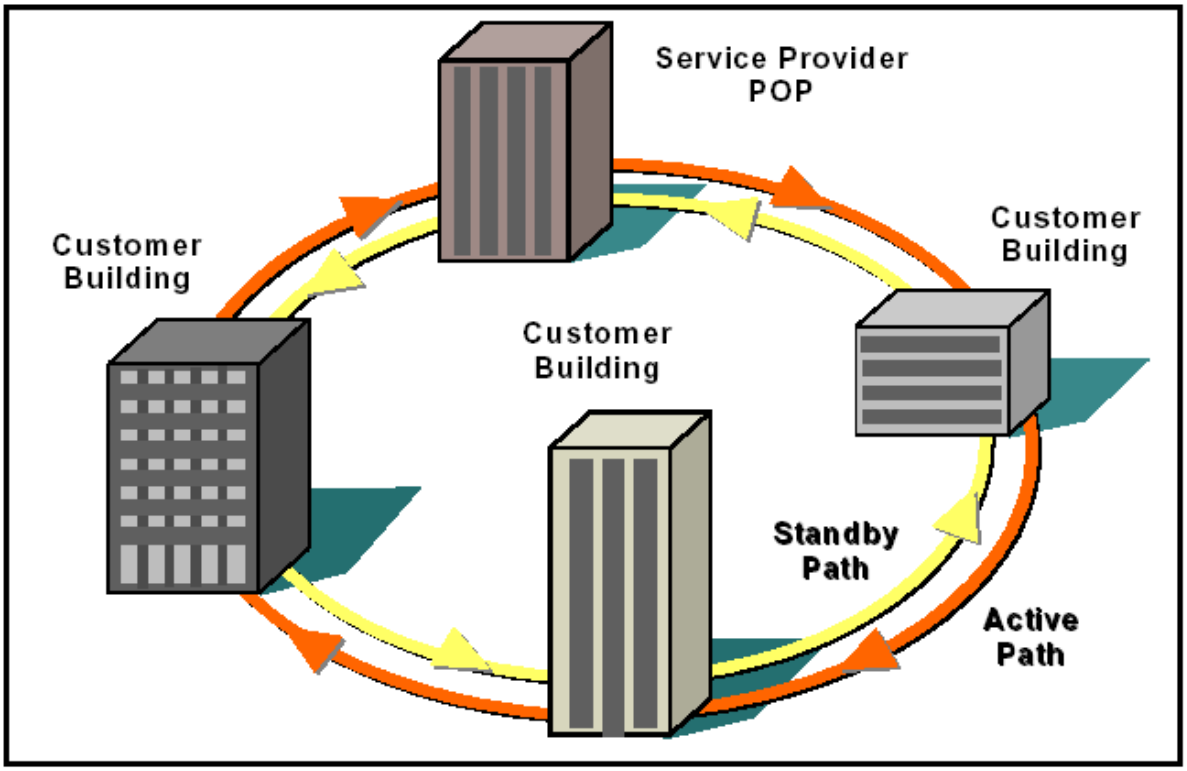


Figure 2-8. Ring Configuration

SONET/SDH rings are inherently self-healing. Each ring has both an active path and a standby path. Network traffic normally uses the active path. If one section of the ring fails, the network will switch to the standby path. Switchover occurs in seconds. There may be a brief delay in service, but no loss of payload, thus maintaining high levels of network availability.

The consecutive point architecture implemented in the Moseley Digital Radio family is based on a point-to-point-to-point topology that mimics fiber rings, with broadband wireless links replacing in-ground fiber cable. A typical consecutive point network consists of a POP and several customer sites connected using an IDU. These units are typically in a building in an east/west configuration. Using east/west configurations, each unit installed at a customer site is logically connected to two other units via an over-the-air radio frequency (RF) link to a unit at an adjacent site.

Each consecutive point network typically starts and ends at a POP. A pattern of wireless links and in-building connections is repeated at each site until all buildings in the network are connected in a ring as shown for an Ethernet network in Figure 2-9. For 2 x 1+0 and 2 x 1+1 nodes payload and NMS connections need to be jumpered between two IDUs. For 1 x 2+0 nodes, there is no need for jumpers as there is a single IDU. For SDH or SONET payloads, the configuration is similar but an external add/drop mux is required.

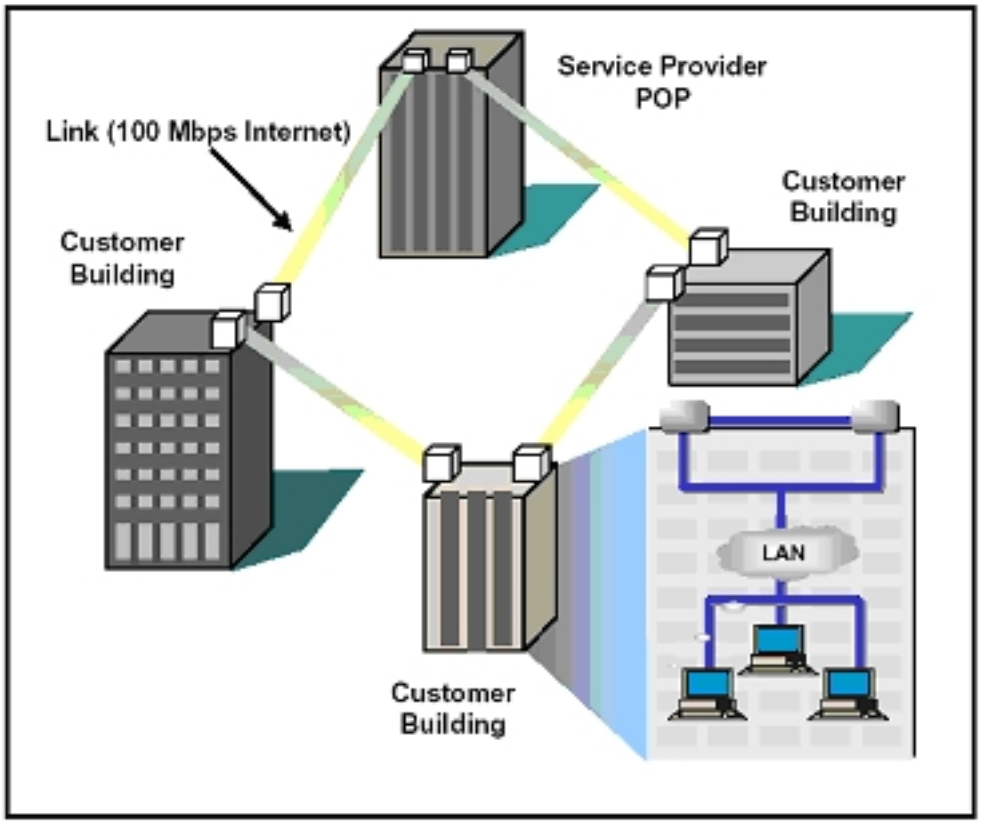


Figure 2-9. Consecutive Point Network

2.6 2+0 (East-West) Configuration

The EVENT-HD supports a 2+0, or east-west, configuration that allows a consecutive point architecture to be achieved with only a single 1 RU chassis at each location. In this configuration the IDU contains two modems and may contain two power supplies. One modem is referred to as the west modem and the other as the east modem. The IDU is

connected to two ODUs, one broadcasting/receiving in one directing of the ring architecture and the other broadcasting/receiving in the other as shown in Figure 2-10.

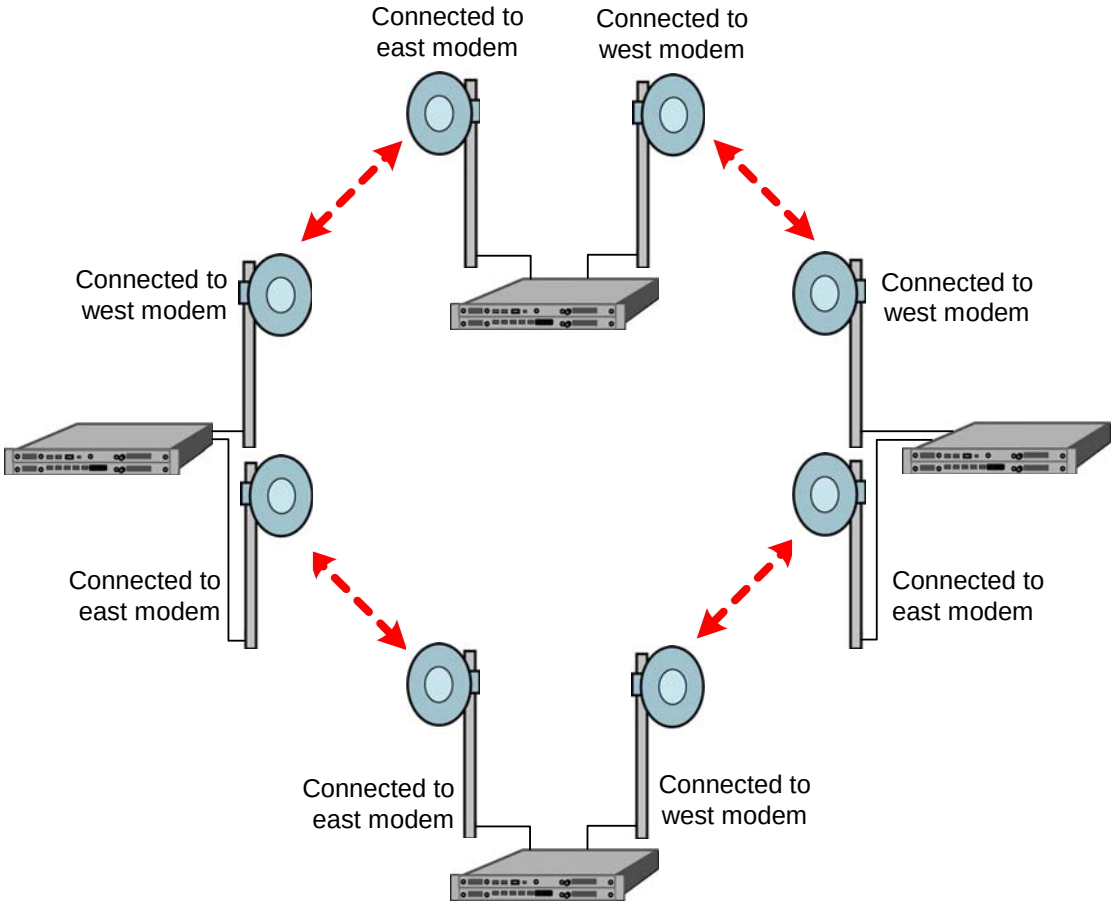


Figure 2-10. 2+0 (East West) Configuration

2.7 Spanning Tree Protocol (STP)

Spanning Tree Protocol (STP) keeps Ethernet loops from forming in a ring architecture. Without STP, loops would flood a network with packets. STP prevents loops by creating an artificial network break. In the event of a network outage, STP automatically removes the artificial break, restoring connectivity.

2.8 1+1 Protection

The EVENT-HD supports 1+1 protection as an option for a critical link. In this configuration, protection is provided in a single 1 RU chassis. The IDU contains two power supplies and two modems. The power supply, ODU, IF/telemetry and modem are protected. The digital framing and LIUs are not. One modem is referred to as the west modem and the other as the east modem. 1+1 protection can be run in two modes called Protected Non-Diversity and Protected Diversity.

2.8.1 Protected Non-Diversity (Hot Standby)

Figure 2-11 shows operation in Protected Non-Diversity mode, also called Hot Standby. In this mode, one ODU at each location transmits to two ODUs at the other location. This

mode does not require the extra bandwidth or interference protection. It provides hitless receive switching and hot standby. The IDU automatically switches transmit ODU upon appropriate ODU alarm or ODU interface error, minimizing transmit outage time.

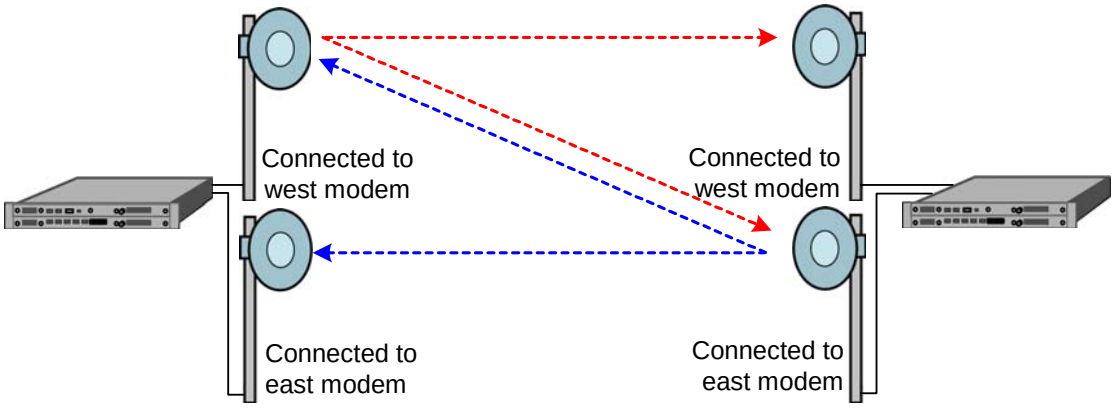


Figure 2-11. 1+1 Protection in Non-Diversity Mode

2.8.2 Protected Diversity

In Protected Diversity mode, the link between each pair of modems is the same, as shown in Figure 2-12, providing complete redundancy. This arrangement requires bandwidth for both links and non-interference between the links, but it provides hitless receive and transmit switching. The IDU supports both frequency and spatial diversity.

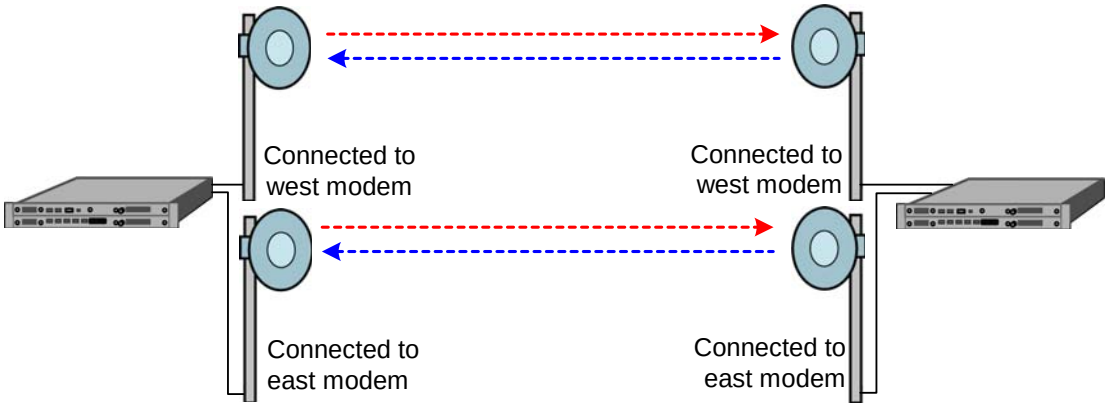


Figure 2-12. 1+1 Protection in Diversity Mode

2.8.2.1 Frequency Diversity

In frequency diversity, two frequencies are used to achieve non-interference. The proprietary framer chooses the best, or error-free, data stream and forwards it to the Line Interface Units (LIUs).

2.8.2.2 Spatial Diversity

In spatial diversity, two non-interfering paths are used. The proprietary framer chooses the best, or error-free, data stream and forwards it to the Line Interface Units (LIUs).

2.8.2.2.1 Single Transmitter

Protected Non-Diversity, or Hot Standby, is also referred to as Single Transmitter Spatial Diversity. For more information on this mode, see Section 2.9.1.

2.8.2.2.2 Dual Transmitter

When using Dual Transmitter Spatial Diversity, two active transmitters are physically isolated to avoid crosstalk.

2.9 1+1 Multi-Hop Repeater Configuration

The EVENT-HD supports a 1+1 multi-hop repeater configuration with drop/insert capability as shown in Figure 2-13. This configuration provides individual 1+1 link protection as described in section 2.7, as well as the full-scale protection inherent in the consecutive point architecture as described in section 2.6. At each location within the network, data may be dropped or inserted. In this configuration each IDU contains two power supplies and two modems.

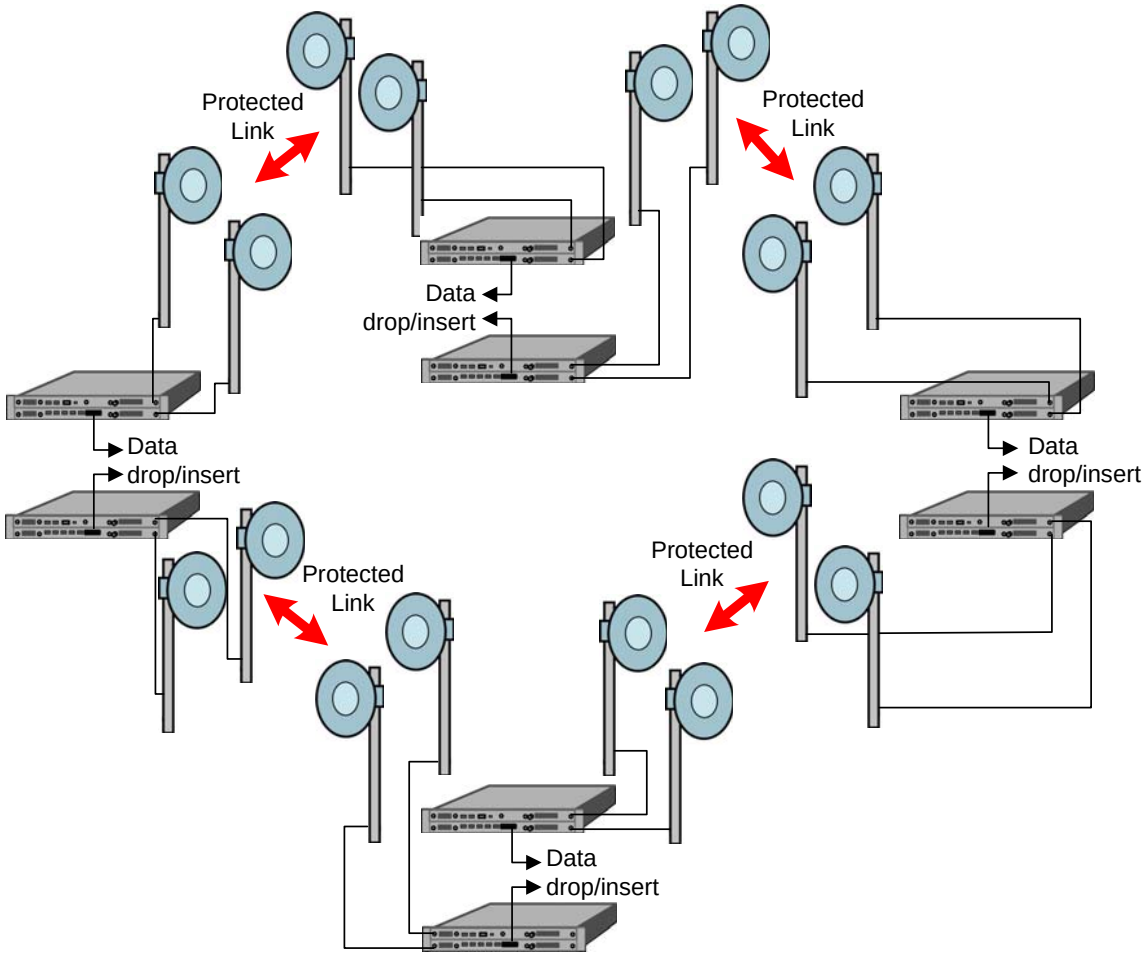


Figure 2-13. 1+1 Multi-Hop Repeater Configuration

2.10 Data Interfaces

The primary interface for video and broadcast applications is the DVB-ASI interface located in the mini-I/O card slot. Alternatively this interface can be replaced with STM-1 Optical/OC-3 or STM-1 Electrical interfaces. The optical interface is single mode at 1300 nm. Consult factory for availability of Mini-IO STM-1/OC-3 Module.

The I/O card has 2x100BaseTX interfaces that can be configured as either primary payload, or secondary wayside channels. The Over-the-air channel has a data-bandwidth capacity that is set by the frequency-bandwidth, modulation, and coding. The data-bandwidth may be allocated to various I/O card interfaces, including 155.52 Mbps for DVB-ASI or STM-1, 2 Mbps per E1, up to 100 Mbps Ethernet, and up to 1 Mbps NMS. Only up to 100 Mbps of data-bandwidth may be allocated for either net data, and the two I/O card 100BaseTX interfaces will share that 100 Mbps data-bandwidth.

2.11 Crosspoint Switch

The IDU crosspoint switch provides any-to-any E1/T1 routing between rear panel ports and RF links, as shown in Figure 2-14. Flexible channel mapping allows selection from predefined routings or custom routing. Custom routings are uploaded to the IDU via FTP. Two examples of the crosspoint capability are to use the crosspoint switch to configure a repeater or an add/drop. These examples are shown in Figure 2-15. In the repeater example, the Crosspoint Switch is used as a passthrough to send E1/T1s from the east modem to the west modem. In the add/drop example, the crosspoint switch connects E1/T1s from the modems to the rear-panel ports.

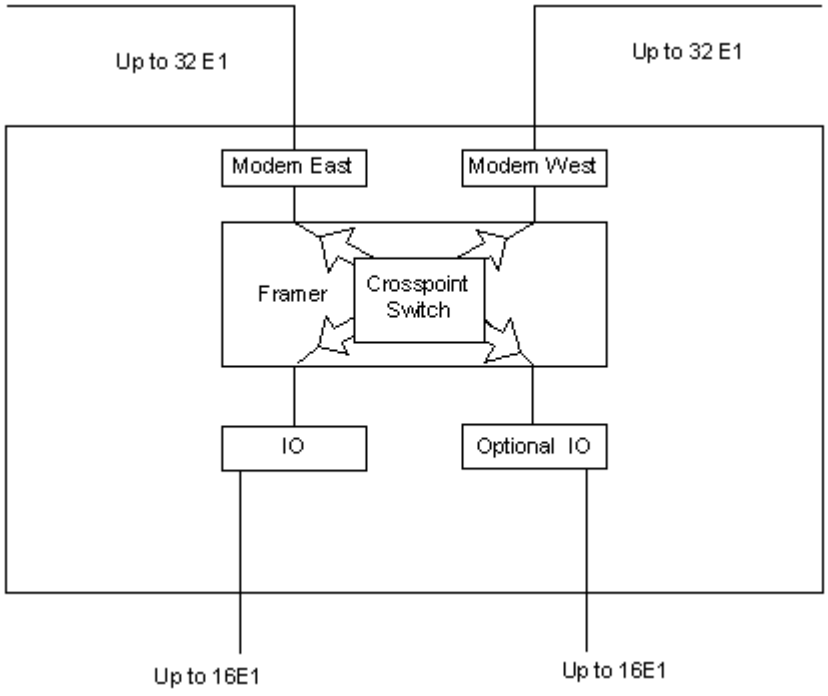


Figure 2-14. Crosspoint Switch

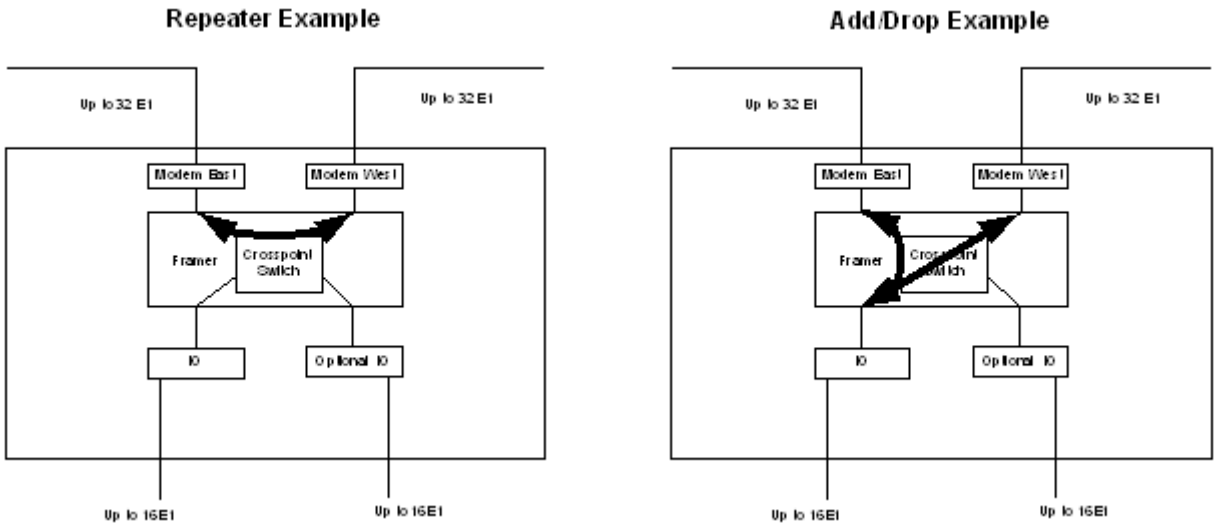


Figure 2-15. (a) Crosspoint Switch used as pass-through in repeater configuration. (b) Crosspoint Switch allows access for add/drop.

2.12 Power Management

RF power management is a radio design feature that controls the power level (typically expressed in dBm) of the RF signal received from a transmitter by a receiver. The traditional goal of power management is to ensure that the RF signal at a receiver is strong enough to maintain the radio link under changing weather and link conditions.

The Quadrature Amplitude Modulation (QAM) is not a constant envelope waveform. Therefore, the average power and peak power are different. The difference in peak and average power depends on the constellation type and shaping factor, where spectral efficiency such as more constellation points or lower shaping factor leading to peak powers higher than average powers. The peak power is typically 5-7 dB greater than the average power and never exceeds 7 dB. Regulatory requirements are sometimes based on peak EIRP which is based on peak power and antenna gain.

Traditional power management techniques such as Constant Transmit Power Control (CTPC) and Automatic Transmit Power Control (ATPC) transmit at a high power level to overcome the effects of fading and interference. However, these techniques continue to operate at a higher power level than needed to maintain the link in clear weather. Because transmit power remains high when the weather clears, the level of system interference increases.

Radios operating at high transmit power will interfere with other radios, even if the interfering source is miles away from the victim. High interference levels can degrade signal quality to the point that wireless radio links become unreliable and network availability suffers. The traditional solution to system interference is to increase the distance between radios. However, the resulting sparse deployment model is inappropriate for metropolitan areas.

In response to the need for a high-density deployment model, EVENT-HD uses a unique power control technique called A_dTPC. A_dTPC enables EVENT-HD to transmit at the minimum power level necessary to maintain a link regardless of the prevailing weather and interference conditions. The EVENT-HD is designed and manufactured to not exceed the maximum power allowed. The purpose of power management is to minimize transmit power level when lower power levels are sufficient. A_dTPC also extends the concept of

power management by controlling not only the power (dBm) of the RF signal, but its quality (signal-to-noise ratio) as well.

In contrast to ATPC, the A_dTPC technique dynamically adjusts the output power based on both the actual strength and quality of the signal. Networked EVENT-HD radios constantly monitor receive power and maintain 10^{-12} BER performance under varying interference and climate conditions. Each EVENT-HD unit can detect when there is a degradation in the received signal level of quality and adjust the transmit power level of the far-end EVENT-HD unit to correct for it.

A_dTPC provides maximum power in periods of heavy interference and fading and minimum power when conditions are clear. Minimal transmit power reduces potential for co-channel and adjacent channel interference with other RF devices in the service area, thereby ensuring maximum frequency re-use. The resulting benefit is that operators are able to deploy more EVENT-HD units in a smaller area.

2.13 Software and Network Management

EVENT-HD parameters can be accessed using:

- a standard web-browser via HTTP to access the built in web server.
- an SNMP Agent using the fully featured MIB, allowing for automation of data collection and network management.
- a command line client accessible from a terminal client connected to the serial port, or telnet over the NMS Ethernet.
- the optional Front Panel

These user interfaces are described in the EVENT-HD User Interface Guide (Moseley Document #602-15038-01).

2.13.1 IP Address

Each EVENT-HD radio is configured independently for network parameters such as IP address, subnet, and gateway. However, the EVENT-HD can also be configured as a DHCP client. In this configuration, a DHCP server assigns an IP address to the radio. A specific IP address may be associated with a particular EVENT-HD radio by configuring the DHCP server to assign IP addresses based upon the IDU Ethernet MAC address.

2.13.2 Network

EVENT-HD uses an Out-of-Band NMS network that is separate from the payload Ethernet network. Each EVENT-HD contains a managed Layer 2 Ethernet switch that supports Spanning-Tree Protocol (STP) for managing NMS traffic. This allows the EVENT-HD to be configured in a protected ring configuration where the STP will prevent an Ethernet loop in the ring. This will also allow the ring to re-configure in the event of an outage. The EVENT-HD acts as a network bridge via the Ethernet switch and STP. The EVENT-HD does not currently support NMS routing capability.

2.13.3 NMS Network Operational Principles

The EVENT-HD does not provide routing capability. Therefore, *all EVENT-HD radios must be on the same subnet as the PC being used to access the EVENT-HD radios.* If the EVENT-HD radios and/or the PC are on different subnets, a router must be used, with the

gateway addresses set appropriately. Figure 2-16 shows the PC and both EVENT-HD units in the same subnet. In this case, no router is required. Figure 2-17 shows the PC and one EVENT-HD in one subnet and the other EVENT-HD in another. In this case, a router is required. Note how the GW addresses are set to allow communication from the PC to the EVENT-HD in the other subnet.

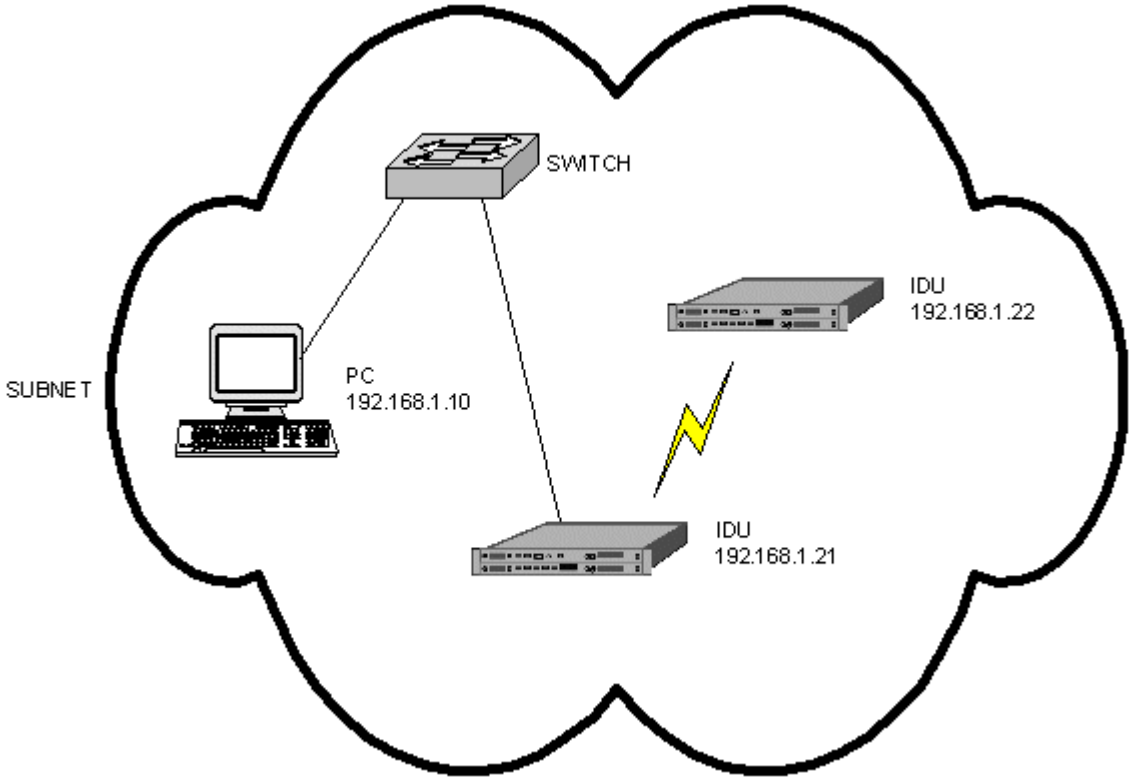


Figure 2-16. PC and EVENT-HD IDUs on Same Subnet

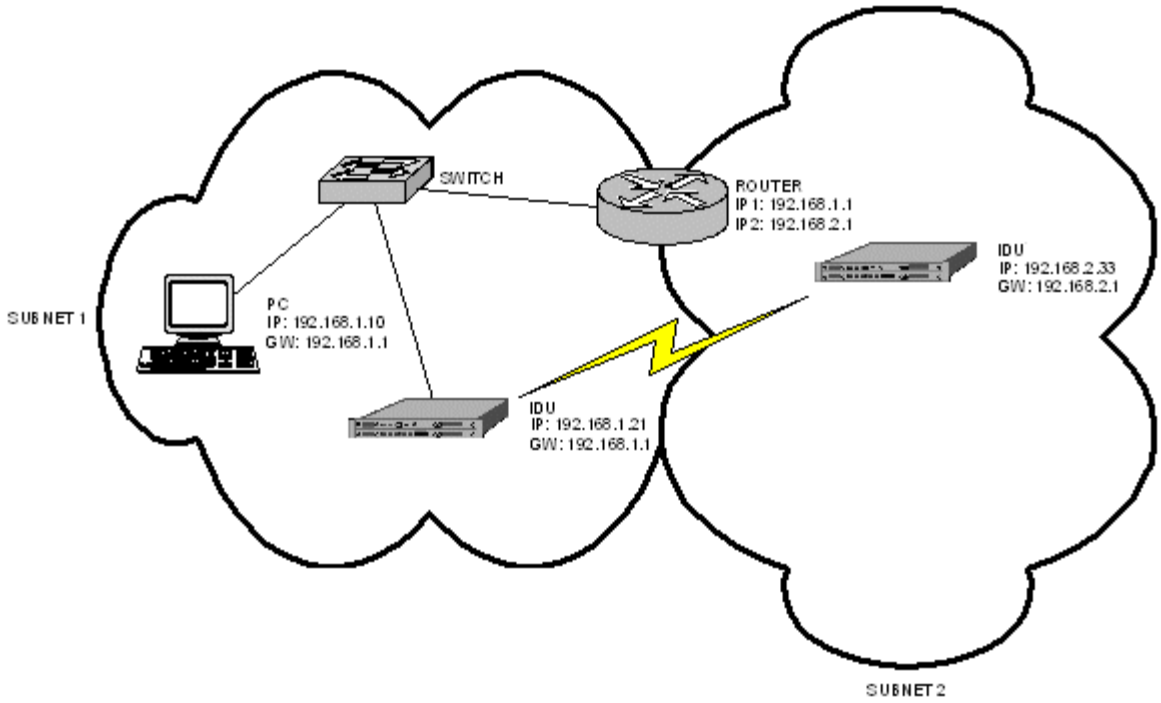


Figure 2-17. EVENT-HD IDUs on Different Subnets

2.13.4 Third Party NMS Support

The EVENT-HD IDU supports SNMPv1, SNMPv2, and SNMPv3 protocols for use with third party network management software. The SNMP agent will send SNMP traps to specified IP addresses when an alarm is set or cleared. Information contained in the trap includes:

- IP address
- System uptime
- System time
- Alarm name
- Alarm set/clear detail

The EVENT-HD IDU may also be managed via HTTP, TELNET, and SSH protocols.

2.14 System Loopbacks

The EVENT-HD supports system loopbacks that can be used to test and verify a unit, link, and/or network. A variety of loopback points, including LIU selection, are available. Loopback points and duration can be selected through the Web Interface or optional Front Panel.

3. Installation

3.1 Unpacking

The following is a list of possible included items.

Description	Quantity
EVENT-HD IDU (1RU chassis)	1
ODU (with hardware)	1
Manual (or Soft copy on a CD)	1

Figure 3-1. EVENT-HD (1+0) Components

Be sure to retain the original boxes and packing material in case of return shipping. Inspect all items for damage and/or loose parts. Contact the shipping company immediately if anything appears damaged. If any of the listed parts are missing, call the distributor or the factory immediately to resolve the problem.

3.2 Notices

CAUTION:

DO NOT OPERATE UNITS WITHOUT AN ANTENNA, ATTENUATOR, OR LOAD CONNECTED TO THE ANTENNA PORT. DAMAGE MAY OCCUR TO THE TRANSMITTER DUE TO EXCESSIVE REFLECTED RF ENERGY.

ALWAYS ATTENUATE THE SIGNAL INTO THE RECEIVER ANTENNA PORT TO LESS THAN -20 dBm. THIS WILL PREVENT OVERLOAD AND POSSIBLE DAMAGE TO THE RECEIVER MODULE.

WARNING

HIGH VOLTAGE IS PRESENT INSIDE THE ODU and IDU WHEN THE UNIT IS PLUGGED IN. TO PREVENT ELECTRICAL SHOCK, UNPLUG THE POWER CABLE BEFORE SERVICING. UNIT SHOULD BE SERVICED BY QUALIFIED PERSONNEL ONLY.

3.3 Pre-Installation Notes

- Use back-to-back bench testing to become familiar with the EVENT-HD.
- We highly recommend installation of lightning protectors on the ODU/IDU Interconnect Cable to prevent line surges from damaging expensive components.

3.4 Back-to-Back Bench Testing

Back-to-back bench testing prior to final installation is highly recommended in order to gain familiarity with the product. The following additional equipment is required for back-to-back testing:

- Low-loss cables, TNC-male connectors on ODU interfaces.
- Three Inline RF attenuators, 2 x 30 dB (10 Watts min.) and 1 x 20 dB (2 Watts min.), rated for ODU frequency.

The EVENT-HD IDU and ODUs must be configured in an operational configuration and set-up as shown in Figure 3-2 for ODUs with transmit powers of 1W and 5W. For 5.3 GHz and 5.8 GHz applications the 20 dB attenuator may be removed. When equipment is connected in an operational configuration, no errors should be reported on the rear panel.

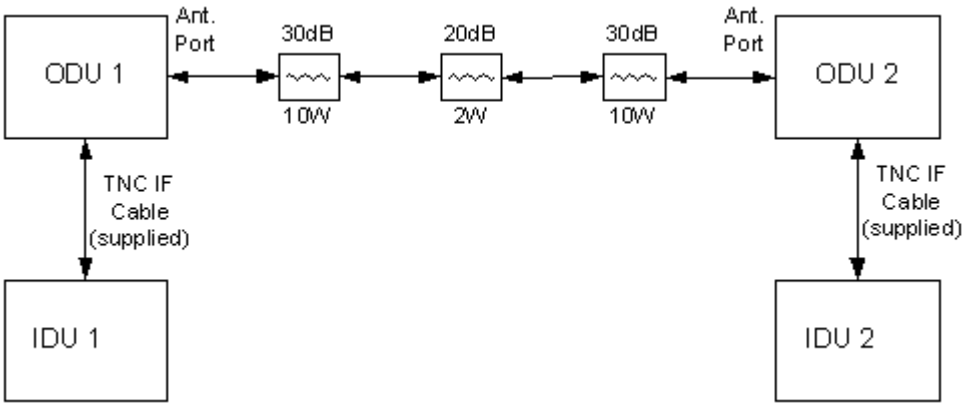


Figure 3-2. EVENT-HD Back-to-Back Testing Configuration

3.5 Overview of Installation and Testing Process

The installation and testing process is accomplished by performing a series of interrelated, procedures. Each procedure is required for the successful implementation of a production EVENT-HD network:

- **Site Evaluation**: Gather specific information about potential EVENT-HD radio installation sites.
- **Cable and Installation**: Test and install ODU cables and optional interface devices at installation sites.
- **EVENT-HD ODU Mounting and Alignment**: Mount ODUs to a pole or wall, perform link alignment and radio frequency (RF) verification.
- **EVENT-HD Digital Radio Configuration**: Use EVENT-HD Link Manager software to install network- and site-specific parameters in the radios.
- **EVENT-HD Digital Radio Testing**: Perform cable continuity checks and RF tests for links, the payload/radio overhead channel, and the management channel.

The following diagram shows where installation and commissioning resides within the EVENT-HD network deployment life cycle and defines the sequence in which the processes should be performed.

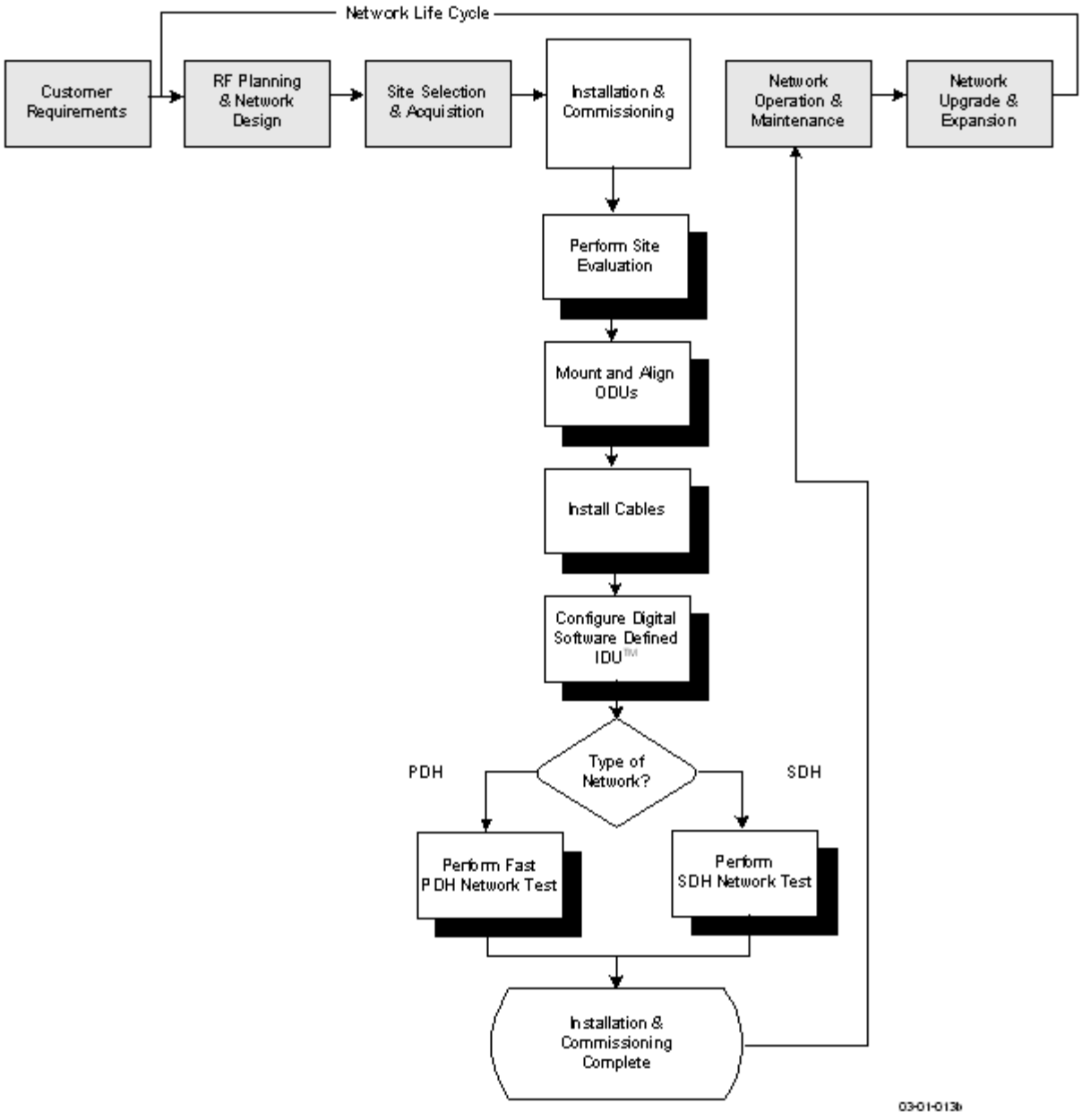


Figure 3-3. Network Deployment Lifecycle

3.6 Site Evaluation

A site evaluation consists of a series of procedures for gathering specific information about potential EVENT-HD locations. This information is critical to the successful design and deployment of a network. Site evaluations are required to confirm whether or not a building meets network design requirements. The main objectives are as follows:

- Confirm
  - Line of sight for each link
  - EVENT-HD ODU mounting locations
  - Site equipment locations

- Cable routes
- Any other potential RF sources

- Prepare site drawings and record site information

3.6.1 Preparing for a Site Evaluation

The following tools are required to perform a site evaluation:

- RF and network design diagrams (as required)
- Binoculars
- Global positioning system (GPS) or range finder
- Compass
- Measuring tape and/or wheel
- Digital camera
- Area map
- Aerial photograph (if available)
- List of potential installation sites ("targeted buildings")

The following tasks must be completed prior to performing a site evaluation:

- Prepare the initial network design by performing the following:
  - Identify potential buildings by identifying targeted customers (applicable if you're a service provider)
  - Identify potential links by selecting buildings based on the high probability of line of sight
- Arrange for access with the facility personnel into the buildings, equipment rooms, and architectural plans to become familiar with the location of all ducts, risers, etc.

3.6.2 Site Evaluation Process

The following steps must be completed to perform a successful site evaluation:

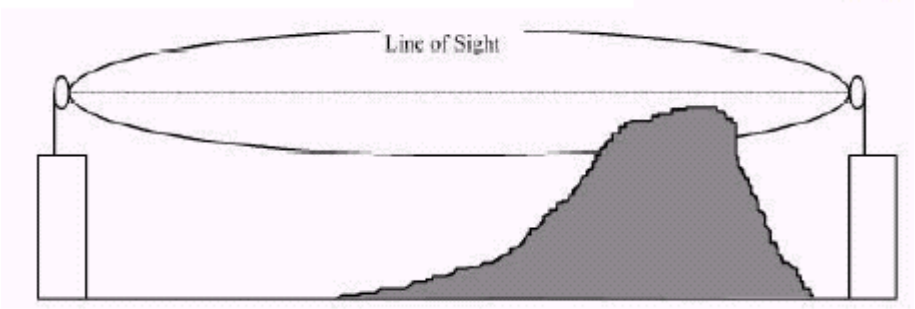
- Ensure RF Safety compliance: Ensure that appropriate warning signs are properly placed and posted at the equipment site or access entry. For a complete list of warnings, refer the Safety Precautions listed at the beginning of this manual.
- Ensure Compliance with Laws, Regulations, Codes, and Agreements: Ensure that any installation performed as a result of the site evaluation is in full compliance with applicable federal and local laws, regulations, electrical codes, building codes, and fire codes.
- Establish Line of Sight between antennas: **The most critical step in conducting a site evaluation is confirming clear radio Line of Sight (LOS) between a near antenna and a far antenna. If LOS does not exist, another location must be used.**

EVENT-HD radios must have a clear view of each other, or "line of sight". Binoculars may be used evaluate the path from the desired location of the near antenna to the desired location of the far antenna.

To confirm Line of Sight:

- Ensure that no obstructions are close to the transmitting/receiving path. Take into consideration trees, bridges, construction of new buildings, unexpected aerial traffic, window washing units, etc.
- Ensure that each EVENT-HD ODU can be mounted in the position required to correctly align the EVENT-HD ODU with its link partner.

The antennas must also have a clear radio line of sight. If a hard object, such as a mountain ridge or building, is too close to the signal path, it can damage the radio signal or reduce its strength. This happens even though the obstacle does not obscure the direct, visual line of sight. The Fresnel zone for a radio beam is an elliptical area immediately surrounding the visual path. It varies in thickness depending on the length of the signal path and the frequency of the signal. The necessary clearance for the Fresnel zone can be calculated, and it must be taken into account when designing a wireless links.



As shown in the picture above, when a hard object protrudes into the signal path within the Fresnel zone, knife-edge diffraction can deflect part of the signal and cause it to reach the receiving antenna slightly later than the direct signal. Since these deflected signals are out of phase with the direct signal, they can reduce its power or cancel it out altogether. If trees or other 'soft' objects protrude into the Fresnel zone, they can attenuate (reduced the strength of) a passing signal. In short, the fact that you can see a location does not mean that you can establish a quality radio link to that location. Consult factory for a link planner spreadsheet that calculates the Fresnel ratio and helps determine link feasibility.

- Determine EVENT-HD ODU Mounting Requirements: EVENT-HD ODUs can be mounted on an antenna mast, brick, masonry or wall. Refer to detailed installation sections specific for each ODU and antenna type.
- Determine EVENT-HD IDU Installation Location: An IDU can be installed on a tabletop or cabinet, wall mount, or rack mount. The site must provide DC power. Refer to detailed installation sections.
- Document Potential Sources of Co-location Interference: When EVENT-HD ODUs are located on a roof or pole with other transmitters and receivers, an interference analysis may be required to determine and resolve potential interference issues. The interference analysis needs to be performed by an RF engineer. The specific information required for each transmitter and receiver includes the following:
  - Transmitting and/or receiving frequency
  - Type of antenna
  - Distance from EVENT-HD ODU (horizontal and vertical)

- Polarity (horizontal or vertical), if applicable
- Transmit power level
- Antenna direction

- Measure the Link Distance: The two ways to measure link distance are as follows:
  - GPS: record the latitude and longitude for the near and far ODU sites and calculate the link distance. Record the mapping datum used by the GPS unit and ensure the same mapping datum is used for all site evaluations in a given network.
  - Range finder: measure the link distance (imperial or metric units may be used).

  Once the link distance has been measured, verify that the link distance meets the availability requirements of the link.
- Select the Grounding Location for both the ODU and IDU: The IDU must be properly grounded in order to protect it and the structure it is installed on from lightning damage. This requires
  - Grounding all ODUs to antenna tower.
  - Grounding all IDUs to the rack.
- Determine the Length of Interconnect Cable from ODU to IDU: The primary consideration for the outdoor interconnect cable is the distance and route between the ODU and IDU. This cable should not exceed 330 feet using Times Microwave LMR-200 cable. Guidelines are provided in Table 3-1. Exact distances should take ODU requirements into account.

Table 3-1. Maximum Cable Lengths

Cable Type	Loss at (dB/100 m)		Maximum Length*
	140 MHz	350 MHz	
LMR-200	12.6	20.1	100 m
LMR-300	7.6	12.1	165 m
LMR-400	4.9	7.8	256 m
RG-214	8	13.1	153 m
Belden 7808	8.6	14	143 m

* Does not account for connector loss.

- Confirm the Presence of DC Power for the IDU.
- Ensure Building Aesthetics: Ensure that the ODU can be mounted so that it is aesthetically pleasing to the environment and to the property owner. Aesthetics must be approved by the property owner and the network engineer.
- Take Site Photographs
- Sketch the Site

3.6.3 Critical System Calculations

3.6.3.1 Received Signal Level (RSL) and Link Budget

The received signal level (RSL) can be estimated using the following formula:

$RSL\ (dBm) = P_{TX} + G_{TX\ ANT} - L_{Path} + G_{RX\ ANT}$

Where: P_{TX} is the transmitter output power (in dBm)

$G_{TX\ ANT}$ is the gain of the transmit antenna (in dB)

$G_{RX\ ANT}$ is the gain of the receive antenna (in dB)

L_{Path} is the Path loss, defined by:

$L_P\ (dB) = 36.6 + 20\log_{10}(F*D)$

Where: F is the Frequency in MHz, D is the Distance of path in miles

This link budget is very important in determining any potential problems during installation. The expected RSL and measured RSL should be close (+/- 5 to 10 dB)

3.6.3.2 Fade Margin Calculation

The fade margin is the difference between the actual received signal and the digital radio's threshold for the modulation mode selected. The fade margin can be used to determine availability and should be at least 10 dB for most cases but is ultimately determined by required application reliability.

3.6.3.3 Availability Calculation

Availability of the microwave path is a prediction of the percent of time that the link will operate without producing an excessive BER due to multipath fading. Availability is affected by the following:

- Path length
- Fade margin
- Frequency
- Terrain (smooth, average, mountainous, valleys)
- Climate (dry, temperate, hot, humid)

Depending on the type of traffic carried over the link and the overall network design redundancy, fade margin should be included to support the desired availability rate. Critical data and voice may require a very high availability rate (99.999% or 5.3 minutes of predicted outage per year). To improve availability, the fade margin can be increased by shortening the path length, transmitting at a higher power level, or by using higher gain antennas.

Availability can be computed using the following formula, which is known as the *Vigants Barnett Method.*

$Availability = 100 \times (1 - P)$

$P = 2.5 \times 10^{-9} \times C \times F \times D^3 \times 10^{(-FM/10)}$

Where F is the frequency in MHz

D is the distance in miles

FM is the fade margin in dB

C is the climate/terrain factor as defined below:

Humid/Over Water: C = 4 (worst case channel)

Average Conditions: C = 1

Dry/Mountains: C = 0.25 (best case channel)

Example: Assume 21 dB fade margin, over 5 miles with average climate/terrain. The availability comes out to be 99.9986. This corresponds to the link being unavailable for 7.6 minutes per year.

3.6.4 Frequency Plan Determination

When configuring EVENT-HD units in a point-to-point or consecutive point configuration, careful engineering of the EVENT-HD frequency plans and antenna locations should be performed in order to minimize potential interference between nearby radios. Nearby radios should operate on different frequencies, transmitting in the same band (high side or low side). Local frequency coordination efforts are often a requirement for broadcast auxiliary service applications. When designing multi-radio configurations, antenna size, antenna polarization, and antenna location are critical.

The frequency plan is selected based band of use. Desired data rate and capacity is selected based on expected link conditions or fixed based on application. In a high interference environment or with lower gain antennas, higher bandwidth, more robust modulation formats must be employed. The available frequency plans are illustrated in Figures 3-4 through Figure 3-9 based on application frequency.

The channel assignments shown in the figures correspond to the channel numbers entered via the Web Interface or SNMP.

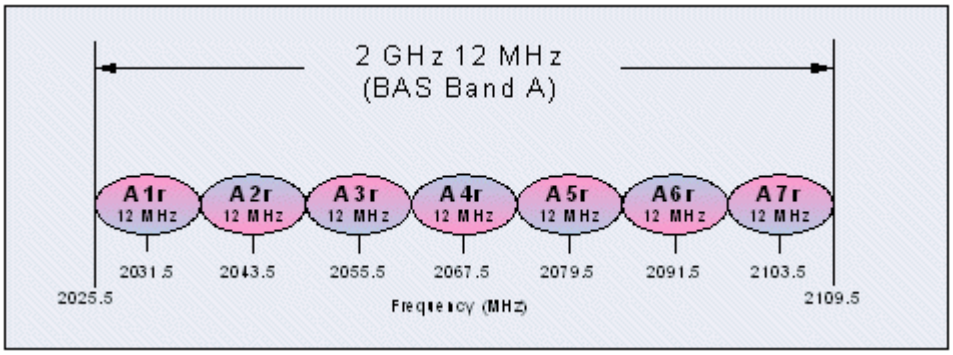


Figure 3-4. 2 GHz, 12 MHz BAS Frequency Plan

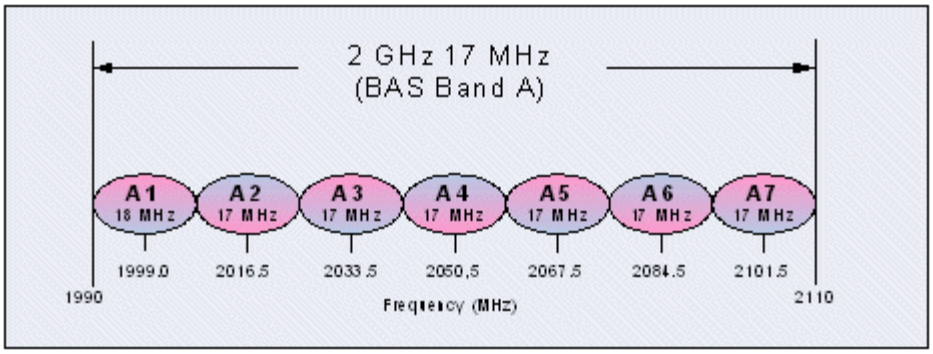


Figure 3-5. 2 GHz, 17 MHz Legacy BAS Frequency Plan

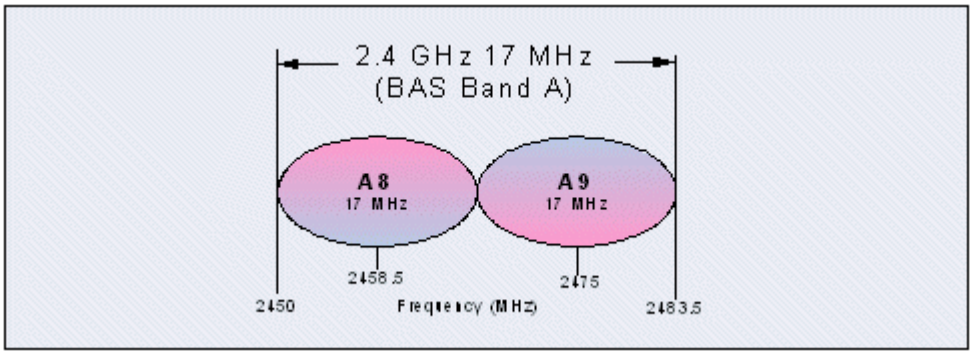


Figure 3-6. 2.4 GHz, 17 MHz BAS Frequency Plan

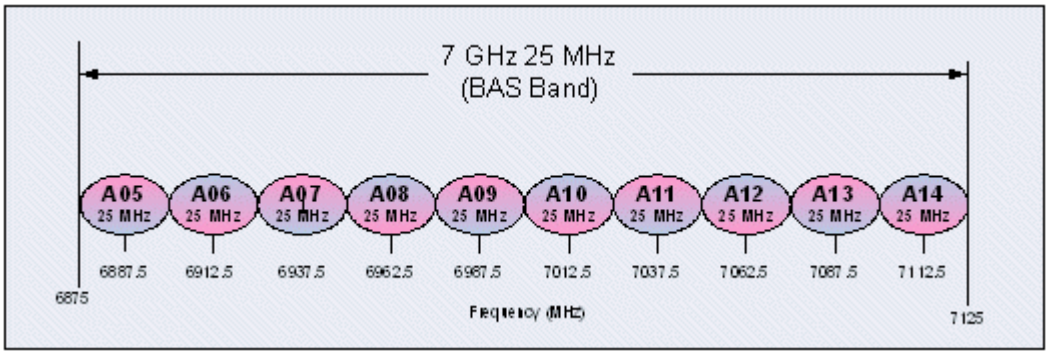


Figure 3-7. 7 GHz, 25 MHz BAS Frequency Plan

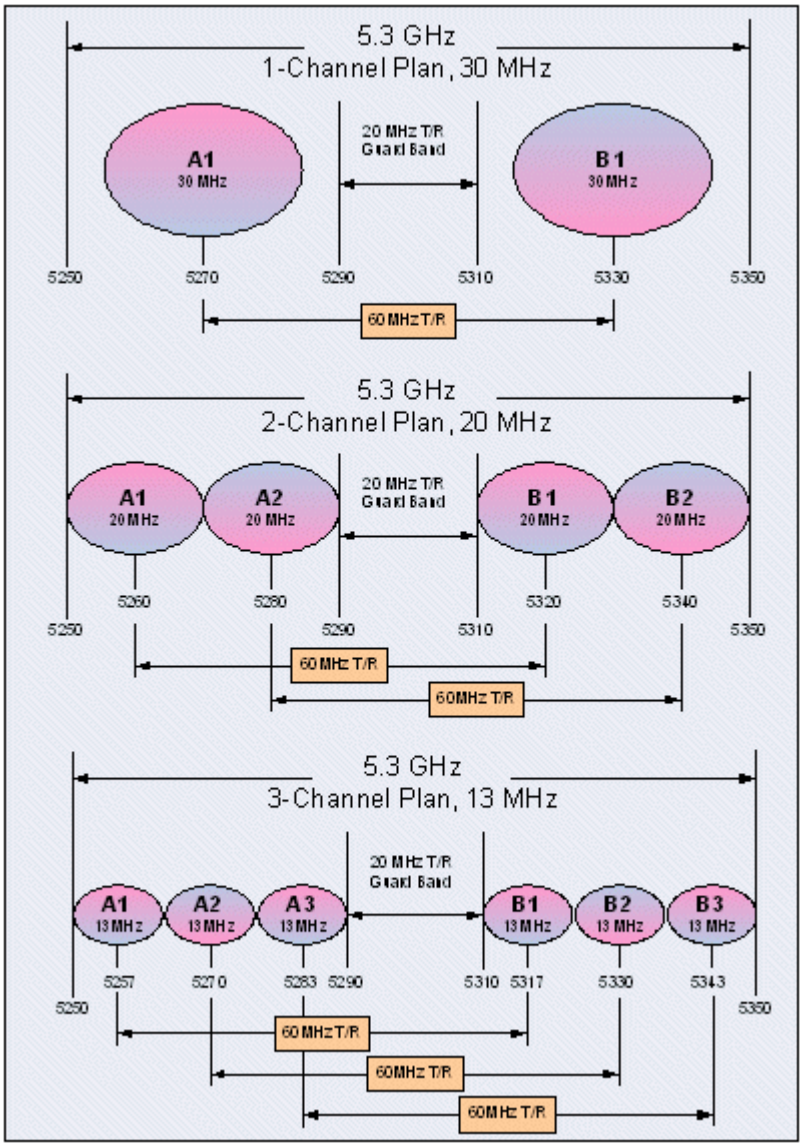


Figure 3-8. 5.3 GHz Frequency Plan

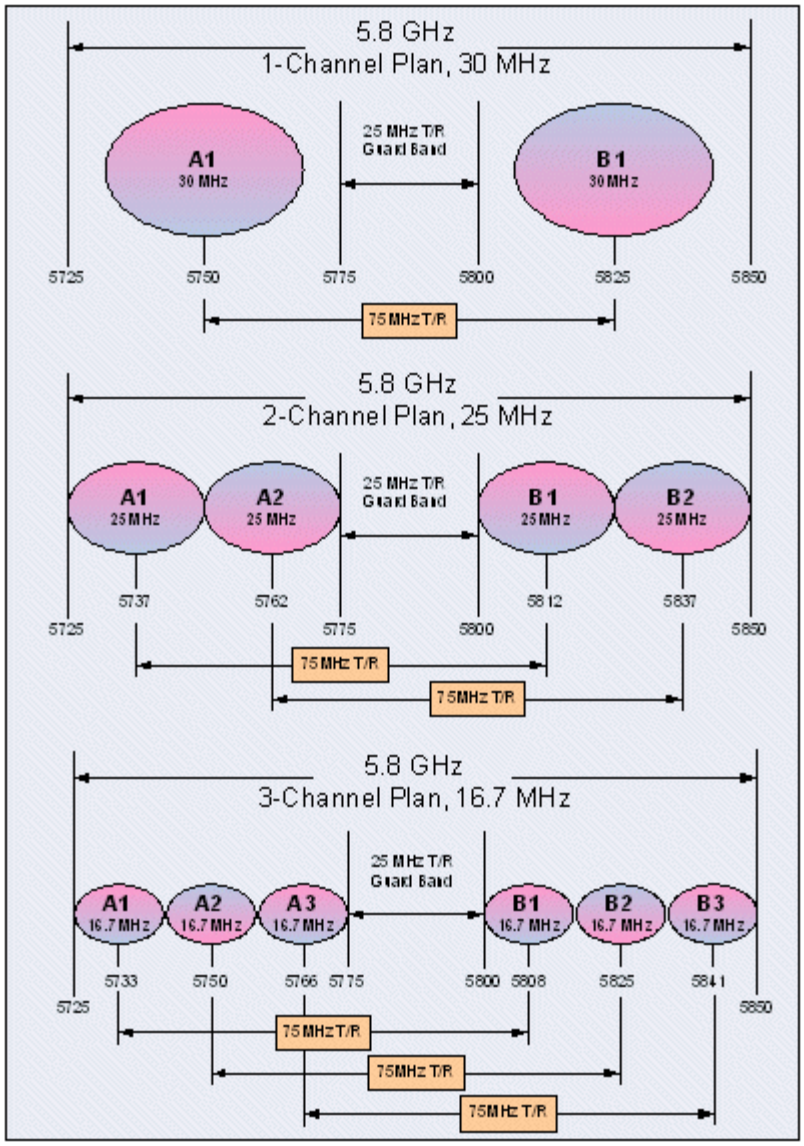


Figure 3-9. 5.8 GHz Frequency Plan

3.6.5 Antenna Planning

Larger antennas have the advantage of providing narrower beam widths and high isotropic gain, which yields better link performance (higher fade margin, better availability), and improves immunity to spatial interference (due to the smaller beam widths). However, larger antennas are more costly to purchase and install than smaller antennas and in some cases, they require special equipment for installation due to narrower beam widths. They are also more easily affected by wind.

1) Select where the cable will enter the building from the outside.

2) Determine the length of cable required. Allow three extra feet on each end to allow for strain relief, as well as any bends and turns.

3.6.6 ODU Transmit Power Setup

Setting the ODU transmit power is conditional on the band and application. The installer of this equipment is responsible for proper selection of allowable power settings. If there are any questions on power settings refer to your professional installer in order to maintain the FCC legal ERP limits.

This warning is particularly true for the 5.3 GHz and 5.8 GHz bands and special instructions are provided below for these bands. For the broadcast auxiliary service (BAS) applications the power should not exceed that necessary to render for satisfactory service.

It is also noted that as QAM mode order increases the linearity requirements also increase. As a rule to maintain requisite signal quality the transmit power should be lowered 1 dB for every order increase in QAM mode order. For instance, the maximum power for the Event 2200 is 37 dBm in QPSK mode. Therefore the maximum power backoff would follow Table 3-2 below:

Table 3-2. Maximum Output Power vs. Modulation Order for Event 2200

Modulation	Backoff (dB)	Max.Output Power (dBm)
QPSK	0	37
16 QAM	-1	36
32 QAM	-2	35
64 QAM	-3	34
128 QAM	-4	33

3.6.6.1 5.8 GHz Band

For fixed point-to-point applications in the United States the maximum EIRP (Effective Isotropic Radiated Power) is unlimited when using directional antennas in accordance with FCC part 15.247b(3). The ODU 5800 may therefore be operated at its maximum output power, +23 dBm, for maximum system gain.

EIRP is calculated for link budget with external antennas as,

EIRP(avg) dBm = External Antenna Gain (dBi) + 23 dBm

For internal antenna (23 dBi) EIRP is, EIRP(avg) = 46 dBm

3.6.6.2 5.3 GHz Band

In the 5.3 GHz U-NII band the peak EIRP (Effective Isotropic Radiated Power) is limited to +30 dBm at the antenna for bandwidths above 20 MHz and is reduced for narrower bandwidths in accordance with FCC part 15.407a(3).

The installer is responsible during set up of transmit power to not exceed FCC limits on transmission power. These maximum power levels are provided in Table 3-3 for both internal antenna and external antenna ODU configurations, along with the operational bandwidths.

Note that though regulatory limits are stated in terms of peak power, the system transmit power levels are calibrated as averaged power readings. Average power is used for link calculations. Therefore the levels provided in the following table is average power levels that have been certified to correspond with the maximum peak EIRP allowed.

3.6.6.2.1 ODU with Internal Antenna

Table 3-3 indicates the maximum average transmit power setting that may be selected ODU 5300 with internal (23 dBi) antenna.

The number of supported channels per band (low band or high band) is shown in the link configuration wizard. The greater number of channels supported the lower the emission bandwidth for each channel.

For link budget, EIRP(Avg) = 23 dBi + Tx Power Setting (dBm).

3.6.6.2.2 ODU with External Antenna

When using external antennas with gains greater than 23 dBi, the transmit power must be reduced in dB from that given in Table 3-3 by the antenna gain difference above 23 dBi for the mode that is being used.

For example, using a 6 foot dish antenna with 37 dBi gain, the output power would be dropped by: Antenna Gain (External) – 23 dBi = Antenna Gain Difference (e.g., 37.6 dBi – 23 dBi = 14.6 dB).

For mode 100FE1 (single channel configuration with 30MHz emission bandwidth) the power would be lowered from: Tx Power (Internal Antenna) – Antenna Gain Difference = Tx Power (External Ant). Example: +5 dBm – 14.6 dB = -9.6 dBm (-10 dBm).

Table 3-3 also shows transmit power settings for various antenna dish sizes.

For link budget, EIRP(Avg) dBm = 37 dBi + Tx Power Setting (dBm).

Table 3-3. Maximum Power Settings for 5.3GHz U-NII Band Operation (US)

		Maximum Tx Power Setting, dBm		
Antenna Diameter	**Antenna Gain, dBi* (example)**	**1 Channel Mode (30MHz BW)**	**2 Channel Mode (20MHz BW)**	**3 Channel Mode (13.3MHz BW)**
6 foot dish	37.6	-10	-11	-12
4 foot dish	34.6	-7	-8	-9
3 foot dish	31.2	-3	-4	-5
2 foot dish	28.0	0	-1	-2
1.5 foot dish	25.3	+3	+2	+1
Internal	23.0	+5	+4	+3

***NOTE**: Many antenna manufacturers rate antenna gain in dBd (dB referred to a dipole antenna) in their literature. To convert to dBi, add 2.15 dB.

Power settings for other modes of operation can be calculated:

EIRP(Avg) dBm= Antenna Gain (dBi) + Tx Power

Transmitter radiated power is limited in the receiver benefits from gain of larger antennas.

3.7 EVENT-HD Installation

The following sections provide installation guides for:

- IDU Installation

- ODU Installation

3.7.1 Installing the IDU

The IDU can be installed in the following three options:

- Table top or cabinet
- Wall mount
- Rack mount

The IDU should be:

- Located where you can easily connect to a power supply and any other equipment used in your network, such as a router or PC.
- In a relatively clean, dust-free environment that allows easy access to the rear grounding post as well as the rear panel controls and indicators. Air must be able to pass freely over the chassis, especially the rear.
- Accessible for service and troubleshooting.
- Protected from rain and extremes of temperature (it is designed for indoor use).

3.7.1.1 Installing on a Table Top or Cabinet

The IDU can be placed on a tabletop or cabinet shelf. In order to prevent possible disruption, it is recommended to use a strap to secure the IDU.

3.7.1.2 Installing on a Wall

The IDU can be mounted to a wall. Consult factory for details. If the wall mount option is being considered, plan to position the IDU at a height that allows LEDs, the connectors on the rear panel, and the rear grounding post to be visible at all times and easily accessible. Also, including plastic clamps to support and arrange the ODU/IDU Interconnect Cable should also be considered.

3.7.1.3 Installing in a Rack

To maintain good airflow and cooling, it is preferred that the IDU is installed in a slot that has blank spaces above and below the unit.

To rack-mount the IDU, use the supplied mounting brackets (Moseley part number 2734001-0001) to secure the chassis to the rack cabinet. As shown in Figure 3-10, the brackets can be attached at any of four points on the sides of the enclosure – back, back, middle facing front, and middle facing back. This flexibility ensures compatibility with most rack mounting arrangements.

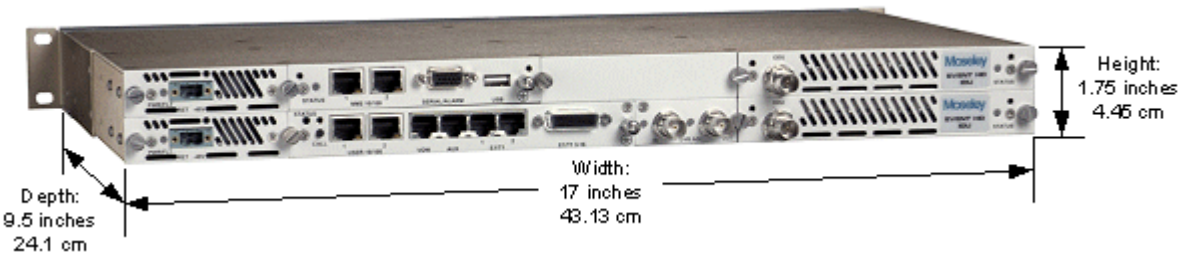


Figure 3-10. IDU Dimensions

3.7.2 Installing the ODU

The EVENT-HD ODU is intended for mounting on either a pole or antenna mast within close proximity to the antenna. Each site must be assessed for the mounting method, location, and height. After defining the mounting location and height, re-confirm the line of sight.

NOTE: When operating a 1+1 configured EVENT-HD (i.e., an IDU with two power supplies and two modem modules installed), an ODU must be connected to the modem in the bottom slot. If the ODU is connected to the modem in the top slot, the IDU will not communicate with the ODU, and a link cannot be established.

For proper support the antenna mast or mounting pole must be mounted in a vertical position (i.e., no tilt), preferably with a plum.

If the ODU utilizes an internal antenna, such as the ODU5300 and ODU5800 with internal antenna option, vertical tilt of the ODU is accomplished from the tilt mounting bracket. Also, it is important to note the direction in which the ODU will point when installing the mounting pole.

The antenna mast or mounting pole must be grounded. Different ODUs may require different mounting hardware and techniques. The next sections describe mounting techniques for various ODU families.

3.7.2.1 Installing ODU2200, ODU6500, ODU7200

1) The ODUxx00 chassis family has mounting holes located on the underside of the unit. There are total of 10 threaded ¼-20 holes available for mounting directly to a plate or to a pole with optional pole mounting hardware. The threaded screw locations are shown in Figure 3-11. Use 4-3/4 inch screws with lock washers.

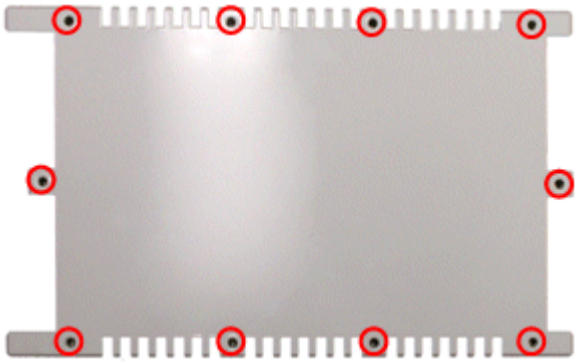


Figure 3-11. ¼-20 threaded mounting hole locations on ODU2200. Use any 4.

2) For pole mounting, optional brackets are installed in the location as shown below in Figure 3-12.

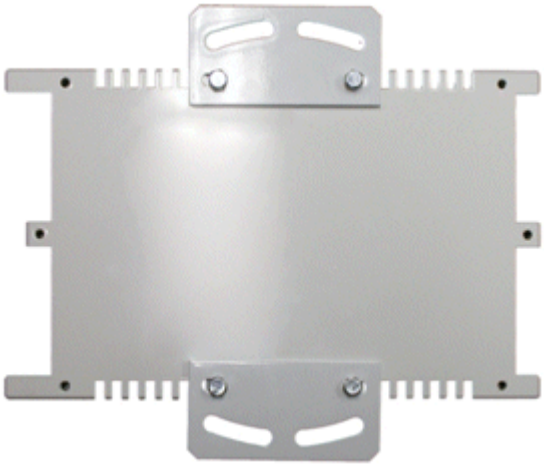


Figure 3-12. Pole Mounting Brackets on ODU2200

3) Install U-bolts to ODU brackets and tighten. Assembled pole-mounted ODU2200 is shown in Figure 3-13.

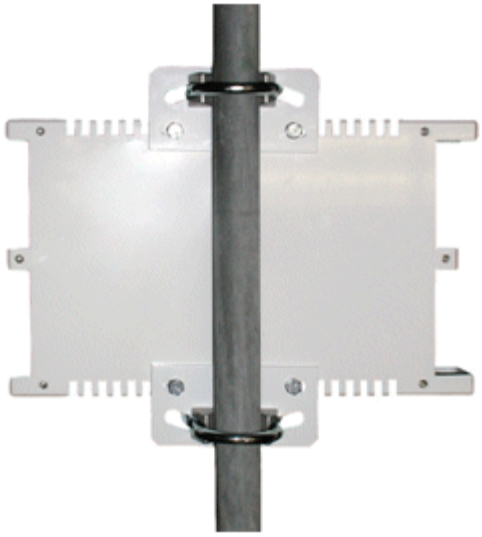


Figure 3-13. Completed Pole Mounting of ODU2200

3.7.2.2 Installing ODU5300, ODU5800

1) Remove the pole mount portion of the tilt bracket from the ODU5800 by loosening the middle bolts and removing the top and bottom bolts on each side.

Figure 3-14. ODU5800 Rear View

2) Mount the tilt bracket to the mounting pole using the U-Bolts and nuts. Insert the U-bolts around the pole and through the holes in the tilt bracket. Install a washer and nut to each side of the threaded U-bolt and hand tighten. Repeat this step for the second U-bolt.

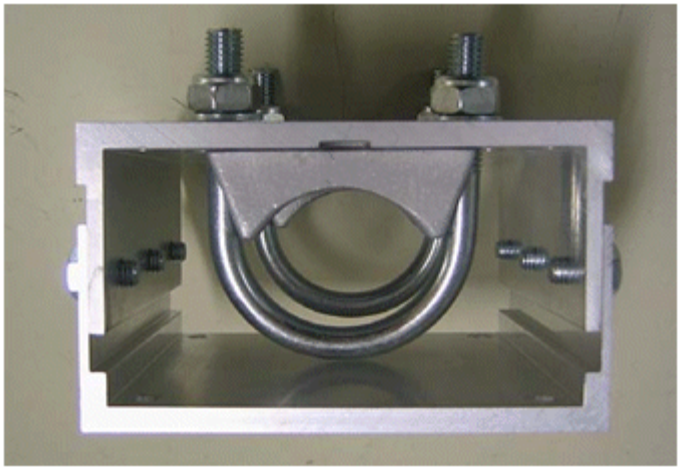


Figure 3-15. Tilt Bracket for ODU5800

3) Place the EVENT-HD ODU5800 on the mating half of the tilt bracket connected by the two center bolts.

4) Add the remaining four bolts to the tilt bracket but do not tighten until the antenna alignment is complete (only applies for internal antenna ODUs).

Figure 3-16. ODU5800 with Mounted Tilt Bracket

5) Manually point the ODU in the direction of the link partner ODU.

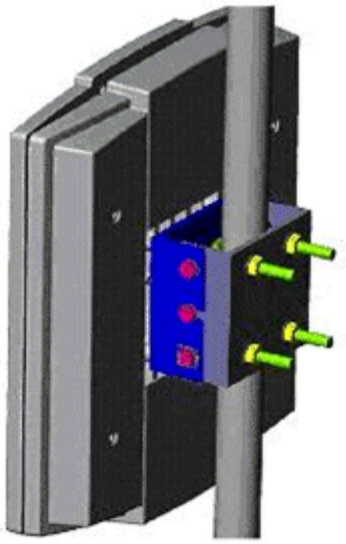


Figure 3-17. Completed Mounting for the ODU5800

3.7.3 Routing the ODU/IDU Interconnect Cable

1) Select where the cable will enter the truck or building from outside.

2) Determine the length of cable required. Allow three extra feet on each end to allow for strain relief, as well as any bends and turns.

3) Route the cable.

The IDU is equipped with TNC female connector on the rear of the chassis. Depending on the ODU type, it will be equipped with either an N-type or TNC female connector at its interconnecting port. A length of coaxial cable (such as Times Microwave Systems LMR-400, LMR-300 or LMR-200) fitted with the appropriate N-type or TNC male connectors is required to connect the ODU to the IDU. This cable assembly may be supplied in fixed lengths with the digital radio. Bulk coaxial cable of equivalent specification may also be used, with terminating connectors applied during cable installation.

Based on an evaluation of the cable routing path, pull the ODU/IDU Interconnect cable from one unit to the other, utilizing cable trays, ducts, or conduit as required. Take care that the ODU/IDU Interconnect cable is not kinked or damaged in any way during installation. Be sure to protect the TNC connectors from stress, damage and contamination during installation (do not pull the cable by the connectors). If multiple ODU/IDU Interconnect cables are to be installed along the same route, the cables should all be pulled at one time. Be sure the installed cable does not have any bends that exceed the specified cable bend radius. The ODU/IDU Interconnect cable should be adequately supported on horizontal runs and should be restrained by hangers or ties on vertical runs to reduce stress on the cable. Outside the building, support and restrain the cable as required by routing and environmental conditions (wind, ice).

The ODU/IDU interconnection must be properly grounded in order to protect it and the structure it is installed on from lightning damage. This requires that the ODU, any mounting pole or mast and any exposed interconnect cable be grounded on the outside of the structure. The IDU must be grounded to a rack or structure ground that also has direct path to earth ground.

The ODU must be directly connected to a ground rod or equivalent earth ground. The ODU/ IDU interconnect cable should also be grounded at the ODU, where the cable enters the structure and at intermediate points if the exposed cable run is long (typically at intervals of 100 ft), with the cable manufacturer's grounding kits. Lightning protection devices used with the interconnect cable must be appropriate for the transmission of the interconnect signals (DC to 350 MHz).

Provide a sufficient but not excessive length of cable at each end to allow easy connection to the ODU and IDU without stress or tension on the cable. Excessive cable length, especially outdoors, should be avoided to minimize signal attenuation and provide a more robust and reliable installation. If installing using bulk coaxial cable, terminate the ODU/IDU Interconnect cable at each end with a TNC male connector on the IDU side and either an N-type or TNC male connector on the ODU side that is appropriate for the cable type. Use of connectors, tools and termination procedures specified by the cable manufacturer is recommended.

Once the cable has been installed but before connection has been made to either unit, a simple DC continuity test should be made to verify the integrity of the installed cable. A DC continuity tester or digital multimeter may be used to verify a lack of DC continuity between the cable center conductor and outer conductor, with the opposite end of the cable unconnected. With a temporary test lead or shorting adapter connected to one end of the cable, DC continuity should be verified between the center and outer conductors at the opposite end.

3.8 Quick Start Guide

Although configuration of the IDU does not require a connection to the ODU, it is suggested that the ODU and IDU are connected prior to configuring the IDU. Each IDU has a Web Interface installed that can be accessed through a computer connection. The Web Interface is described in the EVENT-HD User Interface Guide (Moseley Document #602-15038-01). The section below describes how to get started configuring the IDU via the Web Interface.

3.8.1 Materials Required

The following items are needed to configure an IDU:

1) Power supply (-48 V DC @ 2 Amps) **OR** optional AC/DC power supply and power cable

2) Digital voltmeter with test leads

3) IDU Serial Cable (optional)

4) Computer with networking capability, consisting of either: a laptop computer with Windows 98/2000/XP/Vista operating system, an Ethernet card with any necessary adapters and a Cat-5 Ethernet regular or crossover cable or a networked computer with Windows 98/2000/XP/Vista operating system and an additional Ethernet cable providing access to the network.

5) Web Browser program, Internet Explorer 5.5 (or later) or Mozilla Firefox 1.0.6 (or later) with Java environment installed, available at http://www.java.com.

6) Site engineering folder with site drawings or equivalent IDU configuration information

3.8.2 Grounding the ODU

1) Place the grounding rod so as to allow for the shortest possible path from the grounding cable to the ODU.

2) Drive the grounding rod into the ground at least eight inches from the ground surface.

3) Attach a grounding clamp to the grounding rod. You will use this clamp to attach grounding wires for both the ODU and indoor junction box, reference Figure 3-18.

4) Connect a ground lug to one end of the grounding wire.

5) Remove one of the lower mounting screws of the mounting pole. Insert a screw through the grounding lug terminal and re-install it to the mounting pole.

6) Attach the grounding wire to the clamp on the grounding rod. If necessary, use wire staples to secure the grounding wire to the outside wall.

7) Install a grounding wire from the junction box to the grounding rod.

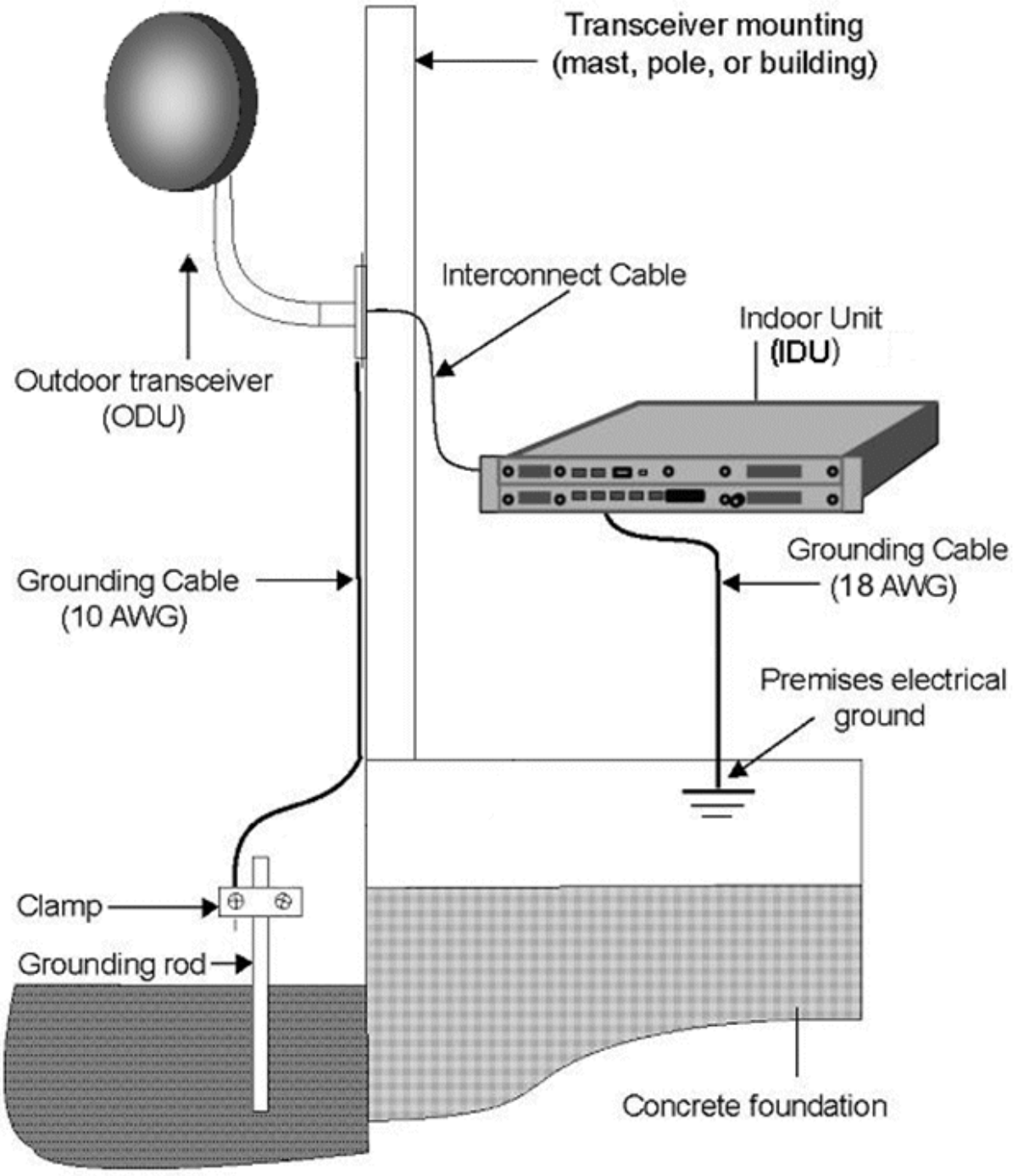


Figure 3-18. Ground Connections to ODU.

3.8.3 Grounding the IDU

1) The IDU should be able to be connected to a system or building electrical ground point (rack ground or power third-wire ground) with a cable of 36” or less.

2) Connect the grounding wire to either grounding point on the rear panel. Use 6-32x5/16 maximum length screws (not provided) to fasten the lug of the grounding cable.

3) Connect the other end of the ground to the local source of ground in an appropriate manner.

3.8.4 Connecting the IDU to the PC and Power Source

1) Using the supplied power cable connector, pin 2 (labeled **-V**) should be connected to the power supply terminal supplying -48 V dc, while pin 1 (labeled **RET**) should be connected to the power supply return. Refer to Figure 3-19. Use of a power supply with an inappropriate ground reference may cause damage to the IDU and/or the supply.

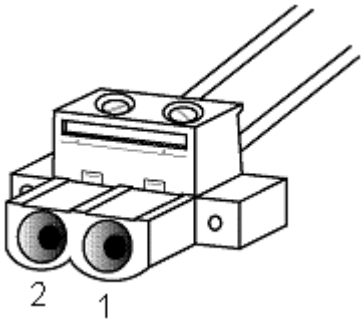


Figure 3-19. IDU DC Power Cable Connector

2) Connect the IDU power cable to the 48 V dc power supply, and place the voltmeter probes on the unconnected IDU end of the power cable, with the positive voltmeter probe on pin 2 (**-V**) of the cable connector and the negative probe on pin 1(**RET**). The connector terminal screw heads may be used as convenient monitor points. Refer to Figure 3-19.

3) Turn on the –48 V dc supply. Verify that the digital voltmeter reads between 44 V dc and 52 V dc when monitoring the cable points specified above. Adjust the power supply output voltage and/or change the connections at the power supply to achieve this reading.

4) Turn the 48 V dc supply off.

5) Plug the IDU power cable into the IDU rear panel DC Power connector (**DC Input**). Place the voltmeter probes on the cable connector terminal screw heads as per step 2 above. Refer to Figure 3-17. Note that the IDU does not have a power on/off switch. When DC power is connected, the digital radio powers up and is operational. There can be up to 5 W of RF power present at the antenna port. The antenna should be directed safely when power is applied.

6) Turn on the 48 V dc power supply, and verify that the reading on the digital voltmeter is as specified in step 3 above.

7) Connect the IDU to the laptop computer, using a Cat-5 Ethernet cable or connect the IDU to a computer network, using a Cat-5 Ethernet cable. Connect the Ethernet cable to the NMS 1 or 2 connector on the IDU rear panel. Refer to Figure 3-18 for the IDU rear panel connections.

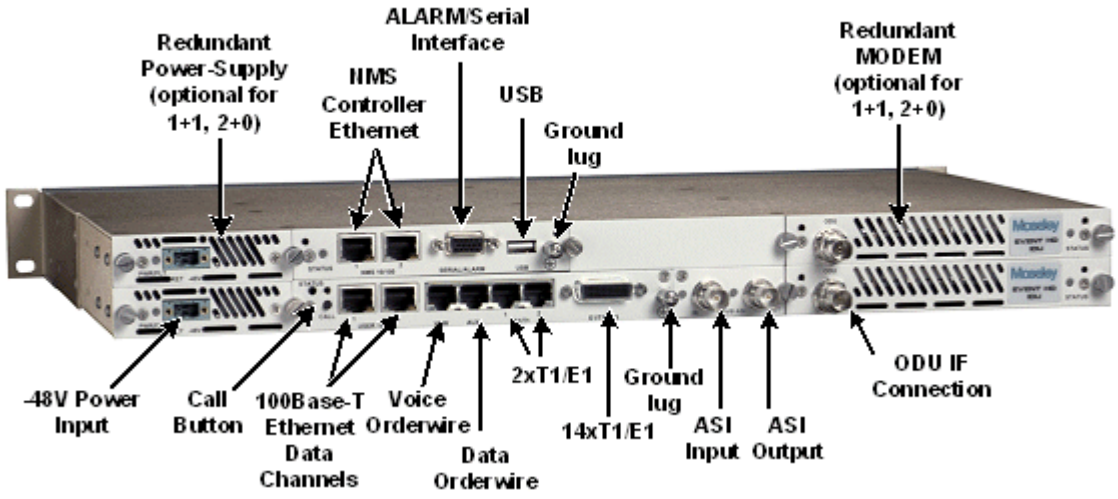


Figure 3-20. IDU-SB, 1+1 Protection, Rear Panel Connections

3.8.5 IDU Configuration

Although basic configuration of the EVENT-HD IDU does not require a connection to the ODU, it is recommended that the ODU and IDU are connected prior to configuring the IDU. A connection to the ODU must be established prior to running the Link Configuration process to configure ODU related parameters.

Using the site attributes identified in the site assessment or equivalent configuration information, configure each IDU by completing the following procedures:

- Setting the IDU IP Address and Network Parameters
- Configuring the IDU
- Setting the IDU Device Information

3.8.5.1 Setting the IDU IP Address

1) The PC's network configuration must be set with the parameters provided at paragraph 3.8.7.

2) The IDU should be accessible from your PC at the default IP address provided at paragraph 3.8.7. A network ping can be done to verify connectivity to the IDU.

3) Start a web browser and use the IDU default IP address as the URL.

4) Log in at the login prompt. The username and password are provided at paragraph 3.8.7.

5) The Web Interface includes a navigation menu in the left frame. If this navigation menu is not visible, make sure the Java environment is properly installed and active. In the navigation menu, select Administration, then Network Configuration, and then General. The IP address, IP Netmask, and IP Gateway are shown.

6) Enter the new IP address, IP Netmask, and IP Gateway. The gateway must be in the same subnet as the IP address for proper operation. Click Update to change the values.

7) To verify the new IP address, change the PC's network configuration to be on the same subnet as the new IP address set in the unit and a network ping may be performed to the new address.

8) To continue using the Web Interface, point the web browser to the new IP address.

3.8.5.2 Link Configuration

Use the Web Interface to configure the IDU as follows:

1) To start the Web Interface, open a web browser and use the IDU IP address (192.168.1.1xx) as the URL and log in when prompted.

2) Use the frame on the left side of the window to navigate to “Radio Link.”

3) Select the subcategory “Link Configuration.”

4) Select the operating mode. If the IDU has one modem installed and is connected to one ODU, select standard. If the IDU has two modems installed and is connected to two ODUs, select 1+1 diversity or 1+1 non-diversity for a protected link or east-west for a 2+0 ring configuration.

5) Follow the wizard located here to enter the rest of the required settings.

3.8.5.3 Configuring the Site Attributes

Use the Web Interface to enter device information as follows:

1) In the navigation menu, select Administration, then Device Information, and then Device Names.

2) Enter the Owner, Contact, Description, and Location. These values are not required for operation, but will help keep a system organized.

3.8.5.4 Power on Reset to Factory Defaults

The IDU may be reset to factory defaults during power up. A power on reset affects the IP address and the user logins/passwords. To perform a power on reset:

1) Power on the IDU

2) During bootup, the IDU will flash the controller-card LED alternating red/green for five seconds.

3) Make sure the call button is not active at the start of this five second period.

4) While the LED is flashing, press the call button and release it within one second of the LED changing to static green.

3.8.5.5 CLI Access via NMS Ethernet

The CLI can be accessed via NMS Ethernet after connecting and configuring the PC as described in the previous section. Use a Telnet client to telnet to the IDU IP address. You will be prompted for a user name and password. Use the user name and password supplied at paragraph 3.8.7.

3.8.5.6 CLI Access via Serial Port

The CLI can be accessed via the front-panel serial port. Table 3-4 shows the pinout for constructing a DB-9 to HD-15 cable.

Table 3-4. Serial Cable Pinout

DB-9 Pin	HDB-15 Pin
2	2
3	3
5	5

The serial port parameters are show in Table 3-5.

Table 3-5. Serial Port Parameters

Parameter	Value
Speed	38400
Bits	8
Stop-Bits	1
Parity	None
Flow-Control	None

After power is supplied to the IDU, the CLI can be accessed by connecting the serial cable between the PC and the IDU. Launch and configure a terminal program (e.g. Hyperterm) and press the enter key. You will be prompted for a user name and password (see paragraph 3.8.7).

3.8.6 ODU Antenna Alignment

Receive signal level indication at the antenna/ODU location is a power tool to aid antenna alignment at the time of installation. The following provides ODU specific information regarding the receive signal.

3.8.6.1 ODU 2200, 6500, 7200

The ODU 2200, 6500, and 7200 have an externally visible LED meter that provides both RSL (Receive Signal Level) and transmit power. For full-duplex operation, the ODU meter displays RSL on the top bar and transmit level on the bottom bar.

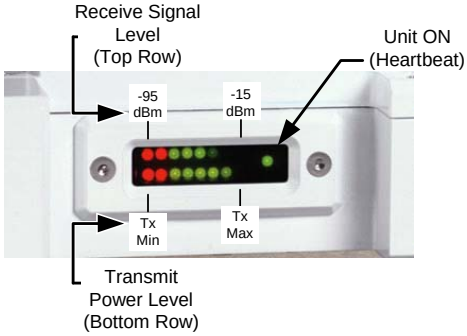


Figure 3-21. ODU 2200 RSSI Output vs. Received Signal.

The upper RSL LED meter is calibrated to represent exactly 10 dB for each LED, going from -95 dBm at the far left (red) to -15 dBm at the far right (green). The brightness of each LED is modulated for levels between 0 to 10 dB such that the far left LED will be

fully extinguished at -95 dBm and the far right LED will be fully illuminated at -15 dBm. When the RSL is in the red region (<-75 dBm) the signal level is approaching or has reached threshold (depends on modulation type).

The transmit LED indicates full power will all 8 LEDs illuminated to minimum power with 1 LED illuminated.

For simplex applications such as broadcast STL or ENG where the ODU is a receiver or a transmitter only, both LED bars represent either RSL for receiver ODU or transmit power for transmitter ODU. For RSL each LED represents 5 dB, with brightness modulated from off for 0 dB to fully on for 5 dB increments.

3.8.6.2 ODU 5300/5800

To use the built-in tuning of the ODU 5300 or 5800 antenna, a complete link is required, with both ends of the link roughly pointed at each other, and transmitting.

Once the links are roughly pointed, connect the voltmeter to the RSSI (Receive Signal Strength Indication) BNC connector seen on the ODU. This mode outputs 0 to +2.5 Volts. Adjust the antenna for maximum voltage. The RSSI voltage is linearly calibrated from 2.5 Volts for maximum RSL (received signal level) at –20 dBm to 0Volts for minimum RSL at -90 dBm. This mapping characteristic is plotted below in Figure 3-22.

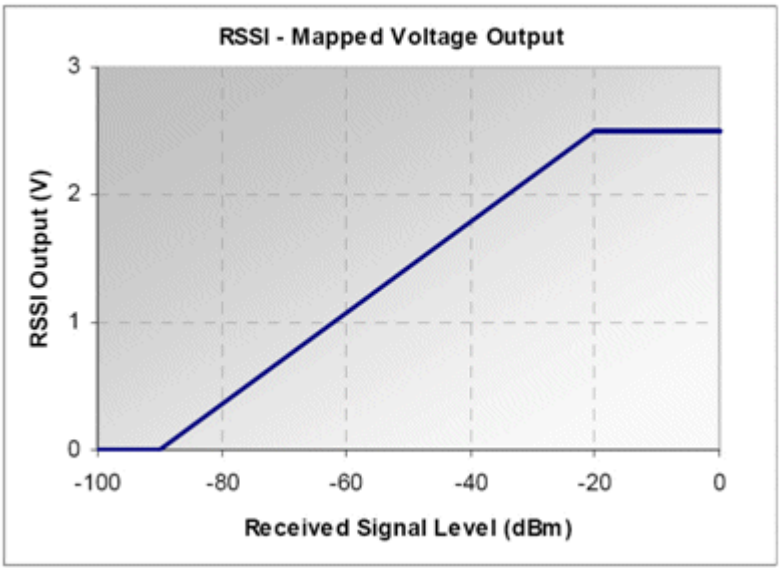


Figure 3-22. ODU RSSI Output vs. Received Signal

3.8.7 Quick Start Settings

PC Network Configuration

The Web Interface can be accessed via NMS by connecting a CAT5 patch cable between the IDU front-panel NMS port and a PC. The PC's network interface must be configured to an open IP address within the same subnet. For the default Moseley configuration, the IP address of the PC must be 192.168.1.x (where x=a value in the range 1-100). DHCP can also be used to set the PC's IP address if a DHCP server is configured on the same subnet.

EVENT-HD IP Address

The system is configured and tested at the factory using these default values:

Parameter	Value
IP Address	192.168.1.1xx
Netmask	255.255.255.0
Gateway	192.168.1.1

Where: xx=a value in the range 01-99. The IP address is indicated on the rear panel as shown in Figure 3-23.

Figure 3-23. IDU IP address label location

After configuring the PC network interface, launch a web browser and enter the following URL (or as specified on the rear panel) in the address bar to access the unit's Web Interface: http://192.168.0.101/

User Name and Password

A dialog box will request a user name and password. The default values are:

- User Name: administrator
- Password: d1scovery

3.9 IDU Service

At times, it may be necessary to service the IDU. This may include installing, removing, or replacing an IDU module. There may be up to 8 modules installed in a single IDU chassis. Figure 3-24 shows the rear panel of the IDU with each module labeled. The basic procedure for removing and installing a module is common to all the modules, with slight variations for the Power Supply Module, Controller Module, and Mini IO Module.

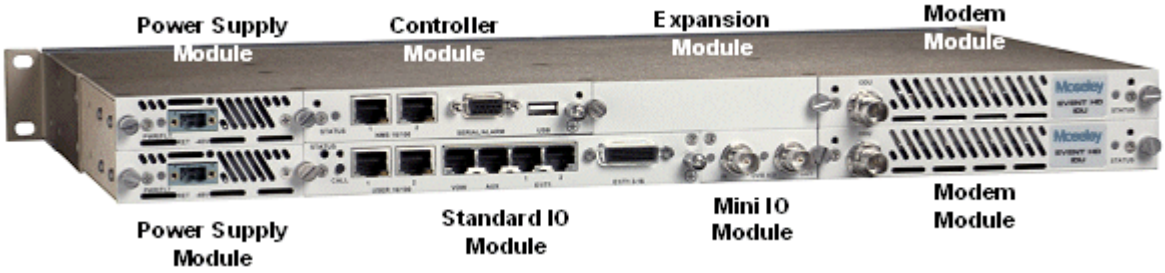


Figure 3-24. IDU Modules

3.9.1 Removing a Module

1) Modules are static sensitive and should only be handled in an ESD-safe environment. When packaging modules for shipment or storage, place in an ESD bag.

2) Remove rear panel connections to the module.

3) Remove the two thumbscrews on either side of the module. Figure 3-23 shows the locations of these thumb screws.

a) The thumbscrew for the Standard IO Module is located on the right side of the Mini IO Module slot.

b) If a Mini IO module is installed and the Standard IO Module is to be removed, both modules will be removed as one unit.

c) When removing only the Mini IO card, remove the corner screw indicated in Figure 3-25 and one thumb screw.

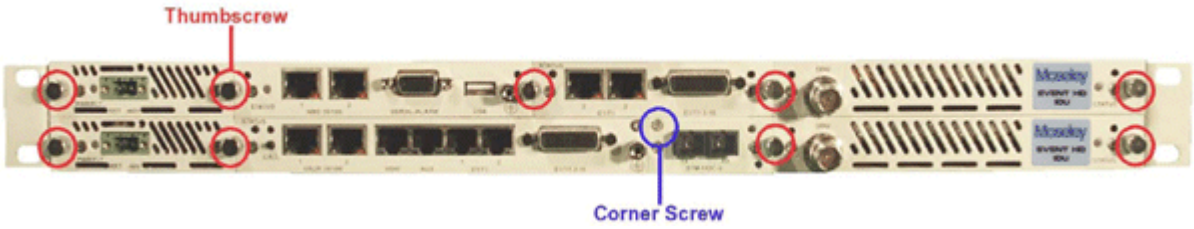


Figure 3-25. Thumbscrew and Corner Screw Locations

4) Thread thumbscrew(s) into hole(s) shown in Figure 3-25. Remove the module by grasping the thumbscrew(s) and pulling the module straight out of the IDU. Both thumbscrews should be used for all modules except the Power Supply and the Mini IO Modules.

5) The Power Supply and Mini IO Modules have only one threaded hole each.

a) When removing the Standard IO Module, the ground lug indicated in Figure 3-26 is used as the second threaded hole. If the IDU is to remain powered on and the ground lug is being used to ground the unit, first move the ground connection to the ground lug located on the Controller Module.

The IDU retains its current configuration when a module is removed, unless that module is the Controller Module. In which case, the IP addresses will need to be reprogrammed.

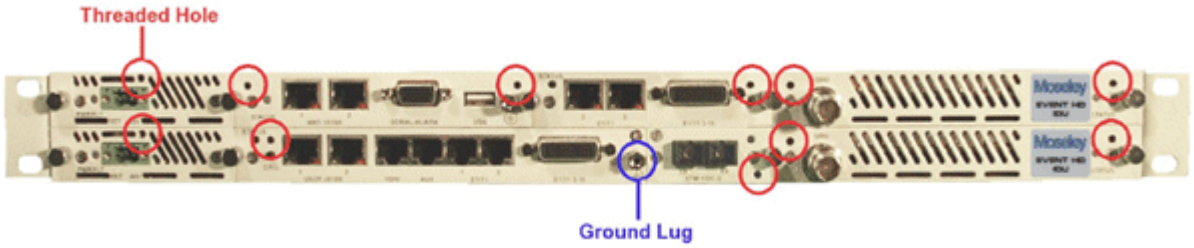


Figure 3-26. Threaded Hole Locations

3.9.2 Installing a Module

1) Modules are static sensitive and should only be handled in an ESD-safe environment. When packaging modules for shipment or storage, place in an ESD bag.

2) Line up the module board with the guides in the chassis and slide the module into the IDU. Figure 3-27 shows a photo of the guides. As the module face plate comes flush with the face of the IDU, connectors on the rear of the module will engage with the IDU backplane. It is possible to encounter interference from adjacent module rear panels. If this occurs, loosen the thumbscrews holding the neighboring panels and shift them as necessary to ensure fit.

a) The Mini IO Module only has one guide on the right side. Take care to insert the Mini IO module carefully and correctly engage the rear connector with its mate on the Standard IO Module.

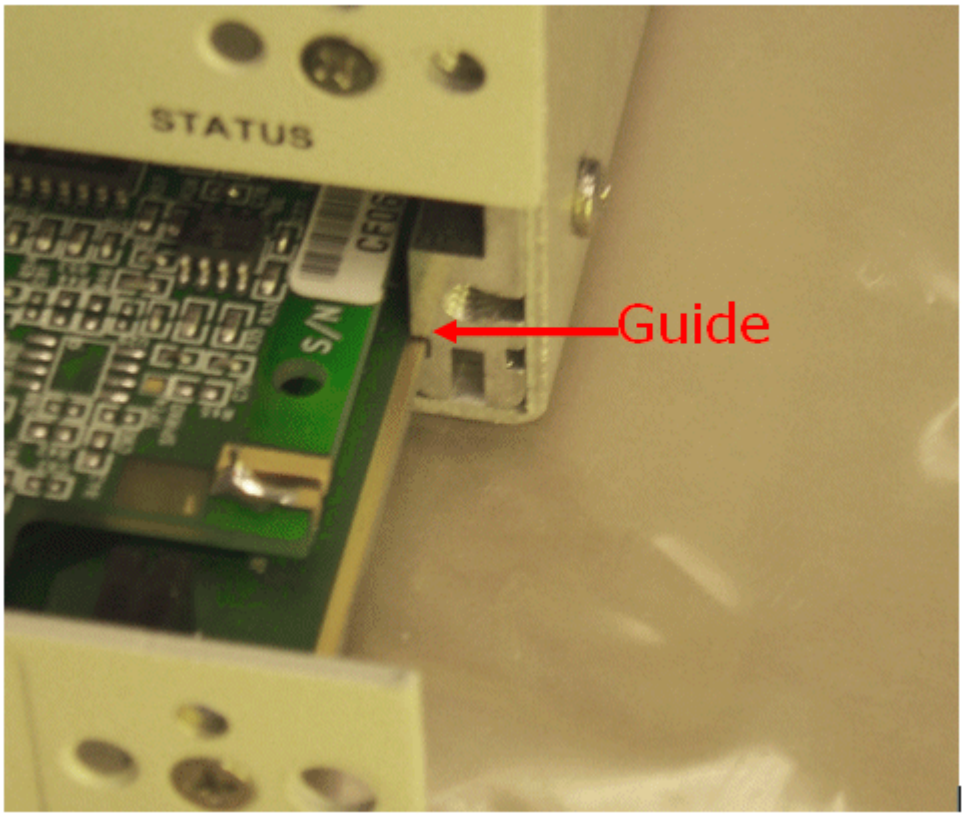


Figure 3-27. Guides for Installing Cards

3) Install thumbscrews on either side of the module as shown in Figure 3-26. The Mini IO card has a corner screw, which should be installed. This corner screw is shown in Figure 3-25.

4) Make rear panel connections to the module and power on the IDU if necessary.

5) Verify proper operation of the unit. If the Controller Module has been changed, reprogram the IP addresses.

Blank Page

4. Summary Specification

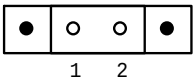
Parameter	EVENT 2200, 2200FD, 2400 2GHz	EVENT 6500, 6800, 7200, 7400 6-7 GHz	EVENT 5800 5.8 GHz	EVENT 5300 5.3 GHz
System				
Frequency Bands (others available on request)	1.990-2.110 2.200-2.300 2.450-2.500	6.425-6.525 6.525-6.875 6.875-7.125 7.125-7.425	5.725-5.850	5.250-5.350
Output Power (avg. max.)	4 Watts	1 Watt	200 mW	+5 dBm
Channelization (others available on request)	12, 17 MHz	20, 25, 28, 30 MHz	12.5, 16.7, 25, 30 MHz	13.3, 20, 30 MHz
Capacity	150Mbps ASI 2-100 Mbps Ethernet 1-16 T1/E1 Various combinations of above			
Input Sensitivity	-84 dBm (or higher, based on selected mode)			
Modulation	QPSK, 16, 32, 64, 128 QAM			
Radio Interfaces				
External Antenna	N-Type Female			
IDU /ODU Link	TNC Female			
Data Interfaces				
Payload DVB/ASI Ethernet 2 T1/E1 14 T1/E1	 BNC Female (2) 10Base-T/100Base-Tx RJ-45 Female (2) 100 Ω / 120 Ω Balanced, RJ-48C Female (2) Molex High-Density 60-pin (14)			
SNMP	10Base-T/100Base-Tx RJ-45 Female			
Control				
Network Management	SNMP, Proprietary Web Interface			
NMS Connector	10Base-T/100Base-Tx RJ-45 Female (2)			
Voice Orderwire	RJ-45 for PTT handset			
Auxiliary Data (64 kbps)	RS422 via RJ-45			

Parameter	EVENT 2200, 2200FD, 2400 2GHz	EVENT 6500, 6800, 7200, 7400 6-7 GHz	EVENT 5800 5.8 GHz	EVENT 5300 5.3 GHz
Encryption (Consult Moseley Sales)	AES			
Alarm Port	2 Form C (SPDT), 2 TTL Output, 4 TTL Input, DB-15HD			
Power/Environment				
DC Power	-48 Volts ±10%, <100 W	-48 Volts ±10%, <100 W	-48 Volts ±10%, <70 W	-48 Volts ±10%, <70 W
IDU Operational Temperature	-5º to 55º C			
ODU Operational Temperature	-30º to 55º C			
IDU Humidity	0 to 95%, non-condensing			
ODU Humidity	0 to100% at 45º C			
Altitude	15,000 feet/4572 meters, maximum			
Physical Dimensions				
IDU Size (WxHxD)	17.2 x 1.75 x 9.4 inches (43.7 x 4.5 x 23.9 cm)			
IDU Weight	7 lbs (3.12 Kg)			
IDU				
EIA Rack Mount	19 inch/48.2 cm, 1 rack unit			
ODU Size (WxHxD)	14.0 x 8.5 x 4 inches	14.0 x 8.5 x 4 inches	14.6 x 15.4 x 2.6 inches	14.6 x 15.4 x 2.6 inches
ODU Weight	16.3 lbs (7.4 kgs)	16.3 lbs (7.4 kgs)	15 lbs (6.8 kgs)	15 lbs (6.8 kgs)
ODU				
Mounting	Custom Bracket			

5. Rear Panel Connectors

5.1 DC Input (Power) Connector

MSTB 2,5 / 2-GF



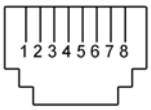
PIN	TYPE	SIGNAL
1	POWER	Power supply return
2	POWER	48 Vdc, nominal

Mating Connector: MSTB 2,5/ 2-STF

Ordering Information: Phoenix Contact Part Number 1786831

5.2 Ethernet 100BaseTX Payload Connector 1-2

RJ-45 Female



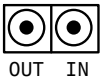
PIN	TYPE	SIGNAL
1	INPUT	RX+
2	INPUT	RX-
3	OUTPUT	TX+
4	N/A	N/A
5	N/A	N/A
6	OUTPUT	TX-
7	N/A	N/A
8	N/A	N/A

Mating Connector: Standard RJ-45 Plug

Ordering Information: Tyco Electronics/Amp Part Number 5-554169-3 or equivalent

5.3 SONET Payload Connector

SC Duplex Female Fiber



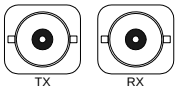
PIN	TYPE	SIGNAL
OUT	OUTPUT	SONET OC-3 payload output (optical)
IN	INPUT	SONET OC-3 payload input (optical)

Mating Connector: SC-Duplex Male

Ordering Information: Molex Part Number 86066-4000 or equivalent

5.4 STM-1 Payload Connector

BNC Female



PIN	TYPE	SIGNAL
TX	OUTPUT	SDH STM-1 payload output (electrical)
RX	INPUT	SDH STM-1 payload input (electrical)

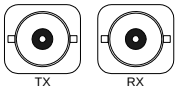
Mating Connector: BNC Male

Ordering Information: Tyco Electronics/Amp Part Number 225395-2 or equivalent

5.5 DVB/ASI, DS-3, E-3, STS-1 Payload Connector

Consult factory for availability.

BNC Female



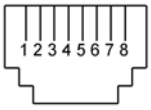
PIN	TYPE	SIGNAL
TX	OUTPUT	DVB-ASI, DS-3, E-3, STS-1 payload output
RX	INPUT	DVB-ASI, DS-3, E-3, STS-1 payload input

Mating Connector: BNC Male

Ordering Information: Tyco Electronics/Amp Part Number 225395-2 or equivalent

5.6 NMS 10/100BaseTX Connector 1-2

RJ-45 Female



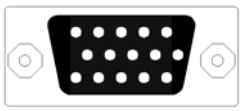
PIN	TYPE	SIGNAL
1	OUTPUT	TX+
2	OUTPUT	TX-
3	INPUT	RX+
4	N/A	N/A
5	N/A	N/A
6	INPUT	RX-
7	N/A	N/A
8	N/A	N/A

Mating Connector: Standard RJ-45 Plug

Ordering Information: Tyco Electronics/Amp Part Number 5-554169-3 or equivalent

5.7 Alarm / Serial Port Connector

DB-15HD Female



PIN	TYPE	SIGNAL
1	OUTPUT	TTL Alarm Output 3
2*	INPUT/ Output	RS-232 RX/TX
3*	OUTPUT/ Input	RS-232 TX/RX
4	OUTPUT	TTL Alarm Output 4
5	N/A	GROUND
6**	N/A	Alarm 1 Form C Contact Normally Open
7**	N/A	Alarm 1 Form C Contact Normally Closed
8**	N/A	Alarm 2 Form C Contact Common
9	INPUT	TTL Alarm Input 1
10	INPUT	TTL Alarm Input 3
11**	N/A	Alarm 1 Form C Contact Common
12**	N/A	Alarm 2 Form C Contact Normally Open
13**	N/A	Alarm 2 Form C Contact Normally Closed
14	INPUT	TTL Alarm Input 2
15	Input	TTL Alarm Input 4

* Pins 2 and 3 are hardware jumper configurable for DCE or DTE operation.

** Form C Contacts are hardware jumper configurable to emulate TTL outputs

Mating Connector: HD-DSUB15 Male (15 pins in a DB9 shell)

Ordering Information: Norcomp Part Number 180-015-102-001 or equivalent

5.8 ODU Connector

TNC Coaxial Female

PIN	TYPE	SIGNAL
Center	I/O	350 MHz TX IF / 140 MHz RX IF / -48 VDC
Shield	N/A	Shield / Chassis GND

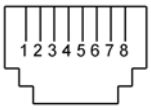
Mating Connector: TNC Male

Cable Type	Ordering Information
LMR-200	Times Microwave Systems Part Number TC-200-TM
LMR-300	Times Microwave Systems Part Number TC-300-TM
LMR-400	Times Microwave Systems Part Number TC-400-TM
RG-214	Tyco Electronics/Amp Part Number 225550-8 or equivalent
Belden 7808	Tyco Electronics/Amp Part Number 1-225550-3 or equivalent

5.9 T1/E1 - Channels 1-2 Connector

RJ-48C Female

100 Ω /120 Ω Balanced



PIN	TYPE	SIGNAL
1	INPUT	RX+
2	INPUT	RX-
3	N/A	GND
4	OUTPUT	TX+
5	OUTPUT	TX-
6	N/A	GND
7	N/A	N/A
8	N/A	N/A

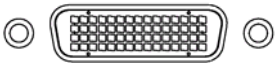
Mating Connector: Standard RJ-45 Plug

Ordering Information: Tyco Electronics/Amp Part Number 5-554169-3 or equivalent

5.10 T1/E1 - Channels 3-16 Connector

Molex LFH Matrix 50 Receptacle

100 Ω / 120 Ω Balanced



PIN	TYPE	SIGNAL
1	OUTPUT	T1 Channel 13 Transmit Tip
2	OUTPUT	T1 Channel 14 Transmit Tip
3	OUTPUT	T1 Channel 15 Transmit Tip
4	OUTPUT	T1 Channel 16 Transmit Tip
5	OUTPUT	T1 Channel 9 Transmit Tip
6	OUTPUT	T1 Channel 10 Transmit Tip
7	OUTPUT	T1 Channel 11 Transmit Tip
8	OUTPUT	T1 Channel 12 Transmit Tip
9	OUTPUT	T1 Channel 5 Transmit Tip
10	OUTPUT	T1 Channel 6 Transmit Tip
11	OUTPUT	T1 Channel 7 Transmit Tip
12	OUTPUT	T1 Channel 8 Transmit Tip
13	OUTPUT	T1 Channel 3 Transmit Tip
14	OUTPUT	T1 Channel 4 Transmit Tip
15	NC	NC
16	NC	NC
17	OUTPUT	T1 Channel 4 Transmit Ring
18	OUTPUT	T1 Channel 3 Transmit Ring
19	OUTPUT	T1 Channel 8 Transmit Ring
20	OUTPUT	T1 Channel 7 Transmit Ring

Molex LFH Matrix 50 Receptacle

PIN	TYPE	SIGNAL
21	OUTPUT	T1 Channel 6 Transmit Ring
22	OUTPUT	T1 Channel 5 Transmit Ring
23	OUTPUT	T1 Channel 12 Transmit Ring
24	OUTPUT	T1 Channel 11 Transmit Ring
25	OUTPUT	T1 Channel 10 Transmit Ring
26	OUTPUT	T1 Channel 9 Transmit Ring
27	OUTPUT	T1 Channel 16 Transmit Ring
28	OUTPUT	T1 Channel 15 Transmit Ring
29	OUTPUT	T1 Channel 14 Transmit Ring
30	OUTPUT	T1 Channel 13 Transmit Ring
31	INPUT	T1 Channel 16 Receive Tip
32	INPUT	T1 Channel 15 Receive Tip
33	INPUT	T1 Channel 9 Receive Tip
34	INPUT	T1 Channel 14 Receive Tip
35	INPUT	T1 Channel 10 Receive Tip
36	INPUT	T1 Channel 13 Receive Tip
37	INPUT	T1 Channel 11 Receive Tip
38	INPUT	T1 Channel 4 Receive Tip
39	INPUT	T1 Channel 12 Receive Tip
40	INPUT	T1 Channel 3 Receive Tip
41	INPUT	T1 Channel 5 Receive Tip
42	INPUT	T1 Channel 8 Receive Tip
43	INPUT	T1 Channel 6 Receive Tip
44	INPUT	T1 Channel 7 Receive Tip
45	NC	NC
46	NC	NC
47	INPUT	T1 Channel 7 Receive Ring
48	INPUT	T1 Channel 6 Receive Ring
49	INPUT	T1 Channel 8 Receive Ring
50	INPUT	T1 Channel 5 Receive Ring
51	INPUT	T1 Channel 3 Receive Ring
52	INPUT	T1 Channel 12 Receive Ring
53	INPUT	T1 Channel 4 Receive Ring

Molex LFH Matrix 50 Receptacle

PIN	TYPE	SIGNAL
54	INPUT	T1 Channel 11 Receive Ring
55	INPUT	T1 Channel 13 Receive Ring
56	INPUT	T1 Channel 10 Receive Ring
57	INPUT	T1 Channel 14 Receive Ring
58	INPUT	T1 Channel 9 Receive Ring
59	INPUT	T1 Channel 15 Receive Ring
60	INPUT	T1 Channel 16 Receive Ring

Mating Connector: Molex LFH Matrix 50 Plug

Ordering Information: Molex Part Number 70929-2000 (connector) + Molex Part Number 51-24-2021 (pins, Qty 4 per connector)

5.11 USB

Consult factory for availability.

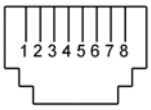
USB Type A Receptacle

PIN	TYPE	SIGNAL
1	OUTPUT	+5V
2	I/O	-Data
3	I/O	+Data
4	N/A	GND

Mating Connector: USB Type A Plug

5.12 Voice Order Wire

RJ-45 Female



PIN	TYPE	SIGNAL
1	N/A	NC
2	INPUT	PTT
3	N/A	GND
4	OUTPUT	PO-
5	OUTPUT	PO+
6	INPUT	TI-
7	N/A	GND
8	N/A	NC

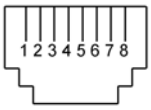
Mating Connector: Standard RJ-6 Plug or Standard RJ-45 Plug

Ordering Information: Tyco Electronics/Amp Part Number 5-554710-3 or equivalent for RJ-6. Tyco Electronics/Amp Part Number 5-554169-3 or equivalent for RJ-45.

5.13 Data Order Wire

5.13.1 RS422

RJ-45 Female



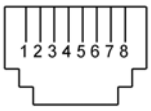
PIN	TYPE	SIGNAL
1	OUTPUT	TX Clock -
2	OUTPUT	TX Clock +
3	OUTPUT	TX Data -
4	INPUT	RX Data -
5	INPUT	RX Data +
6	OUTPUT	TX Data +
7	INPUT	RX Clock -
8	INPUT	RX Clock +

Mating Connector: Standard RJ-45 Plug

Ordering Information: Tyco Electronics/Amp Part Number 5-554169-3 or equivalent

5.13.2 RS-232

RJ-45 Female



PIN	TYPE	SIGNAL
1	N/A	NC
2	N/A	NC
3	N/A	Signal GND
4	N/A	NC
5	INPUT	RX Data +
6	OUTPUT	TX Data +
7	N/A	NC
8	N/A	NC

Mating Connector: Standard RJ-45 Plug

Ordering Information: Tyco Electronics/Amp Part Number 5-554169-3 or equivalent

Moseley

Blank Page

Appendix A. Abbreviations & Acronyms

A_dTPC	Adaptive Power Control
AIS	Alarm Indication Signal
BER	Bit Error Rate
Codec	Coder-Decoder
CPU	Central Processing Unit
DB	Decibel
DBm	Decibel relative to 1 mW
DCE	Data Circuit-Terminating Equipment
DTE	Data Terminal Equipment
EIRP	Effective Isotropic Radiated Power
FEC	Forward Error Correction
FPGA	Field Programmable Gate Array
GPIO	General Purpose Input/Output
IF	Intermediate frequency
IP	Internet Protocol
LED	Light-Emitting diode
LOS	Line of Sight
MIB	Management Information Base
Modem	Modulator-demodulator
Ms	Millisecond
NC	Normally closed
NMS	Network Management System
OAM&P	Operations, Administration, Maintenance, and Provisioning
OC-3	Optical Carrier level 3
ODU	Outdoor Unit
PCB	Printed circuit board
PDH	Plesiochronous Digital Hierarchy
POP	Point of Presence
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RSL	Received Signal Level (in dBm)
RSSI	Received Signal Strength Indicator/Indication
RX	Receiver

SDH	Synchronous Digital Hierarchy
SNMP	Simple Network Management Protocol
SNR	Signal-to-Noise Ratio
SDIDU	Software Defined Indoor Unit (Moseley trademark)
SONET	Synchronous Optical Network
STM-1	Synchronous Transport Module 1
TCP/IP	Transmission Control Protocol/Internet Protocol
TTL	Transistor-transistor logic
TX	Transmitter

Appendix B. Conversion Chart

microvolts to dBm (impedance = 50 ohms)

microvolts	dBm	microvolts	dBm
0.10	-127.0	180	-61.9
0.25	-119.0	200	-61.0
0.50	-113.0	250	-59.0
0.70	-110.1	300	-57.4
1.0	-107.0	350	-56.1
1.4	-104.1	400	-54.9
2.0	-101.0	450	-53.9
2.5	-99.0	500	-53.0
3.0	-97.4	600	-51.4
3.5	-96.1	700	-50.1
4.0	-94.9	800	-48.9
4.5	-93.9	900	-47.9
5.0	-93.0	1,000	-47.0
6.0	-91.4	1,200	-45.4
7.0	-90.1	1,400	-44.1
8.0	-88.9	1,600	-42.9
9.0	-87.9	1,800	-41.9
10	-87.0	2,000	-41.0
11	-86.2	2,500	-39.0
12	-85.4	3,000	-37.4
14	-84.1	3,500	-36.1
16	-82.9	4,000	-34.9
18	-81.9	4,500	-33.9
20	-81.0	5,000	-33.0
25	-79.0	6,000	-31.4
30	-77.4	7,000	-30.1
35	-76.1	8,000	-28.9
40	-74.9	9,000	-27.9
45	-73.9	10,000	-27.0
50	-73.0	22.36 mV	-20 (10 mW)

microvolts	dBm	microvolts	dBm
60	-71.4	70.7 mV	-10(100 mW)
70	-70.1	223.6 mV	0 (1 mW)
80	-68.9	707.1 mV	+10 (10mW)
90	-67.9	2.23 V	+20 (100 mW)
100	-67.0	7.07 V	+30 (1 W)
120	-65.4	15.83 V	+37 (5 W)
140	-64.1	22.36 V	+40 (10 W)
160	-62.9		

Appendix C. Customer Service

Moseley Associates will assist its product users with difficulties. Most problems can be resolved through telephone consultation with our technical service department. When necessary, factory service may be provided. If you are not certain whether factory service of your equipment is covered, please check your product Warranty/Service Agreement.

- Do not return any equipment to Moseley without prior consultation.
- The solutions to many technical problems can be found in our product manuals; please read them and become familiar with your equipment.

We invite you to visit our Internet web site at http://www.moseleysb.com/.

C.1 Technical Consultation

Please have the following information available prior to calling the factory:

- Model number and serial number of unit;
- Shipment date or date of purchase of an Extended Service Agreement;
- Any markings on suspected subassemblies (such as revision level); and
- Factory test data, if applicable.

Efficient resolution of your problem will be facilitated by an accurate description of the problem and its precise symptoms. For example, is the problem intermittent or constant? What are the front panel indications? If applicable, what is your operating frequency?

Technical consultation is available at (805) 968-9621 from 8:00 a.m. to 5:00 p.m., Pacific Time, Monday through Friday. During these hours a technical service representative who knows your product should be available. If the representative for your product is busy, your call will be returned as soon as possible. Leave your name, station call letters if applicable, type of equipment, and telephone number(s) where you can be reached in the next few hours.

Please understand that, in trying to keep our service lines open, we may be unable to provide “walk-through” consultation. Instead, our representative will usually suggest the steps to resolve your problem; try these steps and, if your problem remains, do not hesitate to call back.

After-Hours Emergencies: Emergency consultation is available at (805) 252-2133 from 5:00 p.m. to 10:00 p.m. Pacific Time, Monday to Friday, and from 8:00 a.m. to 10:00 p.m. Pacific Time on weekends and holidays. Please do not call during these hours unless you have an emergency with installed equipment. Our representative will not be able to take orders for parts, provide order status information, or assist with installation problems.

C.2 Factory Service

Arrangements for factory service should be made only with a Moseley technical service representative. You will be given a Return Authorization (RA) number. This number will

expedite the routing of your equipment directly to the service department. Do not send any equipment to Moseley Associates without an RA number.

When returning equipment for troubleshooting and repair, include a detailed description of the symptoms experienced in the field, as well as any other information that well help us fix the problem and get the equipment back to you as fast as possible. Include your RA number inside the carton.

If you are shipping a complete chassis, all modules should be tied down or secured as they were originally received. On some Moseley Associates equipment, printing on the underside or topside of the chassis will indicate where shipping screws should be installed and secured.

Ship equipment in its original packing, if possible. If you are shipping a subassembly, please pack it generously to survive shipping. Make sure the carton is packed fully and evenly without voids, to prevent shifting. Seal it with appropriate shipping tape or nylon-reinforced tape. Mark the outside of the carton "Electronic Equipment - Fragile" in large red letters. Note the RA number clearly on the carton or on the shipping label, and make sure the name of your company is listed on the shipping label. Insure your shipment appropriately. All equipment must be shipped prepaid.

The survival of your equipment depends on the care you take in shipping it. Address shipments to:

MOSELEY ASSOCIATES, INC.

Attn: Technical Services Department
82 Coromar Drive
Santa Barbara, CA 93117-3093

Moseley Associates, Inc. will return the equipment prepaid under Warranty and Service Agreement conditions, and either freight collect or billed for equipment not covered by Warranty or a Service Agreement.

C.3 Field Repair

Some Moseley Associates equipment will have stickers covering certain potentiometers, varicaps, screws, and so forth. Please contact Moseley Associates technical service department before breaking these stickers. Breaking a tamperproof sticker may void your warranty.

When working with Moseley's electronic circuits, work on a grounded antistatic surface, wear a ground strap, and use industry-standard ESD control.

Try to isolate a problem to a module or to a specific section of a module. Then compare actual wave shapes and voltage levels in your circuit with any shown on the block and level diagrams or schematics. These will sometimes allow the problem to be traced to a component.

Spare Parts Kits: Spare parts kits are available for all Moseley products. We encourage the purchase of the appropriate kits to allow self-sufficiency with regard to parts. Information about spares kits for your product may be obtained from our sales department or technical service department.

Module Exchange: When it is impossible or impractical to trace a problem to the component level, replacing an entire module or subassembly may be a more expedient way to correct the problem. Replacement modules are normally available at Moseley Associates for immediate shipment. Arrange delivery of a module with our technical

services representative. If the shipment is to be held at your local airport with a telephone number to call, please provide an alternate number as well. This can prevent unnecessary delays.

Field Repair Techniques: If an integrated circuit is suspect, carefully remove the original and install the new one, observing polarity. Installing an IC backward may damage not only the component itself, but the surrounding circuitry as well. ICs occasionally exhibit temperature-sensitive characteristics. If a device operates intermittently, or appears to drift, rapidly cooling the component with a cryogenic spray may aid in identifying the problem.

If a soldered component must be replaced, do the following:

- Use a 40W maximum soldering iron with an 1/8-inch maximum tip. Do not use a soldering gun. Excessive heat can damage components and the printed circuit. Surface mount devices are especially heat sensitive, and require a lower power soldering iron. If you are not experienced with surface mount components, we suggest that you do not learn on critical equipment.

- Remove the solder from the component leads and the printed circuit pads. Solder wicking braid or a vacuum de-solderer is useful for this. Gently loosen the component leads and extract the component from the board.

- Form the leads of the replacement component to fit easily into the circuit board pattern.

- Solder each lead of the component to the bottom side of the board, using a good brand of rosin-core solder. We recommend not using water soluble flux, particularly in RF portions of the circuit. The solder should flow through the hole and form a fillet on both sides. Fillets should be smooth and shiny, but do not overheat the component trying to obtain this result.

- Trim the leads of the replacement component close to the solder on the pad side of the printed circuit board with a pair of diagonal cutters.

- Completely remove all residual flux with a cotton swab moistened with flux cleaner.

For long term quality, inspect each solder joint – top and bottom – under a magnifier and rework solder joints to meet industry standards. Inspect the adjacent components soldered by the Moseley Associates production line for an example of high reliability soldering.

