



EUM3006 Integrated Outdoor Modem

Installation Guide

APCD-LM048-1.1

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Regulatory Notices

This equipment has been tested and found to comply with the limits for a Class B Intentional Radiator, pursuant to Part 15 of the FCC Regulations. These limits are intended to provide protection against harmful interference when the equipment is operated in a residential environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Notice to User

Any changes or modifications to equipment that are not expressly approved by WaveRider may void the user's authority to operate the equipment.

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Preface

Conventions

The following conventions are used throughout this document:

WARNING!



Whenever you see this icon and heading, the associated text addresses or discusses a critical safety or regulatory issue.



CAUTION: Whenever you see this icon and heading, the associated text discusses an issue, which, if not followed, could result in damage to, or improper use of, the equipment or software.



TIP: Whenever you see this icon and heading, the associated text provides a tip for facilitating the installation, testing, or operation of the equipment or software.

Regulatory Notices

This device has been designed to operate with only its integrated antenna. This device has been tested using unshielded Ethernet CAT-5E cable.

Federal Communications Commission

The EUM3006 has been designed and manufactured to comply with FCC Part 15.

Operators must be familiar with the requirements of the FCC Part 15 Regulations prior to operating any link using this equipment. For installations outside the United States, contact local authorities for applicable regulations.

The FCC ID for the EUM3006 equipment is OOX-EUM3006.

The transmitter of this device complies with Part 15.247 of the FCC Rules.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not

installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

Interference Environment

Operation is subject to the following conditions:

- This device may not cause harmful interference and,
- This device must accept any interference received, including interference that might cause undesired operation.

Operational Requirements

In accordance with the FCC Part 15 regulations:

1. The maximum average power output of the intentional radiator shall not exceed one (1) watt (30 dBm) for all spread spectrum systems operating in the 902 to 928MHz band.
2. Stations operating in the 902 to 928MHz band may use transmitting antennas of directional gain greater than 6dBi, provided the average output power from the intentional radiator is reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.
3. The operator of a spread spectrum system and the user of the radio device are each responsible for ensuring that the system is operated in the manner outlined in [Interference Environment](#) on page xiii.

The EUM3006 with its integrated antenna complies with these requirements, since the maximum average transmitting power is 25.8 dBm measured at the internal antenna port which is not accessible to the user. This is 4.2 dB below the maximum allowed, so the integrated, high-gain, active diversity antenna is allowed to provide an additional 4.2 dB gain for a total of 10.2 dBi gain.

Warnings and Advisories

General Advisory

Installers, operators and maintenance personnel must be familiar with the related safety requirements before they attempt to install or operate the EUM3006.

It is the responsibility of the operator to ensure that the public is not exposed to excessive Radio Frequency (RF) levels. The applicable regulations can be obtained from local authorities.

WARNING!



The EUM3006 Integrated Outdoor Modem must be properly grounded. WaveRider assumes no liability for failure to adhere to this recommendation or to recognized general safety precautions.

WARNING!



To comply with FCC RF exposure limits, the EUM3006 must be fix-mounted outdoors to provide a separation distance of 30 cm (1 foot) or more from all persons to satisfy RF exposure requirements. The distance is measured from the nearest point of the modem to the human body. It is recommended that the modem be installed in a location with minimal pathway disruption by nearby personnel.

Important Safeguards

WARNING!



CAUTION: To reduce risk of electrical shock, do not remove covers, since there are no user-serviceable parts inside. Refer servicing to qualified personnel.

1. Read all these instructions before installing and operating the EUM3006.
2. Retain these instructions for future reference.
3. Heed all warnings on the EUM3006 and in these instructions.
4. Follow all instructions.
5. Do not use EUM3006 and PoE Injector near water.
6. Unplug EUM3006 and PoE Injector from the wall outlet before cleaning. Clean only with a damp cloth.
7. Use only attachments recommended by WaveRider.
8. The fins and metal casing protect the EUM3006 from overheating to ensure reliable operations. Do not cover the EUM3006 and PoE Injector. Do not place the EUM3006 or PoE Injector near or over a radiator, stove, heat register or other source of heat. Do not place the EUM3006 and PoE Injector in a built-in installation such as a bookcase or rack unless proper ventilation is provided. The EUM3006 has an outdoor temperature rating, so it can handle a much larger range of temperatures than the

PoE injector. However, it is still possible to exceed the EUM3006 specifications by improper placement or ventilation.

9. Operate the EUM3006 only from a 48 VDC PoE Mode B power source.
10. Operate the PoE Injector only from a 100 - 250 VAC, single phase, 47-63 Hz AC power source. The PoE Injector is rated for indoor use only.
11. The PoE Injector is equipped with a 3-wire grounding-type plug, which will only fit into a grounding-type power outlet. This is a safety feature. If you are unable to insert the plug into the outlet, contact an electrician to replace your obsolete outlet. Do not defeat the purpose of the grounding-type plug.
12. Route the AC Power-supply cord and Ethernet cables so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cord and cables at their plugs, convenience receptacles and the points where the cords exit the equipment.
13. Provide strain relief for cables near their connections. This is typically done by leaving a loop in the cable near the connection.
14. Ensure the system is properly grounded to provide some protection against voltage surges and built-up static charges.
15. Do not locate the EUM3006 in the vicinity of overhead power lines or other electric light or power circuits, or where it can fall onto such power lines or circuits. When installing outdoors, take extreme care to keep from touching such power lines or circuits, as contact with them might be fatal.
16. For added protection during a lightning storm, or when it is left unattended and unused for long periods of time, unplug the Ethernet cable from the PoE injector to the EUM3006 and unplug the PoE Injector from the wall outlet. If the Ethernet cable to the EUM3006 goes through a PoE Lightning Arrestor, then disconnect the inside Ethernet cable. This will power down the EUM3006.
17. Do not overload wall outlets and extension cords as this increases the risk of fire or electric shock.
18. Never push objects of any kind through openings in this wireless product as they may touch dangerous voltage points or short-out parts that could result in a fire or electric shock. Never spill liquid of any kind on the PoE Injector. The EUM3006 is an outdoor unit, but it is not submersible nor is it immune to all liquids.
19. Do not attempt to service this wireless product yourself, as opening or removing covers may expose you to dangerous voltage or other hazards. Refer all servicing to qualified service personnel.
20. Unplug PoE Injector from the wall outlet and refer servicing to qualified service personnel under the following conditions:
 - When the power supply cord or plug is damaged.
 - If liquid has been spilled or objects have fallen into these products.
 - If the PoE Injector has been exposed to rain or water.
 - If the EUM3006 does not operate normally for an extended period of time when following the operating instructions. Note that it is possible that Internet traffic can

be slow even under normal operations due to network congestion and radio interference and fading and not as result of problems with the EUM3006.

- When the EUM3006 or PoE Injector exhibit distinct changes in performance. This may indicate a need for service.
21. When replacement parts are required, be sure the service technician has used replacement parts specified by the WaveRider or with the same characteristics as the original part. Improper substitutions may result in fire, electric shock or other hazards.
 22. Upon completion of any service or repairs to this wireless product, ask the service technician to perform safety checks to determine that the wireless product is in proper operating condition.
 23. Follow WaveRider recommendations when mounting the EUM3006 on a wall, roof, or tower.
 24. Install the EUM3006 in compliance with local and national electrical codes. The following are the national codes. The installer is responsible for knowing the appropriate local codes.
 - In the United States, use the National Electrical Code (NEC);
 - In Canada, use the Canadian Electrical Code, Part 1, CSA C22.1;
 - In other countries, use International Electrotechnical Commission (IEC) 364, part 1 through 7.
 25. Ensure that the EUM3006 is properly grounded by attaching a grounding cable to the bolt marked “GND” on the back of the EUM3006. Art. 820-40 of the NEC (US) provides guidelines for proper grounding and, in particular, specifies that the grounding cable(s) shall be connected to the grounding system of the building, as close to the point of cable entry as possible.

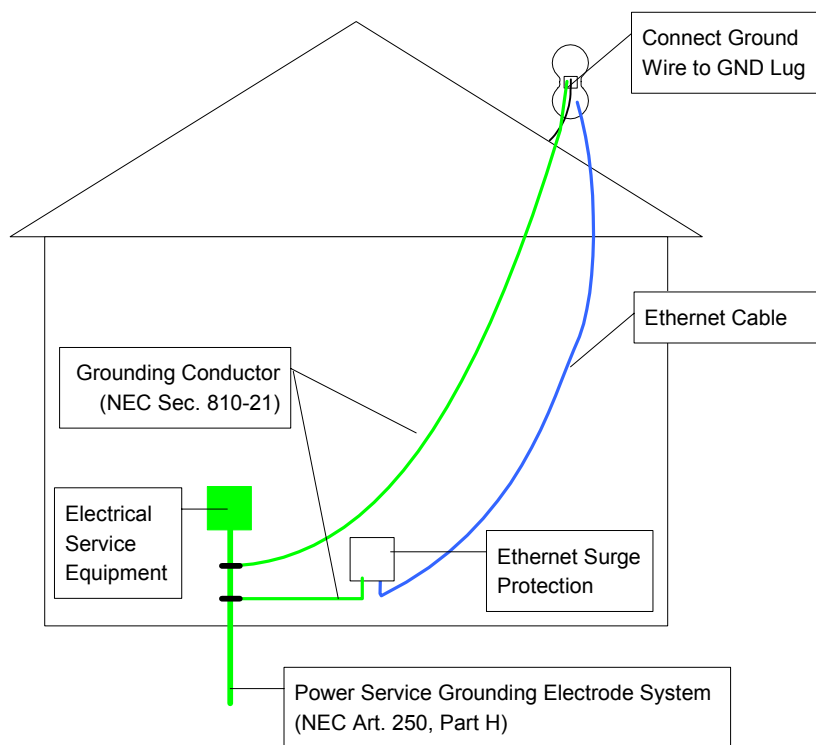


Figure 1 Grounding EUM3006

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1

Introduction

The LMS4000 900 MHz Radio Network provides wireless high-speed Internet connectivity to business, SOHO (small office, home office) and residential customers. LMS4000 operates in a point-to-multipoint configuration, with one base station efficiently serving many subscriber stations. LMS4000 transmission is based on a high-performance MAC protocol, and industry standard IP routing and Ethernet switching technology. No radio license is required, since LMS4000 operates in the 900 MHz ISM band. LMS4000 can deliver Internet service over long ranges and often where the radio paths between the base station and subscribers are partially or even total obscured, that is, non-line-of-sight. Connection between the end-user's computer and the subscriber station is through an Ethernet port.

The EUM3006 Integrated Outdoor Modem is the latest modem for the LMS4000 system and offers significant improvements: outdoor unit with extended temperature range; integrated, high-gain, active diversity antenna; 802.3af compatible, 48 VDC Power over Ethernet; higher output power; improved Rx Sensitivity; DHCP Client; Auto CCU Discovery, Automatic Remote Configuration; easy-to-use Setup menu and MDB1000 alignment tools; VoIP support.

1.1 Document Scope

This Installation Guide covers only the EUM3006 Integrated Outdoor Modem. It provides information on the installation of the EUM3006, its performance, and any required regulatory information, including approved installation notices.

Related information can be found in the suite of available LMS4000 manuals, which includes the following:

- *LMS4000 900 MHz Radio Networking Concepts* (APCD-LM053)
- *LMS4000 Data Networking Concepts* (APCD-LM050)
- *LMS4000 Managing the Network* (APCD-LM052)
- *LMS4000 CLI Reference Manual* (APCD-LM051)
- *LMS4000 SNMP Reference Manual* (APCD-LM049)

These manuals provide information not included in this Installation Guide, including information on:

- Planning, installing and managing the network.
- Diagnostic tools for the network and EUM.
- Details on the Command Line Interface and methods of accessing the EUM.
- Manual configuration of the EUM via the CLI.
- Glossary of network terms.

These manuals, as well as manuals for hardware elements, including EUMs and CCUs, can be found on WaveRider's Web site (<http://www.waverider.com>).

Other documents on the WaveRider web site are useful to assist in installing and operating the EUM3006. For example, you can find information on which roof and wall mounting brackets are recommended.

WaveRider recommends that you be familiar with the following sections before proceeding with the instructions in this guide:

- *Software License Agreement* on page iii
- *Warranty* on page iv
- *Conventions* on page xii
- *Warnings and Advisories* on page xiii
- *Important Safeguards* on page xiv

NOTE: The information contained in this manual is subject to change without notice. The reader should consult the WaveRider web site for updates.

1.2 EUM3006 Features

The EUM3006 is a major step in the evolution of the LMS4000 900MHz Wireless Internet Modems offered by WaveRider. It is a Power-over-Ethernet, outdoor unit with integrated, high-gain, active diversity antenna.

The EUM3006 complements the existing LMS4000 Products:

- The CCU3000 and the NCL1900 are the current base station products;
- The EUM3004 with its diversity antenna is the current indoor end-user modem, providing easy installation for areas with signal levels that allow for indoor installations;
- The EUM3006 with its integrated antenna completes the product line, providing an outdoor unit for areas where the indoor unit is not usable, due to operational or RF link considerations.



Figure 1 EUM3006 Integrated Outdoor Modem

The EUM3006 has new features that provide improved RF performance as well as ease of installation. The RF performance is enhanced due to the integrated, high-gain, active diversity antenna, improved transmit power, and improved receive sensitivity.

Hardware and software improvements make outdoor installation easier than ever, allowing rapid deployment, single person installation, and even end-user self-installation. These improvements include Power-over-Ethernet, mounting and alignment tools, and Automatic Remote Configuration of all parameters using DHCP and RADIUS. The Automatic Remote Configuration of parameters also allows the network operator to easily manage and reconfigure the EUM3006 after it is installed, including changing frequency, passwords, and SNMP parameters.

Key features of the EUM3006 include:

- **Easy Outdoor Installation** - The EUM3006 is tested to meet ETSI 300-019 environmental standards for outdoor installations, with an extended temperature range of -40° C to 50° C plus solar loading. The EUM3006 can also work in uninhabited indoor locations, such as attics, if there is an adequate RF signal. The advantages of an integrated outdoor unit include:
 - More flexible installations.
 - Improved range since there are no RF losses from long cable runs.
 - Lower installation costs.

- **Integrated, high-gain, active diversity antenna** - There are many advantages to the EUM3006's integrated antenna:
 - Integrated, so that there are no RF losses due to long cable runs.
 - High-gain (10 dBi), so that the EUM3006 can generate the maximum RF signal allowed by FCC and increase the overall operating range. Active diversity, which is done on a packet by packet basis, so that the EUM3006 performs better in a multi-path fading environment.
 - Active diversity, which is done on a packet by packet basis, so that the EUM3006 performs better in a multi-path fading environment.
 - Polarization diversity, so that the installer need not worry about what polarization the CCU is. Sector polarization can be readily changed at the base stations, with the EUMs automatically adjusting.
- **Power over Ethernet (PoE)**- The EUM3006 is powered by standard 48 VDC Power over Ethernet (802.3af Mode B compatible). Since the antenna is integrated, there is no need for an RF cable. With PoE, there is no need for a separate power and Ethernet cable. So the EUM3006 has only one standard, unshielded, flexible CAT-5E cable, making installation simpler.
- **48 VDC PoE** - Using 48 VDC power allows the EUM3006 to have up to 100 m of Ethernet cable to the end-user's PC, which is the maximum by the Ethernet standard. The PoE injector can be located anywhere along this 100 m of cable. This provides great flexibility in placing the EUM3006 to get the best RF signal. Systems that use less than 48 VDC restrict the length of Ethernet cable due to voltage losses along the cable.
- **Higher RF Power** - As a result of changes to the FCC rules, the EUM3006 makes best use of its high-gain antenna to generated a full 36 dBm AVERAGE EIRP (Effective Isotropic Radiated Power) out of the antenna. This represents an increase of about 2.5 dB from the previous generations of EUMs with approved high gain antenna systems.
- **Improved RX Sensitivity** - Each EUM3006 is tested to ensure that its RX Sensitivity is -89 dBm or better (average received signal). Combined with the antenna gain of 10 dBi, the EUM3006 can receive signals at -99 dBm.
- **DHCP Client enabled** (factory default)- The EUM3006 can obtain its IP address, subnet mask and IP gateway information from a DHCP server, reducing the amount of configuration needed for installation. This also allows the Network Operator to re-assign IP addresses to EUMs without having to access the EUM itself.
- **Auto CCU Discovery** (factory default) - The EUM3006 searches the full RF frequency range to locate CCUs. It then selects the CCU with the best RF signal that allows it to register. With this and DHCP Client enabled (factory defaults), the installer does not need to enter ANY configuration parameters into the EUM3006 in order to install it.
- **Automatic Remote Configuration** - The EUM3006 will accept parameters from a RADIUS server to set other configurable parameters in the modem. These parameters include: password, all SNMP parameters, RF Frequency (including enabling Auto CCU Discovery), and number of customers. To use this feature, the CCU must use software version V6.0 or later.

- **Installation Tools** - The EUM3006 has two new tools to make installation and alignment easy and error-free.
 - **MDB1000** - This hand-held, battery-powered device displays detailed key signal quality information to allow the EUM3006 to be located and aligned to the best RF signal possible by a single installer. The MDB1000 can be in any position to provide easy viewing.
 - **SETUP Menu** - The EUM3006 supports the local link IP address, 169.254.10.250, on its Ethernet port at all times. Using the local-link address, the user can use the password “setup” to call up the setup menu that allows any user to check the RF link quality to help align the EUM3006 and troubleshoot the link. This avoids needing to know the IP address and password of the modem.

Detailed specifications for the EUM3006 can be found on the WaveRider website.

1.3 EUM3006 - End-user Modem or Customer Premises Equipment

The EUM3006 Integrated Outdoor Modem, shown in [Figure 1](#), is a rugged outdoor wireless modem that connects to the end-user's computer through an Ethernet connection. It is installed at the end-user's premises and provides an interface to the customer's computer or local area network on one side and wireless access to the LMS4000 network on the other

The EUM3006, which acts as a network bridge, receives data from the CCU (Communication Access Point Channel Unit = base station) over the 900 MHz radio link, and then forwards this data to EUM3006 internal processes or to the end-user's computer through the Ethernet port. In the other direction, the EUM3006 forwards data received from the end-user's computer over the radio link to the CCU

1.3.1 Key Components

These key components of the customer-premises equipment are described on the following pages:

- [EUM3006 Integrated, High Gain, Active Diversity Antenna](#) on page 5
- [Ethernet Port](#) on page 6
- [Power over Ethernet \(PoE\) Injector](#) on page 7
- [PoE Lightning Arrestor](#) on page 8

1.3.2 EUM3006 Integrated, High Gain, Active Diversity Antenna

The EUM3006 has its antenna integrated with the modem in one package, designed for the rugged outdoor environment. The EUM3006 antenna is a high gain, active diversity antenna that ensures that the EUM3006 output power is at the maximum allowed by the FCC. The active diversity feature selects the best signal from horizontal and vertical polarizations on a per packet received basis. Active diversity improves performance in a multi-path fading

environment by selecting the alternate polarization when the other polarization signal fades significantly. This effectively reduces the depth, frequency and duration of fades when compared to a non-active or non-diversity antenna system.

Horizontal and vertical polarizations are relative to the earth. Since the EUM3006 can be mounted in one of two orientations, we use the terms longitudinal axis and transverse axis to refer to the axes of the modem. See [Figure 2](#).

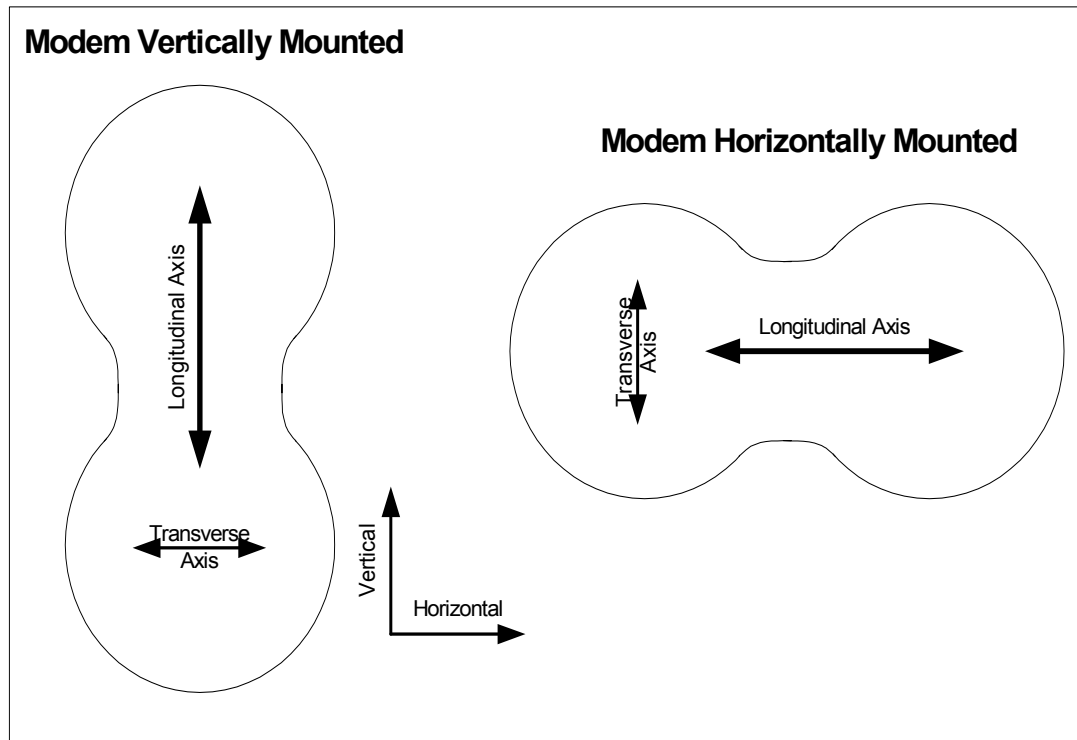


Figure 2 EUM3006 Longitudinal and Transverse Axes

The antenna patterns are longitudinal and transverse polarization. If the modem is mounted vertically, then the longitudinal polarization coincides with vertical polarization and the transverse is for horizontal polarization. If the modem is mounted horizontally, then the longitudinal axis is for horizontal polarization and the transverse is for vertical polarization. See the installation section for suggestions on mounting orientation.

The EUM3006 samples the signal strength from both antenna polarizations during the preamble of every received packet and automatically selects the best signal. When the EUM3006 transmits, it sends on the antenna polarization that was last used to receive a signal.

The integrated antenna has a front-to-back ratio of more than 15 dB, which helps to suppress interference.

1.3.3 Ethernet Port

The EUM3006 has a 10BaseT Ethernet RJ-45 connector at the end of 25 feet of CAT-5e outdoor Ethernet cable. This makes installation much easier and robust, since this length is

sufficient for most installations to reach the Power over Ethernet injector in an indoor location and avoids having connections which are exposed to the outdoor environment.

This Ethernet cable can be plugged into the PoE Injector directly or through extension cables and a UL-approved PoE Lightning Arrestor (where required). Details on the Ethernet port are found in [Appendix B on page 39](#).

There is great latitude available in locating the EUM3006 and routing the Ethernet cable, since up to 330 feet (100 m) of Ethernet cable can be used between the EUM3006 and the end-user's computer, router or Ethernet switch.

1.3.4 Power over Ethernet (PoE) Injector

Power is provided to EUM3006 Integrated Outdoor Modem through its Ethernet cable. This power is provided by a device called a PoE Injector, which takes the Ethernet data-only signals from the cable to the end-user's computer, switch or router and adds the 48 VDC power to the Ethernet cable going to the modem. The 48 VDC power is provided by converting the AC power provided to the injector.



Figure 3 PoE Injector

Using the standard 48 VDC means that the PoE Injector can be located at any point between the end-user and the EUM3006, without worrying about excessive voltage drop.

The supplied PoE injector is rated for indoor conditions.

The supplied PoE Injector need not be used if 48 VDC 802.3af Mode B PoE power is being provided by a router or Ethernet switch. It is beyond the scope of this document to discuss configuring such devices. It is the installer's responsibility to ensure that such devices are compatible with the EUM3006.

WARNING!



Plug the EUM3006 directly into routers or Ethernet switches **ONLY** if these are providing compatible 48 VDC 802.3af Mode B PoE power, in lieu of the supplied PoE Injector.

1.3.5 PoE Lightning Arrestor

A PoE lightning arrestor (not supplied) is used with the EUM3006 if required by the local building code and/or the EUM3006 is being installed in an area subject to direct or indirect lightning induced surges. The lightning arrestor must be able to pass the Ethernet data lines as well as the Power over Ethernet lines. The lightning arrestor must be grounded in accordance with local and national electrical codes.

1.4 Installation Aids

The following features make installation much easier and faster:

- *MDB1000* on page 9
- [Setup Menu](#) on page 15

The chapter on [Installation](#) on page 21 gives step-by-step instructions to ensure a successful installation.

2

MDB1000

To make installation an easy one person job, the MDB1000 (Magnetic Decoder Box) is a light, portable, battery operated device that provides signal performance indicators that assist in locating and aligning the EUM3006. The MDB1000 picks up a magnetic signal from the EUM3006 from any position within 4 inches of the EUM3006. This allows the installer to put the MDB in a convenient position, regardless of the orientation of the EUM3006 or awkwardness of the mounting location. By indicating 8 levels of signal strength and 5 levels of signal quality, the MDB1000 allows the installer to find the optimal location and alignment. The MDB1000 is shown in [Figure 4](#)

2.1 Placing the MDB1000

The MDB1000 comes with a belt clip and two velcro straps, a short one to attach the MDB1000 to your wrist or forearm and a longer one to attach to the EUM3006 itself or the pole mount. So long as the MDB1000 is within 4 inches of the EUM3006, it picks up the magnetic signal sent by the EUM3006. If MDB1000 does not indicate it is receiving a signal, move it closer to the waist of the modem.

The EUM3006 will stop sending the magnetic signal one hour after it has been started. If in doubt, simply re-power the EUM3006 to ensure that it is transmitting the MDB1000's signal.

2.2 Powering the MDB1000

The MDB1000 requires two AA batteries. It is recommended that long-life batteries, such as the Eveready Lithium LN91, be used, which have a long shelf life. Under normal conditions, these batteries should last for many months. Unlike other batteries, lithium batteries are rated to -40 C. However, sustained temperatures below -10 C will severely limit the battery lifetime.

It is recommended that the batteries be tested before starting the installation. Keeping a spare set of batteries with the installation tools may save you a trip down ladders, etc. to get new batteries.

The AA batteries fit into the MDB1000 by removing the battery cover at the back of MDB1000, removing the old batteries, and inserting the new ones. Ensure batteries are inserted with the correct polarity.

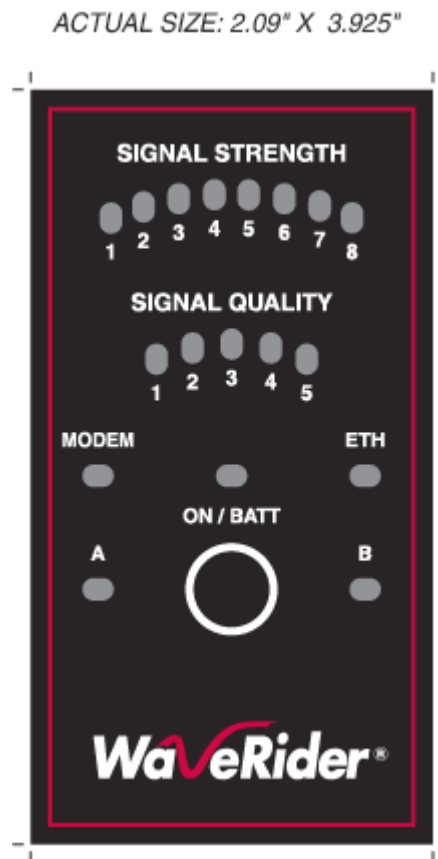


Figure 4 MDB1000

2.3 Turning the MDB1000 On

The MDB1000 is self-tested every time it is turned on. Press the ON button. Each LED should flash on and off twice a second for 5 seconds before showing the signal performance values. If this does not happen, then the batteries could be low and should be replaced.

The ON/BATT LED will flash continually when the battery is low and should be replaced.

2.4 Turning the MDB1000 Off

The MDB1000 automatically shuts off if it is out of range of the EUM3006 for more than 60 seconds. You can tell if the MDB1000 is out of range, since the MODEM LED will go out as well as all of the signal performance indicator LEDs. Only the ON/BATT LED will remain lit (or flashing if the battery is low).

Pressing the ON button has no effect once the MDB1000 is on.

2.5 Interpreting the LEDs

There are 6 groups of LEDs:

ON/BATT

This LED has three states:

- ON - MDB1000 is working and batteries are good
- FLASHING - The batteries are low and should be replaced
- OFF - MDB1000 has turned itself off

MODEM

ON when the MDB1000 is receiving good data from the EUM3006. If the LED is OFF, then all the remaining LEDs are OFF.

ETH

ON when the EUM3006 has an Ethernet link to the end-user PC or router.

SIGNAL STRENGTH

These 8 LEDs show the state of the EUM3006 if the MODEM LED is on. There are three states shown:

1. No CCU - All the Signal Strength LEDs are OFF, indicating that the EUM3006 has acquired a CCU but is not receiving any packets.
2. Auto CCU Discovery Mode - There are two LEDs ON in rotating patterns when the EUM3006 is in Auto CCU Discovery mode and is searching for a CCU.
3. Normal Reception - If only one LED is ON, then the EUM3006 has registered with a CCU and is receiving packets. The LED that is ON indicates the average received Signal Strength Figure of Merit (FOM) for packets from the CCU. [Table 1](#) shows the mapping between signal strength in dBm and the signal strength FOM.

Table 1 MDB1000 Signal Strength FOMs

LED	Meaning	Received Signal is at least	Received Signal is less than
1	Extremely poor		-92 dBm
2	Very Poor	-92 dBm	-89 dBm
3	Poor	-89 dBm	-86 dBm
4	Marginal	-86 dBm	-83 dBm
5	Okay	-83 dBm	-80 dBm
6	Good	-80 dBm	-77 dBm
7	Very Good	-77 dBm	-74 dBm
8	Excellent	-74 dBm	

SIGNAL QUALITY

These 5 LEDs have two interpretations, depending on the state of the EUM3006 if the MODEM LED is on.

1. A rotating pattern of LEDs shows that the EUM3006 is in Auto CCU Discovery mode.
2. When a CCU has been found, the Signal Quality LEDs indicate the figure of merit for a blend of quality indicators, including the carrier phase error and the signal to noise ratios for each antenna pattern. The FOM is a value between 0 and 5 and is much more qualitative than the signal strength. [Table 2](#) shows the meanings of each of the LED values. LED 0 means that there are no LEDs lit.

Table 2 MDB1000 Signal Quality LEDs

<u>LED</u>	<u>Meaning</u>
0	Extremely Poor
1	Very poor
2	Poor
3	Adequate
4	Good
5	Very Good

Getting any Signal Strength reading at all indicates that packets are being received from the CCU. The higher the signal strength and signal quality indicators, the lower the packet error rate and the higher the fade margin for the EUM3006. The goal should be a signal strength of 5 or higher and a signal quality of 4 or 5. Regardless of the levels, the EUM3006 should be aligned so that the indicators are the highest possible for the given site.

A/B

Reserved for future use.

3

Setup Menu

The EUM3006 is equipped with a simple setup menu through which you can monitor the RF link quality and view the key parameters of the modem.

3.1 Accessing the Setup Menu

The setup menu is accessed by connecting a Telnet session to the 'local link' IP address of the EUM3006, 169.254.10.250, with password = 'setup'. The connection must be through the Ethernet port, not over the air via the RF link.

The computer needs to have an IP address of 169.254.x.y with a 16 bit mask (255.255.0.0), where x and y can be any value from 0 to 255 except for 10.250, 0.0, or 255.255. It is recommended that the address 169.254.10.251 be used unless another address is more convenient. This address will be used throughout.

The following assumes the computer has a Windows 2000 or Windows XP operating system. Other operating systems can be used provided the computer has an IP address of 169.254.10.251 and can use 'ping' and 'telnet' programs.

On Windows 2000, XP and similar systems, the IP Address is set using the Control Panel > Network and Dialup Connection > Local Area Connections > right mouse click to select Properties > Internet Protocol (TCP/IP) > Properties.

Once the computer's IP address is set to 169.254.10.251, open a DOS command window and try to ping the EUM3006, using the command "ping 169.254.10.250". If the EUM3006 does not respond, verify the Ethernet cables are connected correctly, that PoE Injector has power and that the computer has the correct address and net mask.

When the EUM3006 replies to the ping command, establish a telnet session with the command "telnet 169.254.10.250".

Once a telnet connection is established, a password is requested. Enter "setup", which will enter the setup menu.

3.2 Setup Menu

The Setup Menu structure consists of a menu with four selections.

Setup Menu

```
WaveRider Communications, Inc. EUM3005
Password: *****
```

```
WaveRider Communications Inc. Setup Menu

Modem Serial Number      : C00017
Station Identifier (EUM ID): 40:00:17
Software Version         : 10.0
Search State             : Searching for CCU

Menu
====

(R)adio Link Status - Use this for pointing the antenna
(T)roubleshooting information - for network operator
(H)elp
e(X)it

type option and press enter > r
```

The Setup menu identifies the modem, the software version and search state. In this case, the modem is configured for Auto CCU Discovery and it is searching to find the best available CCU.

There are 4 options:

- Radio Link Status - see [section 3.3](#), Radio Link Status Display
- Troubleshooting information - see [section 3.4](#), Troubleshooting Information Display
- Help - this provides an on-line explanation of the options and the information displayed with each.
- Exit - this terminates the telnet session.

3.3 Radio Link Status Display

The Radio Link Status display is the key setup display for aligning the antenna and verifying the link, in a manner similar to the MDB1000. The Radio Link Status display shows the search state of the modem, which is either:

- **searching for a CCU** - A complete sweep of all frequencies takes about 30 seconds. The display shows which frequencies may be CCUs. A search is started when any of the following occurs:
 - the modem boots up, either due to a hard (power) reset or software reset,
 - no CCUs are found during the last frequency sweep, so that the modem cannot register with any CCU found during the last sweep,
 - the modem has received no traffic from the CCU in the last two minutes
- **attempting to register with a CCU** - When a frequency sweep has been completed, the modem attempts to register with the CCUs in the order of best signal down to poorest. The modem may not register with a CCU for a number of reasons, in which case the modem attempts the next CCU in the frequency list. If the modem cannot register with any CCU, contact the network operator. The reasons a modem may not be able to register with a CCU include:
 - The modem is not authorized to register at that CCU,
 - The signal detected is not a valid CCU.
- **registered with a CCU** - This state occurs when the modem has a frequency and has successfully registered with a CCU. At this point, the modem can provide a link to the Internet through the CCU.

An example of the Radio Link Status display is shown below.

Radio Link Status Display

```

Searching: found 9070 9086
Searching: found 9070 9086
Searching: found 9070 9086 9114
Searching: found 9070 9086 9114
Searching: found 9070 9086 9114 9142
Searching: found 9070 9086 9114 9142
Searching: found 9070 9086 9114 9142
Searching: found 9070 9086 9114 9142

Registered at 9114

      Signal Strength
      | Poor | Fair | Good
      | 1 2 3 4 5 6 7 8
4.0 *****
4.3 *****
5.0 *****
4.7 *****
6.7 *****
5.0 *****
3.7 *****
6.0 *****
8.7 *****
8.0 *****

      Signal Quality
      | Poor | Fair | Good
      | 1 2 3 4 5
1.5 *****
3.5 *****
3.0 *****
2.5 *****
2.0 *****
1.5 *****
4.0 *****
3.0 *****
3.5 *****
4.5 *****
  
```

The Signal Strength and Signal Quality graphs and values are the same Figures of Merit discussed in [section 2.5](#), Interpreting the LEDs. The goal for aligning the antenna is the same as for the MDB1000, namely a Signal Strength of 5 or better and a Signal Quality of 4 or 5, if possible.

3.4 Troubleshooting Information Display

The troubleshooting information is provided to allow the network operator to troubleshoot the link. It is also useful to record the status of the link once the modem is installed and aligned. This can form a reference baseline so that the network operator can judge if the link in future is better or worse than it was when the modem was installed.

The information provided below is a brief description of the statistics provided. A detailed understanding of this information is not required to install the EUM3006. If there are problems with the installation, then the installer may contact the network operator and report the information on this display so that the network operator can troubleshoot the installation.

The troubleshooting information display is shown below.

Troubleshooting information Display

```

WaveRider Communications Inc. Diagnostic Information
----- MAC Summary -----

Transmitted Payloads
    10k :      35 100.0%
    20k :       0  0.0%
    30k :       0  0.0%
    40k :       0  0.0%
    Fail Retry :    0  0.0%
    Fail Timeout :   1

Received Packets
    HCRC Error :    23993  3.0%
    Directed :     6948  0.8%
    Broadcast :    11178  1.4%
    No Match :    753093 94.7%

Received Packets with Payloads
    FCS Error :       0  0.0%
    Duplicate :       0  0.0%
    Too Busy - Discard : 0  0.0%
    Delivered :      73 100.0%

----- IP Summary -----
DHCP Enabled : YES
IP Address: 192.168.10.250 / 24
IP Subnet : 192.168.10.0 ( 255.255.255.0 )
Gateway IP Address: 192.168.10.1

----- Radio Summary -----
RF Power: 26 dBm
Auto Mode - Locked on frequency 9114

RSSI[dBm]  RX;  TX;  R1;  R2;  R3;  F;Retry%;  SQ; RNA; RNB
RSSI: -69   1;   0;   0;   0;   0;   0;    0;   8; 31; 29

```

The MAC Summary shows the breakdown for transmitted and received packets and payloads. All values are expressed as a count and percentage of total packets or payloads. A payload is a packet with real data.

- Transmitted Payloads: shows how many payloads were successfully transmitted the 1st time or needed to be sent a 2nd, 3rd or 4th time to get through, as well as how many packets failed to get through at all. Note that traffic must be sent from the end user PC in order to generate enough traffic to be meaningful. The rules of thumb are:
 - 1OK should be at least 90%, otherwise the link may not be good enough.
 - The 1OK packets should be 1000 or more to be a reasonable representation of the link.
- Received packets: shows the classification of all packets received from the CCU, whether they contain payloads or not and whether they are directed to this modem or not. This data is for information only and does not indicate the quality of the link for the installer.
- Received packets with payloads: shows the disposal of the received packets with payloads for this modem, either directed to the modem or broadcast to all modems. Only the delivered payloads are successfully received. The rule of thumb here is that the delivered payloads should be better than 95%, otherwise the link is suspect.

4 Installation

4.1 Installation Checklist

A successful installation is divided into pre-installation, installation and post-installation stages, with each stage outlined in the following checklists.

The Pre-Installation Stage Checklist involves the Network Operator as well as the installer.

Table 3 Pre-Installation Stage Checklist

Step	Discussion
section 4.2.1 , Network and EUM3006 Configuration	The network must be properly configured by the Network Operator to accept the new modem.
section 4.2.2 , Installer's Kit and Information	The installer requires some equipment, tools and information prior to installing the modem.
section 4.2.3 , Verifying the EUM3006 Components	Ensure that all the needed parts are included.
section 4.2.4 , End-Users PC	The end-user's PC requires an Ethernet Network Interface to accept the data from the EUM3006.

When everything is ready for the installation stage, then the installer performs the following steps:

Table 4 Installation Stage Checklist

Step	Discussion
section 4.3.1, Locating the EUM3006	Find the best location for mounting the EUM3006, with a good RF signal and at least 1 foot away from where people will stand.
section 4.3.2, Mounting the EUM3006	The EUM3006 mounts to a vertical pole with a diameter between 1 and 3.0 inches. Once a location with good signal levels is found, attach pole mounting hardware such as a standard Satellite TV mount, to the building or support structure. Attach the EUM3006 to the pole with the mounting plate and the two gear clamps.
section 4.3.3, Running Cables	Run the Ethernet cable from the modem to the PoE Injector and run the grounding conductor to a suitable grounding location.
section 4.3.4, Provide Power to the EUM3006	Connect the modem to a power source, usually the PoE injector provided.
section 4.3.5, Connecting the End-User's PC	Connect the modem to the end-user's PC.
section 4.3.6, Testing the Data Link	Confirm that the link is functioning correctly.

Once the installation is complete and verified, the network operator can complete the Post-installation Stage, using the Automatic Remote Configuration feature or manually over the air. This is discussed in [section 4.4](#), Post-Installation

4.2 Pre-Installation Steps

4.2.1 Network and EUM3006 Configuration

There are a number of steps that must be undertaken by the network operator before installing an EUM3006. For more information, see the *LMS4000 Data Networking Concepts*, *LMS4000 Radio Concepts* and *LMS4000 Managing the Network* manuals on the WaveRider web-site.

1. **CCU Authorization:** Ensure that the EUM is authorized at one or more CCUs with the appropriate Grade of Service.
2. **IP Addresses:** Configure a DHCP server to accept the new EUM3006's request for an IP address, if the modem has DHCP enabled (factory default). If not using DHCP, then the EUM must be manually configured with the following settings:
 - IP address
 - Subnet mask
 - Gateway IP address
3. **Frequency Assignment:** If the Auto CCU Discovery feature (factory default) is used, then the EUM will search for the CCU upon power up. This is the recommended approach. If for some reason this is not acceptable, then the EUM3006 must be configured with its radio frequency.

The easiest installation uses the EUM3006 factory defaults, so that the modem will get all its IP address information from DHCP and its RF Frequency from the Auto CCU Discovery feature.

4.2.2 Installer's Kit and Information

The installer needs the following standard items to complete an installation. These items are not provided with the EUM3006 modem.

- Pole Mounting HW - provides a vertically aligned 1 - 3.0" pole or pipe, securely attached to building or tower. Typically this is a Satellite TV wall or roof mount.
- Grounding Conductor and clamps- to provide a good ground for the modem, both for RF performance and safety requirements. The grounding conductor attaches to the bolt marked 'GND' on EUM3006 at one end and to the building's Power Service Grounding Electrode System using a clamp at the other end. The grounding conductor can also be connected to the Pole Mounting Hardware. The grounding conductor must be at least 12 AWG copper wire, with a lug with a hole for #12 bolt at one end. The US National Electrical Code (NEC) Article 810-21 provides guidelines for the grounding conductor.
- Tie wraps - or other means to secure the outdoor Ethernet cable and Grounding Conductor to the mounting HW and walls, in order to provide drip loops and strain relief.
- PoE Lighting Arrestor - may be required by local or national electrical codes. The protector must be able to protect all 8 conductors and must be able to pass the DC power as well as the data.

- Additional straight-through Ethernet cables - needed to connect to the Lightning Arrestor or to extend the Ethernet cable if a run of more than 25 feet is necessary.
- Ethernet cable from PoE Injector - needed to connect to the end-user's computer or switch or router. If the end-user's computer is connected directly to the PoE injector, then this must be a cross-over Ethernet cable.
- Tools to bolt the mounting plate to the modem using the 9/16" hex head bolts and to tighten the gear clamps with either a slot screw driver or 3/8" socket or wrench.

Other useful tools include:

- The MDB1000 makes installation and alignment much easier, avoiding the need for a PC or PDA. This makes installation a one-person operation.
- Extension cord for the PoE injector (or battery operated PoE Injector, if available) - This allows you to take the PoE injector along with the modem and apply power when on a roof or up a ladder. Note that PoE Injector is an indoor unit, so do not use in inclement weather.
- If custom Ethernet cables are made on-site, then an Ethernet connector crimping tool is required.
- If it is necessary to splice Ethernet cables outdoors, then the splice must be weather-proofed, so the appropriate tape and/or outdoor junction boxes are needed.

Useful information includes:

- Direction from the installation site to the CCU.
- Expected signal strength for the installation site based on the network operator's site survey or signal strength for other installations in the vicinity.
- The IP address of a site that accepts pings as well as the name of a site that accepts pings, for testing the data link

4.2.3 Verifying the EUM3006 Components

Verify that the EUM3006 kit is complete with:

- EUM3006 modem with integrated antenna and 25 feet of CAT-5e Ethernet Cable.
- Attaching plate with 4 bolts and lock washers
- 2 Gear Clamps
- AC/DC PoE power supply
- AC power cable

4.2.4 End-Users PC

Ensure that the end-user PC is equipped with an Ethernet interface.

4.3 Installation Steps

NOTE: Turn off all cordless phones in the customer's premises, and any other equipment that uses the 900MHz ISM band. Once the installation is complete, turn this equipment back on and monitor for interference or degraded signal quality.

4.3.1 Locating the EUM3006

Based on the site survey by the network operator and experience in the neighborhood, the installer should have some estimate of the signal levels expected at the end-user's premises. This will influence where the EUM3006 can be located. Examples:

- In areas with very strong signal levels, the EUM3006 could be mounted in the attic or other indoor locations.
- As the signal levels drop, EUM3006 could be located outside, but under the eaves and/or against building walls.
- If the signal levels are weak, the EUM3006 may need to be located on the roof and eventually on a pole above the roof that has good line of sight to the CCU.

If you have no idea what signal levels are expected at your site, it is suggested that you climb to a high point (e.g. on the top of the roof), power up the modem and see what signal level is available. If it is good (e.g. Signal Strength FOM is 5 or better), then you can try lower locations. Remember, the higher the signal level, the better the link in general.

The goal for a good installation is to have the Signal Strength FOM in the range of 5-8 and the Signal Quality FOM to be in the range 4-5. However, there are many good installations with lower figures of merit. Using the MDB1000 or Setup Menu, the installer should find the location that provides the best signal figures of merit and then adjust the EUM3006 to maximize the FOM readings. In most cases, a signal strength of 5 with a signal quality of 4 is a better signal than a signal strength of 6 and signal quality of 2.

The following are suggested guidelines for determining where to locate the modem:

- Survey the area with the modem to assess the signal levels before installing the pole mounting hardware
- Signal indicators should be good.
- Avoid being the highest point nearby if possible, since this is more exposed to lightning. If signal levels are good enough, mounting under the eaves or in an attic are preferred since these locations provide added protection from lightning, winds, rain, and snow.
- Locate the EUM3006 at least 1 foot away from occupied areas to avoid any harm from emissions.

4.3.2 Mounting the EUM3006

Pole Mounting Hardware

Once a good location for the modem has been selected, you need to provide a pole or pipe to which the EUM3006 can be attached. This can be any pole from 1" to 3.0" diameter. If the pole is vertical, it is easy to rotate (pan) the modem for the final alignment. The longitudinal axis must be vertical or horizontal only.

The pole can be held by any standard mounting HW such as Satellite TV mounts. See the WaveRider web site for suggestions regarding pole mounting hardware.



CAUTION: The Pole mounting hardware **MUST BE SECURELY FASTENED** to structure (building, tower, etc.) and must be rated to withstand the same or worse environmental conditions as the EUM3006.

Orientation of the EUM3006

Before mounting the EUM3006 to the pole, the orientation of the modem must be determined. The modem should be mounted vertically (i.e. Longitudinal or long axis mounted vertically (see [Figure 5](#))) unless the location makes vertical mounting difficult.

The advantages of vertically mounting the modem include:

- Easier to point the modem. Being vertically mounted, the pole mount can be closer to other structures and still allow the modem to be pointed.
- Less exposure to wind and rain, since less cross section presented.

Attaching the EUM3006 to the Pole Mounting Hardware

Thread the Gear Clamps straps through the slots on the mounting plate before bolting it down on to the EUM3006. There are two set of slots provided, the closer set are 1" apart and the farther set are 2" apart. For poles up to 2 1/4" diameter, use the closer set. For poles of greater than 2 1/4" diameter, use the farther set of slots. Do not use slots that are too far apart for the diameter of the pole, otherwise there will be excessive bending of the mounting plate.

Bolt the mounting plate to EUM3006 using the bolts and lock washers provided, when the clamps are in place and the orientation has been decided. Attach the grounding conductor to the bolt for the hole marked "GND". Tighten the bolts securely to 8-12 foot-pounds of torque.



CAUTION: The Ethernet cable outlet must be at the lower position for either orientation. There are labels indicating which is the top of the modem for vertical and horizontal mounting. Failure to mount the modem with the correct side to the top will severely reduce the weather protecting ability of the modem.

WARNING!

The grounding conductor must be attached to the bolt in the hole marked “GND”.



TIP: As a safety precaution, before attaching the modem to the pole, use a couple of tie-wraps to secure the Ethernet cable and/or Ground conductor to the pole to ‘catch’ the modem before it hits the roof or ground, should you drop it.

Tighten the gear clamps around the pole enough to hold the modem but allowing it to rotate horizontally. Make the final alignment adjustment so that the modem points in the direction of the best signal. Usually, there are a range of angles with similar signal levels with the levels falling off as the modem moves out of that range. Point the modem to the middle of this range.



TIP: You can also mount just the mounting plate and gear clamps to the pole and then attach the modem to the mounting plate. However, you need to have a stable position since you will be holding the modem while threading the mounting plate bolts to the modem. Again, use a tie-wrap to hold the Ethernet cable to the pole first, as a safety precaution.

Tighten the gear clamp securely to a torque of 24-30 inch-pounds (2.0 to 2.5 foot-pounds). Some distortion of the attachment plate is expected as the gear clamps are tightened.

WARNING!

Both gear clamps must be used and must be tightened securely with a socket or box wrench to the specified torque.

Ensure that the modem will not rotate around the pole when reasonable force is applied. Avoid pressing on the radome, push on the cast base instead.

Provide a drip-loop for Ethernet cable and grounding conductor from EUM3006 to pole (see [Figure 5](#) and [Figure 6](#)). This ensures that there is no strain on Ethernet cable as well as directing any rain drips away from the modem and its cable outlet.

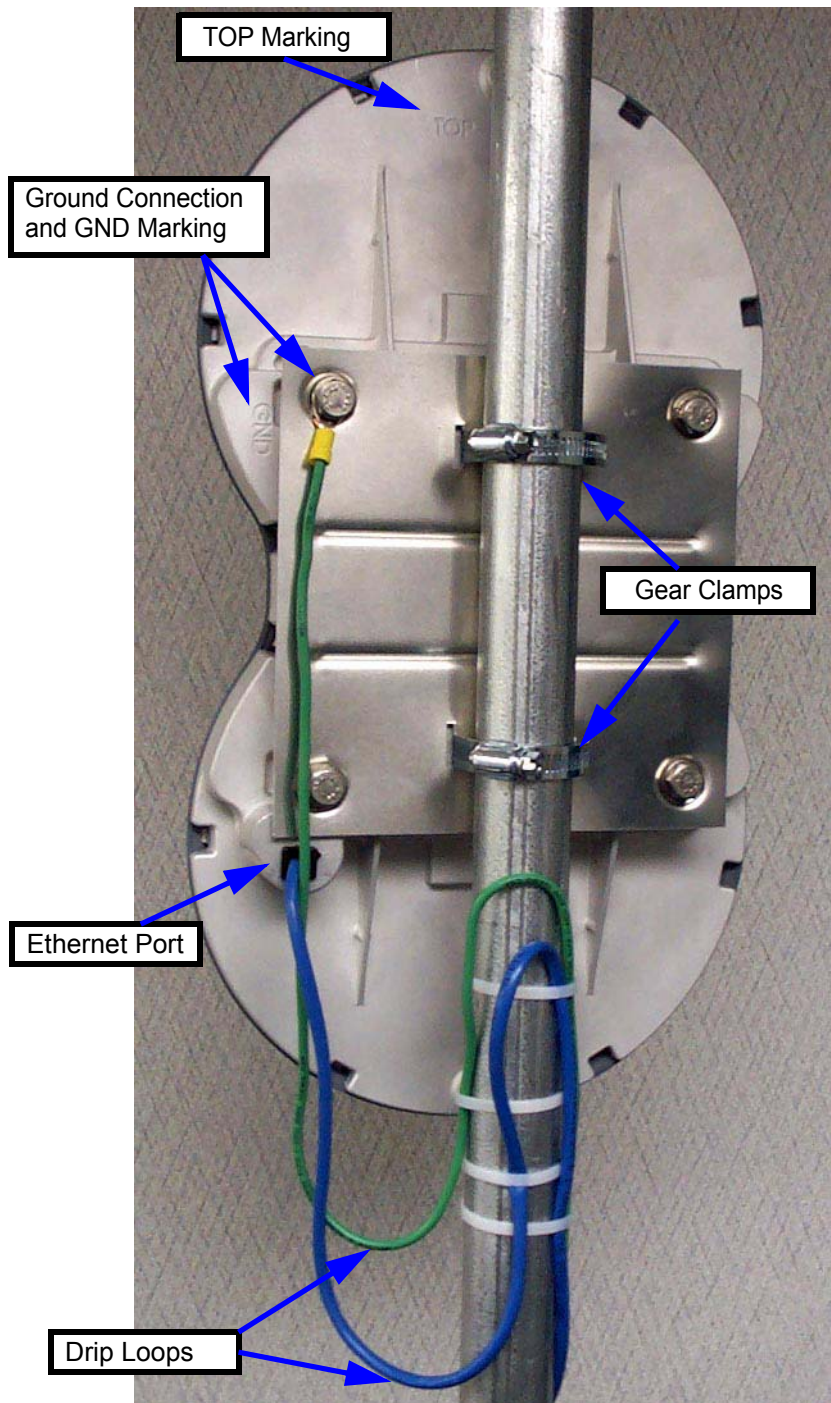


Figure 5 EUM3006 Mounting - Vertical Orientation

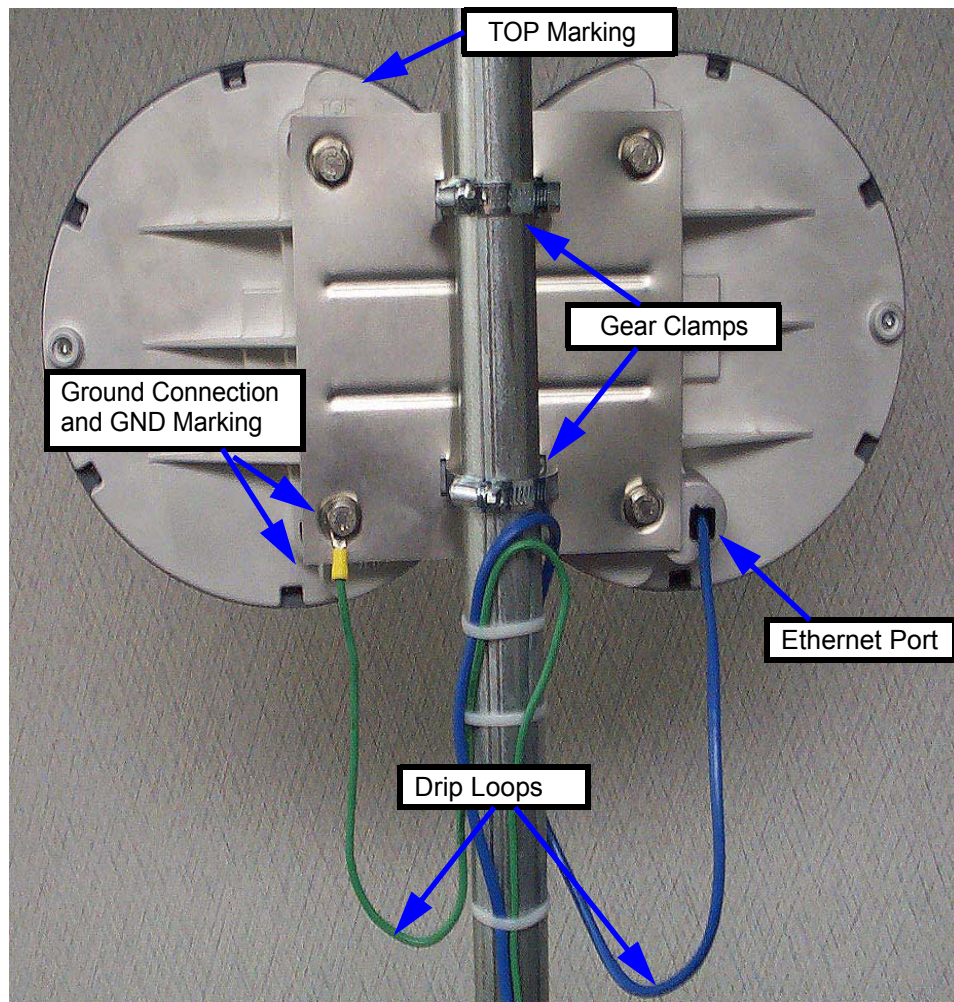


Figure 6 EUM3006 Mounting - Horizontal Orientation

4.3.3 Running Cables

Secure the Ethernet cable and grounding conductor along the pole mounting hardware, the roof and/or any exterior walls, using standard cable ties or anchors, so that there is little or no strain on the wires, but they will not flap in the wind. Add lengths of straight-through Ethernet cables if the provided cable is not long enough. See [Appendix B on page 39](#) for more information on Ethernet cables.

Attach the grounding conductor to the building's Power Service Grounding Electrode System using a ground clamp. See [Important Safeguards](#) on page xiv for discussion on good grounding practices.

If a PoE lightning arrestor is used, it must also be grounded through the building's Power Service Grounding Electrode System. The Ethernet cable from the EUM3006 is attached to the external port of the lightning arrestor and a straight-through Ethernet cable is attached to the other port.

The PoE Injector must be located indoors as it is not rated for outdoor conditions. Therefore the Ethernet cable must enter the building in an appropriate location, preferably near the lightning arrestor.

4.3.4 Provide Power to the EUM3006

An indoor PoE Injector, shown in [Figure 7](#), is provided with every EUM3006. Locate it in a convenient location that has access to an AC plug and the Ethernet cable that runs to the EUM3006. If a Lightning Arrestor is used, the PoE Injector must be located on the protected side of the lightning arrestor.

Plug the Ethernet cable to the modem into the port marked “J1 DATA & PWR.”



Figure 7 PoE Injector - Data & PWR and Data Ports

Alternatives to the PoE Injector provided can be used, such as PoE enabled routers or switches. If these provide 48 VDC 802.3af Mode B PoE power, then the EUM3006 can be connected directly to them.



CAUTION: Failure to use an acceptable PoE power supply may damage the EUM3006 and void the warranty.

4.3.5 Connecting the End-User's PC

There are many ways to connect the EUM3006 to the end-user's PC, using Ethernet switches, IP routers, etc. The discussion below is for the simplest, most direct method of connection, using the provided PoE Injector.

1. Connect the end-user's PC by attaching a crossover Ethernet cable (not provided) between the Ethernet port on the end-user's computer and the DATA only port on the PoE Injector (marked "J2 DATA" in [Figure 7](#)).



CAUTION: Connecting the End-User PC to the "J1 DATA & PWR" port on the PoE Injector will provide a DC voltage that could damage the end-user's Ethernet interface. Ensure that the end-user's equipment is connected to the DATA only port (marked "J2 DATA" in [Figure 7](#)) of the PoE Injector and the EUM3006 or its extension Ethernet cable is connected to the DATA & PWR port (marked "J1 DATA & PWR") in [Figure 7](#)).

2. Plug the PoE Injector into an AC socket.
3. Check the Ethernet LEDs on the Ethernet interface of the end-user's PC to ensure the Ethernet connection between the EUM3006 and the end-user's PC is active. Refer to [Table 5](#) for an explanation of the Ethernet LEDs normally provided on Ethernet interface cards.

Table 5 Ethernet Interface Card LED Status Displays

Ethernet LED	Status
Ethernet Link LED	This LED is lit when there is a correct connection to the computer, and both ends are powered ON.
Ethernet Traffic LED	Flashes when data passes through the Ethernet connection in either direction.

4. When attempting to send data to, or receive data from, the Internet, check the Ethernet Traffic LED to ensure data transmission is taking place. This LED flashes as data traffic passes between the end-user's PC and the EUM3006.

4.3.6 Testing the Data Link

The following are simple tests that the installer or end-user can perform to ensure that the link is functioning correctly. These tests are outlined below. If any test fails, then the subsequent tests are likely to fail as well until the problem is resolved.

1. **Ping the EUM:** Configure the end-user's PC to have the local link IP address and ping the EUM3006 at IP address "169.254.10.250" (see [Ping the EUM](#) on page 33 for more details if needed).
2. **Assess the Link:** Use the Setup Menu as described in [Setup Menu](#) on page 15 to assess the Radio Link Status and to get the Troubleshooting information to baseline the installation. This test verifies that the end-user's PC is communicating with the EUM3006 and provides insight into the state of the RF link. This test is recommended even if the modem was aligned using the MDB1000, since it provides more details on the state of the modem and what CCU(s) it has located.
3. **Verify DHCP:** If the network assigns end-user PC's IP addresses by DHCP, then reconfigure the end-user PC to use DHCP to automatically obtain its IP address. Verify the end-user PC has received an IP address, by using the DOS command "ipconfig" and seeing that an IP address is assigned along with Gateway and DNS server addresses. This confirms that the End user PC is contacting the DHCP server correctly. See [Verify DHCP](#) on page 34 if more details are required.
4. **Ping the Gateway:** Assuming the end-user PC has an IP address and a Gateway address as shown by the "ipconfig" command, ping the gateway to determine if it can be reached. See [Ping the Gateway](#) on page 34 if more details are required.
5. **Ping Internet by IP address:** If everything is good so far, try pinging a known Internet address. If successful, then you know that the end-user PC can access the general Internet. See [Ping Internet by IP address](#) on page 35 if more details are required.
6. **Ping Internet by Name:** Ping a known named Internet address (e.g. "ping www.google.com" or some equivalent). Even if the site refuses ping commands, you should get the IP address for the named site. If so, this shows that DNS is working correctly. See [Ping Internet by Name](#) on page 36 if more details are required.
7. **Link Speed Test:** Go to a known web-site that offers link speed testing, such as "http://bandwidthplace.com/speedtest/". Follow their instructions and determine the link speed. There are many factors affecting the link speed between the end-user's PC and the test site, including the assigned grade-of-service for the modem, the loading on the CCU sector and the loading over the rest of the Internet. So this test is not the best test for ensuring that the modem to CCU link is operating at its correct speed. But it should indicate that the PC is able to communicate with a site on the Internet.

If any of these tests fail, then the installer may need to check the modem, its alignment, the cabling, the PC's configuration and the RF link. If all of these appear good, then the installer should contact the Network Operator for further troubleshooting advice.

Even if all the above tests indicate a good link, WaveRider recommends that the Network Operator remotely test the EUM-to-CCU data link more thoroughly soon after it is installed. The test facilities available to the Network Operator are outlined in the *LMS4000 Managing the Network* manual and other manuals on the WaveRider web-site.

The following sections provide more detail for some of the steps for Testing the Data Link.

Ping the EUM

Note that the EUM3006 may be on a different sub-net than the end-user's PC, so pinging the IP address assigned to the EUM3006 will go through the CCU. Therefore, we ping the EUM3006 using the local link IP address as the 1st test.

1. Ensure the end-user's PC is configured with an IP address of 169.254.10.251, netmask = 16 (or 255.255.0.0). See [Setup Menu](#) on page 15 for more information.
2. Ping the EUM's local-link IP address 169.254.10.250, from the end-user's PC, as follows:
 - Open a DOS window in the end-user's PC.
 - At the command prompt, type `ping 169.254.10.250` and press **Enter**.
3. If there is no response, check the following:
 - The end-user's computer IP address settings.
 - The Ethernet link light on the PC.
 - The Ethernet crossover cable between the PoE Injector and the end-user's PC, to ensure that the pins have not been damaged.
 - The PoE Injector's POWER LED should be on.
 - The Ethernet cables are plugged into the correct ports of the PoE Injector.
 - If you have an MDB1000, cycle the power at the PoE Injector to reboot the EUM3006 and verify that the EUM3006 is communicating with the MDB1000. Note that the MDB1000 needs to be near the EUM3006. Also, if the EUM3006 has been on for more than 1 hour, it will have stopped sending the magnetic signal to the MDB1000, hence the reason for cycling the power on the modem.
4. If there is a response, but with errors, check the Ethernet crossover cable.

This is what a successful ping from the end-user's PC to the EUM looks like:

```
C:\>ping 169.254.10.250

Pinging 169.254.10.250 with 32 bytes of data:

Reply from 169.254.10.250: bytes=32 time<10ms TTL=64
Reply from 169.254.10.250: bytes=32 time<10ms TTL=64
Reply from 169.254.10.250: bytes=32 time<10ms TTL=64
Reply from 169.254.10.250: bytes=32 time<10ms TTL=64

Ping statistics for 169.254.10.250:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

This is what an unsuccessful ping from the end-user's PC to the EUM looks like:

```
C:\>ping 169.254.10.250

Pinging 169.254.10.250 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 169.254.10.250:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Verify DHCP

This step is for networks that use DHCP to provide IP addresses to the end-user's computer. Assuming the Setup command shows that the modem has registered with a CCU and is receiving a signal, then reconfigure the end-user PC to use the correct IP address. This is usually done using DHCP to automatically obtain the IP address.

On Windows 2000, XP and similar systems, the IP Address is set using the Control Panel > Network and Dialup Connection > Local Area Connections > right mouse click to select Properties > Internet Protocol (TCP/IP) > Properties. To enable DHCP, click on the "Obtain an IP Address Automatically" button.

Once properly configured, verify the end-user has received an IP address. For a Windows 2000 or XP PC, in a DOS Window, type "ipconfig" and see that there is an IP address assigned along with a Gateway Address and DNS server addresses. This confirms that the End user PC is contacting the DHCP server correctly. Record the IP Address of the gateway and the DNS servers.

Ping the Gateway

Ensure the end-user's PC is configured properly. Then ping the EUM gateway address from a PC DOS window. The gateway address was recorded during the Verify DHCP address is using DHCP. Otherwise the installer will know the gateway address since it is needed to configure the end-user's PC.

Ping using short packets first (default size) to confirm the connection. Then use long packets (1472 byte packets) to confirm the RF performance. Errors observed on pings with long packets indicate a high error rate on the channel, caused by low signal levels or interference.

The following describes how to ping the gateway:

1. Open a DOS window.
2. At the command prompt, type `ping <aaa.bbb.ccc.ddd> -t -l 1472`, where <aaa.bbb.ccc.ddd> is the Gateway radio IP address and press **Enter**.
3. Press **Ctrl+c** to end the test.

NOTE: If this test fails with the long packets, but pinging the Gateway with the default packet size succeeds, then the connection is working but is not operating at maximum capacity, possibly due to poor antenna placement or orientation, poor signal levels, and/or interference.

The following example assumes the Gateway has an IP address of 172.16.4.1. Replace that address with the correct gateway address from the 'ipconfig' command:

```
C:\>ping 172.16.4.1 -t -l 1472

Pinging 172.16.4.1 with 1472 bytes of data:

Reply from 172.16.4.1: bytes=1472 time=40ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=81ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=80ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=40ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=60ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=80ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=40ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=110ms TTL=64

Ping statistics for 172.16.4.1:
    Packets: Sent = 8, Received = 8, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 40ms, Maximum = 110ms, Average = 66ms
Ctrl-C
^C
C:\>
```

Ping Internet by IP address

Use the following test to determine whether the end-user's PC can communicate with the Internet. If you do not know an IP address, try the DNS servers. Otherwise, skip this step.

```
C:\>ping 216.239.39.104

Pinging 216.239.39.104 with 32 bytes of data:

Reply from 216.239.39.104: bytes=32 time=90ms TTL=113
Reply from 216.239.39.104: bytes=32 time=80ms TTL=113
Reply from 216.239.39.104: bytes=32 time=80ms TTL=113
Reply from 216.239.39.104: bytes=32 time=70ms TTL=113

Ping statistics for 216.239.39.104:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 70ms, Maximum = 90ms, Average = 80ms
```

Ping Internet by Name

Use the following test to verify that the DNS server IP address is correctly configured in the end-user's PC and is operating properly:

```
C:\> ping www.google.com

Pinging www.google.akadns.net [216.239.39.104] with 32 bytes of data:

Reply from 216.239.39.104: bytes=32 time=72ms TTL=241
Reply from 216.239.39.104: bytes=32 time=69ms TTL=241
Reply from 216.239.39.104: bytes=32 time=76ms TTL=241
Reply from 216.239.39.104: bytes=32 time=68ms TTL=241

Ping statistics for 216.239.39.104:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 68ms, Maximum = 76ms, Average = 71ms
```

4.4 Post-Installation

Once a good link between the CCU and the EUM3006 has been established, the configuration can be completed automatically using the Automatic Remote Configuration feature with a RADIUS Server and database in which the EUM3006 information has been entered. The network operator must update the RADIUS database for the new modem. The configurable items that can be included in the Automatic Remote Configuration include:

- password,
- all SNMP parameters,
- RF Frequency (including enabling Auto CCU Discovery)
- number of customers.

If the Automatic Remote Configuration feature is not used, then the network operator can connect to the EUM3006 over the air and complete the configuration.

Details on configuring a RADIUS Server or manually configuring an individual EUMs are covered in the *LMS4000 Managing the Network* manual or other manuals, available on the WaveRider web-site.

Appendix A Factory Configuration

This appendix identifies the factory configuration settings for the EUM3006 Integrated Outdoor Modem

Parameter	Default Configuration
Modem IP Address	From DHCP
Modem IP Netmask	From DHCP
Gateway IP Address	From DHCP
Local Link IP Address (Available on Ethernet Port only)	169.254.10.250
Local Link IP Netmask	16 255.255.0.0 ffff0000
Maximum Number of Customers*	5
Password*	By default, the EUM3006 has no password. Press Enter at the password prompt to enter a null password.
Port Filters	137 (both) 138 (both) 139 (both) 445 (both) 1512 (both)
Radio	Enabled
Radio Frequency*	Auto CCU Discovery

Parameter	Default Configuration
Radio Power	+26 dBm (High) - This is the power at the internal antenna connector, which provides +36 dBm EIRP from the 10 dBi integrated antenna. (NOTE: For configuring the modem, the power values entered are rounded to the nearest dB)
SNMP Name* (= Console Prompt)	EUMID
SNMP Contact*	WaveRider Communications Ltd.
SNMP Location*	www.waverider.com
SNMP Read Communities*	None entered
SNMP Write Communities*	None entered
SNMP Traps*	None entered
Statistics Log Interval	15 minutes

* These parameters can be set using Automatic Remote Configuration if the network is configured to use a RADIUS Server.

Appendix B Ethernet Cables and Connectors

There will be several Ethernet cables used in installing the EUM3006:

- **EUM3006 Cable:** The 25 feet Ethernet cable that is attached to the EUM3006, which is plugged into the DATA & PWR port of the PoE Injector.
- **Cross-over Cable:** The Ethernet cable from the DATA port of the PoE Injector to the end-user's PC must be a cross-over cable. A cross over cable has one end wired according to T568A and the other end according to T568B. Both ends have RJ45 connectors.
- **Straight-Through Cable:** Straight-through Ethernet cables have both ends wired according to T568A with RJ45 connectors. Straight-through cables can be used in a number of locations:
 - If a PoE lightning arrestor is used in the installation, then the cable between the lightning arrestor and PoE injector must be straight-through.
 - If the 25 foot cable with the EUM3006 is not long enough, another straight-through Ethernet cable can be used to provide extended distances.
 - If the EUM3006 is to be connected to a router or Ethernet Switch that do not provide PoE, then a straight-through Ethernet cable is used to connect the router or switch to the PoE injector.
 - If a router or Ethernet switch are used, then they are connected to the end-user's PC by a straight-through Ethernet cable.

The Ethernet cables used between the PoE Injector and the EUM3006 must have all 4 pairs wired as shown in [Table 6](#).

Table 6 Ethernet Interface Specifications

EUM Physical Interface	25 foot CAT-5e (Ethernet) cable with RJ45 connector
Power over Ethernet	802.3af Compliant Mode B PoE at 48 VDC
Wiring standard	TIA - T568A
Pin - Pair/Wire - Color Pin 1 - 3/a - Green/White Pin 2 - 3/b - Solid Green Pin 3 - 2/a - Orange/White Pin 4 - 1/b - Solid Blue Pin 5 - 1/a - Blue/White Pin 6 - 2/b - Solid Orange Pin 7 - 4/a - Brown/White Pin 8 - 4/b - Solid Brown	TX Data + (Output from EUM) TX Data - (Output from EUM) RX Data + (Input to EUM) DC Power A - PoE compliant* DC Power A - PoE compliant* RX Data - (Input to EUM) DC Power B - PoE compliant* DC Power B - PoE compliant*

* The voltage differential between DC Power A and DC Power B must be 48 VDC +/- 10% at the PoE Injector end. Neither should be tied to ground. Typically DC Power A is + 48 VDC and DC Power B is ~0 VDC, but not tied to ground.

The following table and figures show the definitions of wiring for T568A and T568B connectors, used to make cross-over and straight-through Ethernet cables as found in ANSI/TIA/EIA-568-B.2 "Balanced Twisted Pair Cabling Components".

Table 7 Wiring T568A and T568B ends for Ethernet Cables

#	Description	T568A	T568B
1	Connectors	RJ-45	RJ-45
2	Wiring standard	T568A	T568B
3	Pair/Wire - Color 3/a – Green/White 3/b – Solid Green 2/a - Orange/White 1/b – Solid Blue 1/a – Blue/White 2/b – Solid Orange 4/a – Brown/White 4/b – Solid Brown	Pin 1 Pin 2 Pin 3 Pin 4 Pin 5 Pin 6 Pin 7 Pin 8	(Pins in bold are different from T568A) Pin 3 Pin 6 Pin 1 Pin 4 Pin 5 Pin 2 Pin 7 Pin 8

Straight-through Ethernet cables have T568A wiring at both ends while Cross-over cables have T568A at one end and T568B at the other end.

T568A Wiring Scheme

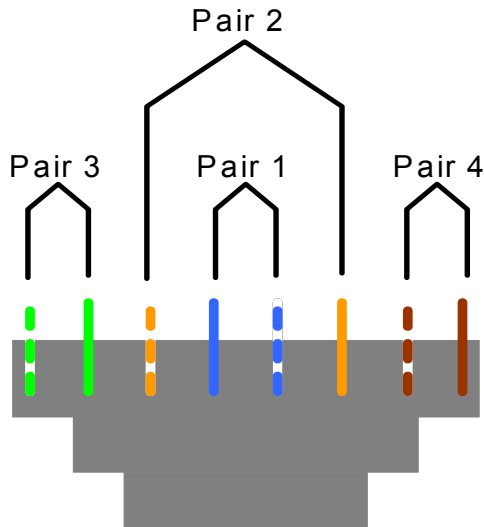


Figure 8 T568A Wiring

T568B Wiring Scheme

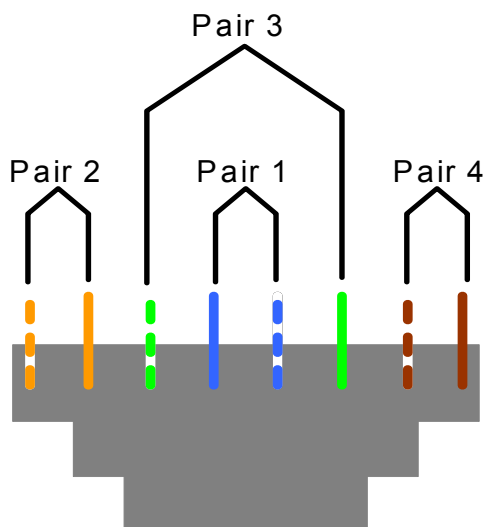


Figure 9 T568B Wiring

Appendix C Acronyms and Abbreviations

Table 8 Acronyms and Abbreviations

Acronym or Abbreviation	Definition
1OK	1st packet sent okay
2OK	2nd packet sent okay (i.e. 1 retry)
3OK	3rd packet sent okay (i.e. 2 retries)
4OK	4th packet sent okay (i.e. 3 retries)
AC	Alternating Current
ANSI	American National Standards Institute
AWG	American Wire Gauge/Gage
BATT	Battery
CAP	Communications Access Point
CCU	CAP Channel Unit
CLI	Command Line Interface
Ctrl+c	Control C - 'Ctrl' key pressed at same time as lower case 'c' key.
dB	decibel
dBi	decibel—with respect to an isotropic radiator
dBm	decibel—with respect to milliwatts
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
DOS	Disk Operating System
EIA	Electronics Industry Association
EIRP	Effective Isotropic Radiated Power

Acronym or Abbreviation	Definition
ETH	Ethernet
EUM	End-user Modem
F	Failed (as in packets that failed to be transmitted)
FCC	Federal Communications Commission (U.S.A.)
FCS	Frame Check Sequence
FOM	Figure Of Merit
HCRC	Header Cyclical Redundancy Check
HW	Hardware
IC	Industry Canada
ID	Identifier, Identification
IP	Internet Protocol
LED	Light-Emitting Diode
LMS	Last Mile Solution®
m	meters
MAC	Media Access Controller
MDB	Magnetic Decoder Box
MHz	Megahertz
ms	milliseconds
NEC	National Electrical Code (US)
PC	Personal Computer
PDA	Personal Digital Assistant
PoE	Power over Ethernet
PWR	Power
R1	Retry 1 time
R2	Retry 2 times
R3	Retry 3 times
RADIUS	Remote Authentication Dial-In User Server/Service
RF	Radio Frequency
RMA	Return Merchandise Authorization
RNA	Received Noise on Antenna A
RNB	Received Noise on Antenna B
RSSI	Received Signal Strength Indicator
RX	Receive
SNMP	Simple Network Management Protocol

Acronym or Abbreviation	Definition
SQ	Signal Quality
TCP	Transmission Control Protocol
TIA	Telecommunications Industry Association
TTL	Time To Live
TX	Transmit
UL	Underwriters Laboratory
VDC	Volts Direct Current

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