LibraPlus 5860 User Guide

Version: 1.0.13
Released: February 16, 2010

This guide is intended for the following products;
9140-2820 LibraPlus 5860-28 RD
9140-2821 LibraPlus 5860-28 ER

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3 Preface

3.1 Regulatory Notice

The specifications and parameters of the device described in this document are subject to change without notice.

The LibraPlus 5860 product presented in this guide complies with the following regulations and/or regulatory bodies:

- IC RSS-210 ISS-03 of Industry Canada
- IC: 8367A-5845001
- IC: 6545A-XR5 Modular Approval
- FCC Part 15.247, subpart C, 15.203, 15.207 (2007), 15.109, 15.407
- ETSI EN 301 489-1, EN 301 893, EN 301 489-17 (EMC Wideband data and HIPERLAN)
- ETSI EN 50385-2002, EN 55022, EN 61000
- Safety: UL 60950 equivalent EN60950 (EU); Modular approvals (electrical)

Operation is subject to the following two conditions:

1. This device may not cause interference
2. This device must accept any interference, including interference that may cause undesired operation of the device

For Canadian regulatory information, go to www.ic.gc.ca. For American regulatory information, see www.fcc.gov. For European regulatory information, see www.etsi.org.

This equipment generates, uses and radiates energy on radio frequencies and, if not installed and used in accordance with this guide, 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 correct the interference by one or more of the following methods:

- reorient or relocate the receiving antenna
- move the equipment and receiver farther apart
- connect equipment to an outlet on a circuit different from that to which the receiver is connected

Changes or modifications to the equipment not expressly approved by EION, Inc., could void the user's authority to operate the equipment.

Appropriately shielded remote I/O serial cable with the metal connector shell and cable shield properly connected to chassis ground shall be used to reduce the radio frequency interference.

All antenna installation work shall be carried out by a knowledgeable and professional installer.

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.

3.2 Warranty and Repair

The standard warranty for the LibraPlus 5860 is one year from the date of purchase.

> **EION provides no direct warranty to the end-users of this product. Please contact the party from whom you purchased the LibraPlus 5860 system for warranty and repair information.**

3.3 Customer Support Contacts

Users of EION equipment who require technical assistance must contact their reseller or distributor. For information on distributors in your area, please visit www.eionwireless.com.

3.3.1 Distributor Technical Support

Distributors may contact EION's Technical Support on EION's products.

When requesting support, please have the following information available:

- configuration of the system, including models of EION equipment, versions, serial numbers, and MAC address
- antenna type and cable lengths
- site information, including possible RF path problems, such as trees, buildings and other RF equipment in the area
- distance of the RF link
- configuration of unit.
- description of the problem

3.3.2 Contacting EION Technical Support

By Telephone	Call: 1-613-271-4400, Hours of operation are 9:00 AM to 5:00 PM (EST)
By e-mail	Send an email message to: techsupport@eion.com
RMA Information	Send an email message to: rma@eion.com

4 Product Description

4.1 LibraPlus Series Products

The information in this guide applies to EION LibraPlus 5860 series products. This chapter presents an overview of the features and different models in the LibraPlus Series product family. EION Wireless products couple additional hardware design, and proprietary firmware, to provide performance that far exceeds that offered by WiFi, while still fully compliant with license free standards around the world.

4.1.1 About OFDM

The LibraPlus system uses Orthogonal Frequency Division Multiplexing (OFDM) technology to process, transmit and receive data in parallel fashion over the air. OFDM divides a wide RF frequency band into several subchannels that work together to deliver data, similar to splitting a road into several lanes that together can handle more traffic than a single lane.

OFDM offers many advantages, including effective use of bandwidth, resistance to interference, ability to take advantage of multi-path characteristics, and advanced error correction and recovery. Because data is spread across all the channels, interference usually affects only a few channels rather than all channels, and lost data can be easily recovered. Since OFDM is insensitive to interference, the amount of ongoing tuning, adjustment and maintenance is minimized. Both multipoint networks and point-to-point backbone systems are supported.

The following diagram illustrates the main concept behind OFDM. The available frequency spectrum is divided into subchannels. Each subchannel is orthogonal, meaning that the peak signal strength of each signal occurs at the null or point of minimum signal strength of its neighbor, so adjacent subchannels do not interfere with each other. Data is carried in parallel across the subchannels.

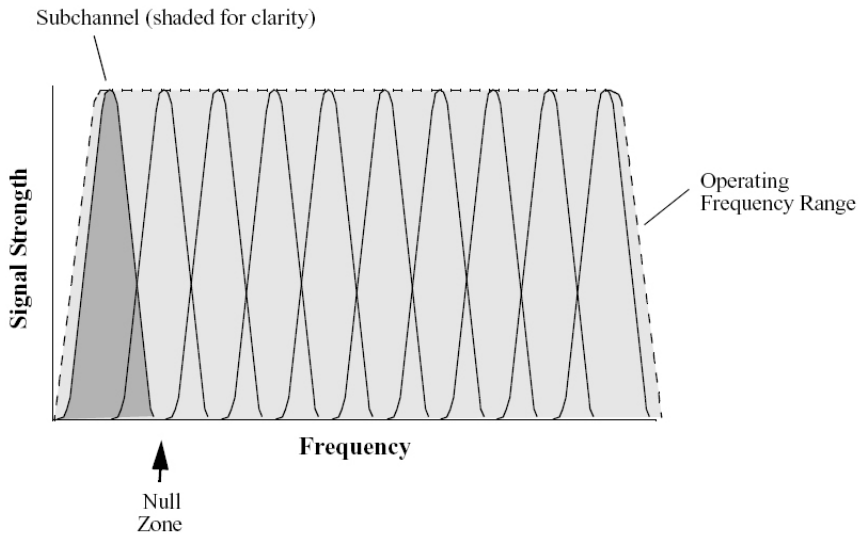


Figure 4:1 Orthogonal Arrangement of OFDM Subchannels

4.2 LibraPlus Point-to-Point (P-P) Systems

For P-P systems LibraPlus comes in two versions, the Rapid Deployment (RD) and the Extended Range (ER) units. P-P links are used when only two locations are connected, for example for backhaul purposes between P-MP Base Stations and the Network Operating Center for connection to the Internet backbone, or in situations where throughput requirements between two locations are such that the bandwidth can't be shared.

4.2.1 EPPS Technology

The LibraPlus 5860 is engineered with EION's proprietary EPPS (EION, Protocol, Protection, Speed) technology for an ultra-secure connection that optimizes the maximum amount of bandwidth available for point-to-point applications. EPPS technology was developed using the latest in encryption and security methods to prevent malicious or non registered users from eavesdropping or intercepting signals.

To provide extra security and high quality link performance, EPPS devices contain the following enhancements:

1. When using WPA2, EPPS will initiate a periodic key exchange for added security against intrusion.

2. With EPPS, the encryption and authentication algorithms are implemented in the hardware layer of the LibraPlus 5860, so that radio performance (speed) is not impacted by the authentication process.

4.2.2 LibraPlus Rapid Deployment (RD) Equipment

The RD equipment is intended for very rapid installation of a P-P link and can be used for links of up to 25 km (up to 3 km at full 60 Mbps actual bandwidth). RD Equipment has two parts: 1) RD and 2) Ethernet Power Inserter with CAT-5 cable (bought separately) and weatherproofing kit (included).

- **LibraPlus RD:** The RD is the main piece of equipment that is normally installed outdoors (indoor installation is permitted when the range and link budget allows it). The RD contains all of the necessary radio equipment to provide a high-speed wireless link. The RD also has an integral 23 dBi antenna such that no RF cables are required for a typical installation.
- **Ethernet Power Inserter:** This piece of equipment is a small box that connects between the RD and the Ethernet network. This box also provides power for the RD equipment to run. A CAT-5 outdoor cable is used to connect the Power inserter to the RD. The weatherproofing kit is used with standard RJ-45 connector to ensure reliable connection for outdoor systems.

4.2.3 LibraPlus Extended Range (ER) Equipment

The ER Equipment allows for the use of different external antennas to achieve links of much longer range (up to 50 km). It can also be used for indoor installation of the units should severe weather conditions require it. The antenna is then mounted outdoors and connected via appropriate RF cables to the unit.

The LibraPlus ER consists of three parts: 1) ER, 2) Ethernet Power Inserter with CAT-5 cable (bought separately) and weatherproofing kit (included), and 3) the External Antenna and cable (both bought separately).

- **LibraPlus ER:** The ER is the main piece of equipment. It is designed for

outdoor installation but can also be installed indoors if needed. The ER is equipped with an N-type connector so that the external antenna can be connected to it. Thus the range of the P-P system can be significantly increased by use of higher gain antennas. Also, in situations where very severe conditions may be encountered outdoors the ER can be installed indoors with cabling to the antenna outside.

- **Ethernet Power Inserter:** This piece of equipment is a small box that connects between the ER and the Ethernet network. This box also provides power for the ER equipment to run. A CAT-5 outdoor cable is used to connect the Power inserter to the ER. The weatherproofing kit is used with standard RJ-45 connector to ensure reliable connection for outdoor systems.
- **Antenna and Cable:** In order to accommodate different range requirements for P-P links, the ER is designed to be used with an external antenna. Antennas and cables are selected by the user based on the network requirements.

4.3 LibraPlus Hardware

This section describes the LibraPlus hardware. Although antennas are part of the equipment in general, antennas are not discussed here. The LibraPlus product has one connector Power/Ethernet Port on the back panel common for all types of LibraPlus equipment. The AP, ER and LCPE units also have a female N-Type connector on the front panel for connection to the antenna.

Figure 4:2 LibraPlus RD Rear Connection Panel,

Power/Ethernet Port: Standard RJ 45 Ethernet Connector. A weatherproofing kit is provided with the unit, so that standard outdoor CAT-5 cable can be used.

Serial Port: 5-pin female connector. This port is for factory configuration only.

Figure 4:3 CAT-5 Weatherproofing Kit

Figure 4:4 Snap-on Cable Bead (x2)

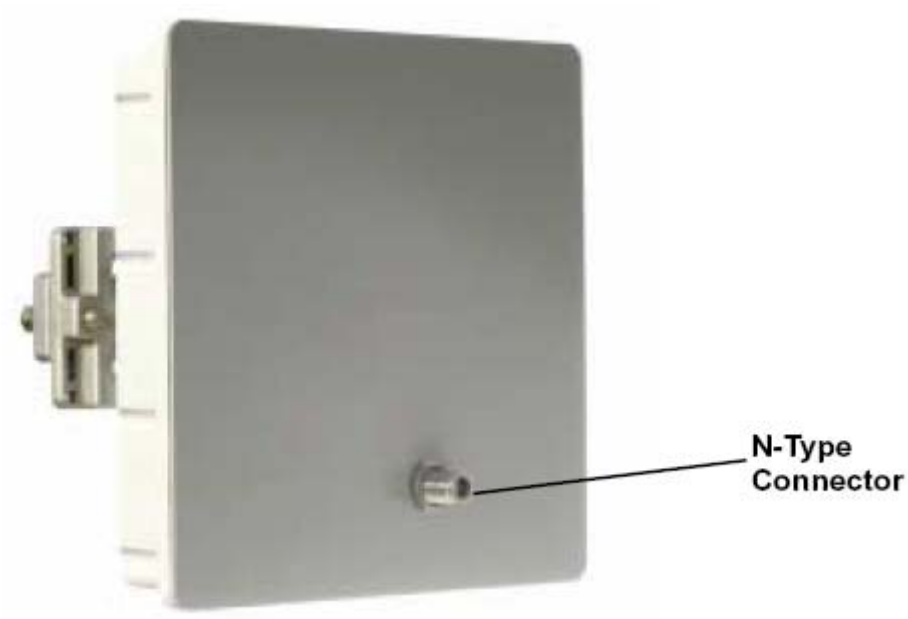


Figure 4:5 LibraPlus AP, ER and LCPE Front Panel RF Connector

Figure 4:6 Ethernet Power Inserter

> ⚠ **WARNING: Before connecting the LibraPlus to a power source, ensure that you are using the correct power supply for your radio.**

4.4 QoS - Quality of Service

In the LibraPlus 5860, Quality of Service (QoS) is achieved through the provisioning of the WMM (Wireless MultiMedia Extensions). WMM prioritizes traffic according to four Access Categories (AC) - voice, video, best effort, and background. WMM creates QoS for traffic priority management to time-sensitive applications such as voice, video and multimedia traffic. A WMM based QoS scheme can be further enhanced through the use of VLAN customer separation.

4.5 VLAN

4.5.1 Overview

By using VLAN, one can logically group networks. Virtual LANs are essentially Layer 2 constructs, whereas IP subnets are Layer 3 constructs. VLANs are created to provide the segmentation services traditionally provided by routers in LAN configurations.

Each VLAN is a logical network, and packets destined for stations that do not belong to the same VLAN must be forwarded through a routing device like the LibraPlus.

The protocol used in configuring virtual LANs is IEEE 802.1Q. IEEE 802.1Q adds explicit tagging to ethernet frames. The IEEE 802.1Q header contains a 4-byte tag header containing a 2-byte tag protocol identifier (TPID) and a 2-byte tag control information (TCI). The TPID has a fixed value of 0x8100 that indicates that the frame carries the 802.1Q/802.1p tag information. The TCI contains the following elements:

- Three-bit user priority
- One-bit canonical format indicator (CFI)
- Twelve-bit VLAN identifier (VID) – Uniquely identifies the VLAN to which the frame belongs

LibraPlus VLAN interfaces always transmit and receive tagged frames. Virtual LANs operate at Layer 2 (the data link layer) of the OSI model. Each VLAN maps directly to

an IP network, or subnet, which gives the appearance of involving Layer 3 (the network layer).

4.5.2 Point-to-Point VLAN System

For Point-to-Point applications VLAN subinterfaces are not required, the bridge is completely transparent to VLAN tags.

4.6 LibraPlus 5860 Specifications

Radio Specifications		
Topology	RD, ER: Point-to-Point	
Frequency	5.150 to 5.320 GHz; 5.500 to 5.700 GHz; 5.745 to 5.825 GHz	
Channel Size	Normal: 20 MHz; Turbo: 40 MHz	
Channel Spacing	Normal: 10 MHz; Turbo: 40 MHz	
Modulation	OFDM: BPSK, QPSK, 16QAM, 64QAM	
Antenna Gain	23 dBi (RD only)	
RF Connector	N-type female (ER only)	
Effective Bidirectional Point-to-Point Throughput	Normal: up to 31 Mbps (20 MHz Channel) Turbo: up to 60 Mbps (40 MHz Channel)	
Output Power	+28 dBm Maximum (configurable in GUI)*	
Duplexing Format	Half-Duplex	
Network Support		
Medium Access Control	EPPS, Proprietary MAC	
Network Connection	10/100 Base T Auto-Negotiate	
Operational Mode	Transparent Bridging	
WMM QoS	Yes, Voice and Video priority	
Fast Frame Aggregation	Yes	
MAC Filtering	Yes	
VLAN 802.1q Transparency	Yes	
Firewall/NAT	Yes	
VLAN Management	Yes	
Wireless Networking		
Output Power Management	Yes, Manual or Automatic Transmit Power Control (ATPC), 802.11h	
Data Rate Selection	Manual or Dynamic	
Dynamic Frequency Selection (DFS)	Yes	
Security		
Radio Access	Username and Password	
Data Scrambling	WPA1, WPA2, WEP (64,128)	
Management		
Remote Management	GUI, SNMPv1/v2	
Management Access	Wireless & Wire	
Software Upgrade	Over the Air, local	
Physical, Electrical & Environmental		
Mounting Bracket	Yes, 2-Axis pole/wall	
Power Consumption	10 W	
Input Voltage	100/240V, 50/60 Hz AC	
Environmental Operating Temperature	-35° C to +65° C	
Relative Humidity	0 to 100%, condensing	
Certifications	Enclosure: NEMA 4x; Designed to IP66 Environmental: RoHS and WEEE IC: RSS-210, ISS-03, 8367A-5845001 FCC Part 15.247, subpart C, 15.203, 15.207 (2007), 15.109, 15.407 ETSI EN 301 489-1, EN 301 893, EN 301 489-17 (EMC Wideband data and HIPERLAN), EN 50385-2002, EN 55022, EN 61000 Safety: UL 60950 equivalent EN60950 (EU); Modular approvals (electrical)	
Lightning Protection	Integrated, Telcordia GR-1089 compliant (Meets IEC 61000-4-2/ 4-4)	
	ER	**RD**
Form-Factor	Outdoor, rugged	Outdoor, antenna integrated
Enclosure	Die-cast with metal cover	Die-cast with antenna housing
Dimensions	230 (w) x 65 (d) x 230 (h) mm	300 (w) x 90 (d) x 300 (h) mm
Weight	2.0 kg	2.3 kg

* Output power varies based on modulation, channel size and power setting

5 Pre-installation

5.1 Introduction

Before you begin installing your LibraPlus radios, you need to take certain issues and conditions into consideration, prior to, and throughout, the entire installation process. This chapter defines some of the more common installation concerns.

Start by reviewing the equipment packing lists to ensure that you have all the cables, connectors, surge protection devices, fasteners, antennas, and any other installation material you will require to properly install your equipment. You should also visually check all components for any physical damage.

If possible, you should connect all necessary cables and power up the radio equipment to confirm that it has not been damaged during shipping. You can also perform the units' initial configuration before they are sent out to the field. This will ensure your equipment and all interconnecting cables are functioning properly.

- **EION provides this document as a general set of guidelines for installing its LibraPlus equipment. In no way does EION provide any warranties as to the effectiveness of these guidelines.**
- **Implementation of these guidelines is solely at your discretion. You must ensure that the equipment is installed and grounded in accordance with the local electrical and building codes and the codes of the country of operation.**
- **The LibraPlus equipment must be installed by a certified professional communication installer, familiar with all necessary local regulations.**

5.2 Required Tools

Before you go on-site or out into the field to install your equipment, make certain you have all the necessary tools to perform the installation properly. The following list of tools is a general guideline of the tools you may need. Some installations may require more specialized tools, while others may only need a few of the tools listed here. Each specific installation will dictate your tool requirements.

Basic Hand Tools

- socket set
- crescent wrench
- cable cutters
- pliers
- a variety of screwdriver types and sizes

Power Tools

- electric drill
- drill bits of assorted sizes and lengths

- hole saw

Specialized Tools

- Crimp tools for:
- Ethernet connectors
- RF connectors
- power and grounding compression lugs
- Laptop or PDA

Test Equipment

- spectrum analyzer to check for interference
- site master to check the antennas for proper VSWR

Consumables

- butyl rubber tape or pads
- anti-oxidizing paste
- low temperature tape

Miscellaneous

- ladders
- compass
- GPS
- binoculars

Cables

- DB9 serial cable (male to female) for the base station
- EION proprietary serial cable for the subscriber station
- Ethernet crossover cable

5.3 Site Evaluation

Before you begin the actual installation of your LibraPlus equipment, you need to make certain that your equipment site is acceptable and has been properly prepared.

5.3.1 LibraPlus 5860 Site Considerations

When making your decisions about the mounting location, you need to consider issues such as its proximity to the power inserter, cable lengths between the LibraPlus radio and the power inserter, and so on.

You should first inspect the site to verify that the antenna mounting structure is suitable for both the antenna and LibraPlus radio. The LibraPlus 5860 needs to be positioned in a location that allows for easy maintenance access. You also must review routes that the cables will follow, when connecting the power inserter to the LibraPlus 5860.

You should review the proposed cabling entrance/exit points for the site's building; they must be practical. You must be able to easily drill the holes for cable access and the cables should be in a location that allows for easy maintenance.

The LibraPlus has a single shielded CAT5/5e cable to connect the LibraPlus 5860 to the power inserter. It is important not to exceed the maximum allowed length of 100 meters for this cable. This Ethernet cable provides power to the AP.

5.3.2 LibraPlus 5860 Power Sources

If your equipment uses AC power, make certain that the power is provided from a separate, isolated circuit and that you are using a surge protected power source or a dedicated Uninterruptible Power Supply (UPS). This will aid in protecting your equipment against power surges, spikes and/or possible lightning damage. Providing clean, filtered power will also minimize the possibility of system performance degradation due to RF interference.

5.4 Grounding

Grounding your equipment properly is one of the most important operations you will perform during installation. Equipment grounding is required for both safety and effective operation of the installed lightning protection devices.

- **You must ensure that your system is grounded in accordance with your local electrical codes and safety laws. EION does not provide any warranties as to the effectiveness of the grounding concepts and processes described here, they are for your reference only.**
- **EION is not liable for any damage to your equipment or any injuries to you resulting from improper grounding.**

5.4.1 ESD Warning

Before you begin to install your LibraPlus and its components, you should ensure that your equipment will be protected against electrostatic discharge (ESD). This section lists some guidelines that you should take into account during installation.

- Proper grounding is extremely important. Make certain that you ground yourself before you begin working with your equipment. Also try to ensure that your workspace is static-free and make use of an anti-static wrist or leg straps. If you do not have access to static protection, ground yourself to your environment by first touching your finger to a metal surface before touching your equipment.
- All electrical components should be moved or stored in an anti-static bag. Before you remove a component from its anti-static bag, you should first hold the bag in one hand while touching a metal surface with the other hand, then perform the same action with the component.
- Handle electronic components as little as possible and when you do handle them, hold all parts by their edge.
- Never slide static-sensitive equipment across any type of surface. Friction can cause static build-up.

- Keep any non-conductive material, such as Styrofoam and other plastics, away from your work area

5.4.2 LibraPlus Unit Grounding

When you are installing your outdoor units, you need to follow proper grounding practices. The proper grounding of outdoor units helps to minimize lightning damage and dissipate static buildup. In general, grounding is accomplished by installing a single heavy gauge wire, such as a 6 gauge, copper cable, between the outdoor unit's grounding lug and the mounting structure's grounding point.

The following section sets out some grounding guidelines for you to follow during installation.

- It is very important that the grounding system for your outdoor equipment be installed by a fully qualified, professional installer, and that proper safety practices are followed in accordance with your local electrical code.
- Locate your grounding point as close to the outdoor unit as possible. It must be below the unit and must not be inside a building.
- The grounding point can be located on an unpainted section of a metal tower, as section of a building's metal structure or a ground riser per your applicable local electrical code.
- When you run the ground cable to the grounding point, make certain that it follows a direct path and that you avoid sharp bends in the cable.
- Do not drill holes in tower supports or cross braces to provide a grounding point.
- Do not remove any paint on the outdoor unit chassis.
- Do not secure the ground cable in a bundle with other data, power, or RF cables.
- The chassis of the outdoor unit's power supply must be connected to the frame or cabinet via a ground strap.

If you are installing more than one radio (ODU) and they will be in close proximity to each other, do not daisy chain the units' grounds to each other. This means that you should not connect the ground of one unit to the ground of another unit and finally to the grounding system, as shown in Figure 5:1 Daisy Chain Configuration.

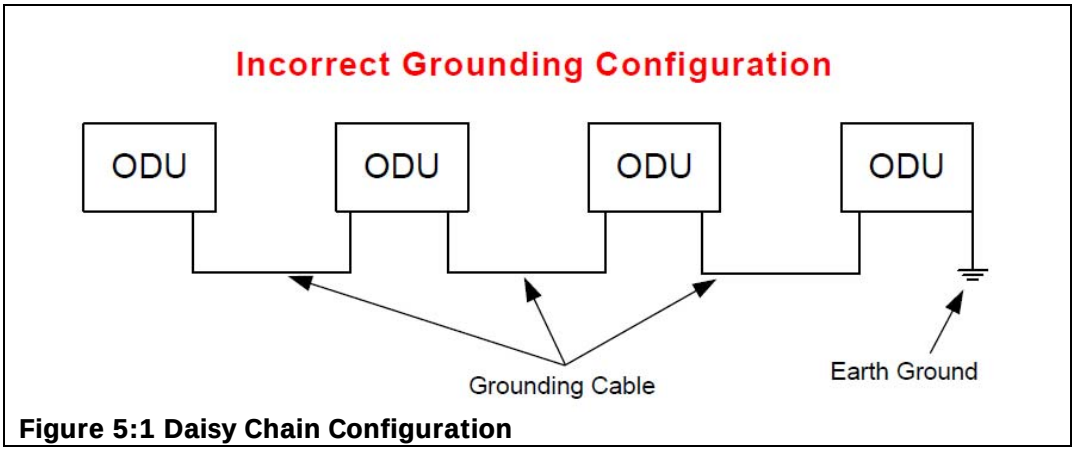


Figure 5:1 Daisy Chain Configuration

Daisy chaining the grounds of your units will cause problems such as ground loops, high resistance paths between units, and reduced ability for dealing with lightning. Instead, you should use a star configuration, as shown in Figure 5:2 Star Configuration. In this configuration, each outdoor unit's grounding lug is connected to a common grounding point that is then connected to the earth ground.

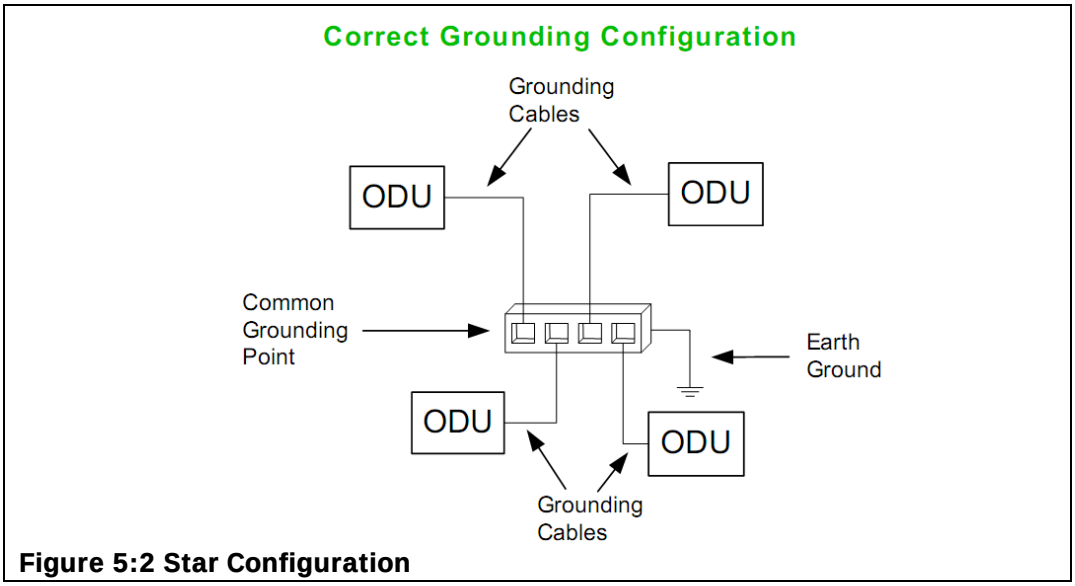


Figure 5:2 Star Configuration

5.4.3 Lightning Protectors

The use of lightning protectors and surge suppressors is extremely important and, although your LibraPlus equipment will operate without them, it is highly recommended that you make use of them. Lightning protectors and surge suppressors are used to aid in the protection of your outdoor units against lightning damage and static discharge.

During installation, it is important to note that all lightning protection devices have a surge (or cable-facing) side and an equipment facing side, as shown in Figure 5:3 Surge Suppressor Sides. The equipment side generally faces the outdoor unit or the indoor power adapter. The surge side faces the other surge suppressor.

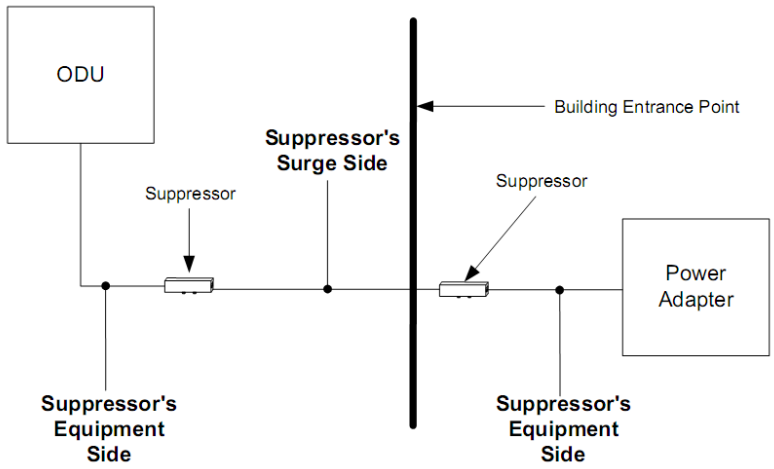


Figure 5:3 Surge Suppressor Sides

5.4.4 Surge Suppression Unit Location

Lightning arrestors and surge protectors should be installed at all input/output points on the LibraPlus equipment. Additionally, they should be properly grounded by connecting the body of the arrestor or protector to the grounding system with a heavy gauge (6 AWG) copper wire. This grounding wire should be as short as possible.

The following figures illustrate the locations where the surge suppressors must be installed, when cabling a LibraPlus 5860.

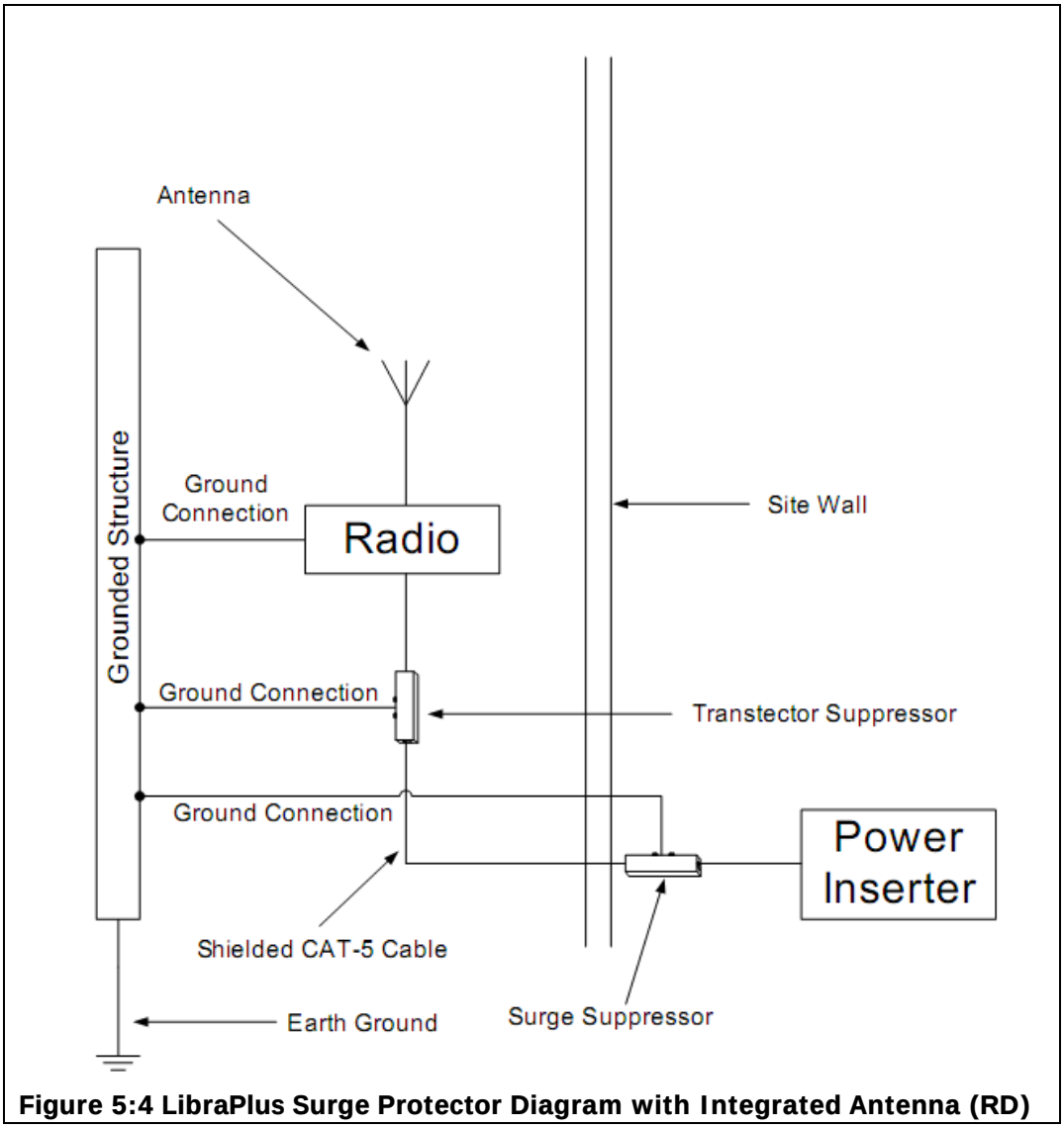


Figure 5:4 LibraPlus Surge Protector Diagram with Integrated Antenna (RD)

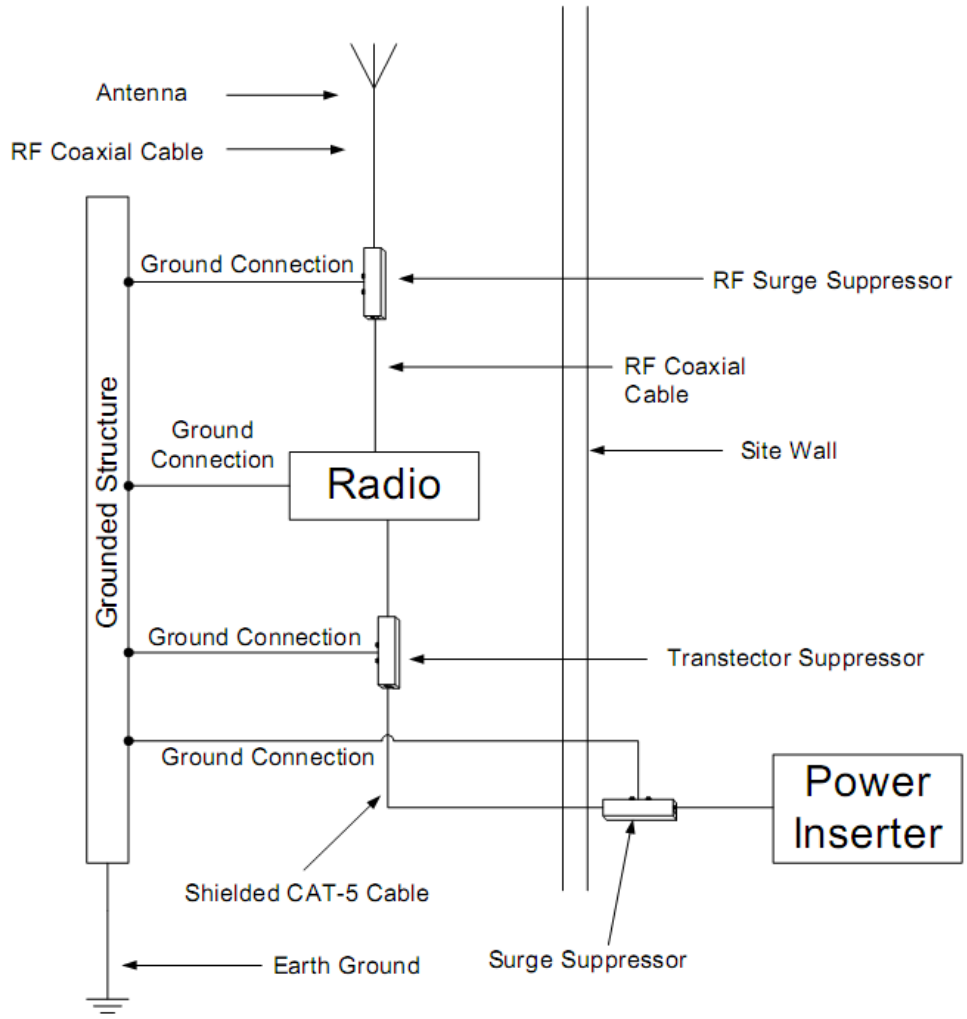


Figure 5:5 LibraPlus 5860 Surge Protector Diagram with External Antenna (ER)

When installing surge suppressors between your LibraPlus unit and the antenna, use protectors that provide a DC short such as an L-C circuit or one quarter-wave shorting stub. These protectors should be physically located as close as possible to the ODU, preferably no further than five (5) feet (1.52 metres). Also, a star configuration should be used when grounding your surge suppressors.

5.5 Weatherproofing Connectors

One of the most common installation problems is water intrusion, due to improper weatherproofing. Unfortunately, this activity is often overlooked and can lead to costly repairs and unnecessary expenses if not completed properly or not performed at all. Therefore, it is extremely important to properly weatherproof your connectors.

> **An additional reason for using tape to weatherproof your cable connections is to prevent the connection loosening, due to environmental conditions.**

One method is to apply two layers of high quality rubber tape to the connectors, then apply two layers of high quality vinyl electrical tape, such as:

- Scotch® 130C Linerless Rubber Splicing Tape
- Scotch® Super 88 Premium Vinyl Electrical Tape

Corrosion is another problem that arises if your cabling system is not properly weatherproofed. Corrosion can lead to high impedance at contact points, which can drastically reduce the effectiveness of your lightning protection. To help stop corrosion, you should use an anti-oxidizing paste on all contacts. When using anti-oxidization paste, keep the following guidelines in mind:

- read the instructions and warnings for the selected product
- lock washers should be used since the anti-oxidization paste acts as a lubricant
- use a small amount. A thin film applied to exposed surfaces and on contact points is adequate
- do not apply the anti-oxidization paste to the data cable connections on the outdoor unit. The anti-oxidization paste is conductive and may degrade performance and damage equipment.
- using electrical or rubber tape is not recommended for sealing the grounding connections when anti-oxidization paste is used
- do not use thread-locking compound on the same bolt or screw as anti-oxidization paste is used.

5.6 CAT-5 Ethernet Cable Shielding

Using shielded CAT-5 Ethernet cable is very important when installing your LibraPlus ODU, as it will help in reducing data errors caused by nearby interference.

It is also very important that the shield be connected at only one end of the cable, the end that connects to the indoor unit. This is required to eliminate ground loops caused by current flowing between the indoor and outdoor units, due to a possible difference in ground levels. Such currents can damage equipment at either end or introduce noise that will interfere with the user data traffic on the cable.

6 LibraPlus Installation

This chapter discusses how to install your LibraPlus equipment. There are four general tasks that you will need to perform when you install your LibraPlus. They are:

1. Configuring your LibraPlus
2. Installing your LibraPlus
3. Mounting the antenna, if the equipment uses a separate antenna
4. Cabling the LibraPlus

> **Please review the Pre-installation chapter before you begin installing your LibraPlus equipment.**

6.1 Connecting the Ethernet Cable

Before mounting your LibraPlus, either on a pole or a wall temporarily connect an Ethernet cable between the unit and your computer's Ethernet port. This is to allow you to configure your LibraPlus Radio.

If connecting the LibraPlus directly to a laptop or PC, a crossover Ethernet cable is required.

6.2 Mounting Conditions

The six (6) general LibraPlus mounting scenarios are:

1. pole mount, external antenna (ER)
2. wall mount, external antenna (ER)
3. pole mount, integrated antenna, vertical polarization (RD)
4. wall mount, integrated antenna, vertical polarization (RD)
5. pole mount, integrated antenna, horizontal polarization (RD)
6. wall mount, integrated antenna, horizontal polarization (RD)

6.3 External Antenna Mounting

If you are mounting your LibraPlus using an external antenna, you will not have to concern yourself with the polarization of the antenna. In this instance, attach the mounting bracket unit anchor to the side of the unit housing as shown in the figure below.

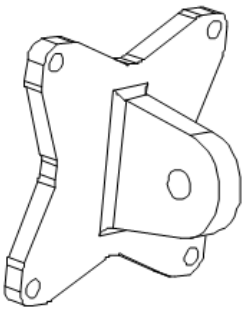


Figure 6:1 Mounting Bracket Unit Anchor

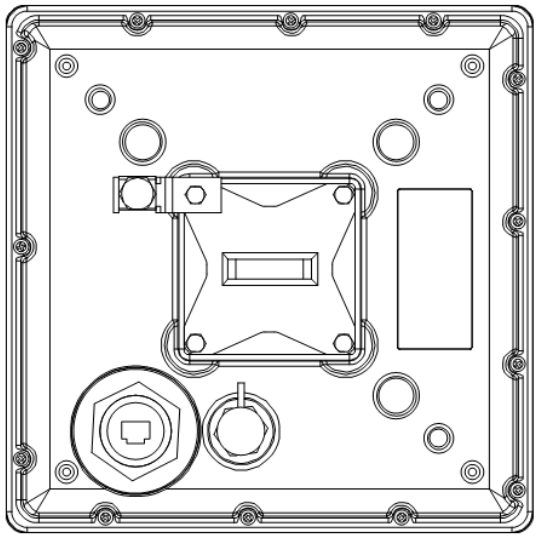


Figure 6:2 Attaching the Mounting Bracket Unit Anchor

6.4 Integrated Antenna Mounting

If you are mounting your LibraPlus and the unit has an integrated antenna, you will have to consider the antenna's polarization. When you later install the unit on the pole or wall, you will need to install it so that the antenna's polarization arrow is pointing as shown in the examples below.

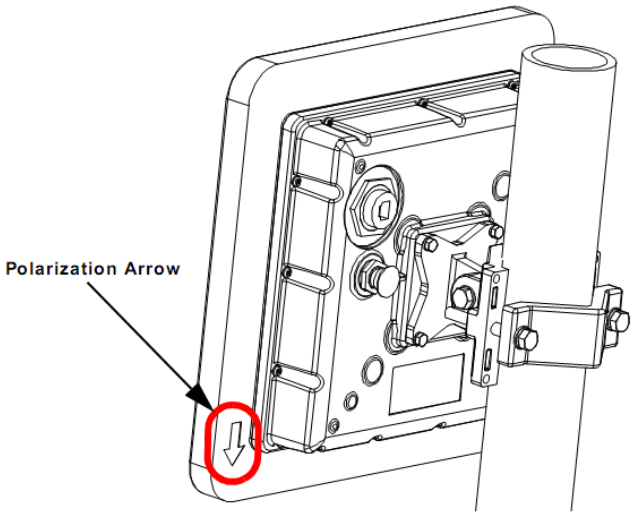


Figure 6:3 Mounted for Vertical Polarization

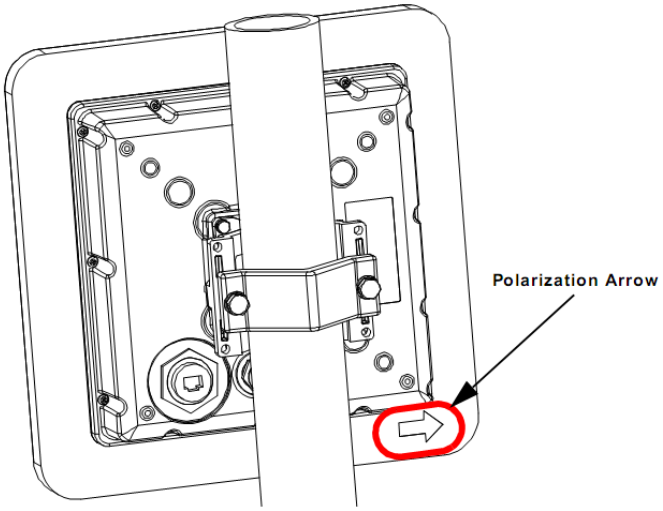


Figure 6:4 Mounted for Horizontal Polarization

6.5 Pole-mounting the LibraPlus

Your next task is to install the unit. Before you begin, review the material in the Pre-installation chapter of this manual and make certain that you have met all of the conditions laid out there. Also, you should make certain that all of the necessary brackets and bolts are included in the box with your unit.

To mount your LibraPlus unit on a pole:

1. Mount the LibraPlus Radio on the pole.

    1.1. Mount the bracket clamp to the pole, as shown in the figure below. If the pole is two (2) inches (5.08 cm) in diameter or less, turn the mounting bracket clamp back over so that the angle faces the pole. This will allow you to mount the bracket to a smaller pole.

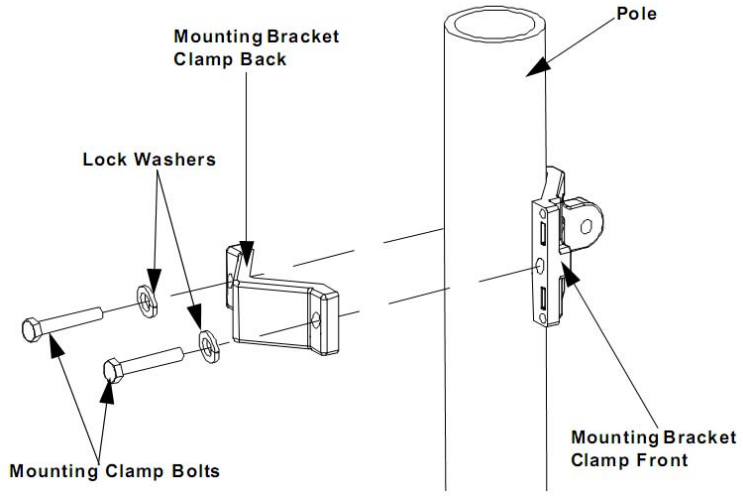


Figure 6:5 Attaching the Bracket to the Pole

1.2. Tighten the bolts so that the bracket will not move. The recommended maximum torque is 24 N/m (17.7 ft/lbs). If your LibraPlus has an integrated antenna, as shown in the figure below, do not tighten the mounting clamp bolts unit you have aligned your antenna.

1.3. Bolt the mounting bracket's unit anchor to the unit's housing, as shown in the figure below. Tighten the bolts so that they are snug. Do not over tighten the bolts, as they could crack the housing. The recommended maximum torque is 5.7 N/m (17.7 ft/lbs).

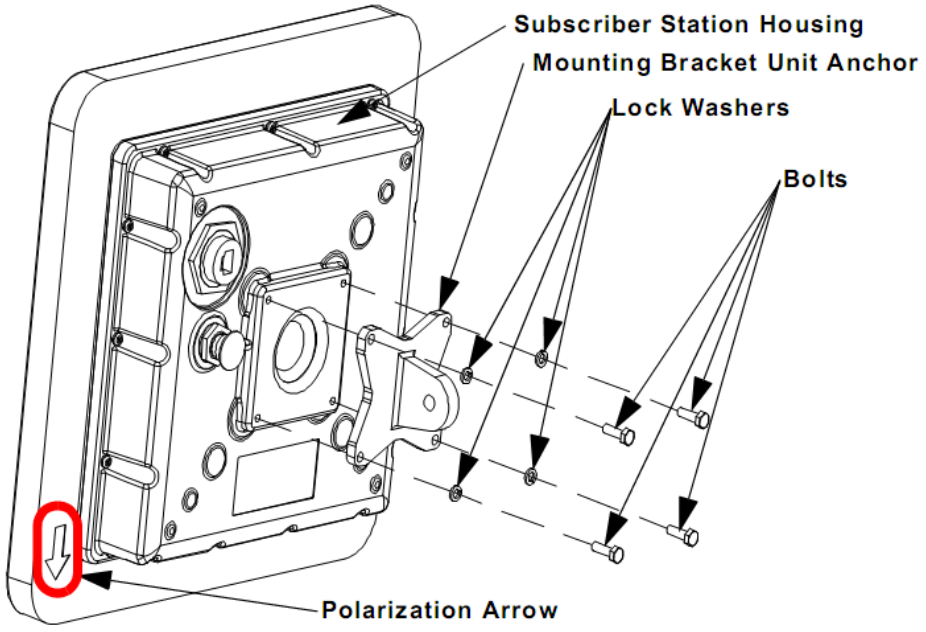


Figure 6:6 Attaching the Bracket to the radio

1.4. Secure the unit to the pole, as shown in the figure below.

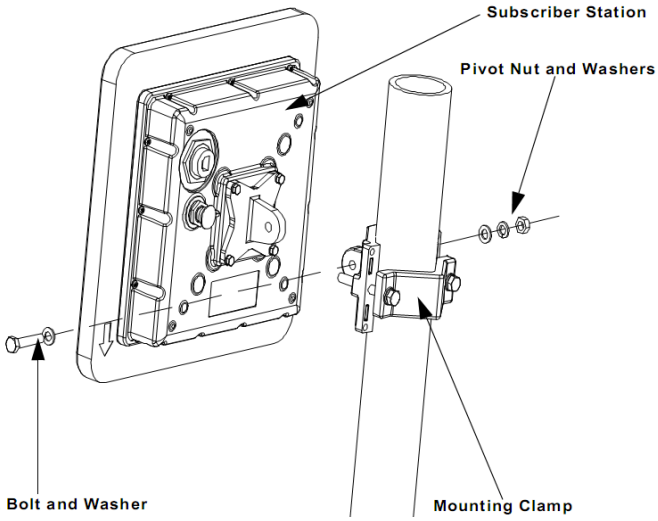


Figure 6:7 Securing the radio to the pole

1.5. Tighten the pivot nut and bolt. The recommended maximum torque is 24 N/m (17.7 ft/lbs). If your LibraPlus radio has an integrated antenna, do not tighten the pivot nut and bolt until you have aligned your antenna.

6.6 Wall-mounting the LibraPlus Radio

1. To mount your LibraPlus radio to a wall:

   1.1. Prepare the wall to hold the mounting bracket. The type of mount you create will depend upon the type of wall surface and material your wall is made of. It may be that you only need to drill holes and insert bolt anchors, or you may have to fabricate a strong mount that will withstand the unit's weight, outside temperature change, or other variables. For this reason, EION requires that you supply your own fastening bolts, lag-screws, or other fastening devices.

   1.2. Place the back of the bracket against the wall mount, as shown below.

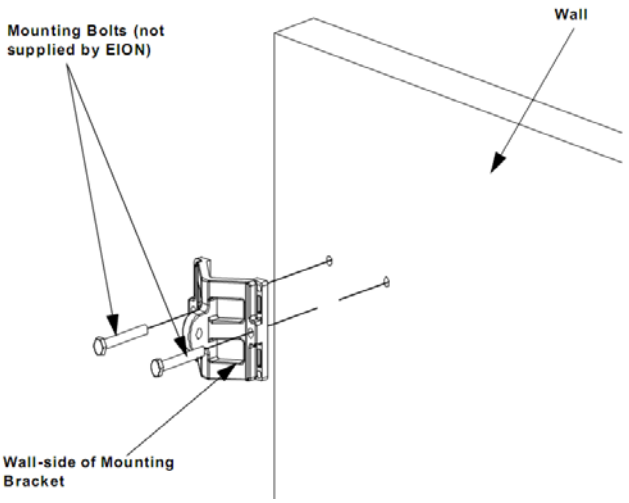


Figure 6:8 Bolting the Wall-side Bracket to the Wall

1.3. Secure the mounting bracket to the wall, using the necessary bolts.

1.4. Bolt the bracket's unit anchor to the housing, as shown below.

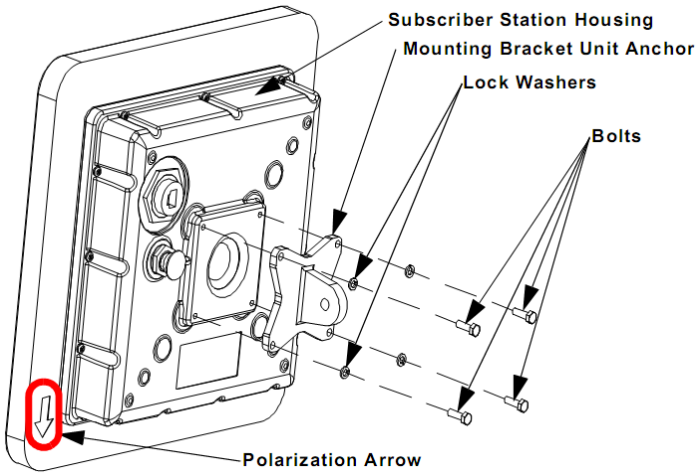


Figure 6:9 Attaching the Bracket to the radio

1.5. Tighten the bolts so that they are snug. Do not over tighten the bolts, as they could crack the housing. The recommended maximum torque is 5.7 N/m (4.2 ft/lbs).

1.6. Connect the radio to the mounted wall-side bracket, using the pivot arm, as shown below. If your LibraPlus radio has an integrated antenna, do not tighten the pivot nuts and bolts unit you have aligned your antenna.

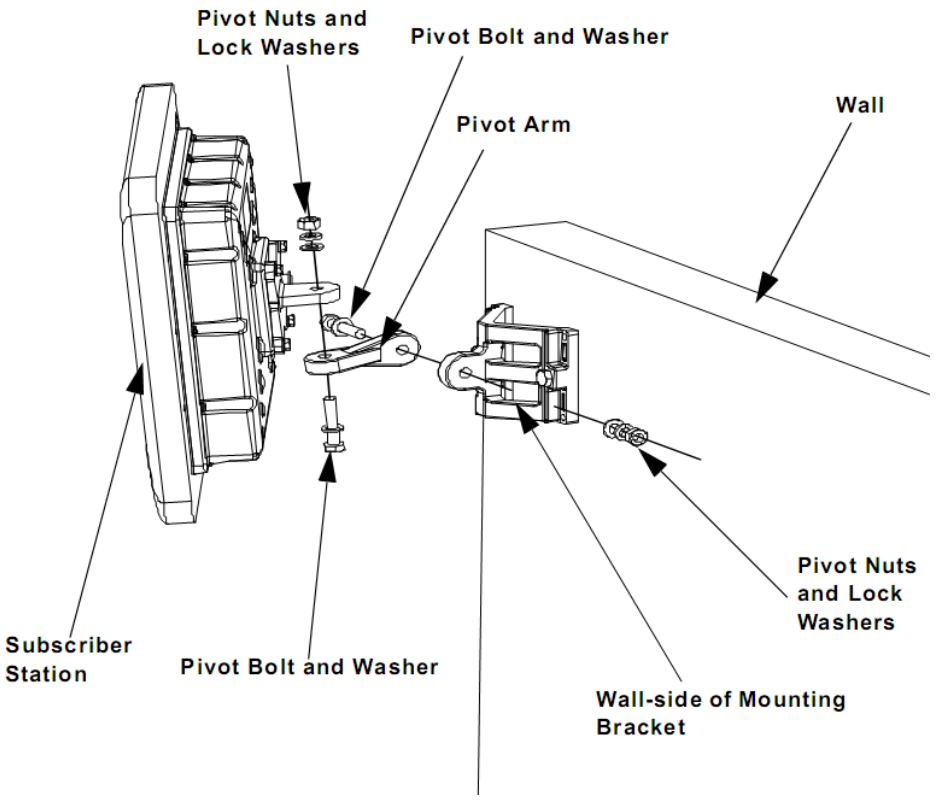


Figure 6:10 Bolting the radio to the Wall Bracket

6.7 Antenna Mounting Guidelines

If your LibraPlus does not have an integrated antenna, it is essential that you properly install an external antenna. This ensures that your system is operating at optimum performance and aids in protecting it against lightning damage.

To correctly install your antenna, it is very important that you follow your antenna manufacturer's installation instructions closely. In addition, keep the following guidelines and practices in mind while performing your installation.

6.7.1 Mounting the Structure

Make certain that the mounting structure (i.e.: pole mount, wall mount, etc.) is perpendicular to the horizontal, as shown in the figure below. This is essential, because the antenna's mechanical tilt indicator or indicators rely on using a vertical mounting surface for its reference point. The degree of vertical accuracy should be checked and, if necessary, corrected prior to the installation of the antenna. The mounting surface's vertical angle can be verified using a level or angle indicator

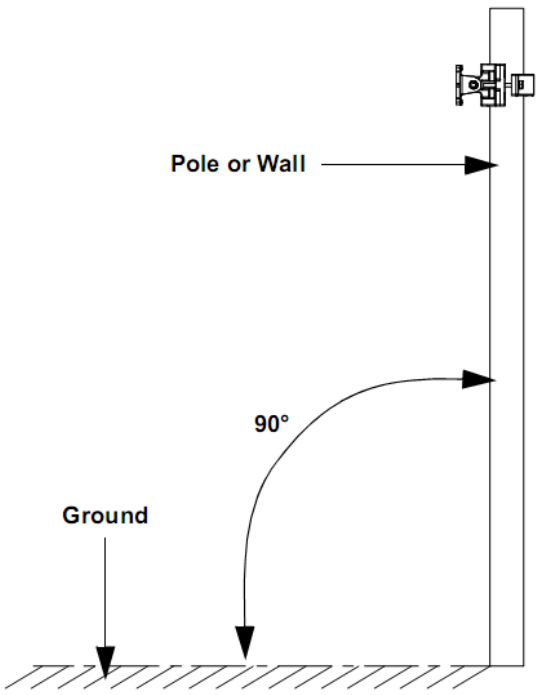


Figure 6:11 Vertical Mounting Surface

6.8 Cabling the LibraPlus

Once you have installed and mounted your LibraPlus equipment, you will need to connect the cable that powers the unit and transfers the data. The following sections set out the steps that you should follow in order to install the cable needed by your LibraPlus radio.

When you have completed cabling your LibraPlus radio either with or without an integrated antenna, your cable connections should resemble those shown in figures below.

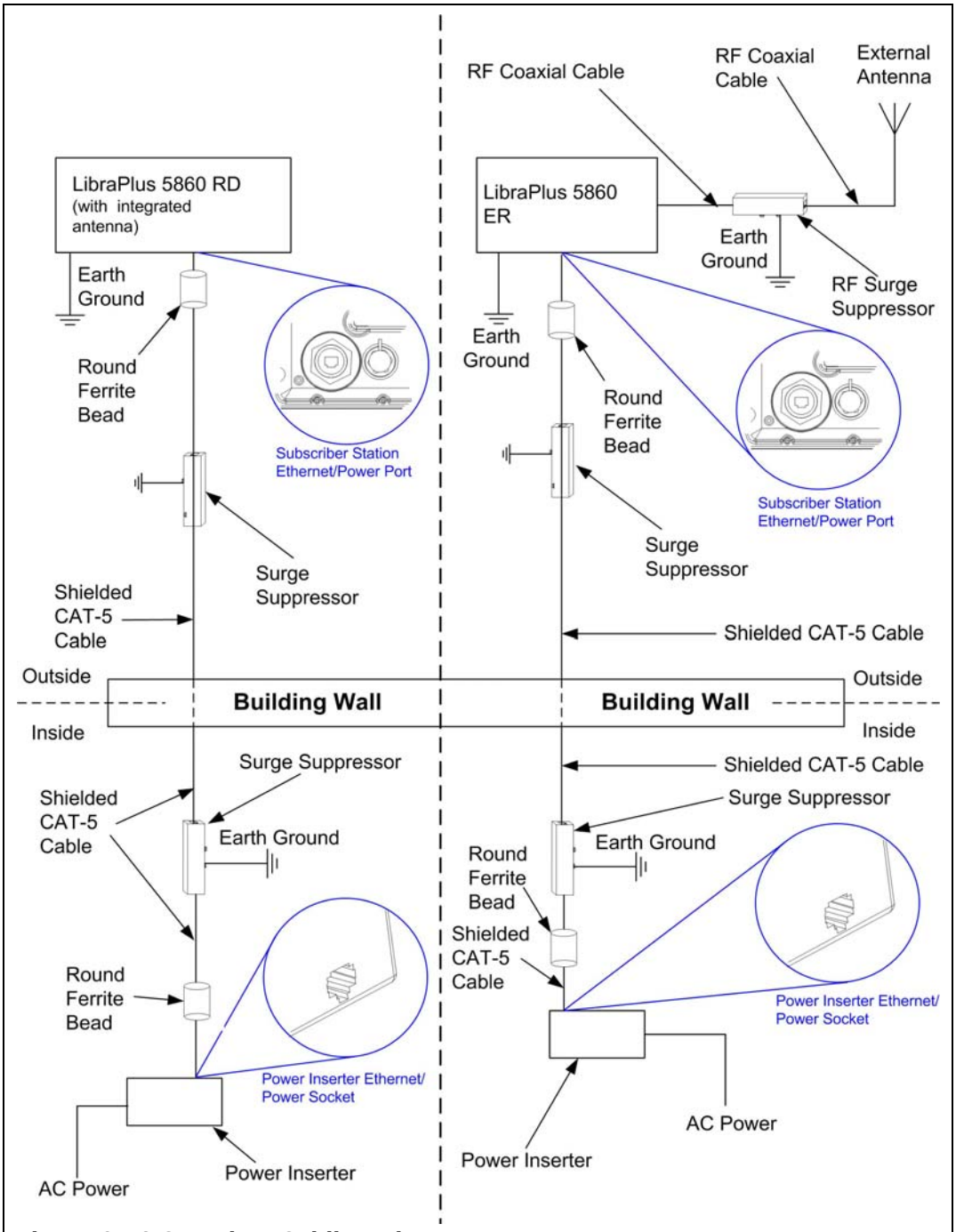


Figure 6:12 Complete Cabling Diagram

6.9 Cabling up to the LibraPlus Radio

Cabling from your indoor terminal equipment (PoE) to your radio is straightforward. To cable your LibraPlus radio:

- Mount the radio's power inserter on the wall, close to the cable's exit point from the building. How you mount the power inserter will depend upon certain issues, such as the type of wall surface and material your wall is made of.
- Connect an Ethernet cable from your terminal equipment to the Data port of your radio's power inserter, as shown in the figure below.

⚠ WARNING: Power Inserters may have different labeling applied to the unit. See the diagrams below to determine the appropriate ports to connect the equipment.

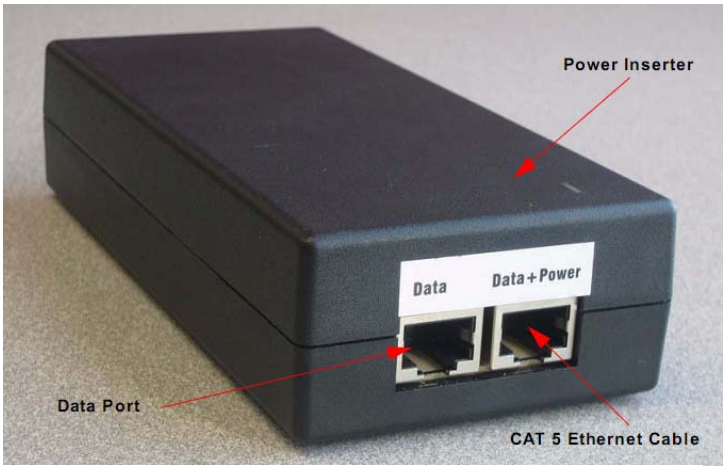


Figure 6:13 Connecting an Ethernet Cable to the Power Inserter

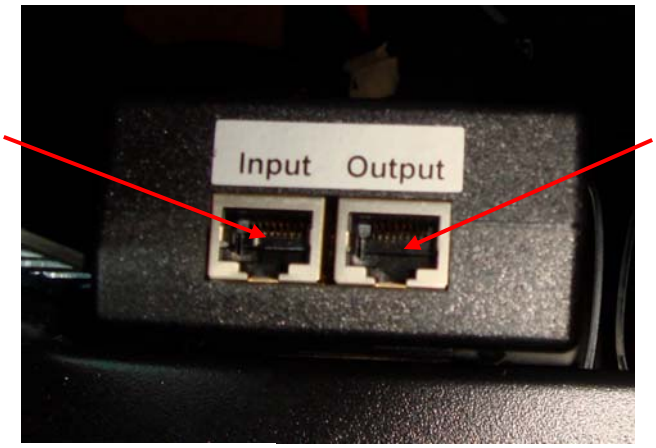


Figure 6:14 Alternate PoE Labeling

- Install the round ferrite bead on the RJ45 Ethernet cable on the end close to the power inserter.
- Connect the LibraPlus Radio's Ethernet/power cable to the Data and Power port of your power inserter, as shown in the figure above.

Note: use crossover Ethernet cable in Data port (unless Laptop/PC is used), and a straight cable in Data+Power port of PoE.

- Install a Ethernet CAT-5 in-line surge protector on the Ethernet/Power cable, before the Ethernet/Power cable exits the building.
- Ground the surge protector to a common earth ground, outside the building, per the manufacturer's instructions. This surge suppressor is not weatherproof, so it must be installed inside the building.
- Run the Ethernet/power cable out of the exit point of the building to the outside.
- Install the round ferrite bead on the RJ45 Ethernet cable on the end close to

the LibraPlus Radio.

- Connect the Ethernet/Power cable to the Ethernet/Power port on the radio, as shown below.

> **NOTE: When moving the PC Ethernet connection from the Slave side to the Master side it will take up to 60 seconds for the PC to be able to access the GUI. There is no delay when going from Master to Slave.**

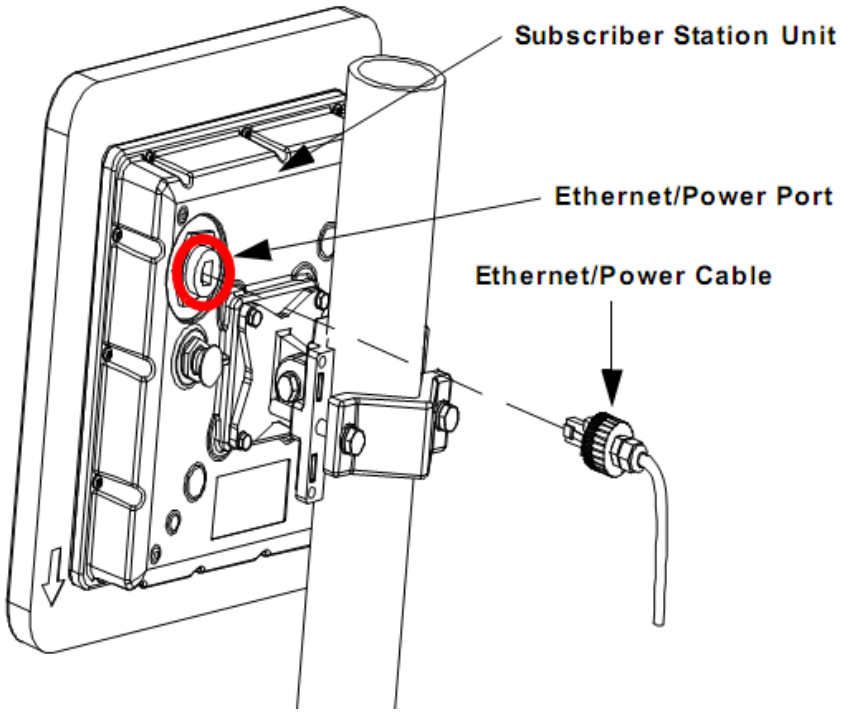


Figure 6:15 Connecting the Ethernet/Power Cable to the LibraPlus

6.10 Weatherproofing Cable Connections

One task that is extremely important is weatherproofing the connections between your cable and an outdoor unit or antenna. Not only does this prevent corrosion and keep water from interfering with the connection, it also aids in keeping the connection tight.

In general, you will weatherproof two types of connection, cable to outdoor unit or antenna and cable to cable.

6.10.1 Cable to Outdoor Unit Connections

Most antenna or outdoor unit problems are caused by coaxial cable connections that loosen due to vibration, allowing moisture to penetrate the connector interface. EION recommends that all outdoor unit to cable connections be weatherproofed using a procedure similar to the one described below.

Fasten connectors securely together, as shown in below. Ensure the connector and cables are free of foreign substances such as oil, water, grease, dirt, etc.

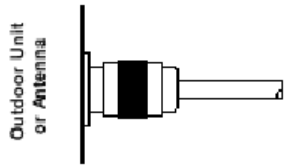


Figure 6:16 Secure Cable Connection

Tightly wrap two (2) layers of rubber splicing tape over the connection extending one (1) inch (2.54 cm) beyond the connectors and overlapping the tape on each turn, as shown below.

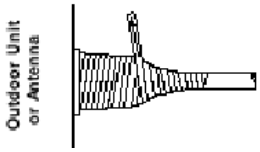


Figure 6:17 Wrap 2 layers of electrical tape

Tightly wrap two (2) layers of electrical tape over the rubber splicing tape extending one (1) inch (2.54 cm) beyond the rubber splicing tape, as shown below.

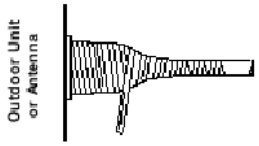


Figure 6:18 Wrap with two layers of electrical tape

6.10.2 Cable to Cable Connections

Problems that occur in coaxial cable connections are often due to moisture penetration and corrosion in loose connections, caused by vibration. EION recommends that all cable to cable connections be weatherproofed using a procedure similar to the one described below.

Fasten connectors securely together, as shown below. Ensure the connector and cables are free of foreign substances such as oil, water, grease, dirt, etc.

Figure 6:19 Secure connection

Tightly wrap two (2) layers of rubber splicing tape over the connection extending one (1) inch (2.54 cm) beyond the connectors and overlapping the tape on each turn, as shown below.

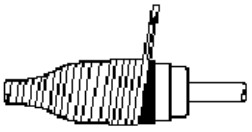


Figure 6:20 Wrap with rubber and electrical tape

Tightly wrap two (2) layers of electrical tape over the rubber splicing tape extending one (1) inch (2.54 cm) beyond the rubber splicing tape, as shown below.

6.11 Installing a Drip Loop

Another preventative measure that you can perform is to install a drip loop, as shown in the figure below. Drip loops should be incorporated into the cable before it is connected to outdoor devices, such as outdoor units, antennas, etc. For example, if you are installing one of the cables that run between the indoor unit and outdoor unit, you may want to install a drip loop in the cable immediately before it enters the building.

Drip loops should be incorporated into a system's external cabling at any point where a connection is made. Some examples of where a drip loop should be used are:

- cable to outdoor unit connection
- cable to antenna connection
- cable to cable connection
- the junction where a cable enters a building or structure
- a common grounding junction box or bar

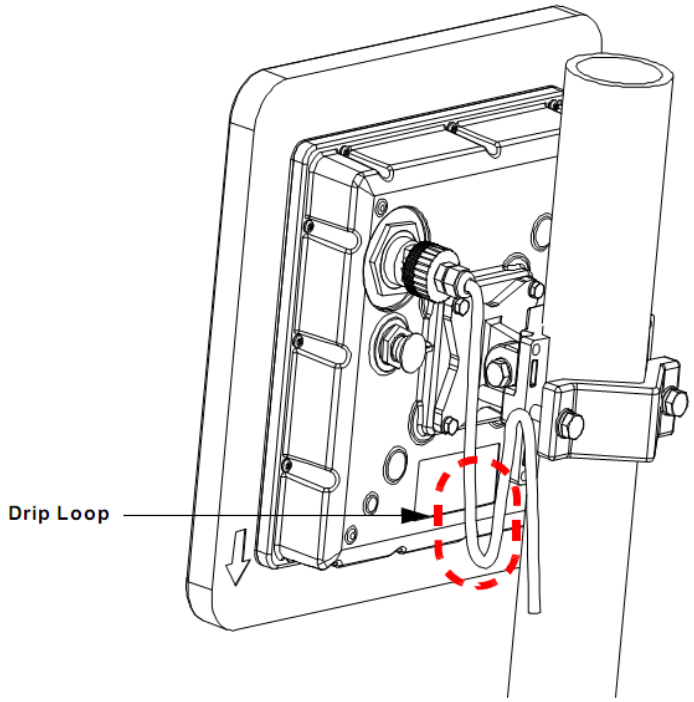


Figure 6:21 Cable Drip Loop

6.12 Cabling to the Antenna

Once you have connected the Ethernet/Power cable to the LibraPlus radio, you will need to connect the radio to the antenna.

> **You will only need to perform these steps if you are using an external antenna. If your unit makes use of an integrated antenna skip this section.**

To connect the LibraPlus radio to the antenna, perform the following steps:

1. Connect the radio frequency cable to the RF port on the LibraPlus, as shown in

the figure below.

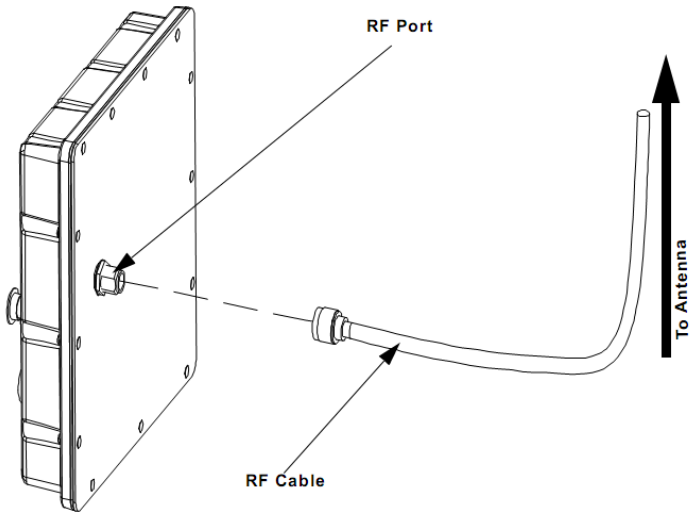


Figure 6:22 Connecting the RF Cable to the LibraPlus Radio

2. Weatherproof the cable connection, as outlined in Weatherproofing Cable Connections section above.
3. Connect the surge suppressor to the cable, per the manufacturer's instructions. Selection of the lightning protector should be of the Non DC Pass as this will also aid in the prevention of static discharge damaging the equipment or degrading performance by introducing noise to the receiver portion of the outdoor unit.
4. Weatherproof the suppressor connection, as outlined in Weatherproofing Cable Connections section above.
5. Connect the cable from the surge suppressor to the antenna, per the antenna manufacturer's instructions.
6. Weatherproof the suppressor connection, as outlined in Weatherproofing Cable Connections section above.
7. Ground the suppressor to a common earth ground, per the manufacturer's instructions.

6.13 Connecting the Power/Ethernet to the LibraPlus

Once the LibraPlus has been installed and cabled, you should connect the power to the unit's power inserter and check that it is operating correctly.

6.13.1 AC Power

To plug your power inserter into an AC mains outlet:

1. Plug the power cord into the power inserter, as shown in the figure below.

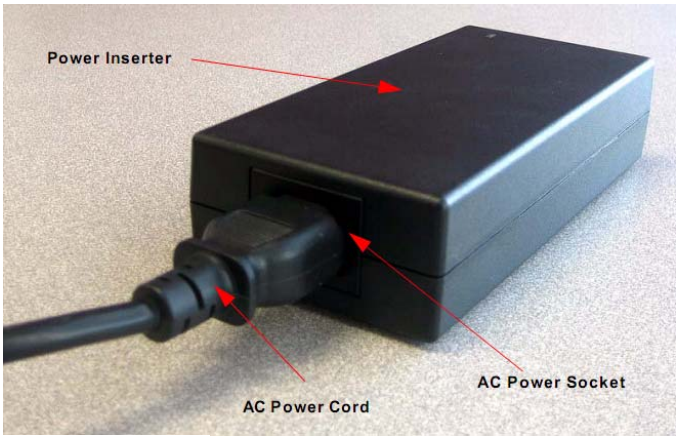


Figure 6:23 AC Power Socket

2. Plug the power cord into your power bar or uninterruptible power supply. Make certain that your power bar or uninterruptible power supply is plugged into the AC wall outlet.

7 Configuration

The LibraPlus contains an integrated web based GUI that controls the operation and configuration of the radio unit. It is administered over an Ethernet connection using a web-based GUI.

7.1 Accessing the GUI

To connect to the LibraPlus GUI do the following:

1. Configure the PC in the same subnet as the LibraPlus 5860
2. Open the web browser on the PC.
3. Type "**http://192.168.1.44**" in your web browser and press "Enter"
4. When prompted to login, type "**admin**" as the login, and "**admin123**" as the password, and then click the on the "OK" button.

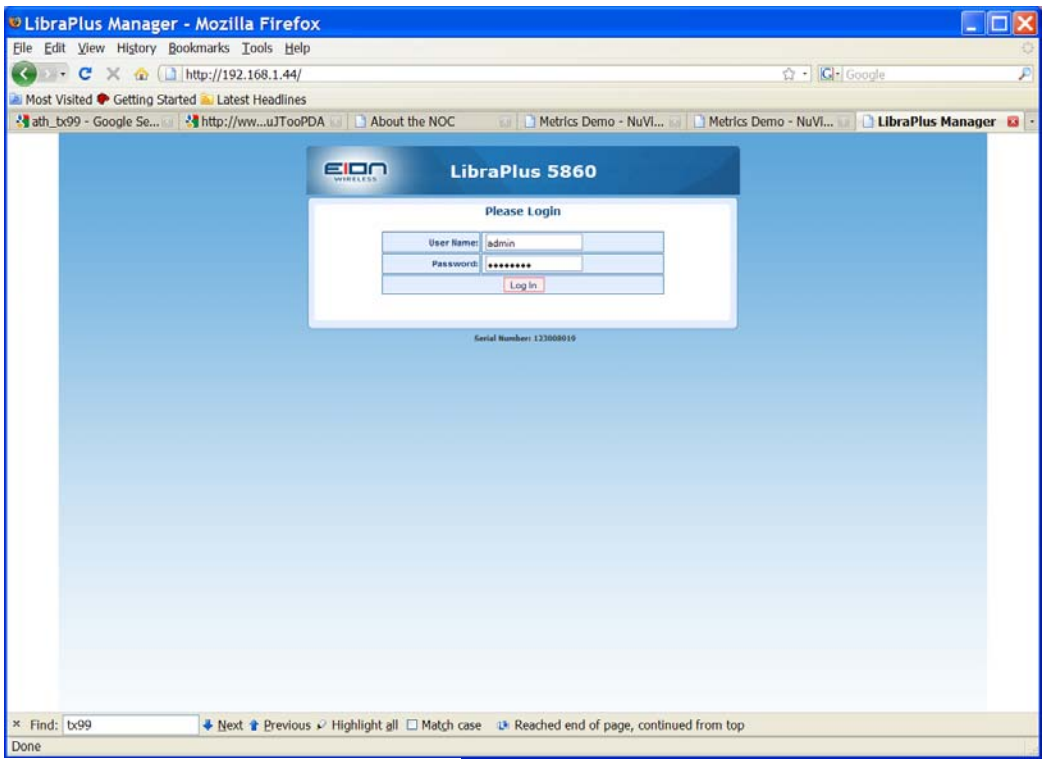


Figure 7:1 LibraPlus Login Prompt

NOTE: Default login information for the radio is:

IP address: **192.168.1.44**

Username: **admin**

Password: **admin123**

5. After successful login, the Master Home Page appears. You are now logged in and may begin configuring the radio.

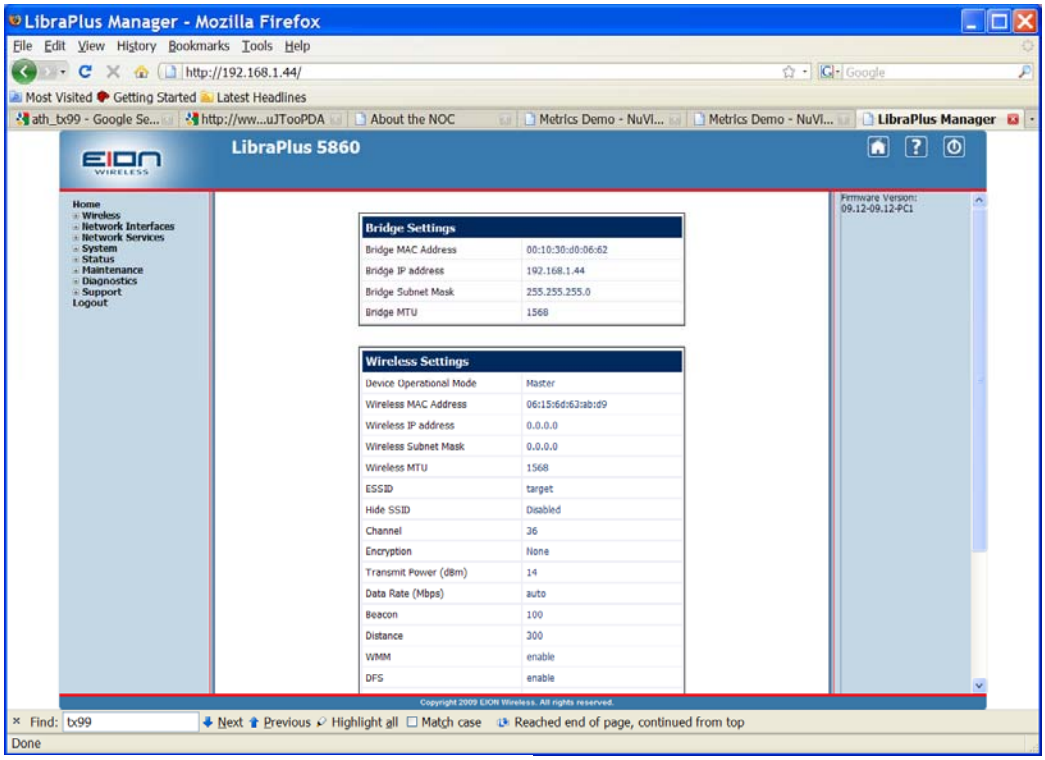


Figure 7:2 LibraPlus Master Home Page

7.2 Wireless

7.2.1 Wireless Settings

The wireless settings page configures the PHY operation of the radio. Depending on the Device operational Mode selected, different options will appear in the Wireless Settings page. For this reason it is recommended that this option is configured first.

Any change in the wireless settings requires a save and reboot in order for the changes to be applied to the system. Once the “Apply” button is clicked, the system will ask for the user confirmation, If the user presses “OK” then the configuration is saved and will reboot automatically.

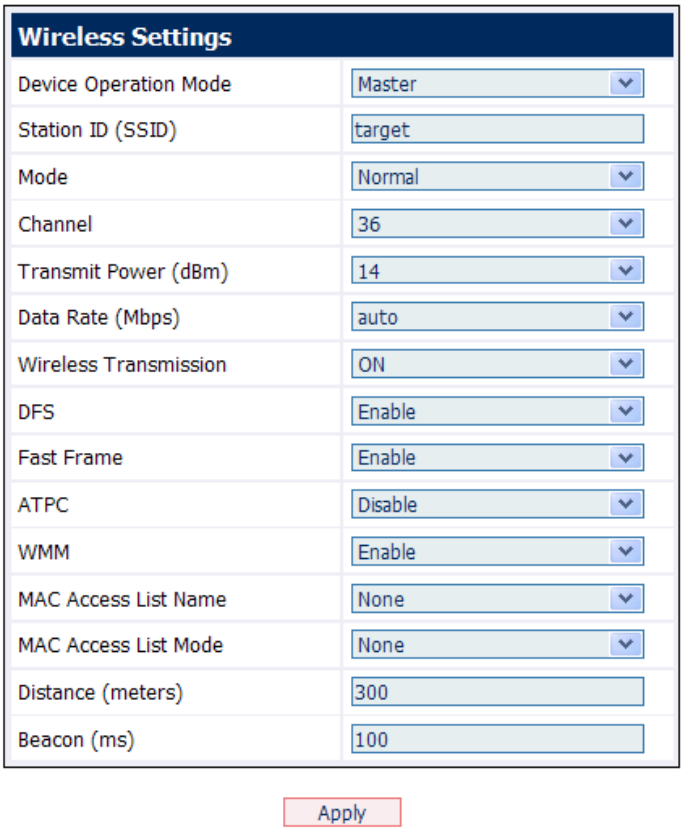


Figure 7:3 Wireless Settings at Master (p2p)

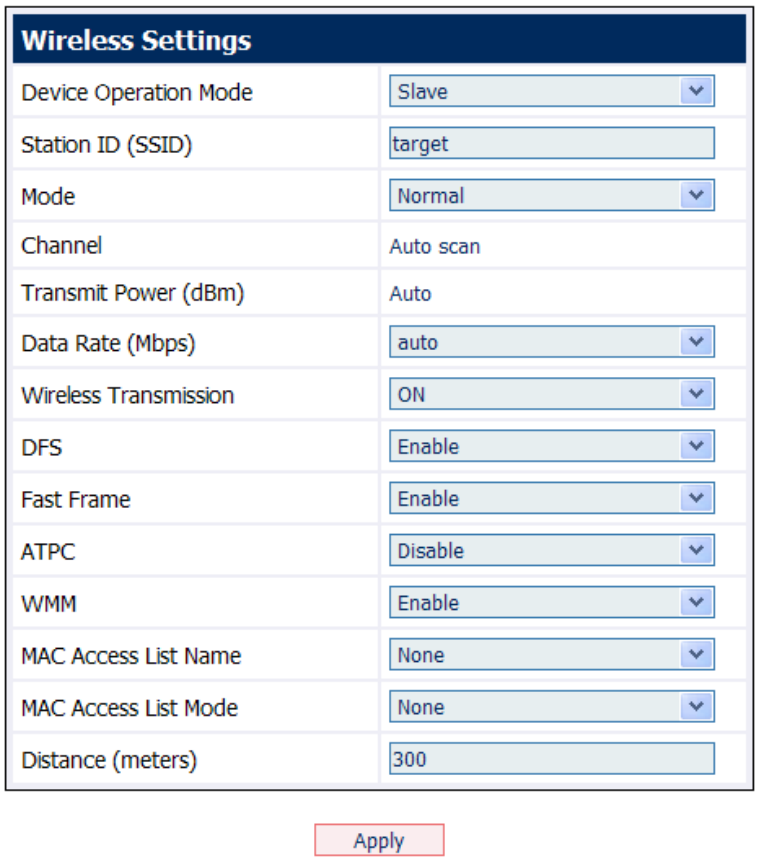


Figure 7:4 Wireless Settings at Slave (p2p)

7.2.1.1 Wireless Settings - Field Descriptions

Field Name	Description
Device Operation Mode	This is the mode in which the system can operate. For Point-to-Point LibraPlus radios (RD and ER), the available modes are "Master" and "Slave". If "Master" is selected then the LibraPlus 5860 acts as a Radio Access Point. If "Slave" is selected then the LibraPlus acts as a Radio Station. Depending on the Mode selection, the below configurable parameters will change. The default mode is "Master". *Note: It is advised to select the operating mode before selecting other wireless parameters*

Field Name	Description
Station ID (SSID)	This is the SSID of the radio. SSID is a string parameter which can be a maximum of 32 characters. The default SSID is “target”. For Point-to-Point operation, only a single SSID can be configured. Multiple SSID is a Point-to-Multipoint feature.
Mode	The radio can operate on two different modes. They are “Normal” (20 MHz channel width) and “Turbo” (40 MHz channel width). Depending on the selected mode, the channel list below will change. Only certain channels can operate on “Normal” and “Turbo” respectively. The default mode is “Normal”. *Note: Always select the “Mode” before selecting the “channel”.* *Note: Mode should always be selected at the Slave, even though the channels are in auto scan mode*
Channel	This is the list of available channels. The channel list changes depending on the “Mode” selected. For the channel vs. frequency mapping please check the right side of the “Wireless Settings” screen. The default channel is “36”. *Note: The Slave is in “auto scan” mode always*
Transmit Power	This is the transmit power of the radio in dBm. The maximum transmit power changes depending on the channel selected. For the Maximum transmit power on a given channel, please check the right side of the “Wireless Settings” screen. The user can select any of the power settings between 1 and the maximum power per channel. The user can also select the “auto” option. The default average Transmit Power is “14” dBm. **IMPORTANT: Actual power output can vary greatly depending on the modulation and channel size.** *Note: The Slave is in “auto” mode always*
Data Rate	This is the Data Rate of the radio. The user could select any one of the value shown in the drop down box. The default Data Rate would be “auto”
Wireless Transmission	This setting toggles the radio on and off. The Default is Radio “ON”.

Field Name	Description
DFS	This is the Dynamic Frequency Selection parameter for the radio. The options for DFS are “Enable” or “Disable”. The default is DFS “Enable”.
Fast Frame	This setting enables or disables Fast Frame aggregation. Fast Frame aggregation increases the data throughput of the radio by creating jumbo packets that are sent over the wireless link. The default is Fast Frame “Enable”.
ATPC	This is the Automatic Transmit Power Control. When ATPC is enabled the output power changes based on the conditions to a maximum of 17 dBm average. The default value for ATPC is “Disable”
WMM	WMM is Wireless Multi Media services. This feature differentiates the quality of service, depending on the IP TOS. The Wireless Multimedia provides a form of QoS that provides a higher Quality of Service for multimedia traffic when enabled. The default for WMM is “Enable”
MAC Access List Name	This is the MAC access list name for which the Master or Slave will give access to connect other Slave or Master respectively. If the below “MAC Access List Mode” is chosen “White”, then it would allow the access for only the MAC address listed in the MAC list. If the below “MAC Access List Mode” is chosen “Black”, then it would deny the access for only those in the MAC list and it would allow others to get connected. If the user configures the “MAC Access List” in the “System” menu, then it would display those access list names here automatically. If the user wants to remove the “MAC access List”, then he could select the “None” option in the drop down box. The default value for MAC Access List Name is “None”.
MAC Access List Mode	This could be “Black” or “White” or “None”. If it is “White” and if the “MAC Access List Name” is selected then it would allow only those MAC address to connect. If “Black” is selected then it would deny the connection for those MACs. The default value for MAC Access Mode is “None”.
Distance	This is the distance between the “Master” and “Slave”. This is in the units of meters. The default value is “300” meters.
Beacon	This is the Beacon interval. This is in the units of milliseconds. The default value is “100” milliseconds. *Note: This field is only available when “Master” is selected as the operation mode.*

7.2.2 Wireless Encryption

This is the configuration procedure to configure the wireless encryptions on the LibraPlus5860 product.

1. Log into the LibraPlus 5860 GUI and click the "+" sign near the "Wireless" at the left side of the page. After pressing the "+" sign", the "wireless" will expand showing "Wireless Settings" and "Wireless Encryption".
2. Now click the "Wireless Encryption" Select the "Authentication Type" in this page. The type could be "WEP" or "WPA" or "None".
3. If user selects "WEP", then automatically "Encryption Phrase" text will be displayed. The user can enter the "encryption phrase". The encryption phrase can be maximum 5 characters.
4. If the user selects "WPA", then automatically "Auth Mode" and "Encryption Phrase" text boxes will appear. Here the user can select the "Auth Mode" (option of "TKIP or "CCMP) and enter the encryption phrase. The encryption phrase should be between 5 and 13 characters. The Default is be "None"

Note: If user selects the authentication in the Master, then the user should select the same authentication and the key at the Slave.

5. Once the parameters are selected, click the "Apply" button below
6. Any change in the wireless encryption parameters to take effect it requires a reboot. So the system will ask for the options "Save and Reboot" or "Save" or "Cancel".
7. If the user presses "Save and Reboot", then the configurations is going to get saved and reboot the system
8. If the user presses "Save" then the configuration will get saved, but not functionally active. This would become active in the next reboot
9. If the user presses "Cancel" then there is no effect.

Figure 7:5 Wireless Security without Encryption

Figure 7:6 Wireless Security with WEP Enabled

Figure 7:7 Wireless Security with WPA Enabled

7.2.2.1 Wireless Security - Field Descriptions

Field Name	Description
Authentication Type	This is the type of authentication which the user is choosing. This can be “None”, “WEP” or “WAP”. The default is “None”.
Auth Mode	This is the authentication mode which the user needs to select. The possible “Auth Mode” are “TKIP” and “CCMP”. This parameter will appear only when the user selects “WAP” authentication type. The default is “TKIP”.
Encryption Phrase	This is the encryption key which the user needs to enter if the user selects “WEP” or WPA” encryption type. *Note: WEP allows only 5-13 characters. WPA allows 8 to 63 characters.*

7.3 Network Interfaces

7.3.1 Bridge Settings

This is the configuration procedure to configure the bridge settings of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 GUI, click the “+” sign near the “Network Interfaces” at the left side of the page.
2. After pressing the “+” sign”, the “Network Interfaces” will expand showing “Bridge”.
3. Now click on “Bridge”
4. Any of the parameters list in the “Bridge” page can be changed. Once the bridge parameters are changed, click the “Apply” button below.
5. These changes take effect immediately without reboot.

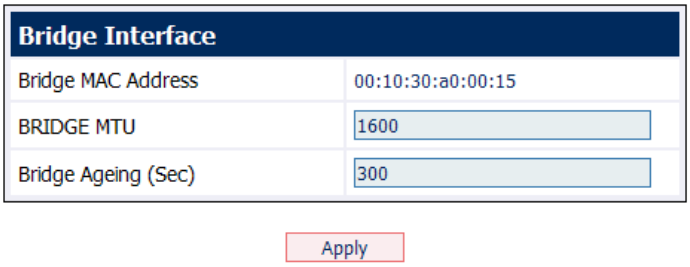


Figure 7:8 Bridge Settings

7.3.1.1 Bridge Settings – Field Descriptions

Field Name	Description
Bridge MAC Address	This is the MAC address of the bridge. This cannot be changed.
BRIDGE MTU	This is the Bridge MTU. Bridge MTU takes values from 576 to 2290. The default Bridge MTU is "1568".
Bridge Ageing	This value is the Ageing of the bridge learnt entries in seconds. The default ageing period is "300" seconds.

7.3.2 Bridge Multicast Settings

This is the configuration procedure to configure the bridge multicast settings of the LibraPlus 5860 product

1. After logging into the LibraPlus Product, click the "+" sign near the "Network Interfaces" at the left side of the page.
2. After pressing the "+" sign", the "Network Interfaces" will expand showing "Bridge". Now click on the "+" sign near the "Bridge".
3. Click on "Multicast".
4. It will show the option of "Enable" or "Disable". The default is "Enable".
5. Once the bridge multicast option is chosen click the "Apply" button below. This setting takes effect immediately without reboot.

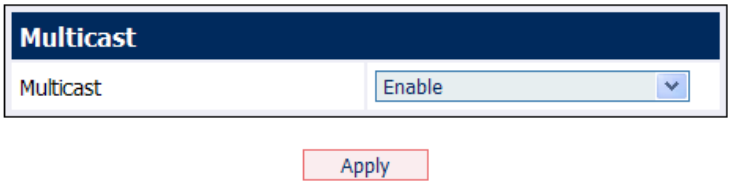


Figure 7:9 Bridge Multicast Settings

7.3.2.1 Bridge Multicast – Field Descriptions

Field Name	Description
Multicast	This is the field which enables or disables the multicast traffic passing through. The default is “Enable”

7.3.3 Management Settings

This is the configuration procedure to configure the management settings of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 Product, click the “+” sign near the “Network Interfaces” at the left side of the page.
2. After pressing the “+” sign”, the “Network Interfaces” will expand showing “Management”.
3. Now click on “Management”
4. Any of the parameters listed in the “Management” page can be changed
5. Once the Management parameters are changed click the “Apply” button below. This setting takes effect immediately without reboot.

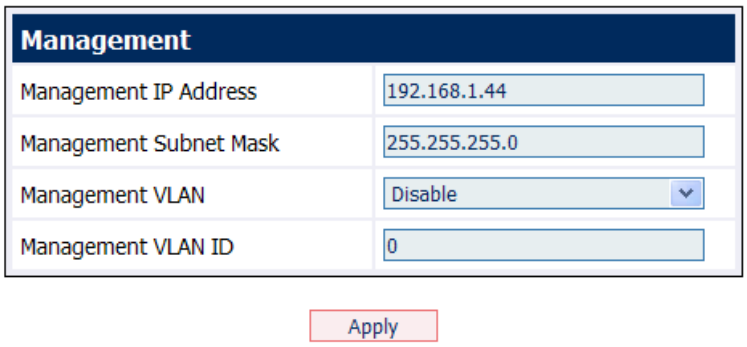


Figure 7:10 Management Settings

7.3.3.1 Management Settings – Field Descriptions

Field Name	Description
Management IP Address	This is the management IP address of the Radio. The default Management IP address is “192.168.1.44” Note: users should not use IP address 192.168.1.40 or the subnet 192.168.3.0/24 because these addresses have been reserved for internal purposes.
Management Subnet Mask	This is the management subnet mask of the Radio. The default Management Subnet Mask is “255.255.255.0”

Field Name	Description
Management VLAN	This is the option to enable or disable the Management VLAN The default Management VLAN setting is “Disable”
Management VLAN ID	This is the Management VLAN ID. This value should be in the range between 1 and 4095.

7.3.4 Gateway and Hostname Settings

This is the configuration procedure to configure the Gateway IP address and the Hostname of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 Product, click the “+” sign near the “Network Interfaces” at the left side of the page.
2. After pressing the “+” sign”, the “Network Interfaces” will expand showing “Gateway & Hostname”.
3. Now click on “Gateway & Hostname”.
4. Any of the parameters listed in the “Gateway & Hostname” page can be changed.
5. Once the Management parameters are changed click the “Apply” button below. This setting takes effect immediately without reboot.

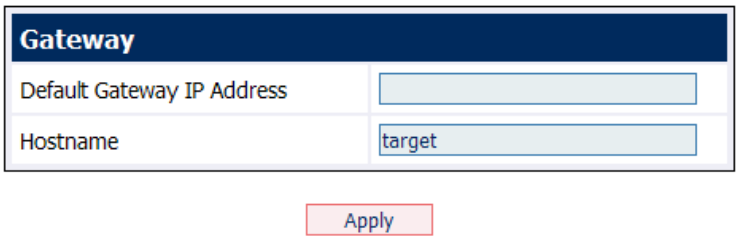


Figure 7:11 Gateway and Hostname Settings

Field Name	Description
Default Gateway IP Address	This is the Default gate IP for the radio. There is no default gateway IP configured. *Note: The Default Gateway IP Address should belong to the same subnet as the management IP address.*
Hostname	This is the hostname of the radio. The default Hostname is “target”

7.4 Network Services

7.4.1 DHCP Server Settings

This is the configuration procedure to configure the DHCP server parameters of the

LibraPlus 5860 product.

1. After logging into the LibraPlus Product, click the "+" sign near the "Network Services" at the left side of the page.
2. After pressing the "+" sign", the "Network Services" will expand showing "DHCP-SERVER". Now click on the "DHCP-SERVER"

Note: This link will be shown only in the "Master" mode

3. Any of the parameters listed in the "DHCP-SERVER" page can be changed
4. Once the DHCP server parameters are changed click the "Apply" button below.

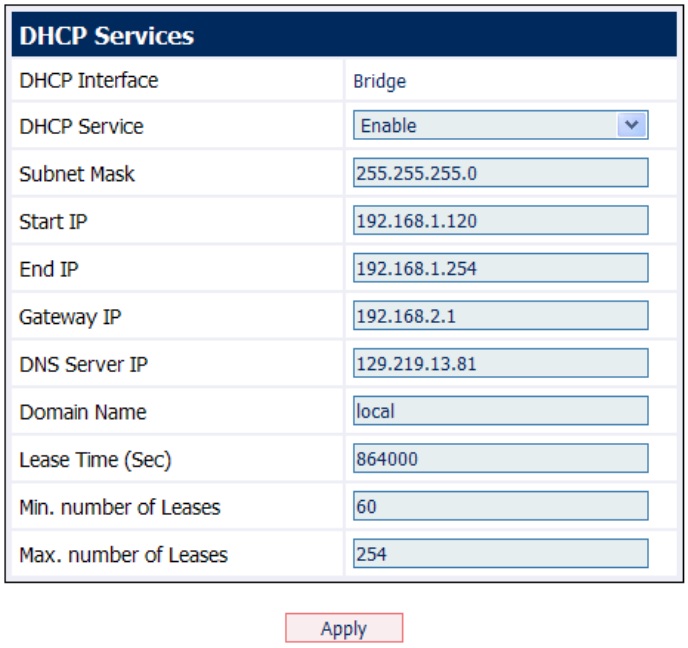


Figure 7:12 DHCP Server Settings

7.4.1.1 DHCP Server Settings – Field Descriptions

Field Name	Description
DHCP Interface	This is the interface on which the DHCP server runs on. This would be running only on the "bridge" interface. User will not be able to change this parameter.
DHCP Service	This is to enable or disable the DHCP Server. The default is "Disable"
Subnet Mask	DHCP subnet mask
Start IP	DHCP start IP *Note: This IP should be on the same subnet as the bridge IP*
End IP	DHCP End IP
Gateway IP	DHCP Gateway IP

DNS Server IP	DHCP DNS server IP
Domain Name	DHCP domain name
Lease Time	This is the renew lease time in seconds
Min. number of Leases	DHCP Minimum leases
Max. number of Leases	DHCP Maximum leases

7.4.2 DHCP Client Settings

This is the configuration procedure to configure the DHCP client parameters of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 Product, click the "+" sign near the "Network Services" at the left side of the page.
2. After pressing the "+" sign", the "Network Services" will expand showing "DHCP-CLIENT".
3. Now click on "DHCP-CLIENT"

Note: This link will be shown only in the "Slave" mode

4. DHCP client can be enabled or disabled
5. Once the DHCP client enabled or disabled click the "Apply" button below.

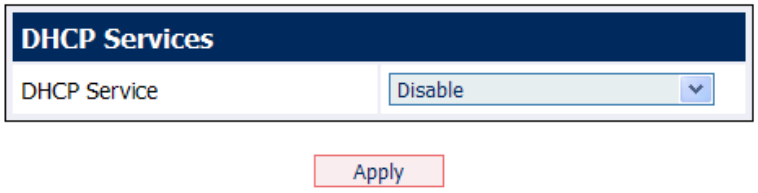


Figure 7:13 DHCP Client Settings

Field Name	Description
DHCP Services	This is to enable or disable the DHCP client. The default is "Disable"

7.4.3 SNMP Settings

This is the configuration procedure to configure the SNMP parameters of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 product, click the "+" sign near the "Network Services" at the left side of the page.
2. After pressing the "+" sign", the "Network Services" will expand showing "SNMP".
3. Now click the "SNMP".
4. The user can change the required parameters in the SNMP.
5. Once the SNMP parameters are modified click the "Apply" button below. This need a save and reboot to get the changes to be in effect.

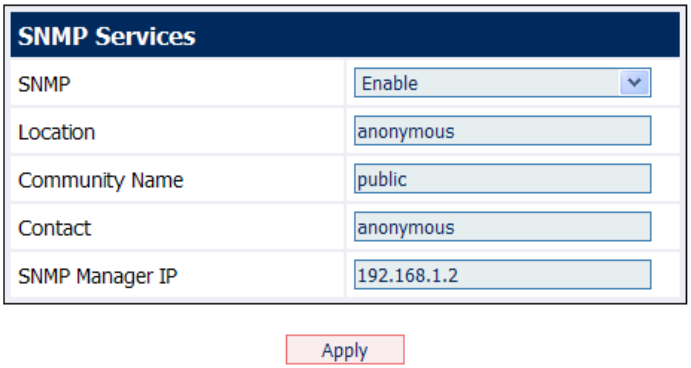


Figure 7:14 SNMP Services Settings

7.4.3.1 SNMP Settings – Field Descriptions

Field Name	Description
SNMP	This field is to enable or disable the SNMP services. The default SNMP setting is “Enable”
Location	SNMP Location information The default Location is “anonymous”
Community Name	SNMP community Name. The default Community Name is “public”
Contact	SNMP contact name The default Contact is “anonymous”
SNMP Manager IP	This is the SNMP Manager IP address. This is the IP SNMP would choose to send the traps. The default IP is “192.168.1.2”

7.4.4 Firewall and NAT

7.4.4.1 Firewall

Access Control Lists (ACLs) allow the LibraPlus to permit or deny packets from specific IP addresses to specific destination IP addresses and ports. They also allow the LibraPlus to specify different types of traffic such as ICMP, TCP or UDP.

Passing packets are compared to ACL entries based on the order that the entries occur in the list. New statements are added to the end. When a matching entry is found, the permit or deny action is immediately applied to the packet. For this reason, you should have frequently hit entries at the top of the list. In addition, the last ACL entry should be the default policy that blocks or transmits all the previously unmatched packets.

7.4.4.2 Network Address Translation (NAT)

Network Address Translation (NAT, also known as Network Masquerading) is a

technique of transceiving network traffic through a router that involves re-writing the source or destination IP addresses and usually also the TCP/UDP port numbers of IP packets as they pass through. EION refers to destination and source address translation as DNAT and SNAT respectively.

SNAT substitutes the packet source address with an explicit IP address. In most cases, the explicit address is one of the router network interface addresses. However, sometimes the router address is dynamic and is therefore not known at the time of NAT configuration.

DNAT and SNAT rules can be configured using the NAT menu. The setup of NAT is similar to ACL. Each NAT entry has a list identifier, an action, a source and a destination.

The difference is that snat and dnat rules have the "**to**" section, which describes an address or a range of addresses used for substitution. The "**to**" section may also be used to specify TCP/UDP ports to put into the translated packets.

7.5 System

7.5.1 Syslog Settings

This is the configuration procedure to configure the Syslog parameters of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 Product, click the "+" sign near the "System" at the left side of the page.
2. After pressing the "+" sign", the "System" will expand showing "Syslog".
3. Now click on "Syslog".
4. The user can choose "Enable" or "Disable".
5. Once the Syslog is enabled or disabled click the "Apply" button below.

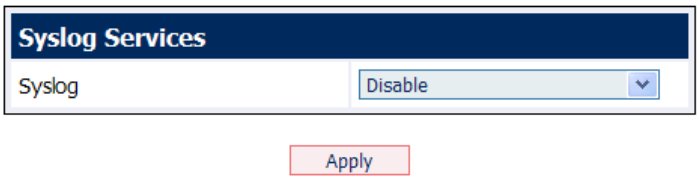


Figure 7:15 Syslog Settings

Field Name	Description
Syslog	This field is to Enable or Disable Syslog. The default value is "Disable"

7.5.2 Watchdog Timer Settings

This is the configuration procedure to configure the Watchdog parameters of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 Product, click the "+" sign near the "System" at the left side of the page.
2. After pressing the "+" sign", the "System" will expand showing "Watchdog

Timer".

3. Now click on "Watchdog Timer"
4. The user can "Enable" or "Disable" watchdog timer. The user also can also change the watchdog expiry timer value.
5. Once the Watchdog configuration is done click the "Apply" button below. If watchdog timer value is changed, then it will take effect on the next save and reboot.

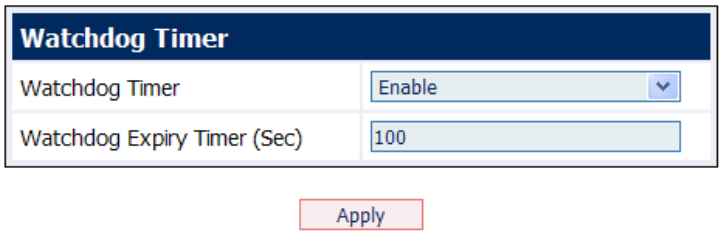


Figure 7:16 Watchdog Timer Settings

7.5.2.1 Watchdog Timer – Field Descriptions

Field Name	Description
Watchdog Timer	This field is to Enable or Disable Watchdog Timer. The default value is "Disable". *Note: If the watchdog timer is disabled, then the LibraPlus 5860 will request a reboot.*
Watchdog Expiry Timer	This is the watchdog timer value in seconds. The default value is "60" seconds. *Note: If the timer is changed the changes will not take effect until the next reboot.*

7.5.3 MAC Access List Settings

This is the configuration procedure to configure the MAC Access List parameters of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 Product, click the "+" sign near the "System" at the left side of the page.
2. After pressing the "+" sign", the "System" will expand showing "MAC Access List". Now click on the "MAC Access List"
3. The user can create and new MAC Access List name, by entering the access list name in the "MAC Access List Name" box and click the create button
4. All the MAC Access List Name will appear in the "Add MAC Access Entries" table. The user can choose the "MAC Access List Name" and enter the MAC entries for that particular MAC Access List Name.
5. Once the MAC Access List Entries are configured click the "Add" button below to add the MAC Address to a particular MAC Access List. If the user wants to

delete any MAC entries from the list, then enter the corresponding list name and MAC entry and then click “Delete” button.

6. In order for the new MAC address settings to take effect, the radio must be rebooted.

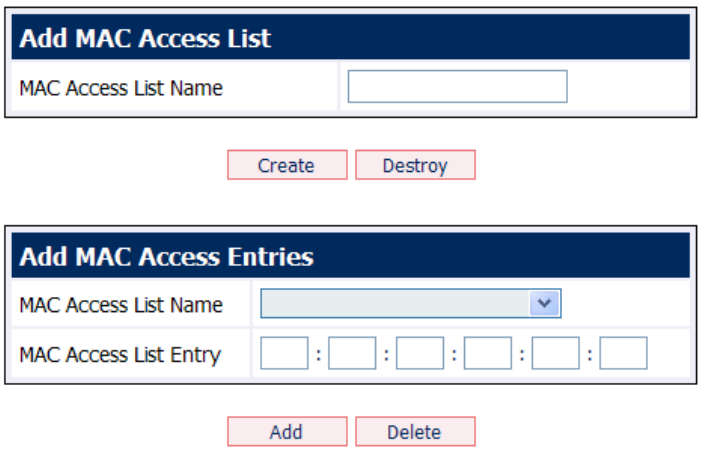


Figure 7:17 MAC Access Lists

7.5.3.1 MAC Access List – Field Description

Field Name	Description
MAC Access List Name	This is the MAC Access List Name. This is the name which would be added to the “Wireless Settings” to add the “White” or “Black” list peers.
MAC Access List Entry	This is the MAC entries added/deleted to the list

7.5.4 Date and Time Settings

Procedure for Date and time settings

1. After logging into the LibraPlus 5860 Product, click the “+” sign near the “System” at the left side of the page.
2. After pressing the “+” sign”, the “System” will expand showing “Date and Time Config”.
3. Now click on “Date and Time Config”.
4. Displays the current time and date set in the product.
5. The user can change the Date in the “Date” box.
6. The user can change the Time in the “Time” box.
7. Once the Date and/or Time are configured click the “Apply” button below to set them. This setting will take effect immediately.

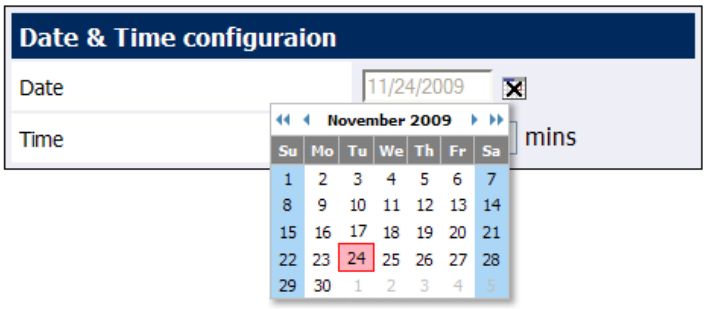


Figure 7:18 Date and Time Configuration

7.5.4.1 Date and Time Setting – Field Descriptions

Field Name	Description
Date	This is the Date that is currently set in the LibraPlus 5860 product.
Time	This is the Time that is currently set in the LibraPlus 5860 product.

7.5.5 User Password Settings

This is the configuration procedure to change the Password for the current username of the LibraPlus 5860 product.

1. After logging into the LibraPlus Product, click the "+" sign near the "System" at the left side of the page.
2. After pressing the "+" sign, the "System" will expand showing "User Password". Now click on the "User Password".
3. Type the new password in the "New Password" box for the current username.
4. Once the Password is modified click the "Apply" button below to set them. This change will take effect immediately.
5. If there is any error, then re-enter the values once again.

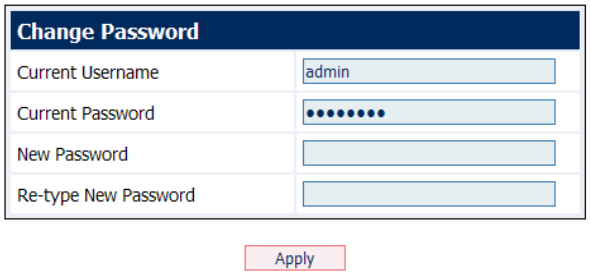


Figure 7:19 Change Password

7.5.5.1 User Password – Field Descriptions

Field Name	Description

Field Name	Description
Current Username	This is the current user name that is used in the LibraPlus 5860 product. The default value is “admin”
Current Password	This is the Current password for the user name that is used in the LibraPlus 5860 product. The default value is “admin123”
New Password	This is the new password for the current user name.
Re-Type New Password	This field verifies that no typos were made entering the new password.

7.6 SSH Access

SSH access to the LibraPlus is restricted for factory configuration only.

8 Monitoring Status

The LibraPlus 5860 contains several screens in the GUI that display the current status of the radio and the network. This is the procedure to check the status screens of the LibraPlus 5860 product.

1. After logging into the LibraPlus 5860 Product, click the "+" sign near the "Status" at the left side of the page.
2. After pressing the "+" sign", the "Status" will expand showing the available status screens.

> **Note: Some status screens will only be available on the "Master" side of the link.**

Status screens contain a "Clear" and a "Refresh" Button. The "Clear" button will clear the counters of the Network Status. The "Refresh" button will check the updated counters of the Network Status.

8.1 DHCP Leases

> **Note: DHCP Lease status is only available if the LibraPlus 5860 is configured as a "Master"**

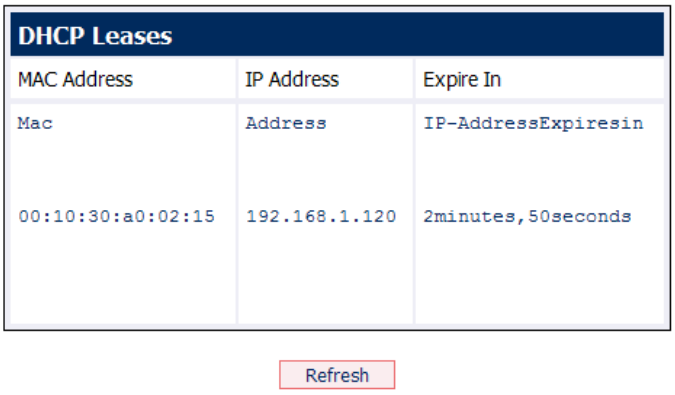
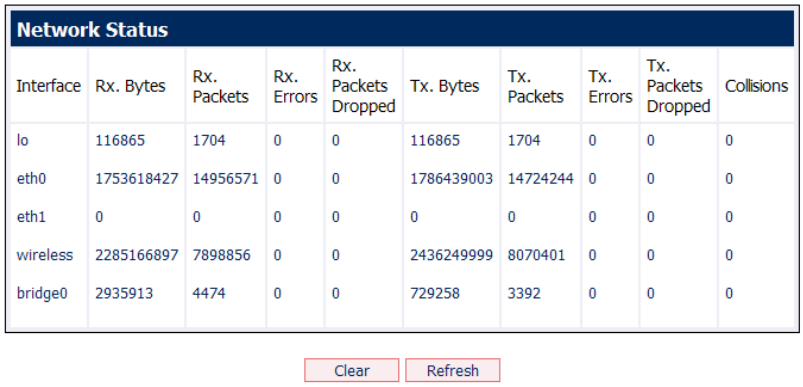


Figure 8:1 DHCP Leases Status

8.2 Network Status



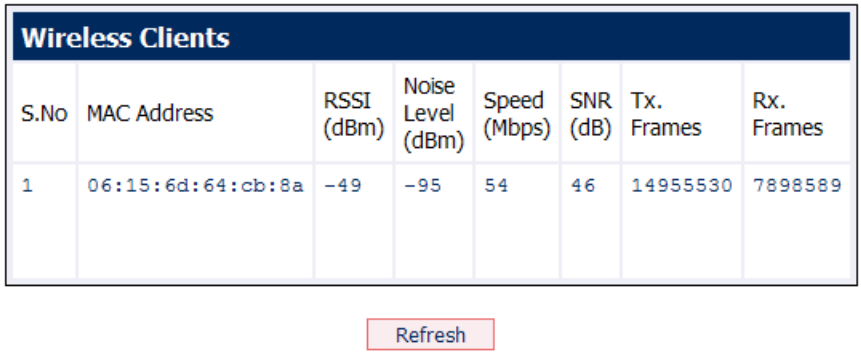
Network Status

Interface	Rx. Bytes	Rx. Packets	Rx. Errors	Rx. Packets Dropped	Tx. Bytes	Tx. Packets	Tx. Errors	Tx. Packets Dropped	Collisions
lo	116865	1704	0	0	116865	1704	0	0	0
eth0	1753618427	14956571	0	0	1786439003	14724244	0	0	0
eth1	0	0	0	0	0	0	0	0	0
wireless	2285166897	7898856	0	0	2436249999	8070401	0	0	0
bridge0	2935913	4474	0	0	729258	3392	0	0	0

Clear Refresh

Figure 8:2 LibraPlus 5860 Network Status

8.3 Wireless Status



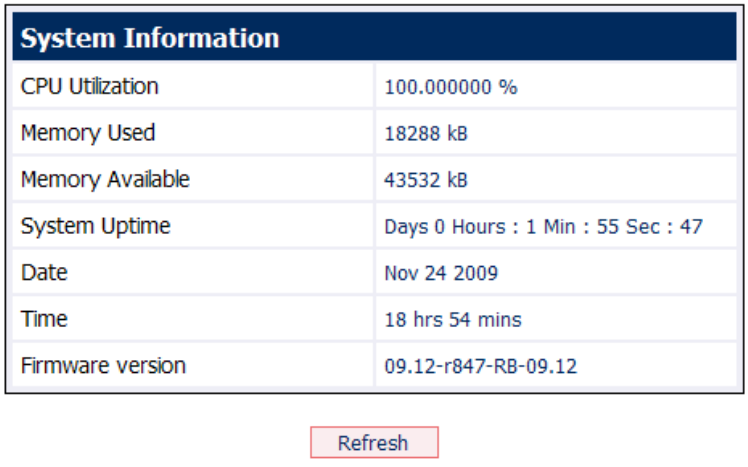
Wireless Clients

S.No	MAC Address	RSSI (dBm)	Noise Level (dBm)	Speed (Mbps)	SNR (dB)	Tx. Frames	Rx. Frames
1	06:15:6d:64:cb:8a	-49	-95	54	46	14955530	7898589

Refresh

Figure 8:3 LibraPlus 5860 Wireless Status

8.4 System Information



System Information

CPU Utilization	100.000000 %
Memory Used	18288 kB
Memory Available	43532 kB
System Uptime	Days 0 Hours : 1 Min : 55 Sec : 47
Date	Nov 24 2009
Time	18 hrs 54 mins
Firmware version	09.12-r847-RB-09.12

Refresh

Figure 8:4 LibraPlus 5860 System Information

8.5 Mac List Status

There are two steps to viewing a MAC list. First the list must be selected by checking the box and pressing the “Display” button. The selected MAC list will be displayed on the next screen.

Figure 8:5 Selecting the MAC List

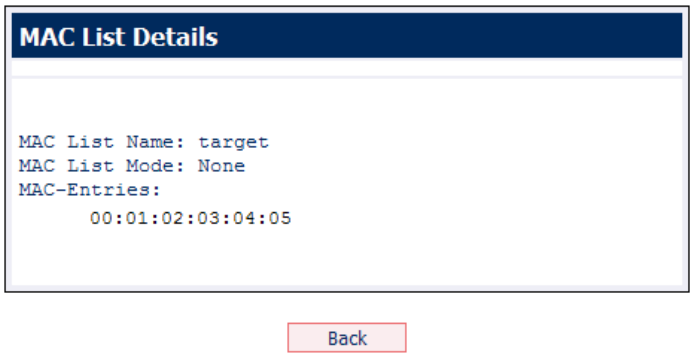


Figure 8:6 Displaying the MAC List

8.6 Bridge Status

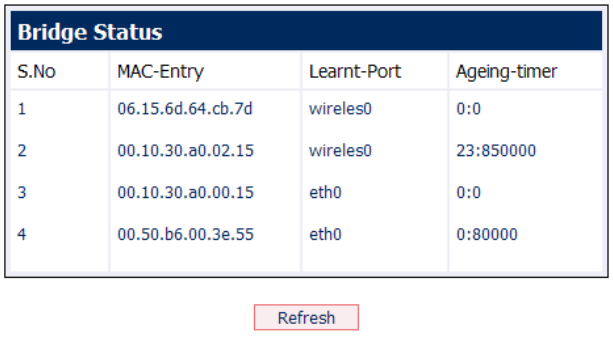


Figure 8:7 LibraPlus Bridge Status

8.7 Running Configuration

The Running Configuration Status Screen displays all of the configurable settings in the LibraPlus 5860 with their configurations.

Bridge Settings	
Bridge MAC Address	00:10:30:a0:00:15
Bridge IP address	192.168.1.44
Bridge Subnet Mask	255.255.255.0
Bridge MTU	1568
Bridge Status	UP

Wireless Settings	
Device Operational Mode	Master
Wireless MAC Address	06:15:6d:64:cb:7d
Wireless IP address	0.0.0.0
Wireless Subnet Mask	0.0.0.0
Wireless MTU	1568
ESSID	target
Mode	Turbo
Hide SSID	disable
Channel	42
Transmit Power (dBm)	14
Data Rate (Mbps)	0
ATPC	disable
WMM	enable
DFS	enable

Figure 8:8 Running Configuration

9 Utilities

The LibraPlus 5860 contains several utilities that are useful for installation and troubleshooting your wireless network. The Utilities are accessible via the "Maintenance" and "Diagnostics" Menus.

9.1 Maintenance

9.1.1 Save Configuration

This utility will save the current running configuration of the LibraPlus 5860 radio.

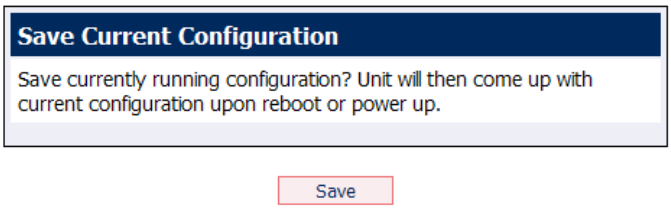


Figure 9:1 Save Configuration

9.1.2 Factory Default

The Factory Default utility will restore all configurable settings to their factory default configurations.

List of Factory Default Settings:

Field Name	Default Setting MASTER	Default Setting SLAVE
Wireless Settings		
Device Operation Mode	Master	Slave
Station ID (SSID)	target	target
Mode	normal	normal
Channel	36	auto scan
Transmit Power	14 dBm	auto
Data Rate	auto	auto
Wireless Transmission	ON	ON
DFS	Enable	Enable
Fast Frame	Enable	Enable
ATPC	Disable	Disable
WMM	Enable	Enable
MAC Access List Name	None	None
MAC Access List Mode	None	None

Field Name	Default Setting MASTER	Default Setting SLAVE
Distance	300 meters	300 meters
Beacon	100 ms	N/A
Wireless Security		
Authentication Type	None	None
Bridge Settings		
BRIDGE MTU	1568	1568
Bridge Ageing	300 seconds	300 seconds
Bridge Multicast Settings		
Multicast	Enable	Enable
Management Settings		
Management IP Address	192.168.1.44	192.168.1.44
Management Subnet Mask	255.255.255.0	255.255.255.0
Management VLAN	Disable	Disable
Username	admin	admin
password	admin123	admin123
Gateway Settings		
Default Gateway IP Address	<null>	<null>
Hostname	target	target
DHCP Server Settings		
DHCP Service	Disable	Disable
SNMP Settings		
SNMP	Enable	Enable
Location	anonymous	anonymous
Community Name	public	public
Contact	anonymous	anonymous
SNMP Manager IP	192.168.1.2	192.168.1.2
Syslog Settings		
Syslog	Disable	Disable
Watchdog Timer Settings		
Watchdog Timer	Disable	Disable
Watchdog Expiry Timer	60	60

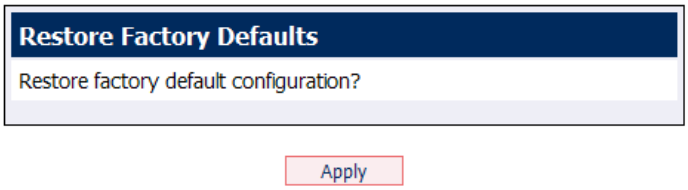


Figure 9:2 Factory Defaults

NOTE: The LibraPlus unit must be rebooted for the factory default settings to take effect.

9.1.3 Upgrade Firmware

The firmware of the LibraPlus 5860 radio can be upgraded via the GUI using the following procedure. The firmware upgrade procedure requires that the firmware package is saved in the root folder of the FTP server.

1. After logging into the LibraPlus Product, click the "+" sign near the "Maintenance" at the left side of the page.
2. After pressing the "+" sign", "Maintenance" will expand showing "Upgrade Firmware".
3. Now click on "Upgrade Firmware"
4. Enter the FTP server details like IP address, username, password and the file name. The FTP server must be accessible from the LibraPlus and configured in the same subnet. The new firmware package should be placed in the root directory of the FTP server.
5. Select the "Upgrade" button to upgrade the firmware. This configuration will take effect immediately. While giving the filename enter the complete path to the file.
6. If the file is downloaded from the FTP server and extracted correctly, Success message string will be displayed otherwise Failure message will be displayed to the user.
7. Reboot the LibraPlus 5860 for the new firmware load to take effect.

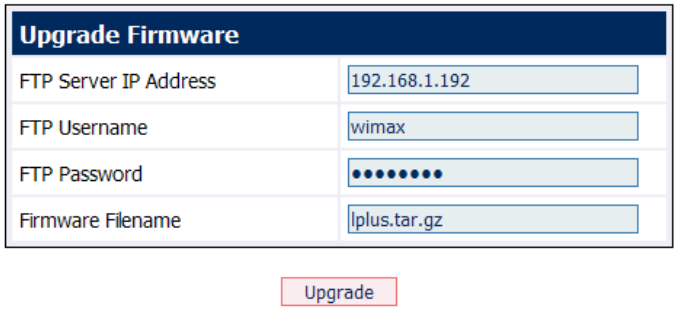


Figure 9:3 Firmware Upgrade Utility

9.1.4 Reboot

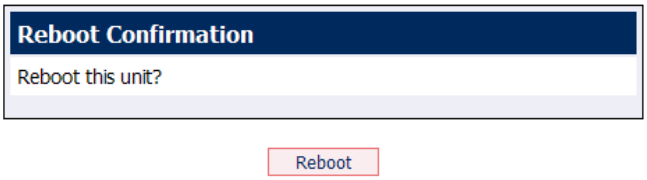


Figure 9:4 Reboot Utility

9.2 Diagnostics

9.2.1 Ping

The Ping Utility will ping the IP address entered from the LibraPlus radio and display the results.

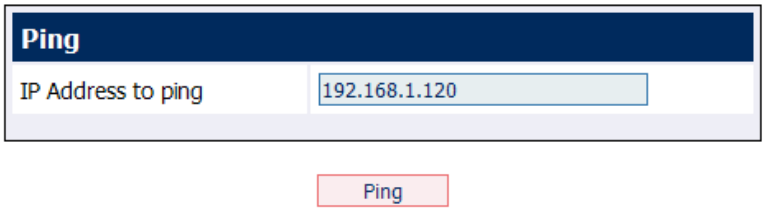


Figure 9:5 Ping Utility - IP Address Entry

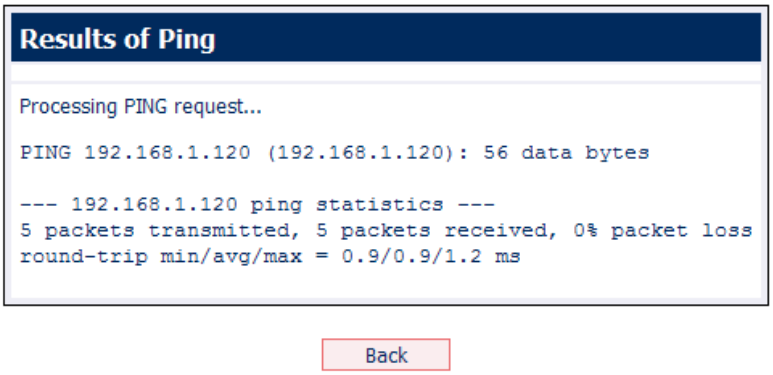


Figure 9:6 Ping Results

9.2.2 Traceroute

The Traceroute Utility will traceroute the IP address entered from the LibraPlus radio and display the results.

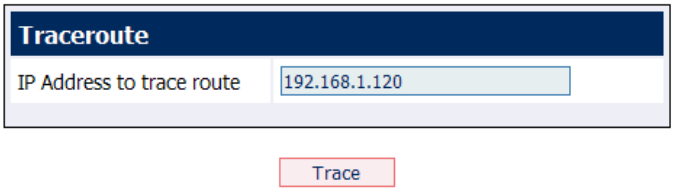


Figure 9:7 Traceroute Utility - IP Address Entry

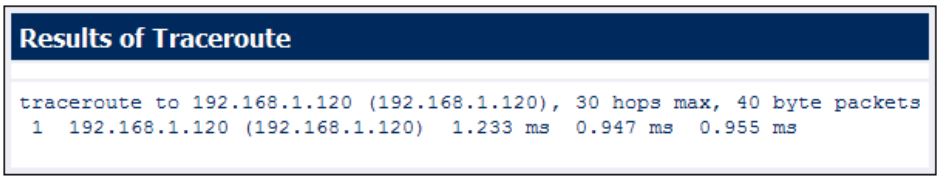


Figure 9:8 Traceroute Results

9.2.3 Link Monitoring

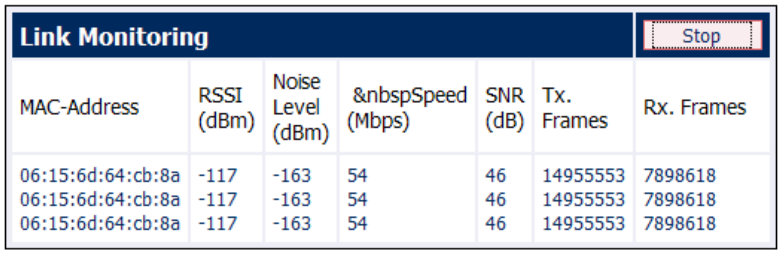


Figure 9:9 Link Monitoring

9.2.4 Scan AP

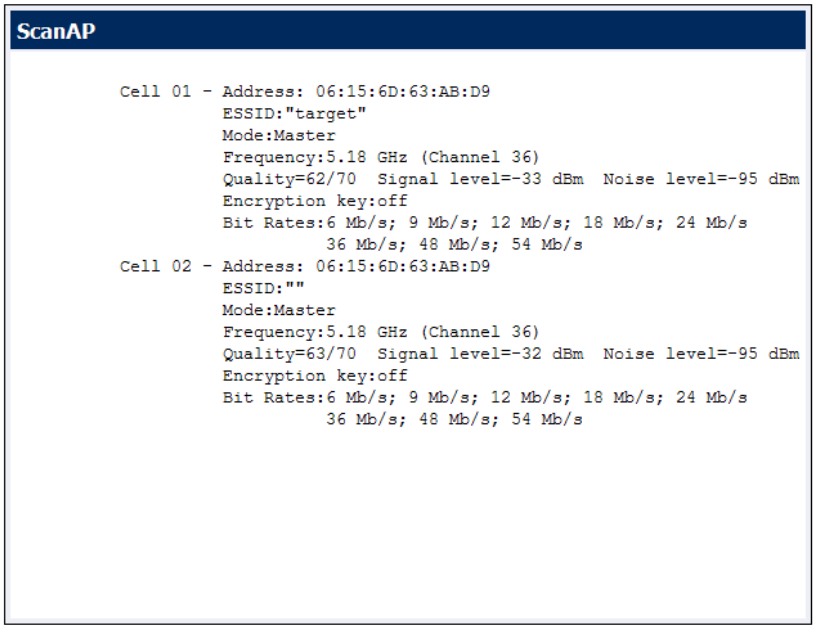


Figure 9:10 Scan AP

9.3 Syslog Message

This utility will display Syslog messages from the LibraPlus 5860 product.

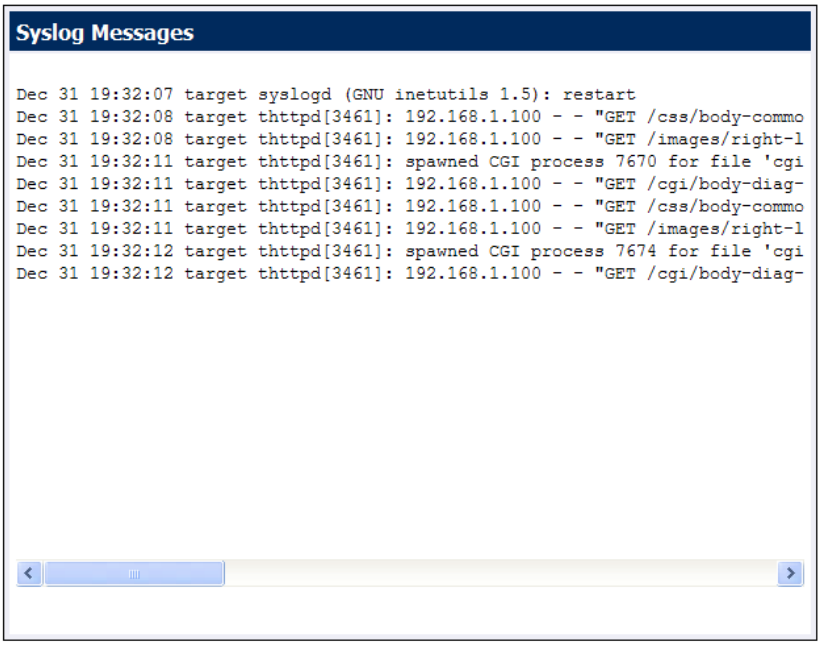


Figure 9:11 Syslog Messages

10 Appendix A: Troubleshooting

10.1 Preventative Maintenance

Administering and maintaining your system properly can prevent many problems and alert you to minor problems before they become serious. Some recommendations follow.

- Measure and document system performance at the time of the original installation.
- Change menu passwords so that only authorized people can reconfigure the system.
- Maintain the integrity of the system design when adding to or changing a system. The introduction of new elements to a system can cause problems unless you revise the network plan to take into account the changes. For example, improper installation of a co-located antenna can add unwanted system interference.
- Keep records of all changes. Especially document the addition of units, hardware and software changes, and changes to configuration settings. Configuration errors often cause other problems. Current records can be compared with original installation records and function as benchmarks to help in troubleshooting.
- Keep a log of past and present problems and solutions. Store the log on-site for easy reference, if possible. The log identifies common failure points and fixes. Before contacting EION's Technical Assistance Center, document the symptoms of the fault and the steps taken to diagnose and fix the problem. Record the current configuration of the system.
- Perform preventive maintenance at a regular interval, for example every six months.
- Perform link monitor tests to verify the system after periods of extreme weather, and inspect towers, antennas, ODUs, cables, and connectors for damage.
- Monitor system performance regularly. Environmental change as well as normal wear and tear on components can affect system performance.
- In some cases a bench test is a useful tool in diagnosing problems.

10.2 Troubleshooting Areas

There are four areas to keep in mind with troubleshooting:

1. **Network integrity:** The continued performance and reliability of a network depend upon maintaining the integrity of the network. If you change a network's design, you will affect its operation. Be aware of recent changes to your network.
2. **Quality of RF links:** Data communication depends first on good RF links. If you establish and maintain high-quality RF links, then you can be sure the links will carry high-speed data. If the quality of the RF links degrades for some reason, the quality of the data and the associated performance will also

degrade.

3. **Radio Hardware:** This consists of three parts: Main unit, antenna, and mounting hardware. To verify the radio performance, you can run diagnostic tests, such as RSSI and CINR.
4. **Correct Unit Configuration:** Units must be configured properly, according to the network plan. Configuration errors can cause an inability to communicate or poor performance. The addition of units or other changes to your system may require you to change configuration settings.

10.3 Troubleshooting Chart

Indication	Possible Cause	Corrective Action
High BER	Signal strength is too low	• Record RSSI to determine fade margin • Check for RF absorbent obstacles in the antenna path • Search for indirect RF paths between antennas (i.e. ones that use beneficial reflections or multipaths) • Check and replace cables if necessary • Reposition antenna or if possible remove obstruction
High BER	Signal strength is too high	• Adjust antennas • Increase distance between units to add attenuation • Adjust Tx Power level
High BER	Interference	• Change center frequency • Increase RF power • Change polarization of antennas • Increase separation or change location of antenna • Increase separation between co-located antennas
High BER	Radio Performance (Tx/Rx)	• Contact EION Inc. Technical Support

Indication	Possible Cause	Corrective Action
No Ethernet connection	Bad CAT-5 cable	• Visually inspect cable • Change cable
No Ethernet connection	Bad Connectors	• Visually inspect connectors • Change cable/connectors
No Ethernet connection	Temperature	• Determine if ambient operating temperature is too high or low • Change ambient temperature to specified range
Low signal strength or fade margin	Bad ratio	• Bench test system • Change LibraPlus unit
Low signal strength or fade margin	Poor antenna alignment	• Use RF diagnostics to realign antenna
Low signal strength or fade margin	Bad cable	• Visually inspect cables/connectors • Sweep cable • Change cable/connectors
Low signal strength or fade margin	Incorrect radio configuration	• Bench test the radio to confirm configuration • Reconfigure radio
Low signal strength or fade margin	No Fresnel zone clearance or severe NLOS	• Check LOS for obstacles such as trees • Change alignment of antenna to take advantage of beneficial multipath signals • Increase antenna height to obtain clearance • Move antenna to better location or remove obstacle if possible

Indication	Possible Cause	Corrective Action
High packet loss	Signal to strength too low	• Record RSSI to determine fade margin • Check for obstacles in RF path • Check for interference • Point antenna in different directions to take advantage of beneficial multipaths • Reposition antenna to establish better LOS • Replace LibraPlus and perform bench test
High packet loss	Interference	• Change center frequency • Increase RF power • Change polarization of antennas • Get separation or change physical location of antenna
High packet loss	Temperature	• Determine if ambient operating temperature is too high or low • Increase or reduce ambient temperature

Indication	Possible Cause	Corrective Action
No communication between units	Configuration problems	Check the following configuration settings: • MAC Address–Each unit must have a unique MAC Address • Center frequency–Units must have the same center frequency to communicate • IP address/subnet mask–Incorrectly configured • IP addresses result in units being unable to communicate. Check that IP addresses are unique for each unit within a subnet and that the correct subnet mask is being used.
Poor Link Performance	Distance	• Check the distance configuration setting on Slave
Poor Link Performance	Signal absorption	• Check LOS for obstacles such as trees • Change alignment of antenna to take advantage of beneficial multipath signals • Move antenna to better location or remove obstacle if possible
Poor Link Performance	Interference	• Set units from different systems in the same geographical area to different center frequencies. Overlapping wavelengths from other systems will degrade performance.
Poor Link Performance	Overpowering Co-located Unit	• Output power from one unit can overpower another, co-located, radio, even if units operate on different channels
New configuration will not take	Incorrectly upgraded software	• Reload the software image

Indication	Possible Cause	Corrective Action
Unable to access main configuration menu	Invalid Passwords	• Contact EION, Inc. for information about how to re-enter your system. • Units will need to be reset
Unit will not operate	Faulty unit	• Bench test unit
Unit will not operate	Corrupt unit software	• Reload unit software

11 Appendix B: Definitions

11.1 A

Absorption — Antennas mounted too close to “soft” objects, such as trees, may experience a reduction in signal strength due to absorption. Absorption is most often encountered in antennas installed during fall or winter. The problem does not start until the spring, when leaves appear.

Access Hub — A group of APs, each serving a group of CPEs. Also called a cellsite.

Access Point — The base station of the network. AP refers to the machinery - ODU, and antenna – that comprises the link with the wired network. Sometimes AP means the point where the wireless network touches the wired network.

Agent — An agent runs on each unit in a Simple Network Management Protocol (SNMP) context. An agent accepts configuration commands from the manager and collects network and terminal information specified in the Management Information Base (MIB).

Antenna — A device which takes electromagnetic energy from a circuit or wire and radiates it.

Antenna Gain — Gain of the antenna over a dipole antenna (dBd) or isotropic radiator (dBi). Gain measures of the ability of an antenna to amplify signals in its tuned band. Antenna gain comes from focusing the signal. A higher-gain antenna has a more tightly directed signal.

ARP — Address Resolution Protocol. This is low-level protocol that maps IP addresses to Ethernet addresses. An ARP request goes out to the network along with an IP address. The node with the address responds to the request with a hardware address so the transmission can take place.

ASCII — American Standard Code for Information Interchange. A system used by personal computers to convert letters, numbers and symbols into binary notation.

Automatic Frequency Control — A method by which the CPEs stayed tuned to the correct frequency for communicating with the AP, despite frequency variations caused by the hardware.

Attenuation — Any loss in signal strength, due to resistance, absorption, capacitance, or any characteristic of the medium or design of the system.

11.2 B

Bandwidth The size of a communications channel, measured in cycles per second. "Bandwidth" is often used as a synonym for data rate.

Base Station The central control unit of the wireless network. A base station polls remote units and routes traffic to them. The base usually connects to a major access point of main network.

Beamwidth The beamwidth of an antenna describes how a signal spreads out from the antenna, as well as the range of the reception area. Beamwidth is measured between the points on the beam pattern at which the power density is half of the maximum power. These are often called the -3 dB points. A high-gain antenna has a narrow beamwidth and may be more difficult to align.

BER The proportion of bits received with errors. The default measurement is per million sent.

Bit Error Rate.

11.3 C

Cable Loss The loss a signal experiences as it passes through a cable. Expressed in dB.

CAM Content Addressable Memory.

Channel The width of the spectrum band taken by a radio signal, usually measured in kilohertz (kHz).

Chip Rate Chip rate signifies the time occupied by a single frequency. Also the period of a code clock, or the output of a code generator during one clock interval.

CPE Customer Premise Equipment – the remote or subscriber unit in the EION Broadband Wireless Access System.

Co-Location Placing antennas in the same place. With proper frequency planning, one rooftop may host up to six antennas, each attached to a different AP ODU and Power inserter.

Coaxial Cable A type of wire that has an inner conductor surrounded by an outer conductor. The outer conductor also serves as an electrical shield.

Collision A collision occurs when two devices send signals over the same medium at the same frequency at the same time.

Community Names A kind of password. The Public Community Name offers read-only SNMP access to the AP and CPE. The Private Community name grants write access.

Configuration Menus The menus in the user interface on the Access Points that allows the operator to view and configure their parameters.

Cross-Polarization Discrimination

This specifies the signal isolation achieved when the receiving element of an antenna is perpendicular to the radiating element.

This is important when co-locating Access Points.

11.4 D

dB

Decibel. A relative measure used to specify power gains and losses. The difference between power P1 and power P2 expressed in dB is: $10\log_{10}(P1/P2)$

DB-9

A D-shaped connector to the serial port on EION equipment, with nine pins. Used to connect the IDU and PC.

dBd

dBd is antenna gain referenced over a half-wave dipole. This is an antenna with a doughnut-shaped radiation pattern. Gain of a Standard Dipole = 2.14 dBi.

dBi

dBi is antenna gain referenced to an isotropic radiator. This is a theoretical antenna that radiates equally in all directions, like the sun. EION references antenna gain in dBi. The conversion factor is 0 dBd = 2.14 dBi

dBm

A power measurement with respect to one milliwatt. This is an absolute measure of power rather than a relative measure such as a gain or a loss.

Default Gateway IP Address

This is the address of the gateway from the wireless network to the wired one. All packets bound for a destination on the wireless network must go here first. All packets meant for the next network must leave from here.

Diffraction

Diffraction occurs when a radio signal bounces off a solid object. The level of diffraction could lead to connectivity problems if the remaining signal level is too low. Two types of diffraction are shadowing and multipath.

Dipole

An antenna fed from the center. Antenna gains are often measured in relation to a standard dipole.

Downtilt

Some antennas have a downtilt or an uptilt. The tilt further focuses the signal either downward or upward with respect to the horizon. A tilt may be either electrically built into the antenna or achieved mechanically with the mounting gear. A downtilt or uptilt may be required when there is a significant deviation between the elevation of the remote sites and the base site.

Dynamic Time Allocation (DTA)

A process for determining how active a CPE is. A poll allows a unit a brief time to respond before considering that remote an idle one.

11.5 E

EEPROM Electrically Erasable, Programmable Read Only Memory: Nonvolatile memory, it must be removed from board to be erased.

EIRP Effective Isotropically Radiated Power. EIRP is the amount of power transmitted to the air by the antenna. EIRP levels depend on the power of the radio transmitter, the type of antenna, and the losses incurred in the antenna cable.

ERP Effective Radiated Power. The power radiating from an antenna taking into account the output power from the transmitter plus the antenna gain, less connector and cable losses.

ESD Electrostatic Discharge. Caused by static electricity. ESD Protection should be used to protect electronic components from damage.

11.6 F

Fade Margin The amount by which the system gain plus the total antenna gain exceed the path loss is called the fade margin. The fade margin is the number of dB that the received signal strength exceeds the minimum receiver sensitivity.

FEC Forward Error Correction. A method of correcting data errors without retransmission.

Filtering Filtering in remote stations limits certain data packets.

Flash A type of electrically erasable non-volatile memory that can easily be erased without removal from a unit. Using Flash, the Access Point can be upgraded in the field.

Fresnel Zone The line of sight between two antennas. It consists of one of a theoretically infinite number of a concentric ellipsoids of revolution that define volumes in the radiation pattern of a usually circular aperture. The cross glossdiv of the first Fresnel zone is circular. Subsequent Fresnel zones are annular in cross-glossdiv, and concentric with the first. Odd-numbered Fresnel zones have relatively intense field strengths and even-numbered Fresnel zones are nulls. Fresnel zones result from diffraction by the circular aperture.

Front to Back Ratio (F/B) Directional antennas focus the signal in a forward path, reducing the signal in the opposite direction. The proportion between the two is called the front-to-back ratio. A higher gain antenna typically has a greater F/B ratio.

Frost Loading A concern of antenna operation affected by low temperatures.

FTP File Transfer Protocol. A method of copying files from one site to another. An operator of EION equipment might use ftp to download software upgrades.

11.7 G

Gain — The ability of a device to amplify a signal. Gain is the ratio of output power divided by input power, usually expressed in decibels (dB). Gain can also be measured as an absolute value, referenced to an input signal of one milliwatt (dBm). For antennas, gain measures the ability of an antenna to focus a signal and is expressed in dBd (half-wave dipole reference) or dBi (isotropic radiator reference).

GPS — Global Positioning System. EION Broadband Wireless Access Systems installers may use GPS devices instead of maps and compasses to locate their unit and orient it toward another station.

11.8 I

Ice loading — A problem of antenna operation in cold countries. Ice collects on the antenna and degrades its performance.

IEEE — Institute of Electrical and Electronics Engineers.

Image — An image is a collection of configurations or settings for a particular device. The System Image File in the Access Point contains a collection of configurations used when the unit is rebooted.

Interference — Any signal that tends to hamper the reception of a desired signal. This is equivalent to jamming, except that interference is not hostile.

IP Address — A number assigned to a network node, domain, or subdivision. An IP Address consists of four numbers in the form *nnn.nnn.nnn.nnn*. The first two identify the network and subnetwork, and the last two identify unique nodes within the network. No two units may possess the same IP within a LAN.

IP Filter — Internet Protocol filtering allows the system administrator to permit only certain IP addresses to receive or send data using a CPE. This keeps non-subscribers from using the network.

ISM — Industrial, Scientific, and Medical. This is the family of license exempt radio bands in North America and some European countries. These are described in part 15.247 of the FCC regulation that defines the parameters for use of the ISM band in the U.S., including power outputs, spread spectrum, and noninterference.

11.9 L

LAN — A localized network linking computers, servers, printers and other peripheral devices. Typical configuration is within buildings or between closely situated buildings.

LOS **Line of Sight** **(Free Space)**	An unobstructed straight line between two transmitting devices. The transmission path is not established by nor dependent upon reflection, refraction or diffraction. As long as 60 per cent of the first Fresnel zone is clear, then it may be considered almost equivalent to LOS transmission.
Link budget	The amount of power, expressed in decibels, needed for a radio link to work.
Linktest	A method of proving a new radio link or troubleshooting an existing one. Linktest sends data packets in both directions and accumulates statistics on the data that indicate how well the link works.

11.10 M

MAC address	Media Access Control address. Alphanumeric characters that uniquely identify a network-connected device.
Management Port	The DB-9 port on the IDU to which a PC may be attached.
Manager	This element is installed on the network's host computer and is controlled by the network administrator when used in SNMP. From the host, the manager configures agents, or polls agents for information.
MIB	Management Information Base. A set of commands that you can execute using the SNMP Manager to access the MIB database. A standard MIB and a EION-customized MIB store information relevant to the operation of a wireless network.
Multipath Interference	As a radio signal travels, it may reflect off objects in the environment and take various paths to the receiver. As a result, the signal arrives at the receiver at different times, confuses the receiver, and causes bit errors and processing delays. A related type of interference is multipath fading, in which a reflected signal shifts out of phase with the original signal and cancels it.

11.11 N

Near Line of Sight (NrLOS): **Suburban**	NrLOS is a visually-obstructed line of sight between two transmitting devices but a straight line can still be drawn between them. Any combination of reflection, refraction and diffraction on a direct ray between the transmitter and receiver may have occurred.
Non Line of Sight (NLOS): **Dense Urban**	No line can be drawn between two transmitting devices. Total visual blockage has occurred between the transmitting and receiving devices. Extremely large amounts of reflection, refraction and diffraction can occur on a direct ray between the transmitter and receiver.

Null An RF signal component with a smaller amplitude than the rest of the RF signal in multipath interference. Nulls are caused by subtractive combination as a result of multipath fading.

Null Depth The ratio in dB between the strongest OFDM carrier and the weakest carrier in multipath interference. A null depth of zero indicates that there is no multipath reception.

11.12 O

Obstructed Line of Sight (OLOS) OLOS is a partially blocked elliptical cylinder, whose diameter depends on frequency and distance that can be drawn between two transmitting devices. An object is infringing or cutting into the cylinder. OLOS can occur in various degrees of severity. Large amounts of reflection, refraction and/or diffraction occur on a direct ray between the transmitter and receiver.

Urban

OFDM Orthogonal Frequency Division Multiplexing. A method of splitting the data stream into a number of channels, each transmitted simultaneously on a different frequency. Allows greater range with less power, higher data rates, less distortion and greater immunity to interference.

OFDM Station Type Configuration setting where the base and remote are defined. The APs are base stations. The CPEs are remote stations.

OID nodes Object Identifier Nodes. These are the individual nodes in an MIB. See SNMP and MIB.

Orthogonal An adjective that refers to the way the many carrier waves in a OFDM system affect each other. The carriers are spaced in such a way that the center frequency of each signal lies in the null spot of its neighbors. This minimizes interference.

Overhead Anything that reduces the payload capacity of a system is overhead, even if it is useful. Link monitor data determines transmission statistics, but it reduces the message-carrying capacity of the system and is considered overhead.

11.13 P

Packet Loss Occurs when one or more packets of data traveling across a computer network fail to reach their destination. Packet loss is distinguished as one of the three main error types encountered in digital communications; the other two being bit error and spurious packets caused due to noise.

Path Loss The total loss from one end of the path to the other. This includes propagation losses, cable losses, and any other losses that affect the system performance.

Ping A method of testing a link. Executing the ping command sends a signal to the remote station. The station returns the signal. If the signal comes back on time and intact, the link works. See Also **FTP**.

Polarization The orientation of the radiating element of an antenna with respect to Earth. The polarization of antennas is usually described as vertical, horizontal, or circular.

PN Pseudo-random noise. A code used to change a narrowband signal into a spread spectrum signal.

Point-to-Multipoint A wireless system with one base unit communicating with many remote units. In the BWS system, the AP is the base and the CPEs the remotes.

Point-to-Point The simplest wireless system, consisting of a base and a remote.

Polling The AP unit handles multiple CPEs by contacting them in the order they appear in the polling list. When an AP polls a CPE, they exchange data. The CPE cannot exchange information with the AP until it is polled again.

Polling List The order in which the AP contacts the CPEs in its sector.

Propagation Loss The weakening of a signal as it travels through the air. Expressed in dB.

11.14 Q

QAM Quadrature Amplitude Modulation. A kind of modulation that varies signal amplitude.

11.15 R

Reed-Solomon A way of accomplishing Forward Error Correction. Reed-Solomon describes a data block in such a way that errors in the data block can be detected and repaired without retransmission.

Remote Unit A unit that can communicate with a base station or other remote units. A remote unit forms a wireless link between a network segment and a base station. CPEs are the remote units in the BWS system.

RF Radio Frequency. RF communication uses electromagnetic waves propagated through space. Because of varying characteristics, radio waves of different lengths are used for different purposes and are usually identified by their frequency.

RF Center Frequencies EION Broadband Wireless Access Systems sometimes use two center frequencies. The AP transmits on one and the CPEs transmit on another.

RF Station ID This is a configurable number, from one to 2.048, that identifies an AP or CPE to the network.

RSSI Received Signal Strength Indicator. Strength of received signal expressed in dB. The Access Point measures RSSI as a fade margin value.

11.16 S

Sensitivity The minimum signal strength required for usable performance, expressed in dBm.

Shadowing Shadowing is a form of diffraction typically caused by antennas being mounted too close to a structure, where they lose a portion of the signal lobe due to reflection. The receiving antenna is in a shadowed area. To minimize shadowing, mount the antenna higher.

SNMP Simple Network Management Protocol. A protocol used to remotely manage a network element by polling, setting terminal values, and monitoring network statistics and events. It is the de facto internet work management standard, designed to provide a mechanism for exchanging management information in a TCP/IP based Internet environment.

SNMP NMS Trap IP Address This is the address to which all the alarms and event messages are sent.

Spectrum Analyzer An instrument that captures RF energy and displays its amplitude and frequency on a screen.

Spread Spectrum (SS) Any of a group of modulation formats in which an RF bandwidth much wider than the signal bandwidth is used to transmit data, resulting in a greater immunity to noise interference.

Straight-Through Cable A straight-through cable is wired the same at both ends. That is, pin one connects to pin one, pin two to pin two, and so on. Straight through cables are used to connect an IDU to a PC.

System Gain The maximum path loss that the system can support and produce usable data transmission.

System Image File The Access Point uses system image files to store system configuration settings. The default system image file is called the factory image and is used when the units are first powered up.

11.17 T

Telnet An Internet communications protocol that enables a computer to function as a terminal working on a remote computer. A computer with a network connection to an Access Point can telnet to any of the units and access their configuration menus.

11.18 U

Uptilt See Also **Downtilt**.

11.19 V

VSWR (Voltage Standing Wave Ratio) VSWR is the voltage ratio of minimum to maximum across a transmission line. A VSWR of 2.0:1 or less in an antenna is considered effective. Most antennas have a VSWR of 1.5:1. For example, when using a radio with a four-watt output with an antenna VSWR of 1.5:1, the reflected power will be 160 milliwatts.

VT 100 A terminal emulation system.

11.20 W

WAN Wide Area Network. A network covering a larger area than a Metropolitan Area Network which covers a city.

Wind loading A problem of antenna installation and operation.

11.21 Numbers

10/100 BaseT The Ethernet cable that connects the LibraPlus Unit to the wired network. 10- or 100-BaseT cable uses category three or five twisted pair wiring. Maximum length is 100 meters.

12 Appendix C: 5 GHz US Channel Spacing

5 Ghz US-Channel spacing 20MHz-Occupied Bandwidth 20MHz			
Max Tx-power	Channels	Frequencies (Mhz)	DFS-TPC Required
16dBm	36	5180	No
	40	5200	
	44	5220	
	48	5240	
23dBm	52	5260	Yes
	56	5280	
	60	5300	
	64	5320	
23dBm	100	5500	Yes
	104	5520	
	108	5540	
	112	5560	
	116	5580	
	120	5600	
	124	5620	
	128	5640	
	132	5660	
	136	5680	
	140	5700	
28dBm	149	5745	No
	153	5765	
	157	5785	
	161	5805	
28dBm	165	5825	

5 Ghz US-Channel spacting 10MHz-Occupied Bandwidth 10MHz			
Max Tx-power	Channels	Frequencies (Mhz)	DFS-TPC Required
16dBm	36	5180	No
	38	5190	
	40	5200	
	42	5210	
	44	5220	
	46	5230	
	48	5240	
23dBm	52	5260	Yes
	54	5270	
	56	5280	
	58	5290	
	60	5300	

5 Ghz US-Channel spacting 10MHz-Occupied Bandwidth 10MHz			
	62	5310	
	64	5320	
23dBm	100	5500	Yes
	102	5510	
	104	5520	
	106	5530	
	108	5540	
	110	5550	
	112	5560	
	114	5570	
	116	5580	
	118	5590	
	120	5600	
	122	5610	
	124	5620	
	126	5630	
	128	5640	
	130	5650	
	132	5660	
	134	5670	
	136	5680	
	138	5690	
	140	5700	
28dBm	149	5745	No
	151	5755	
	153	5765	
	155	5775	
	157	5785	
	159	5795	
	161	5805	
	163	5815	
28dBm	165	5825	

5 Ghz US-Channel spacing 5Mhz-Occupied Bandwidth 5MHz			
Max Tx-power	Channels	Frequencies (Mhz)	DFS-TPC Required
16dBm	36	5180	No
	37	5185	
	38	5190	
	39	5195	
	40	5200	
	41	5205	
	42	5210	
	43	5215	
	44	5220	
	45	5225	
	46	5230	
	47	5235	
	48	5240	

5 Ghz US-Channel spacing 5Mhz-Occupied Bandwidth 5MHz			
23dBm	52	5260	Yes
	53	5265	
	54	5270	
	55	5275	
	56	5280	
	57	5285	
	58	5290	
	59	5295	
	60	5300	
	61	5305	
	62	5310	
	63	5315	
	64	5320	
23dBm	100	5500	Yes
	101	5505	
	102	5510	
	103	5515	
	104	5520	
	105	5525	
	106	5530	
	107	5535	
	108	5540	
	109	5545	
	110	5550	
	111	5555	
	112	5560	
	113	5565	
	114	5570	
	115	5575	
	116	5580	
	117	5585	
	118	5590	
	119	5595	
	120	5600	
	121	5605	
	122	5610	
	123	5615	
	124	5620	
	125	5625	
	126	5630	
	127	5635	
	128	5640	
	129	5645	
	130	5650	
	131	5655	
	132	5660	
	133	5665	
	134	5670	
	135	5675	

5 Ghz US-Channel spacing 5Mhz-Occupied Bandwidth 5MHz			
	136	5680	
	137	5685	
	138	5690	
	139	5695	
	140	5700	
28dBm	149	5745	No
	150	5750	
	151	5755	
	152	5760	
	153	5765	
	154	5770	
	155	5775	
	156	5780	
	157	5785	
	158	5790	
	159	5795	
	160	5800	
	161	5805	
	162	5810	
	163	5815	
	164	5820	
28dBm	165	5825	

5 Ghz US-Turbo Mode-Occupied Bandwidth 40MHz-Non DFS channels			
Max Tx-power	Channels	Frequencies (Mhz)	DFS-TPC Required
	42	5210	No
	50	5250	Yes
	58	5290	
	152	5760	No
	160	5800	

13 Appendix D: Integrated Antenna Specifications

The specifications below apply to the integrated antenna that is included with the LibraPlus RD.

Electrical	
Regulatory Compliance	ETSI EN 302 085 V.1.1.2 (2001-02)
Frequency Range	5.15 – 5.875 GHz
Gain	23 dBi (min)
VSWR	1.7 : 1 (max)
3 dB Beamwidth	9°(typ)
Polarization	Linear Vertical or Horizontal
Sidelobes Level	ETSI EN 302 085 V.1.2.2 Range 1, TS1-TS3
Cross Polarization	-28dB (max)
F/B Ratio	-32 dB (max)
Input Impedance	50 (ohm)
Input Power	6W (max)
Lightning Protection	DC Grounded
Mechanical	
Antenna Dimensions (LxWxD)	305x305x25mm (max)
Weight	1.2 kg (max)
Connector	N-Type Female
Radome	Plastic
Base Plate	Aluminum with chemical conversion coating
Environmental	
Low Temperature (IEC 68-2-1)	-55 C for 72h

High Temperature (IEC 68-2-2)	+71 C for 72h
Temperature Cycling (IEC 68-2-14)	-45°C to +70°C, 3 cycles, 1h
Vibration (IEC 60721-3-4)	30 min/axis, Random 4M3
Shock Mechanical (IEC 60721-3-4)	4M3
Humidity (ETSI EN300-2-4 T4.1E)	95%, 144 h
Water Tightness (IEC 529)	IP67
Solar Radiation (ASTAM G53)	1000 h
Flamability (UL 94)	Class HB
Salt Spray (IEC 68-2-11 Ka)	500 h
Ice and Snow	25mm Radial
Wind Speed Operation (Survival)	160 km/h (220 km/h)
Wind Load Survival Front TH (SideTH)	26.8 kg (2.2 kg)

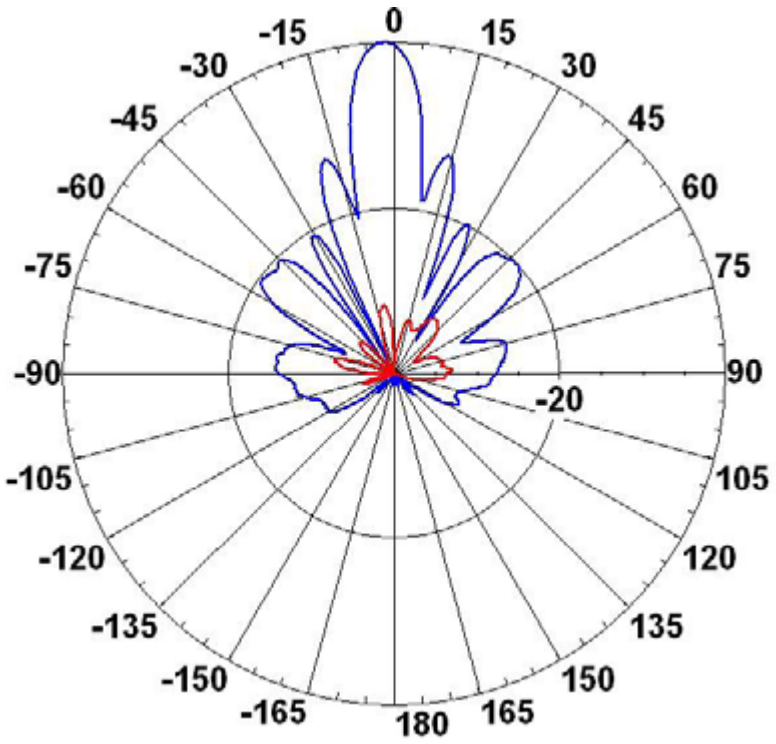


Figure 13:1 Azimuth Radiation Pattern Midband Freq. 5.45 GHz

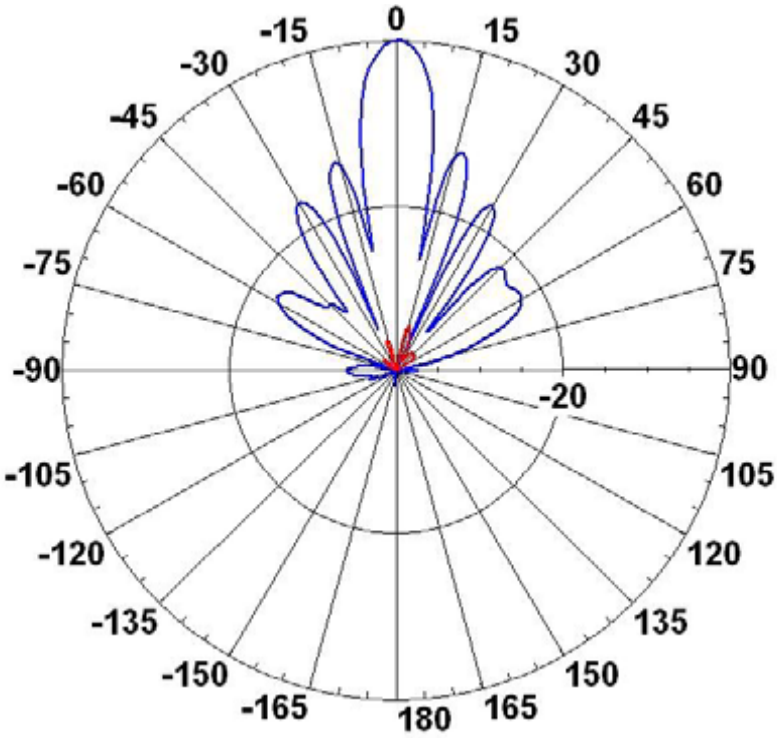


Figure 13:2 Elevation Radiation Pattern Midband Freq. 5.35 GHz