BridgeWave
COMMUNICATIONS

BW64
Installation Guide

045-57012 Rev ~~A~~ B

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Export Control

All BridgeWave radio products are restricted commodities that fall under ECCN 5A002 of the Department of Commerce. These products are "ENC restricted" under section 740.17(b)(2) of the Export Administration Regulations (EAR). BridgeWave products may only be exported, re-exported, transferred, or retransferred in accordance with Export Administration Regulations. Diversion contrary to U.S. law is expressly prohibited.

Product Compatibility

While every effort has been made to verify operation of this product with many different communications products and networks, BridgeWave makes no claim of compatibility between its products and other vendors' equipment. It is assumed that users have thoroughly evaluated this product's performance in the communications environment in which it will be used.

Safety

CAUTION, WARNING, and DANGER statements have been strategically placed in the text to alert personnel of possible hazards. These statements must be closely observed.

The following general safety precautions must be observed during all phases of operation and service of the products covered in this manual. Failure to comply with these precautions or with specific warnings elsewhere in this manual willfully violates standards of design, manufacture, and intended use of the product. BridgeWave assumes no liability for the customer's failure to comply with these requirements.

- *These BridgeWave radios meet all applicable FCC and Industry Canada (IC) safety requirements for general population exposure to radio frequency emissions; however, it is best to avoid prolonged, unnecessary exposure to the front of the radio while it is operating.*
- *The outdoor equipment must be properly grounded to provide some protection against voltage surges and built-up static charges. In the event of a short circuit, grounding reduces the risk of electrical shock.*

  For installations in the U.S.A., refer to Articles 810830 of the National Electrical Code, ANSI/NFPA No. 70, for information with respect to proper grounding and applicable lightning protection for DC cables. The installer must also follow any additional local building and electrical code regulations.

  For installations in all other countries, implement protection in accordance with the safety standards and regulatory requirements of the country where the equipment is to be installed.
- *Do not install or operate this equipment in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.*
- *Do not install substitute parts or perform any unauthorized modification to the equipment. Changes or modifications not expressly approved by BridgeWave can void the user's authority to operate the equipment.*

Regulatory Information

This device complies with FCC Part 15.255 and Industry Canada RSS-210.

Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and,

(2) This device must accept any interference that may cause undesired operation.

French Translation:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

(1) l'appareil ne doit pas produire de brouillage;

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Equipment Precautions

Water and Moisture - These BridgeWave radios are designed to withstand weather conditions typically encountered when installed outdoors.

Power information

A suitable transient voltage suppressor shall be installed if the length of the DC supply cable exceeds 140 feet.

The power supply for the equipment shall be a listed ITE power supply of Listed Class II power unit rated at +/-37.5 to 60VDC, minimum 60Watts.

When used with the optional POE64 kit, the PoE Extractor accepts a ±37.5 to ±60VDC, minimum 60Watts input from an external Power Supply Equipment (PSE) source.

RF Radiation Safety, Maximum Permissible Exposure (MPE) Limits

Regarding guidelines for Human exposure limits to Radio Frequency (RF) electromagnetic fields, the BW64 product has been evaluated for compliance with FCC OET Bulletin 65 and human exposure limits recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), IEEE, and adopted by ANSI.

BW64 devices, utilizing 10inch (25.4cm) integrated antennas and BW64E devices utilizing 2ft (60cm) diameter antennas, are below the General Population/Uncontrolled Exposure limits of 1 mW/cm^2, and well below the Occupational/Controlled Exposure limit of 5mW/cm^2 at a distance of 82.02 centimeters for the BW64 and 206 centimeters for the BW64E.

Product Changes or Modifications

Users of this equipment are hereby cautioned that changes or modifications not expressly approved by the party responsible for the compliance could void the user's authority to operate the equipment

~~*The BW64unit, utilizing internal 10" diameter antenna is below the General Population/Uncontrolled Exposure limits of 1 mW/cm^2, and well below the Occupational/Controlled Exposure limit of 5mW/cm^2 at any Near-Field, Transition, or Far-Field distance region including the antenna surface.*~~

Restricted Access

This product is for installation in a restricted-access location, where there will be no access to the equipment, except by trained service persons.

Table of Contents

1 Introduction

1.1 Purpose

The information in this guide is directed to persons who must perform or coordinate the tasks associated with the process of installing wireless communication devices, and planning communication network applications.

1.2 Prior Knowledge

This manual assumes the operator has at least basic experience with and an understanding of wireless technology and some familiarity with configuring and operating networking equipment. Preferably, the person installing this equipment fully understands the information covered in this manual prior to attempting these procedures.

DANGER, WARNING and **NOTE** statements have been placed in various sections throughout this document to alert personnel of possible traffic affecting issues and to provide additional tips and helpful information. These statements should be closely observed.

Symbol	Description
	*Indicates that personal injury can result if the user does not comply with the given instruction.* *A DANGER statement will describe the potential hazard, its possible consequences, and the steps to perform to avoid personal injury.*
	*Indicates that equipment damage, process failure and/or loss of data can result if the user does not comply with the given instructions.* *A WARNING statement will describe the potential hazard, its possible consequences, and the steps to perform to avoid serious equipment damage.*
	*Provides supplementary information to emphasize a point or procedure, or provides a tip for easier operation.*

1.3 Contact Information

Technical Assistance and Customer Service

BridgeWave distributors and resellers are authorized local service providers and are responsible for immediate Tier 1 customer support. If a problem cannot be resolved, contact BridgeWave Customer Service for assistance:

Regional Standard Support

Available Monday through Friday from 8:00 AM to 5:00 PM UTC local time, per region.

NAM (North America) UTC -8

+1 (408) 567-6906

EMEA (Europe, Middle East, and Africa) UTC +0

+1 (408) 457-6658

APAC (Asia Pacific) UTC +8

+1 (408) 457-6659

 Note	*The UTC coverage times do not reflect daylight saving time adjustments.*

E-mail: support@bridgewave.com

Return Material Authorization (RMA)

Should BridgeWave equipment have to be returned for repair or replacement, an RMA number must be obtained from BridgeWave. When returning equipment, be sure to write the RMA number on the outside of the shipping carton, and follow instructions received from support upon approval of the RMA.

BridgeWave Sales

For questions pertaining to the purchase of equipment, software licenses, warranties, or services please contact sales at the following:

E-mail: sales@bridgewave.com

Inside Sales: +1.866.577.6908

2 Site Planning

2.1 General

Before the start of an installation, a survey should be conducted of the proposed area of the site(s). The survey personnel should be familiar with the details required to install the BridgeWave radio system.

2.2 Equipment Checklist

The person performing the survey will need the following equipment:

- Binoculars
- GPS Navigation Device
- Tape Measure
- Site Survey Report Form

2.3 Line of Sight

Clear line of sight (LOS) is required for proper operation. Planning should include an investigation into future building plans that could block the LOS path, and other long-term incremental obstructions, such as trees. Intermittent obstructions, such as aircraft at a nearby airport, should also be considered.

The following table details the minimum clearance needed from obstacles near the path in order to ensure the radios will operate properly.

Path Length (meters)	Minimum Clearance (meters)
250	0.56
500	0.79
750	0.97
1000	1.12

Table 2-1: Minimum Clearance at Mid Path for Various Path Lengths

2.4 Link Distance Limits

Measurement of the link distance is important in estimating the link availability and calculating the expected Receive Signal Level (RSL). This measurement can be performed using the Latitude and Longitude readings from a Global Positioning System (GPS) device, which is placed near the proposed locations of the antennas.

The minimum link distance of the BW64 is 65 feet (20 meters).

The maximum distance of the BW64 is dependent on the desired level of availability and the rain rate associated with the region where the product will be installed. BridgeWave provides an Availability Calculator which uses industry standard formulas for determining regional rain rates and estimating availability percentages for a given distance. To obtain the latest version of BridgeWave's Availability Calculator, contact BridgeWave's Customer Service or search the eService center knowledgebase at www.bridgewave.com/support/kbrma.htm

2.5 Antenna Location

The optimum location for the antennas must be determined. The ideal location should provide for ease of erecting and mounting the antenna, as well as unimpeded LOS to the other site. The following factors should be taken into account:

- Type of mounting—wall or pole
- Location where the cabling will enter/exit the building
- Length of cable runs
- Grounding connection points
- Potential path obstructions
- Accessibility

Warning	*There is a finite incline and decline range of the elevation adjustment when installing the radio link.* *The mount can only accomplish +/- 30 degrees from the mechanical elevation adjustment.*

2.6 Cabling & Power Requirements

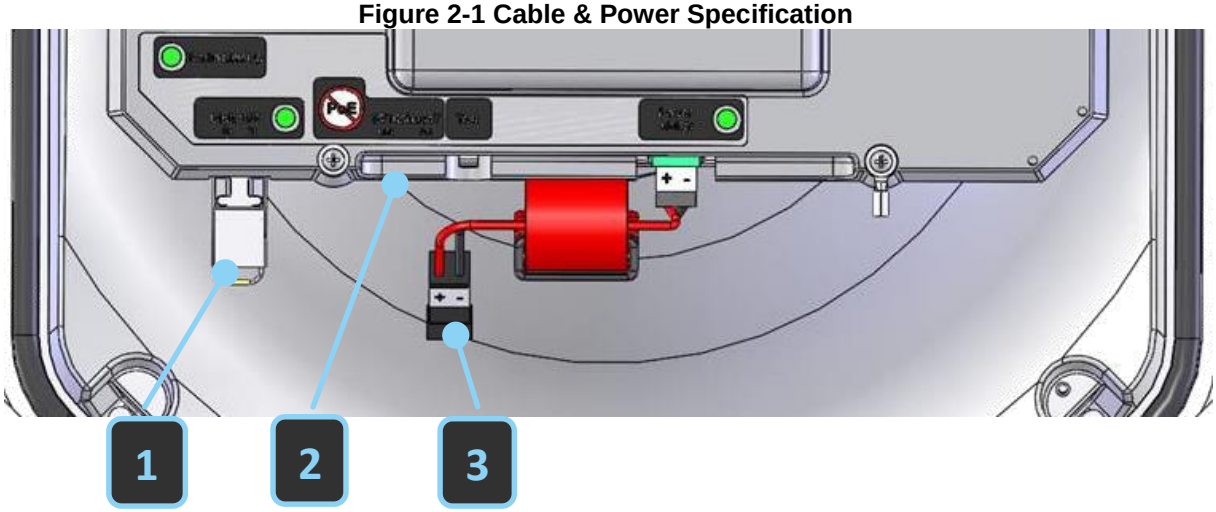
Inspect the installation site to determine the cable run paths from the radio equipment to the termination point. Locations for roof penetration should be identified. The routing and securing of all cables should conform to all applicable codes and requirements.

Cabling and power requirements depend on whether the optional POE64 kit is installed or not, and whether the 10/100BaseT port will be used for out of band management or AdaptPath features. When the POE64 kit is not installed the GigE SFP port allows for selection of various SFP types.

Form

Figure *2-1* ~~*Figure 2-1*~~ and **Error! Reference source not found.** ~~*Figure 2-2*~~ provide diagrams for installations with and without the optional POE64 kit and outline the power requirements, SFP options, cable types and lengths accordingly.

Figure 2-1 Cable & Power Specification

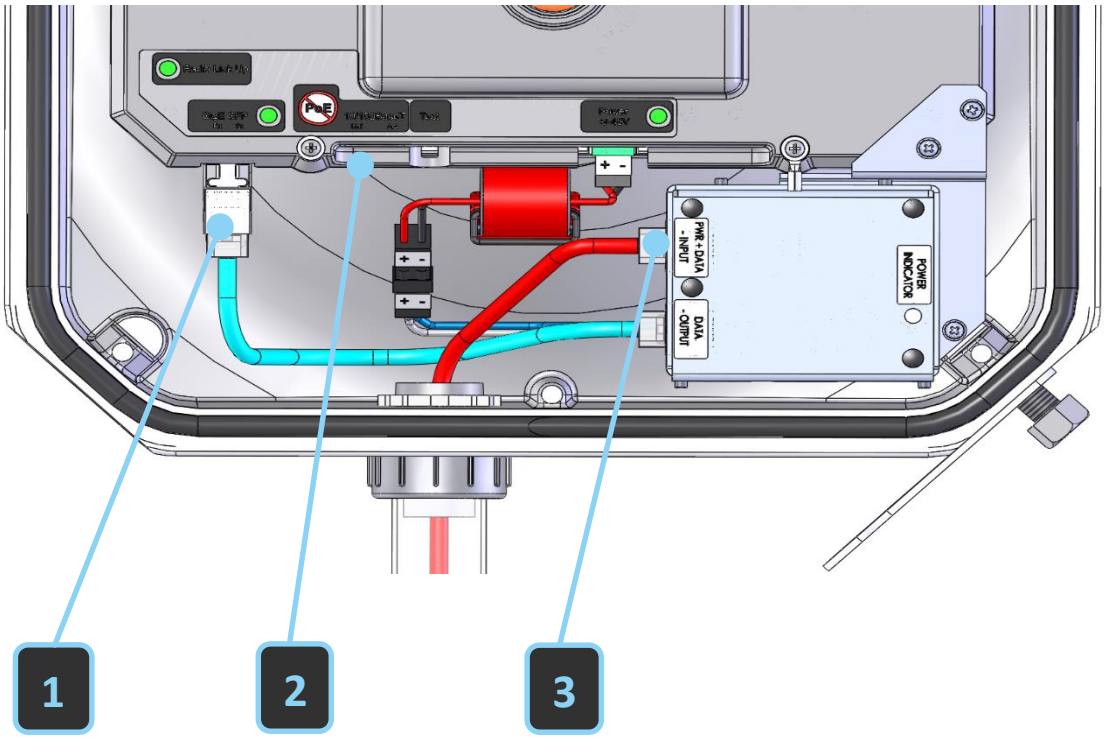


1 - GigE SFP		
Part #/Type	**Part #**	**Cable Type/Length**
171-00511 1000Base-SX GigE, multi mode, 850nm LC Connector		62.5/125µm MMF 270m 50/125µm MMF 500m
171-00512 1000Base-LX GigE, single mode, 1310nm LC Connector		9/125µm SMF 10km
171-00513 1000Base-T GigE RJ45 Connector		Cat5e/Cat6 100m

2 – 10/100BaseT (Optional for Out of Band Management)	
Cable Length	**Cable Type**
100 meters	Cat5

3 – Power +/-48V	
Power Requirements	**Cable Type**
+/-37.5 to 60VDC 45W Max Power Dissipation ***(Recommend Min 60W Power Source)***	12 AWG - Stranded ($4mm^2$) -or- 14 AWG - Stranded ($2.5mm^2$)

Figure 2-2 Cable & Power Specification (With POE64 Kit Option)



1 - GigE SFP		
Part #/Type	**Part #**	**Cable Type/Length**
171-00513 1000Base-T GigE RJ45 Connector (Supplied with POE64 Kit)		Cat5e Jumper (Supplied with POE64 Kit)

2 – 10/100BaseT (Optional for Out of Band Management)	
Cable Length	**Cable Type**
100 meters	Cat5

3 – Power & Ethernet ("Surge" port of POE64 Extractor)	
Power Requirements	**Cable Type/Length**
56 VDC 45W Max Power Dissipation ***(Recommend Min 60W PoE Power Source)***	Cat5E or Cat6 100m

2.7 Example Cabling Diagrams

Figure 2-3~~Figure 2-3~~ and Figure 2-4~~Figure 2-4~~ depict example diagrams for typical terminal installations for scenarios with and without the use of the optional POE64 kit.

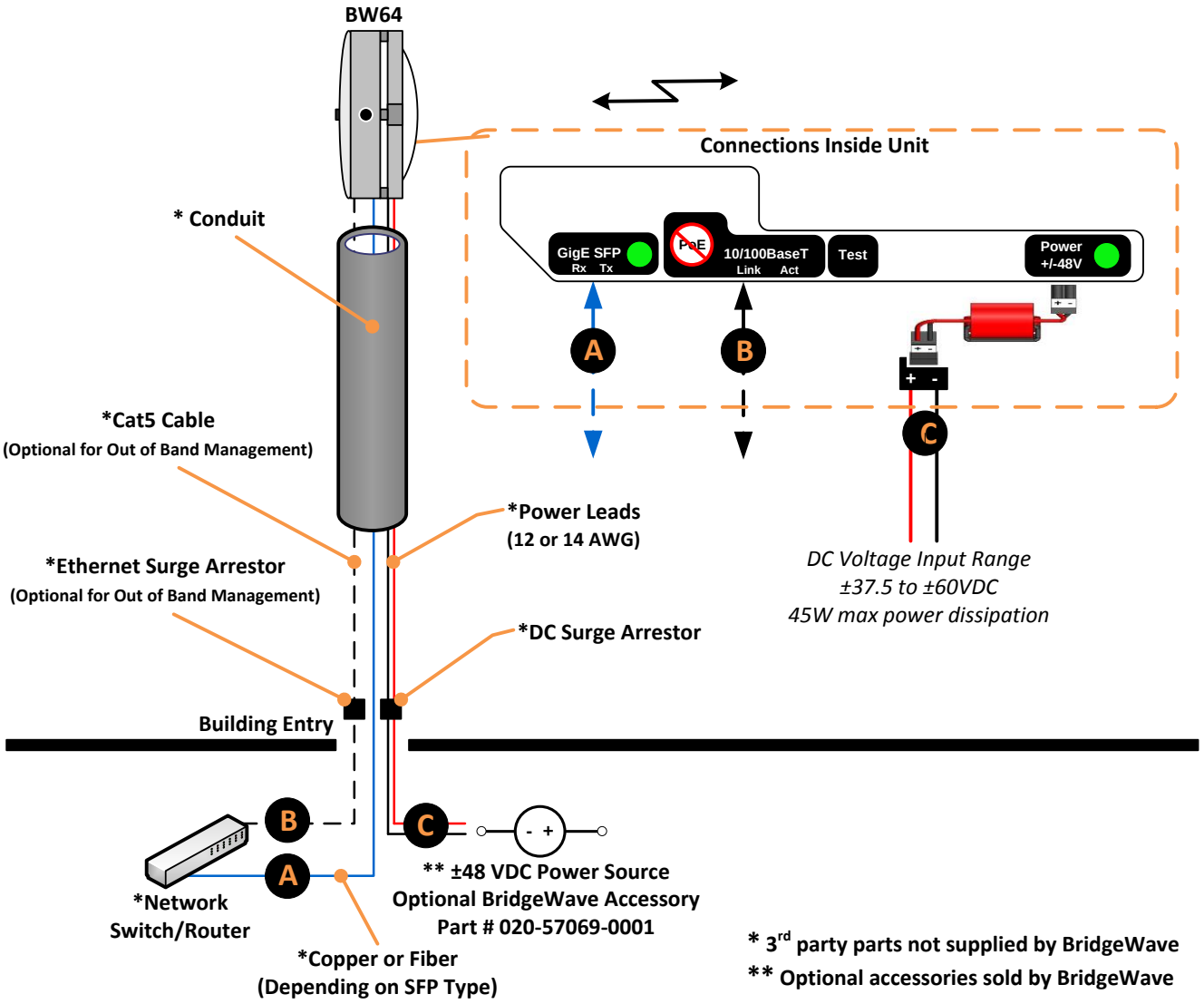


Figure 2-3 Example Terminal Diagram (Without Optional POE64 Kit)

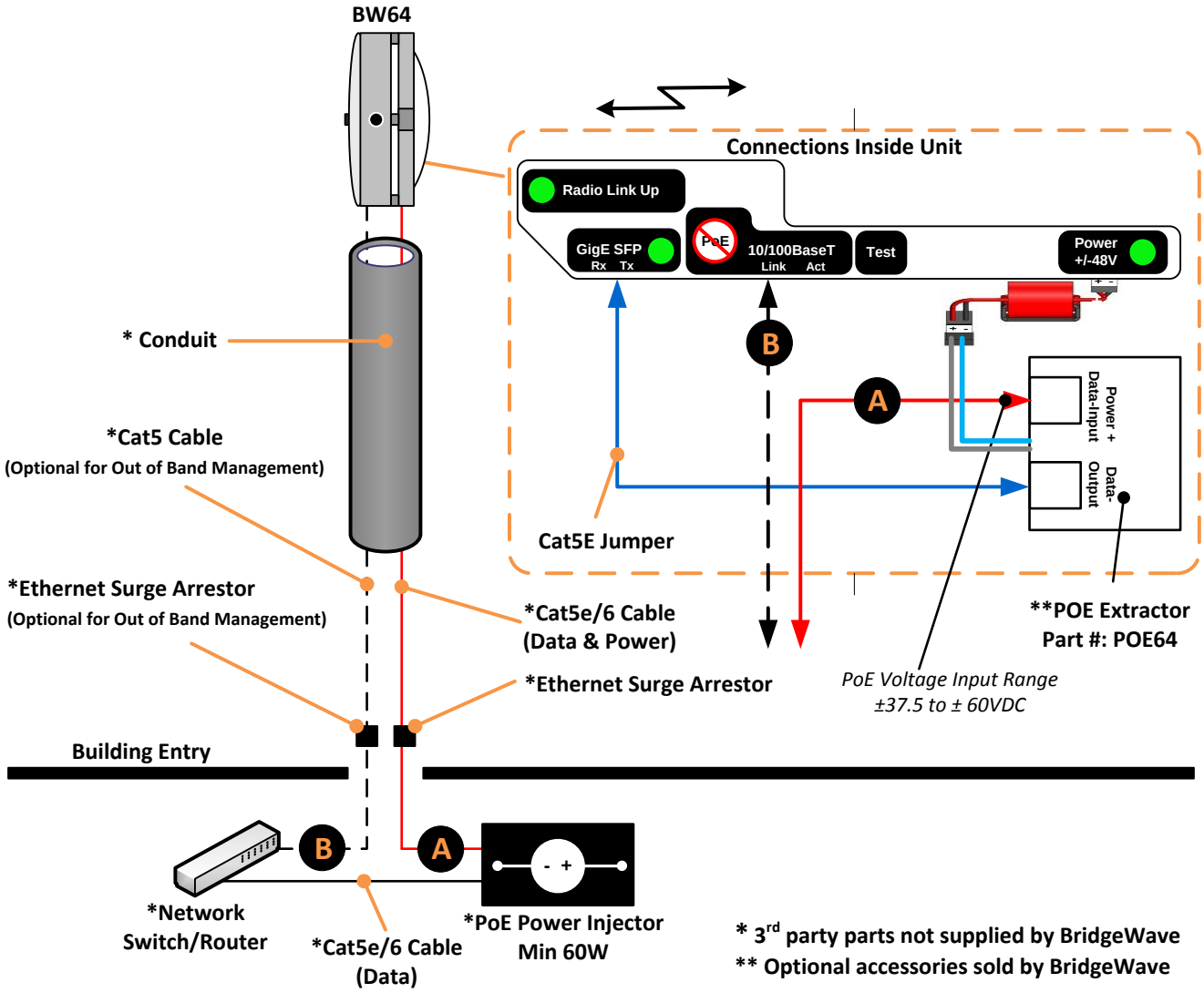


Figure 2-4 Example Terminal Diagram (With Optional POE64 Kit)

2.8 Grounding & Lightning

	*Proper grounding of the outdoor equipment reduces electromagnetic interference, provides lightning protection, and protects against electrical discharge.* *Using improper techniques in lightning-prone geographic areas may pose a danger to local personnel.* *The source and connection points for the building-to-earth ground in the vicinity of the antenna location should be determined.*

It is recommended to integrate the radio ground into the building ground utilizing the pole-mount hardware. For wall or ungrounded pole mounts, connect a grounding wire to the grounding point on the radio. Select the size of the ground wire based on the National Electrical Code.

In addition to grounding the equipment, **BridgeWave strongly recommends,** and local building codes may require, that the DC electrical cable, and or copper Ethernet cables are protected from lightning strikes by the use of surge suppressors.

The surge suppressor must be installed at the point where the cables exit/enter the building, however, use of a surge suppressors at the radio unit are optional because surge suppression is built into the unit.

	*For more information on recommended accessory devices and kits, contact BridgeWave Sales.*

2.9 Conduit

Conduit is recommended for enclosure of the cables as they enter the radio. The conduit provides a water-tight entry to the radio, as well as weather or physical protection required by the cables.

The conduit should be flexible, waterproof, and non-metallic. An example of this is LIQUID-TUFF™ UL Liquid tight Flexible Non-Metallic Conduit (Type LFNC-B) or equivalent.

Conduit should be 3/4 inches (19 mm) in diameter to match the radio's opening.

A drip loop should be created to ensure sufficient length to enable the radio to be moved during servicing and to prevent water from following the conduit down to any junction box or building entrance. A suggested length is 24 inches (60 cm) from the radio to the bottom of the loop. The opposite end of the conduit is inserted into the cable tray if on a tower or attached to a NEMA or junction box.

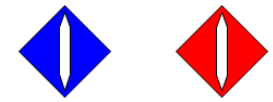
3 Installation

3.1 Overview

It is recommended that installation personnel read this section in its entirety prior to installing the system.

3.2 Equipment Unpacking

Inside the main packaging box there will be a box containing a low-band unit and another box containing the high-band unit. Check the site plans to determine which band will be installed at each location and then locate the desired box (low-band or high-band) accordingly before beginning installation. It is recommended that the shipping cartons and packing materials be retained in the event that it is necessary to return any equipment.

Note	*Unpacked radios can be identified by the color of their labels found on their front faces or inside the unit after removing the plastic back weather cover. The blue color label indicates a high-band radio and the red color label indicates a low-band radio.* 

Warning	*Avoid applying force to the antenna radome as this may damage the internal feed horn. Never rest the unit on a surface with the radome facing down.*

3.3 Equipment Inventory

The following is a typical inventory lists for each site.

Table 3-1 Equipment Inventory List

Part Number	Qty (Per Site)	Description
BW64-L or BW64-H	1	BW64 Low Band or BW64 High Band unit
1047-410-00614	1	YOKE, MOUNTING BRACKET
1047-410-00615	1	BRACKET, WALL MOUNTING
1047-410-00616	4	BRACKET, POLE-MOUNT
1047-411-00600	1	SHIM,BRACKET,TEFLON
1047-420-00549	1	CBL ASSY, TEST, PROD (RSL and Quality Test Cable
1047-425-00526	1	HARD RESET BOX
1047-515-00790	1	ASSY, PWR, CONN, POLARIZATION (Green DC Connector)
1047-651-00507	1	TOOL, 9/16 INCH COMBINATION WRENCH
1047-370-00600	10	BOLT, 3/8-16 UNC X 3/4, SS
1047-370-00601	18	WASHER, 3/8, SPLIT,SS
1047-370-00604	4	3/8-16 UNC X 9,ROD,ALL-THREAD,SS
1047-370-00605	12	NUT, 3/8-16 UNC,HEX,SS
1047-370-00608	1	WASHER,#8,FLAT,SS
1047-370-00613	1	SCR,#8-32 UNC X 3/8,PHIL,PAN,SS
1047-370-00693	18	WASHER,FLT,3/8,0.81 OD,0.06 THK,SST

Additionally, the following accessories are available as optional parts for use with the BW64:

Table 3-2 Optional Equipment List

Part Number	Qty (Per Site)	Description
020-57069-0001	1	PWR SUPPLY,48V AC/DC,90W,BRK PWR SUPPLY - Isolated and Connectorized - (Optional for non Power over Ethernet applications)
POE64	1	BW64 POE EXTRACTOR KIT (Required only for Power over Ethernet applications)
515-00913	1	ICE SHIELD FOR INTEGRATED ANTENNA

Warning	*The radio is sealed at the factory warranty stickers on the inner (metal) cover of the radio. There is no need to open this cover in the field. Tampering with these seals will void the warranty.*

3.4 Installation Tools

The following tools, not provided by BridgeWave, should be used for installing the radio:

- Screwdriver, slotted 0.1 inch (2.5mm) wide
- Ratchet with 6 inch (15cm) extension and 9/16 inch (14mm) deep socket
- Wire stripper/cutter/crimp tool (10-16 gauge)
- Electrical tape
- Fish tape for pulling cable
- Cable tie wraps
- Hand-held DVM (digital voltmeter) with standard banana plug receptacles

3.5 Radio Mount Installation

3.5.1 Wall Mounting Option

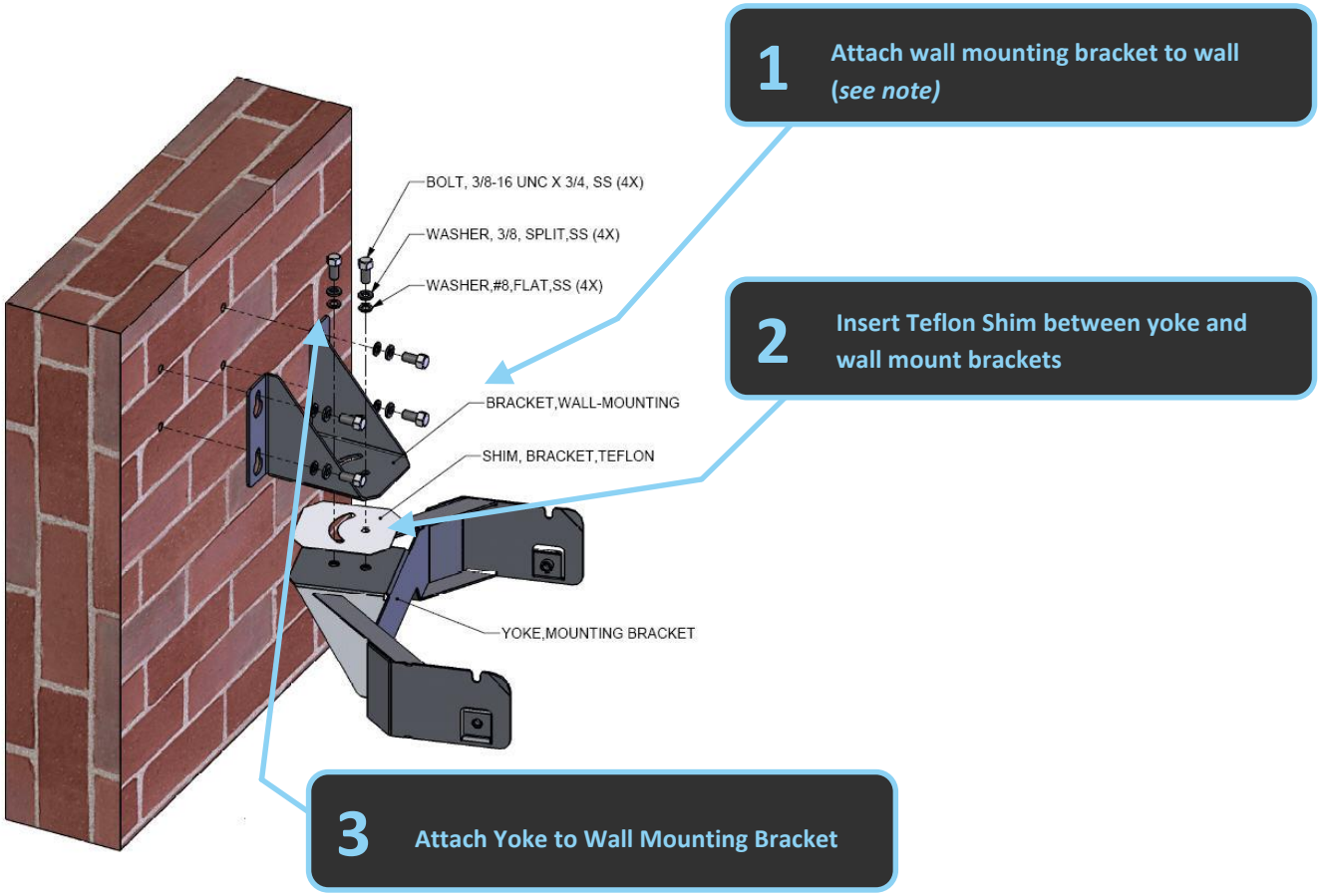


Figure 3-1 "Wall Mount" Installation Steps

Note	*The bolts (normally ⅜-16) should extend 0.8 to 3.0 inches (2cm to 7.5cm) from the wall and be strong enough to secure the radio to the wall under foreseeable environmental conditions. The environmental conditions may include, but not limited to, wind, rain, ice, etc. Depending on the wall material the mount is being attached to, a different size bolt may be appropriate. In this case, bolts up to ¾ inch in diameter may be used.*

3.5.2 Pole Mounting Option

The pole mount kit can be used to secure the mount to a pole with diameter from 2.0 to 4.5 inches (5 to 11.5 cm).

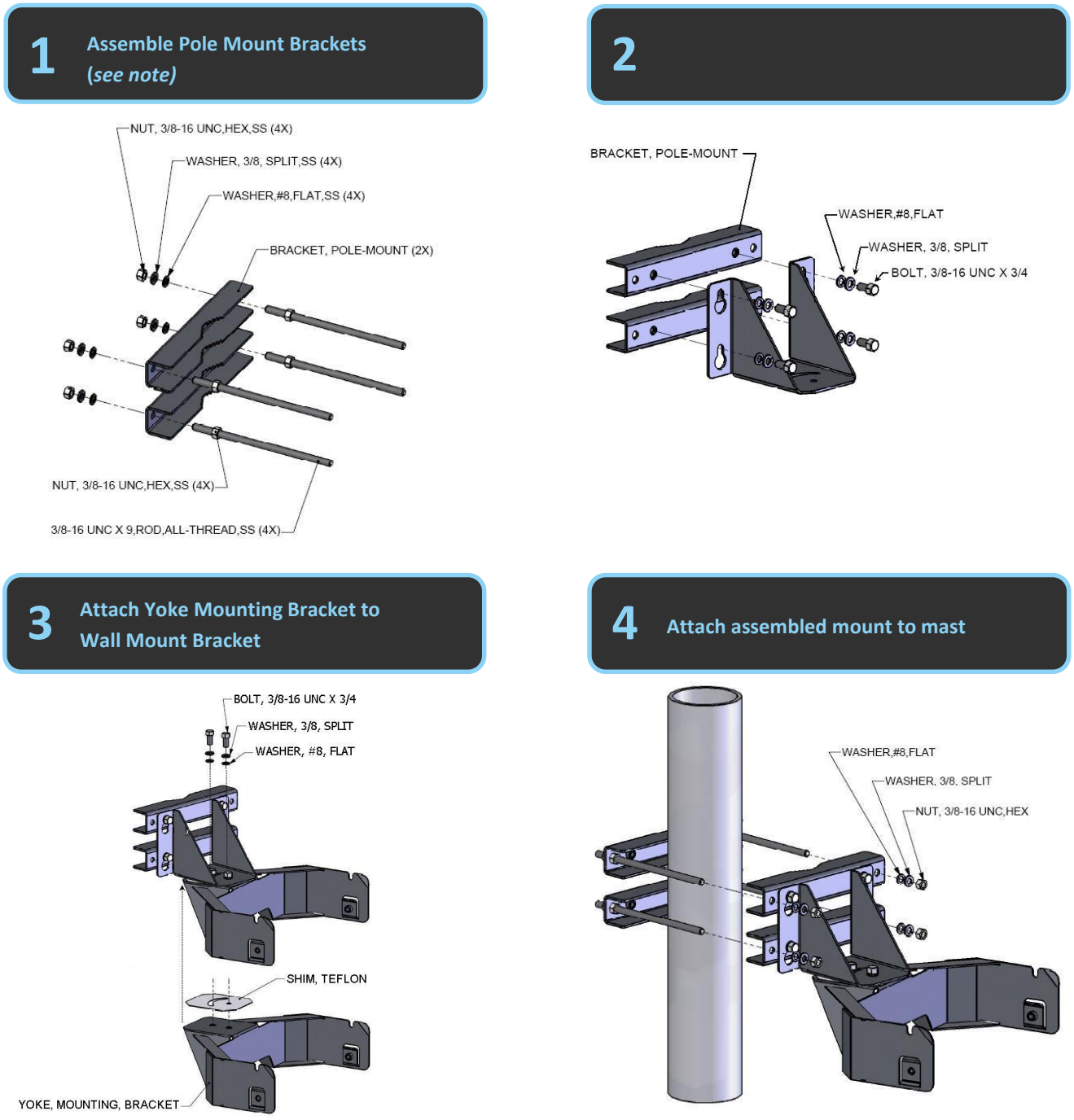


Figure 3-2: 'Pole Mount' Installation Steps

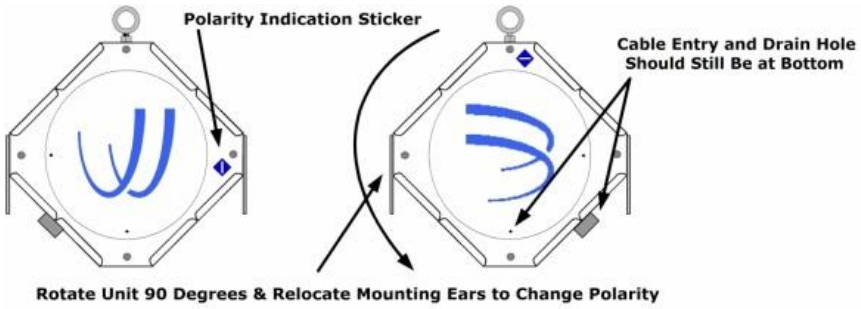
Note	*The nuts on the inside of the pole mount brackets do not require any washers since they are only holding the threaded rods in place and to not bear any load.*

3.6 Radio Installation

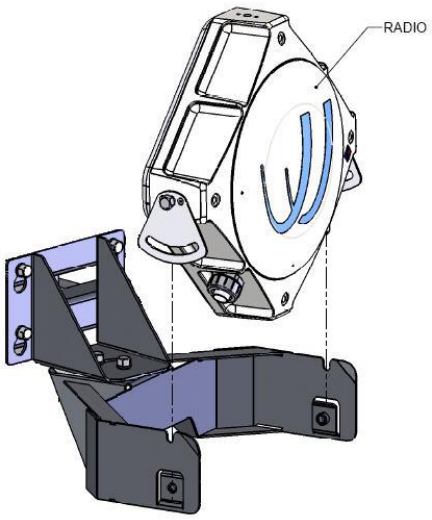
1

a. Locate polarity sticker

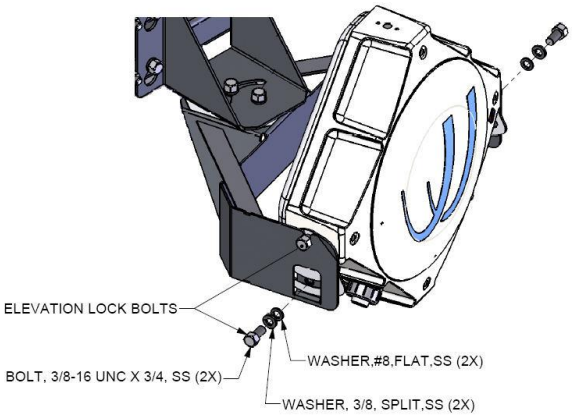
b. Orient unit so that line is left to right for horizontal or up and down for vertical.



2



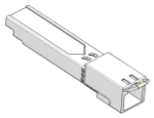
3 Install the lower elevation lock bolt



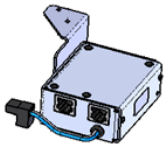
 Note	*It is critically important during installation to ensure the radios on each side of the link are in the same polarization (horizontal-horizontal or vertical-vertical). A link that has a radio on one side of the link set in the horizontal polarization and the other side of the link set in the vertical polarization will not operate properly.* *It is also critically important that a high-band radio is paired with a low-band radio to ensure the system will operate properly. Prior to installation, check each radio to verify one is a high-band and the other is a low-band version. The label on the radio will indicate the band (blue for high or red for low).*

3.7 Installing Optional POE64 Kit

3.7.1 Required Parts



GiGE Copper SFP
(Qty. 1)



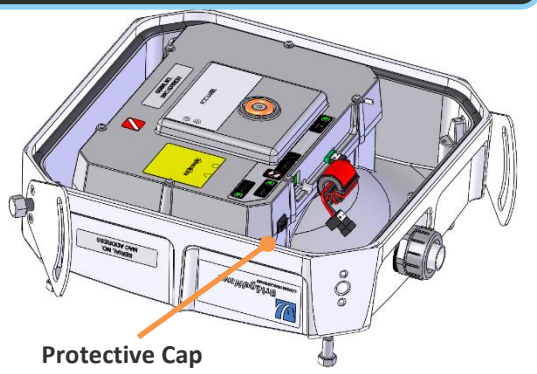
PoE Extractor
w/Bracket
(Qty. 1)

CAT5E Jumper
(Qty. 1)

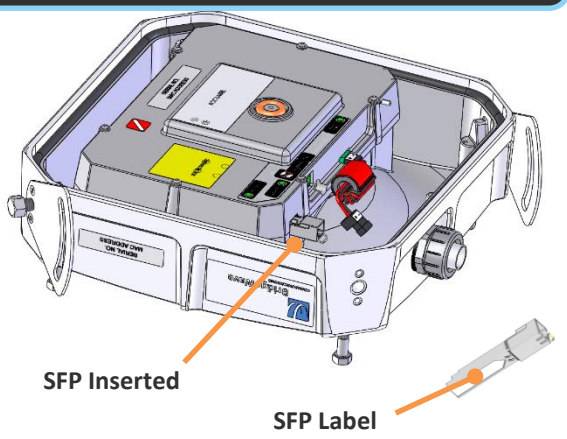
4-40x1/4 Screw & Washer
(Qty. 3)

3.7.2 Installation Steps

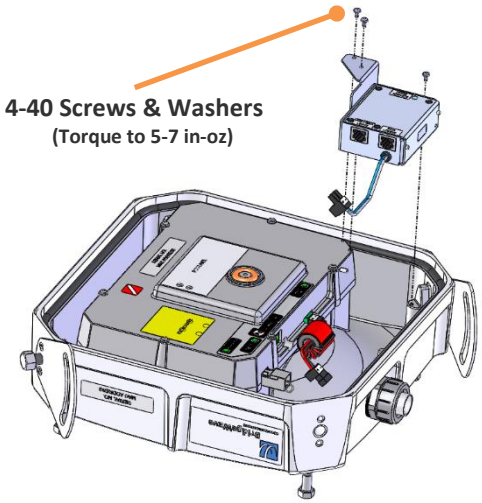
1 Remove protective cap from SFP cage



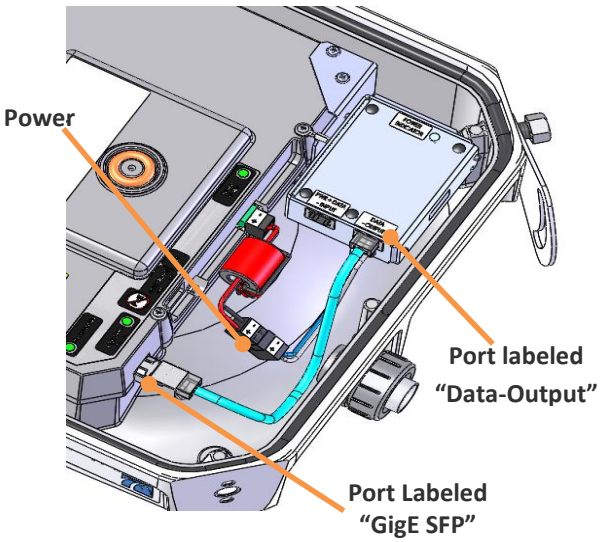
2 Insert GiGE Copper SFP into SFP cage with SFP label facing down



3 Attach PoE Injector Bracket to chassis using the (3) supplied screws and washers



4 Connect DC Connector to port labeled "Power" and install CAT5E Jumper between "Data-Output" port of Injector and SFP



5 PoE Wiring Pinouts

The "Surge" port on the PoE Extractor uses all eight wires (four pairs) to extract power from the Ethernet cable, two pairs for "+" voltage and two pairs for "-" voltage.

The internal extractor circuitry allows for flexibility in the wiring of the "+" and "-" power pairs. The following are supported.

	Pin	Ethernet	PoE Voltage				568B wire color
Pair 1	1	TX+_D1	+	-	-	+	
	2	TX-_D1	+	-	-	+	
Pair 2	3	RX+_D2	-	+	-	+	
Pair 3	4	BI+_D3	+	-	+	-	
	5	BI-_D3	+	-	+	-	
Pair 2	6	RX-_D2	-	+	-	+	
Pair 4	7	BI+_D4	-	+	+	-	
	8	BI-_D4	-	+	+	-	

Do not connect a "+" and a "-" voltage to a single pair.

6 PSE Recommendations

A PoE Power Supply Equipment (PSE) is not supplied with the POE64 kit. The following are specifications and part recommendations for sourcing a PSE.

Power Output: 56VDC/60W
Ethernet Speed: GigE (1000Mbps)
Power Pinouts: Power on all 4 pairs (required)
PoE Handshaking: Supported (not required)

Indoor Applications

Altronix
NetWay1D

Microsemi
PD-9501G

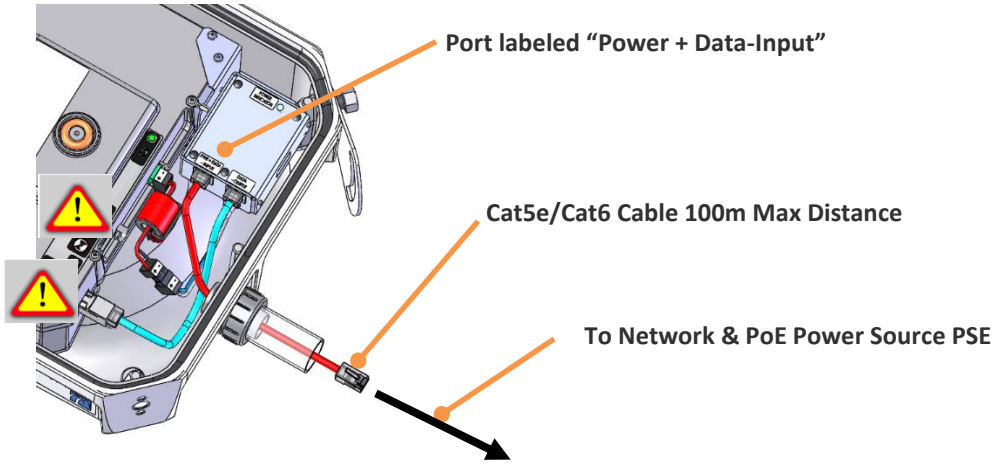
Outdoor Applications

Altronix
NetWay1DWPM

Microsemi
PD-9501GO

7 Connect External PoE Power

A) Run Cat5e or Cat6 cable from external PoE power source through the conduit and fitting into the unit and attach to the port labeled "Power + Data-Input" on the Poe Extractor



Do not connect PoE power directly to the SFP or built in 10/100 copper port. These ports do not support PoE and damage may occur.

3.8 Attach Grounding

The preferred method for grounding the radio unit is to ground the mast (or wall-mount bracket) to a ground source, since this provides the largest grounding surface contact possible. If this is not possible, then use the following procedure:

1. Attach the lug of a 10 AWG ground cable to the radio at one of the two #8 holes at the bottom of the enclosure using a #8-32 bolt, #8 lock washer and #8 flat washers (not provided).

2. Connect other end of the ground cable to a nearby building exterior ground location.

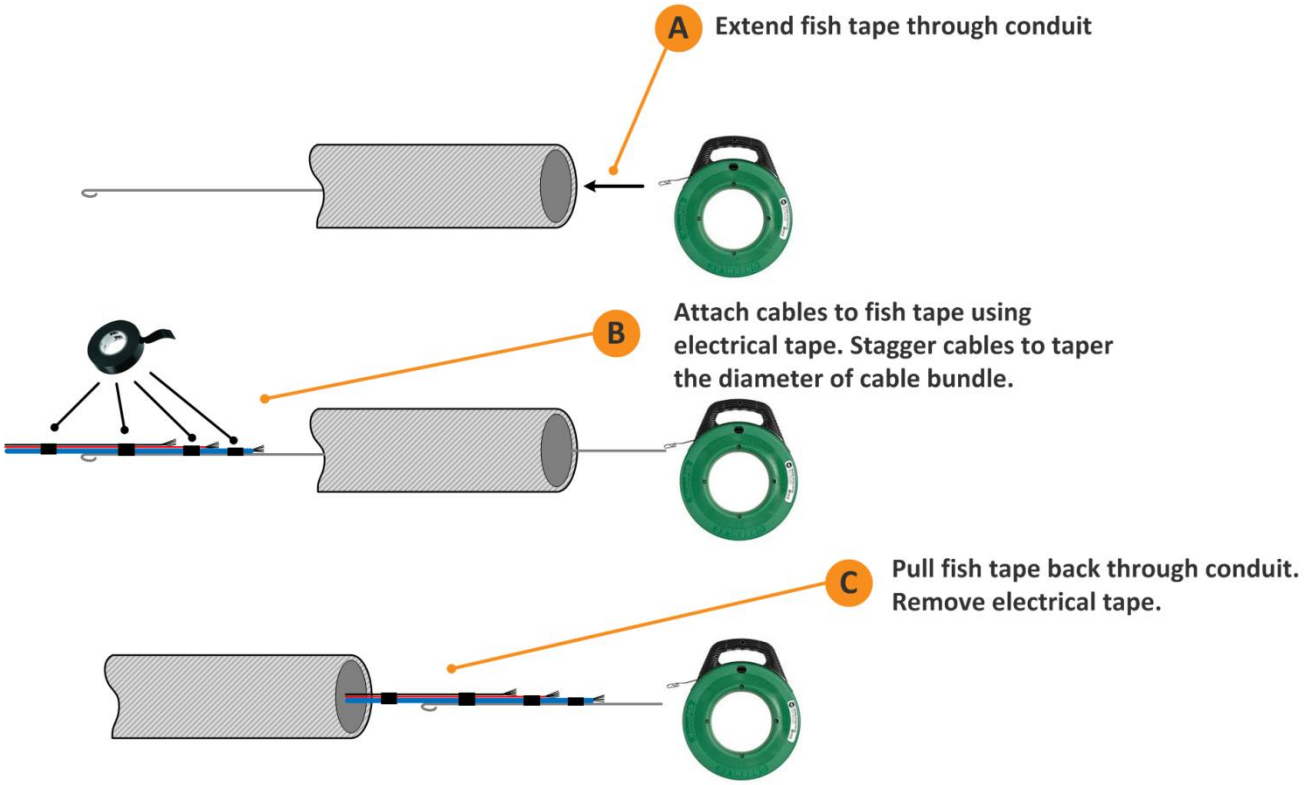
3.9 Cable & Conduit Installation

Conduit is recommended for enclosure of the cables as they enter the radio. The conduit provides a water-tight entry to the radio, as well as any weather or physical protection required by the cables.

The conduit should be flexible, waterproof, and non-metallic. An example of this is LIQUID-TUFF™ UL Liquidtight Flexible Non-Metallic Conduit (Type LFNC-B) or equivalent.

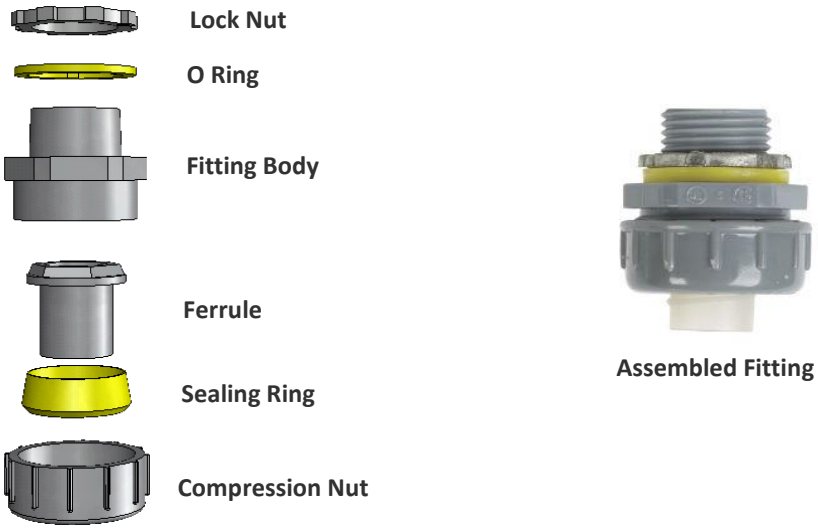
Conduit should be 3/4 inches (19 mm) in diameter to match the radio's opening.

3.9.1 Pull Cables Through Conduit



3.9.2 Attach Conduit to Units Conduit Fitting

The conduit fitting comes preinstalled on the unit chassis. The fitting is comprised of the parts depicted below:



The following instructions describe attaching the conduit to the conduit fitting.

1. Unscrew the ***"Compression Nut"*** and remove the ***"Sealing ring"*** and ***"Ferrule"***, leaving the ***"Fitting Body"***, ***"O-Ring"***, and ***"Lock Nut"*** attached to the units housing.

2. Insert the cables through the ***"Compression Nut"*** and slide the ***"Compression Nut"*** onto the conduit.

3. Pass the cables through the ***"Sealing Ring"*** and slide the ***"Sealing Ring"*** over the conduit so that the tapered end of the ***"Sealing Ring"*** faces away from the ***"Compression Nut".***

4. Next, pass the cables through the ***"Ferrule"*** and screw the ***"Ferrule"*** onto the end of the conduit. Depending on quantity and type of cables being used it may require inserting only a single cable at a time through the ***"Ferrule"***.

Note	*When using a fiber SFP, the simplex LC connectors on the fiber cabling must be inserted individually through the components of the fitting as there is not sufficient room for both to fit through at the same time. If you have a duplex hood joining the LC connections, it should be temporarily removed during this process.*

5. Pass the cables, one at a time if needed, through the ***"Fitting Body"***, ***"O Ring"***, and ***"Lock Nut"*** and into the chassis of the unit.

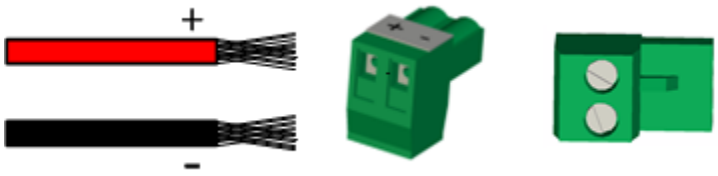
6. Push the conduit and ***"Ferrule"*** up against the ***"Fitting Body"***, making sure the hex head of the ***"Ferrule"*** seats properly in the ***"Fitting Body"***, and then screw the ***"Compression Nut"*** onto the ***"Fitting Body"*** and hand tighten.

7. Loop the cables around the inside of the enclosure: This minimizes tension on the cables when connected and maintains a proper bend-radius of cabling.

8. A drip loop should be created with the conduit to ensure sufficient length to enable the radio to be moved during servicing and to prevent water from following the conduit down to any junction box or building entrance. A suggested length is 24 inches (60 cm) from the radio to the bottom of the loop. The opposite end of the conduit is inserted into the cable tray if on a tower or onto the NEMA or junction box.

3.9.3 Attach DC Wires to DC Connector (not required when using POE64 kit)

1. Ensure that the DC wire used is either 12 or 14-gauge and the center conductor is comprised of stranded wiring and ensure that a grounded surge suppressor is located at the building's indoor/outdoor entry point.
2. Confirm that the power source is turned off before proceeding to attach the connector.
3. Connect the provided DC connector onto the wire by inserting the stranded conductors into the "+" or "-" terminal and then using a small flat screw driver to secure the terminals on the connector.



4. Turn on the external power and confirm that the ***"Power"*** LED on the unit turns green.

3.9.4 Attach Optional Cat5 cable to 10/100BaseT Interface

For applications that require a dedicated out of band management connection to the unit, or for applications using the AdaptPath feature, a CAT5 Ethernet cable can be connected to the 10/100BaseT interface of the unit.

If the cable is run to a point of entry into the building then it is recommended to install an Ethernet surge arrestor at the point of entry into the building.

3.10 Pre-Antenna Alignment Concepts

Prior to performing the antenna alignment it is important to understand the fundamentals of the signal being transmitted out of the antenna so that the alignment process can be visualized. It is equally important to understand proper user of the supplied test cable and how it is to be used with a voltmeter. The following sections describe this in detail.

3.10.1 Antenna Lobes

The “Main Beam”, “Side Lobes”, and “Nulls” are terms used to describe the common components of a signal being radiated from a parabolic antenna.

An antenna focuses, or shapes the radiated energy into a specific direction. As a result of this focusing a majority of the energy directed into the main beam. However, as a byproduct side lobes are also formed. These side lobes are weaker in amplitude than the main beam and radiate out of the antenna at a different angle. A similar concept is the act of squeezing a water balloon. If you squeeze the balloon in the middle it will bulge out in different directions.

Between the main beam and the lobes are nulls where the signal drops off.

The first side lobe is the next highest peak in relationship to the main lobe and is typically around –20dB lower than the main lobe.

When aligning the antennas the goal is to peak the signal on the main lobe.

The diagram in **Figure 3-3~~Figure 3-3~~** depicts the concept of a main beam vs. side lobes and nulls.

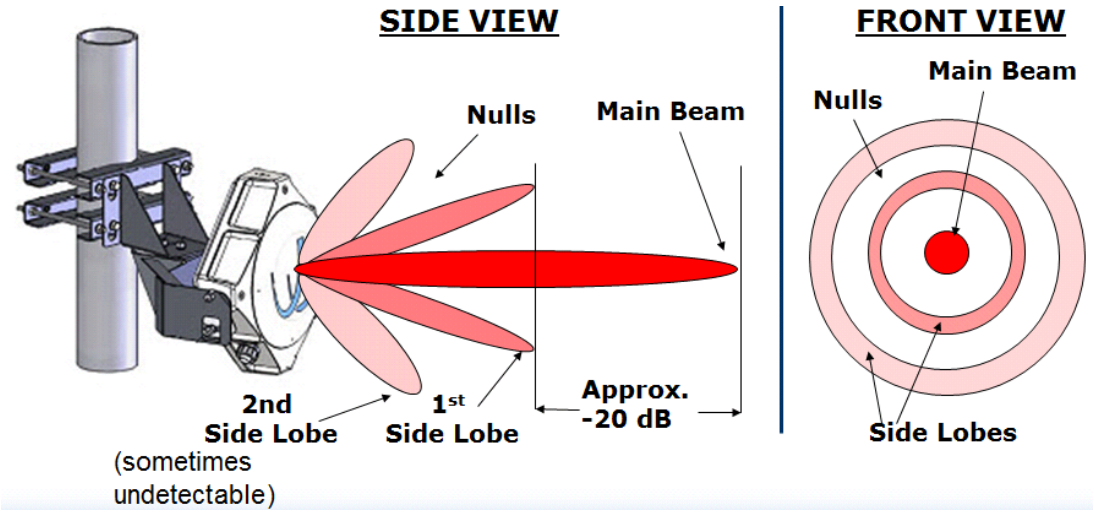


Figure 3-3Antenna Lobe Concepts

3.10.2 Using the RSL/QUAL Test Cable

The antenna alignment is achieved by using the supplied “RSL/QUAL Test Cable” and a DC voltmeter to peak a received signal level voltage at each end of the link until the maximum voltage is reached.

One end of the “RSL/QUAL Test Cable” contains a plug that connects to the jack labeled “Test” on the unit chassis. The other end contains three banana plugs for connecting to a voltmeter. The voltmeter should be set to measure DC voltage and set to the x20 scale.

For alignment, only the lead labeled GND and the lead labeled RSL are needed. The RSL voltage will be dependent on the link distance but will max out at just over 3VDC. Refer to the graph in Appendix B to determine the target RSL voltage for the path distance.

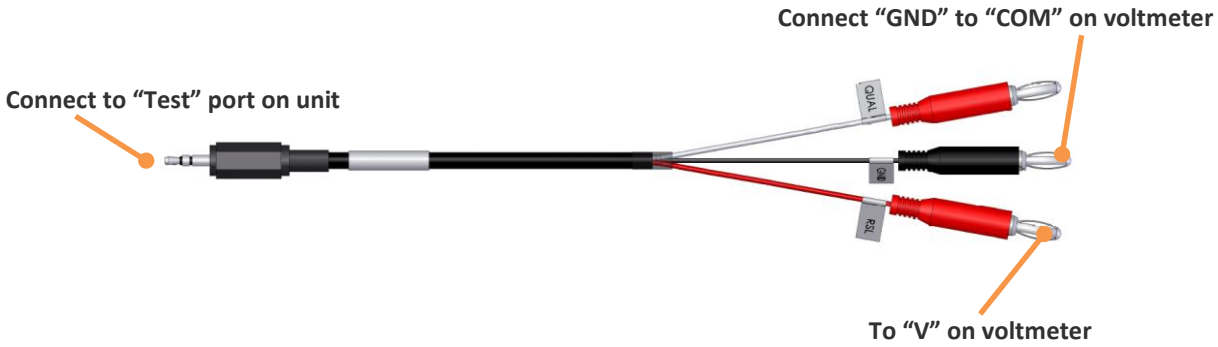


Figure 3-4 RSL Test Cable

The “RSL/QUAL Test Cable” can also be used to check the quality of the received signal level. The QUAL lead of the test cable out puts a value (between 0 and 3.3V) to indicate the error performance of the link. The quality voltage should be disregarded until the target receive signal level has been reached and a calibration of the unit has been performed from the Maintenance page of the web interface

Refer to **Figure 3-5~~*Figure 3-5*~~**

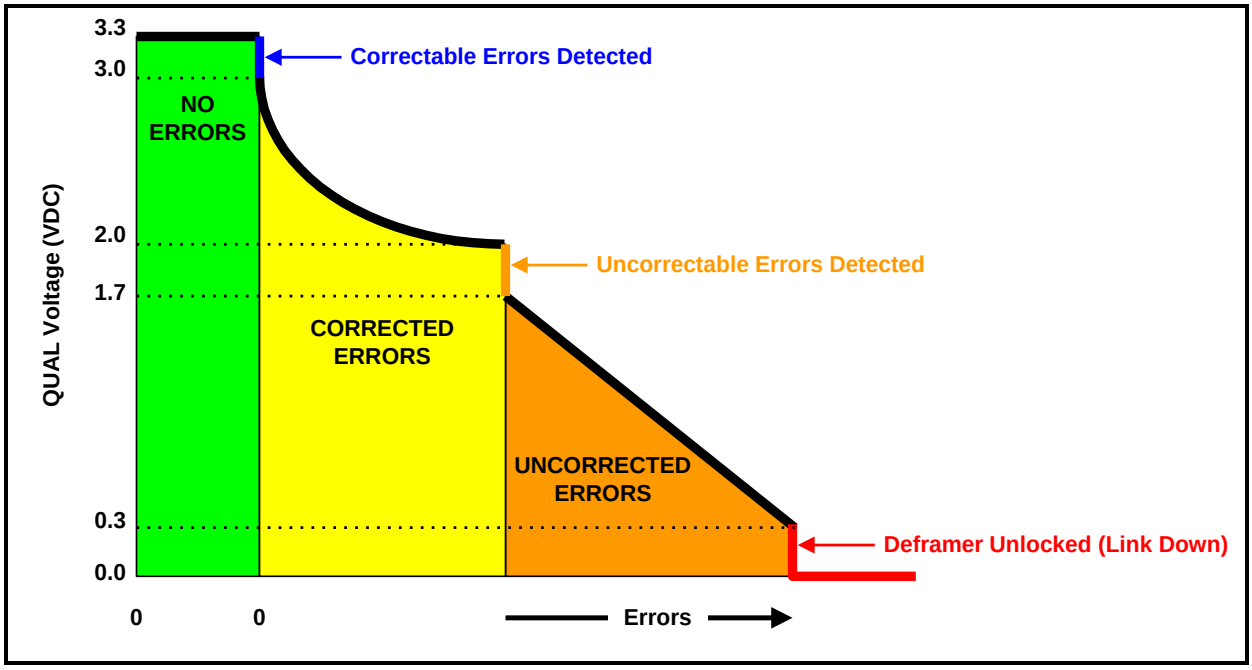


Figure 3-5 Qual Voltage Graph

- Quality Voltages between 3.0V and 3.3V indicate an error-free wireless link.
- Quality Voltages between 1.5V and 3.0V indicate a low rate of errors, and that the forward error correction will correct. The lower the voltage, the more errors are being corrected.
- Quality Voltages between 0.5V and 1.0V indicate excessive errors in the wireless link that cannot be corrected by the FEC. To indicate this change in error performance, the quality voltage will drop from 1.5V to 1.0V in a single step.
- Quality Voltages below 0.5V indicate an unlocked deframer condition. This will be recognized as a link-down condition.

3.11 Antenna Alignment

The following procedure assumes that both ends of the link have been installed and power has been applied to the units per the instructions listed in the previous sections.

1. Confirm your target Received Signal Level (RSL) voltage from the chart in the RSL Voltage vs. Distance graph in Figure 3-6 RSL Voltage vs. Distance~~Figure 6~~ of Appendix B, or by using the BridgeWave Availability Calculator.

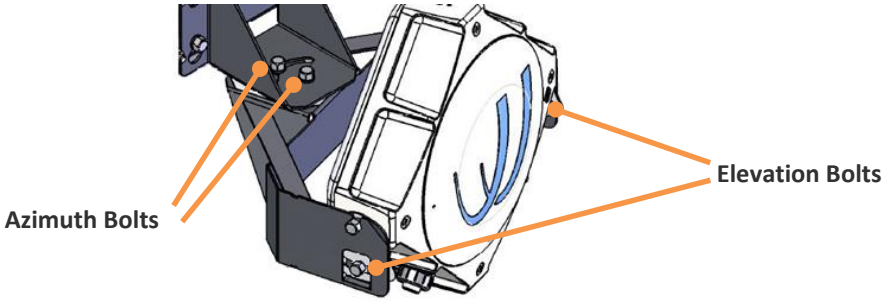
2. Connect a PC to the "10/100BaseT" copper port and web browse into the unit.

Note	*The default IP address is 192.168.0.1 for the low band unit and 192.168.0.2 for the high band. The default subnet mask is 255.255.255.0, and the default user name is "admin" and default password is "adminpass"*

3. Go to the "Setup" page and set the "Alignment Mode" parameter to "Enabled".

Note	*Alignment Mode is Enabled by default. For new installations steps 2 and 3 can be skipped.*

4. Slightly loosen the azimuth and elevation bolts and course align the unit so that it roughly points towards the other end of the link and then lock down the bolts to prevent movement.



5. Perform Steps 1 – 4 at both ends of the link.
6. Connect the provided "RSL/QUAL Test Cable" to port labeled "Test" and connect the "RSL" and "COM" lead to a DC voltmeter per section 3.10.2

7. Slightly loosen only the "Azimuth Bolts" and slowly move the unit from left to right and back to find the maximum RSL voltage reading. Note how the signal may go up and down as you sweep through the azimuth. This is a result of the side lobes and nulls. Tighten down the "Azimuth Bolts" before proceeding to the next step.
8. Slightly loosen only the "Elevation Bolts" and slowly move the unit up and down to find the maximum RSL voltage reading. Again, the voltage may go up and down as you pass through the side lobes and nulls. Tighten the "Elevation Bolts" once the maximum RSL voltage is observed.

9. Perform steps 6 -8 on both ends of the link. Only align one end of the link at a time.

10. Once the target RSL is achieved, log into the web interface and go to the Maintenance page. Press the "Auto Cal" button to calibrate the receiver. The process takes approximately two minutes per end, during which time the link will go down and the Link LED on the unit will flash on and off. Perform the calibration at both ends of the link but only calibrate one end of the link at a time.

11. Confirm that the Radio Link light is "Green" and verify that the Quality voltage is 3.3VDC to indicate an error free link.

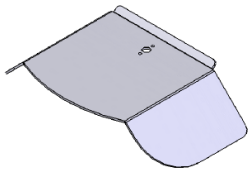
12. Remove the test cable from the radio, replace the back plastic cover and hand tighten the back cover nut to the point where the back cover stops (that is, when it hits the metal ring on the back metal plate). The installation is now complete.

3.12 Ice Shield Installation (Optional)

The Ice Shield assembly (part number 515-00913) is an optional item and can be ordered through a BridgeWave distributor.

3.12.1 Required Parts

The Ice Shield kit contains the following parts for installation at one site. Two kits are required if installing at each end of the link.

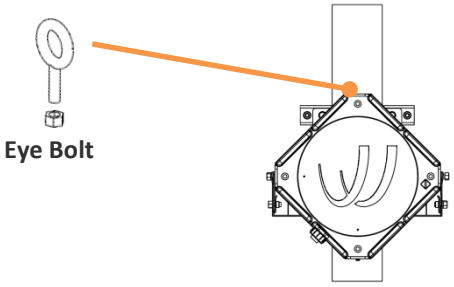


Ice Shield
(Qty. 1)

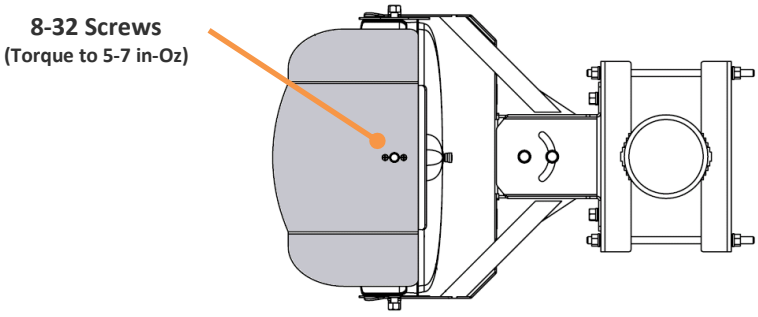
8-32 x 1/2" Screw
(Qty. 2)

3.12.2 Installation Instructions

1. Remove the protective liner from the Ice Shield.
2. Remove the eye bolt from the unit chassis, if equipped, using a 9/16inch wrench.



3. Use the supplied screws to attach the Ice Shield to the radio.



4. Re-install the eye bolt.

Appendix A: Troubleshooting

The following table provides a summary of possible problems you might encounter while installing, along with possible solutions.

Note	*Extensive troubleshooting support and knowledgebase articles are available at the BridgeWave eService Center online at: http://bridgewave.com/support Contact support@bridgewave.com to obtain a login account.*

Problem	Possible Cause	Resolution
No power to radio	Power source is not rated to supply proper wattage requirement	Check the specifications of the attached DC supply to confirm it meets the 60Watt minimum recommendation.
	The supply voltage is outside of operating range.	Check the output of the power supply with the DC cabling disconnected from the supply. If within range, then the cable run is too long or the cable gauge is too small. Shorten the length of the cable or use larger gauge cable.
Fiber light lit at radio but not on network equipment	LSP is enabled and radio link is down.	This is normal behavior if LSP is enabled. Check LSP configuration on setup page of web interface.
	TX and RX fibers are swapped.	Try swapping the TX and RX fibers at one/both ends of the connection.
	Error in the configuration of the networking equipment	Verify the configuration of the network equipment is consistent with radio unit's fiber port settings (auto-negotiation and flow control).
	One or both of the fibers have been damaged or is not connected at both ends.	Try swapping the TX and RX fibers at one/both ends of the connection. Visually inspect the fiber cable.

Problem	Possible Cause	Resolution
Cannot establish the wireless link	Obstacle in link	Verify the line of sight conditions and check for required clearance. (See Section 2.3 for clearance distances).
RSL voltage lower than expected	Incorrect calculation of link distance	Verify that the calculation tool used and the GPS used both use the same annotation system (degree hours minutes seconds or degree with a decimal value).
	Antennas aligned on side lobes	Realign antenna to main lobe.
	Antennas set to different polarizations	Verify that both radios are set to the same polarization (see Section **Error! Reference source not found.**~~3.6~~).
	Installed two high or low band radios in one link	Verify that one end of the link is high and the other end is a low band radio (see Section **Error! Reference source not found.**~~3.6~~).
	Link exceeds maximum specified range.	Verify that maximum path length has not been exceeded.
Low link quality voltage	Antennas are not aligned for maximum RSL.	Verify antenna alignment (see Section 3.10~~3.9~~).
	Auto-calibration not completed	Force an auto calibration operation (see Section 3.10~~3.9~~).
	Interference	Check for possible interference by turning off the radio at the other end of the link and verify the RSL voltage on the local site drops below 0.5V.
	Minimum distance exceeded	Install on a path that exceeds the minimum distance.
Wireless link established, but no data transfer over the link	Network equipment configuration and radio configuration incompatible	Verify settings on network equipment to be consistent with radio unit's fiber port settings. Verify network equipment port configured not to enter *error-disable* state due to link up/down transitions (see Section **Error! Reference source not found.**~~4~~).

Appendix B: RSL Voltage vs. Distance

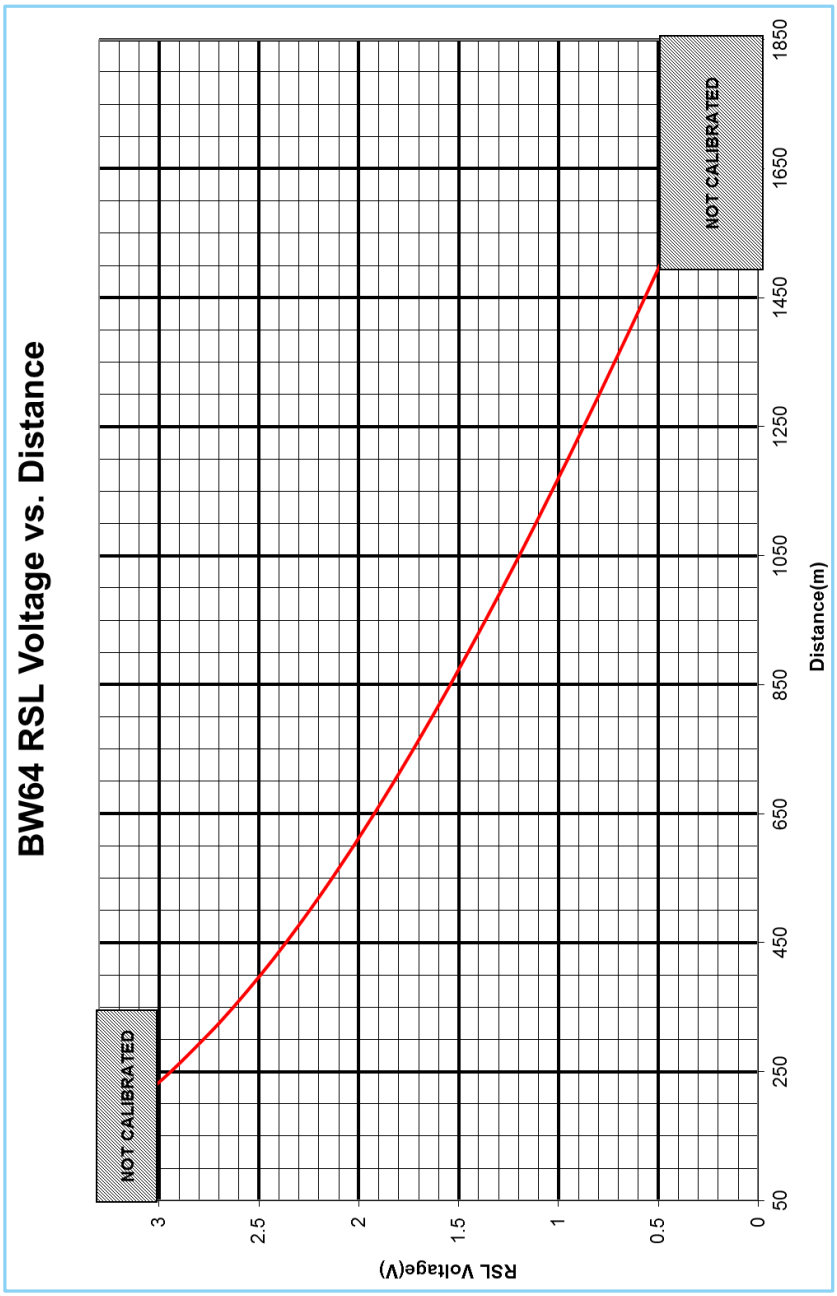


Figure 3-6 RSL Voltage vs. Distance

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