BridgeWave
COMMUNICATIONS

making connections in a high-speed world

Wireless Gigabit Ethernet Links
Models GE80 and AR80

Installation Manual

P/N 580-00519
Revision A
September 2006

Copyright Notice & Disclaimer

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. Customer is responsible for thoroughly evaluated this product's performance in the communications environment in which it will be used.

Safety

CAUTION, WARNING, and DANGER statements have been 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.

- *The GE/AR80 meets all applicable FCC safety requirements for radio equipment; 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.

  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 Part 101 of the FCC Rules.

> Links installed in the U.S. must be registered with the FCC as provided for in Part 101 of the FCC regulations. For more information contact BridgeWave's Customer Service via E-mail support@bridgewave.com or call at 408-567-6906.

Equipment Precautions

Water and Moisture - The GE/AR80 is designed to withstand precipitation conditions typically encountered when installed outdoors.

Power Sources - This product should only be operated with the type of power supply provided by BridgeWave Communications Inc.

Table of Contents

1 Introduction

1.1 Purpose of Manual

The information in this manual 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! 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.

WARNING! Indicates that serious damage to the equipment can result if the user does not comply with the given instruction. A WARNING statement will describe the potential hazard, its possible consequences, and the steps to perform to avoid serious equipment damage.

CAUTION! Indicates that equipment damage, process failure, and/or loss of data can result if the user does not comply with the given instruction. A CAUTION statement will describe the potential hazard, its possible consequences, and the steps to perform to avoid equipment damage, process failure, and/or loss of data.

NOTE: 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 problems are not resolved, contact BridgeWave Customer Service for assistance:

Location:	Santa Clara, CA USA
E-mail:	support@bridgewave.com
Tech Support Hot Line:	+1.408.567.6906

Return Material Authorization (RMA)

Should BridgeWave equipment have to be returned for repair or replacement, an RMA number must be obtained in advance from BridgeWave or a local BridgeWave distributor. When returning equipment, be sure to write the RMA number on the outside of the shipping carton.

2 Site Planning

2.1 General

Before the start of an installation a survey should be conducted of the proposed area of the deployment site(s). The survey personnel should be fully familiar with the details required to install the GE/AR80 radio system.

2.2 Equipment Checklist

We suggest the site survey team may need the following equipment:

- Binoculars (not always required)
- GPS location device
- Tape measure to determine distances for cable runs to ingress points
- Digital camera (not always required)
- Site survey report form to document and help assess site
- Signaling mirror (provided and not always required)
- 70-90GHz Link Registration Datasheet. Contact BridgeWave Tech Support to learn where one can obtain the latest version of this form. You may E-mail support@bridgewave.com for this request.

2.3 Line of Sight (LOS)

The GE/AR80 Wireless Gigabit Ethernet link requires LOS for proper operation. Binoculars and spotting mirrors can be used to assist in confirming a LOS.

Path planning should include an investigation into future building plans that could block the LOS path, and other long-term incremental obstructions such as tree growth. Intermittent obstructions such as aircraft at a nearby airport should also be considered.

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

Path Length (meters)	Minimum Clearance (meters)
1000	0.58
2000	0.82
5000	1.3
10000	1.8

Table 2-1: Minimum for Various Path Lengths

2.4 Link Distance

Measurement of the link distance is important in estimating the link availability and calculating expected Receive Signal Level (RSL). This measurement can be performed using the Latitude and Longitude coordinate readings from a Global Positioning System (GPS) device, which is placed near the proposed locations of the antennas. Additionally GPS reading will be required in order to comply with the FCC registration process.

To quickly obtain estimated distances and availabilities for a given product and region, use BridgeWave's path calculator. To obtain the latest version of BridgeWave's Path calculator, contact BridgeWave's Customer Service.

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 providing unimpeded LOS to the remote location. The following factors should be taken into account:

- Type of mounting—fixed or roof-safe pole mounting
- Location where the fiber and DC power wiring will enter/exit the building
- Length of cable runs
- Grounding connection points
- Obstructions, including allowances for tree growth
- Accessibility of mounting location
- Access to building after regular working hours

2.6 Cabling

The installation site should be inspected to determine the run paths for the fiber cable and power cable 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. Depending on the likelihood of damage due to foot traffic or equipment movement, cabling conduit may be required. The maximum cable run length as specified for the equipment being installed must not be exceeded.

The radio requires LC type connectors on a pair of simplex multi-mode fibers to properly connect between the radio and the users network equipment. Single-mode fiber connections are not supported for use with the standard product. The network equipment end of the fibers should be terminated with connectors that match the user's network equipment fiber interface.

Fiber Cable Length	Cable Type
Up to 270 meters	62.5/125 µm
Up to 500 meters	50/125 µm

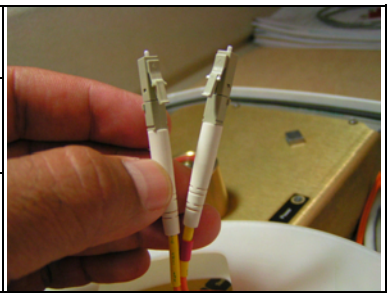


Table 2-2: Fiber Cables with LC Type connectors

The GE/AR80 radio includes a 100-240 VAC power adaptor suitable for indoor operation only that converts the AC voltage from a standard electrical outlet in the wall to DC voltage. The radio requires a minimum of 15.0 VDC at the connector on the radio unit (24.0 VDC maximum) to function properly. When planning the cable run from the indoor AC power adaptor to the radio unit, it is required to use the cable gauge (AWG) indicated below to ensure adequate voltage at the radio. The indoor and outdoor portions of the DC power cabling must conform to all respective indoor and outdoor national and local electrical and building codes; note that requirements may differ for the indoor and outdoor portions of the cabling and that a grounded surge protector is normally required at the point where the cable enters the building. The DC power cabling must consist of two 12 or 14 gauge conductors based on the required cable run length.

Minimum Cable Size

DC Cable Length	Conductor size
Up to 125 meters	14 AWG ($2.5mm^2$)
Up to 200 meters	12 AWG ($4mm^2$)

Table 2-3: Minimum DC Cable Size

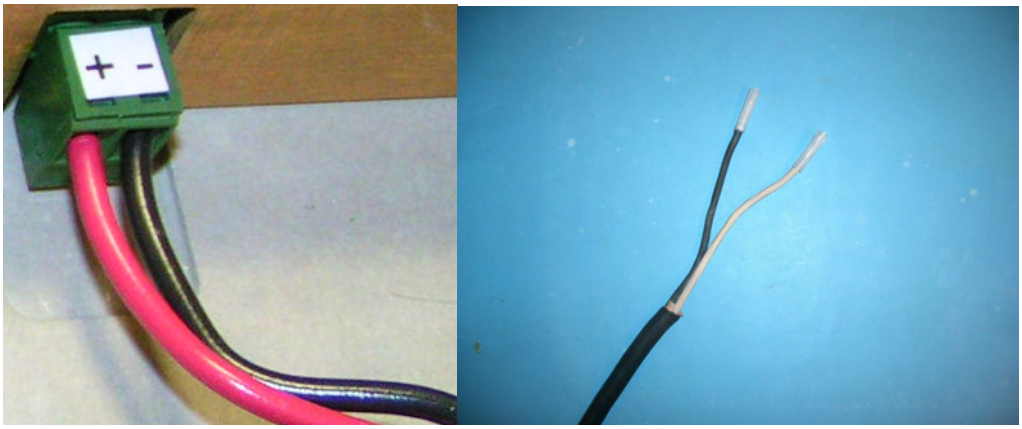


Figure 2-4: 14-gauge DC power cable terminated to radio end and power supply end.

Figure 2-4 (right) details a standard 14-gauge wire that has been fitted with the power connectors (provided) for the radio's internal power supply necessary to mate with the (not provided) power cord. A standard crimping/splicing tool (not provided) is required to terminate the power connectors onto a 14-12-gauge cable required for use with the GE/AR80.

On the radio end (left) no connectors are required; simply screw terminals to appropriate polarity.

2.7 Grounding & Lightning Protection

WARNING!

Proper grounding of the outdoor equipment reduces electromagnetic interference, provides surge protection, and protects against electrical discharge. 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 connect the radio to the building ground by connecting the building ground to the conductive pole mount hardware structure. 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, the DC electrical cable to be protected from electrical surges. You should use a Polyphaser surge suppressor, model # IS-PSP-24 or equivalent (not provided). The surge suppressor must be installed at the point where the DC electrical cables exit/enter the building.

The Polyphaser device is available from the following companies:

Hutton Communications	877-648-8866	www.huttoncom.com
TESSCO Technologies	800-472-7373	www.tessco.com
Winncom Technologies Corp.	888-946-6266	www.winncom.com

2.8 Environmental

The structure to which the equipment will be mounted should be adequate to bear all wind and weather conditions. The environmental conditions at the location must conform to the operating environment specified for the equipment.

2.9 Simple Network Diagram

Following is a diagram detailing the equipment and cabling found on a typical installation of BridgeWave's 80GHz radio equipment.

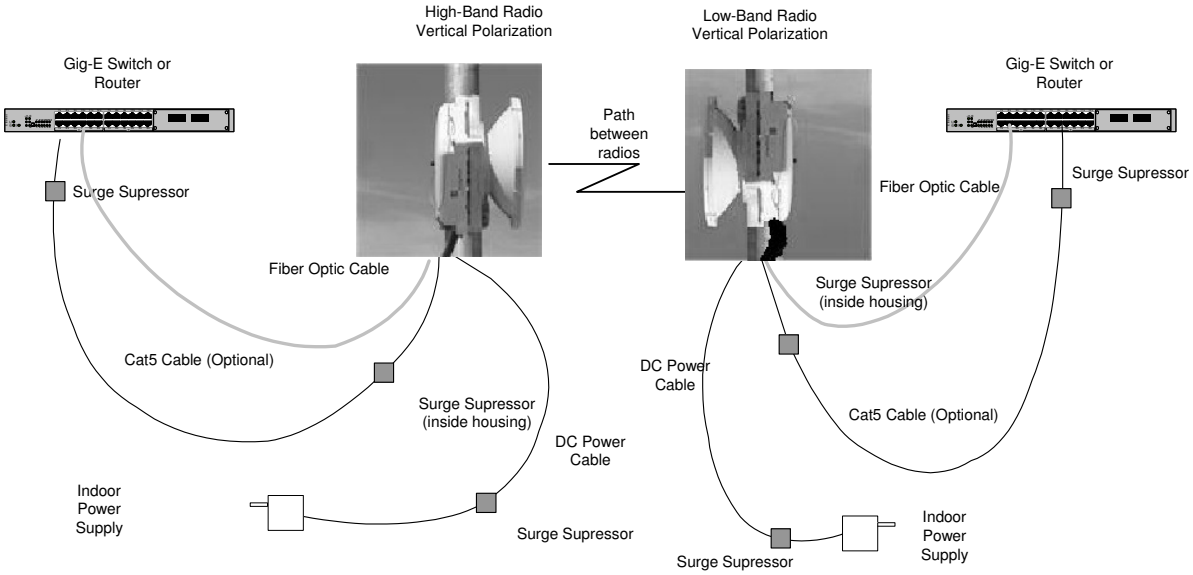


Figure 2-5: Simple Network Diagram

3 Installation

3.1 General

It is recommended that installation personnel read this section in its entirety prior to installing the BridgeWave System. During a particular phase of installation, the user may refer directly to the applicable subsection.

The Installation section is comprised of seven subsections covering the procedures and guidelines for installing the BridgeWave Radio System.

Subsections 3 through *3.4* contain information necessary to **prepare for the equipment installation.**

Subsection 3.5 through *3.7* covers equipment **installation procedures**.

Subsection 3.8 contains information necessary for **aligning the antenna.**

3.2 Equipment Packing & Unpacking

The radio system equipment will arrive in two boxes—one box for the low band radio and one box for the high band radio. Locate the correct box (low band or high band) before beginning installation by checking the label on the outside of the box or on the radio itself. It is recommended that the shipping cartons and packing materials be retained in the event that it is necessary to return any equipment.

Note: The polarity can be identified on unpacked radios by the first letter of the polarity V or H (Vertical or Horizontal) on the top of the unit chassis. See Figure 3-8 for further details.

3.3 Equipment Inventory

Following are inventory lists for a typical system:

Qty Description

2 ea. GE80 radio units (1 low band transmit unit & 1 high band transmit unit)

2 ea. AC-DC power adapters & power cords

1 ea. CD-ROM containing Installation Manual and NMS Manual (1 CD provided per pair of radios)

2 ea. DC power connectors for use with outdoor radio

4 ea. DC power connectors

2 ea Antenna and mount kits

1 ea. Sighting mirror, 3" X 5"

1 ea. Hard reset box

2 ea. RSL and Quality voltage test cables

2 ea. Stainless Steel Screws # 8-32 X 3/8, Phillips pan head

GE80 Antenna and Mount Kit Parts List

Item	Description	Qty.
1	Antenna	1
2	Lower pole mount assembly	1
3	Upper pole mount assembly	1
4	Antenna mounting plate	1
5	3/8 bolts	2
6	3/8 lock washers	2
7	3/8 flat washer	2
8	3/8 nylon washer	2

Table 2-4

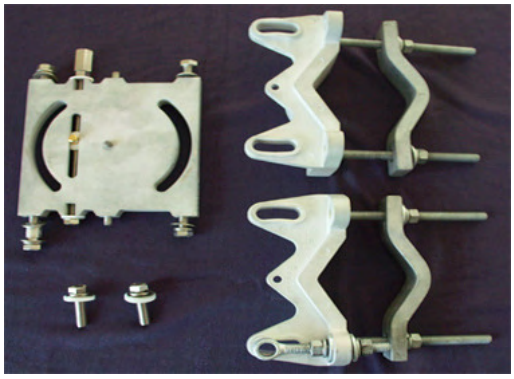


Figure 3-1

CAUTION!

Tampering with seals will void the warranty.

Notice the warranty stickers on the inner (metal) cover of the radio. The radio is sealed at the factory. 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, are required for installing the radio and the antenna:

Screwdriver, slotted 0.1 inch (2.5mm) wide
Open-end wrench 11/32 (9mm)
Open-end wrench 9/16 (14mm) - 2 ea.
Open-end wrench 1/2 (13mm)
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 Antenna Mount Installation

WARNING!

1. Read these instructions before beginning installation. Caution should be used. Qualified persons experienced with antenna assembly and installation are required for installation.
2. BridgeWave Communications Inc. disclaims any responsibility or liability for damage or injury resulting from incorrect or unsafe installation practices.
3. The antenna has been formed to a very close tolerance parabolic shape. Careful handling and assembly is required to avoid denting the reflector, which would degrade antenna performance.

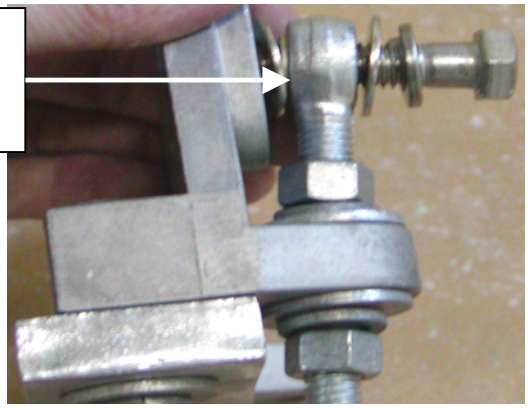
1. Attach the upper pole mount.

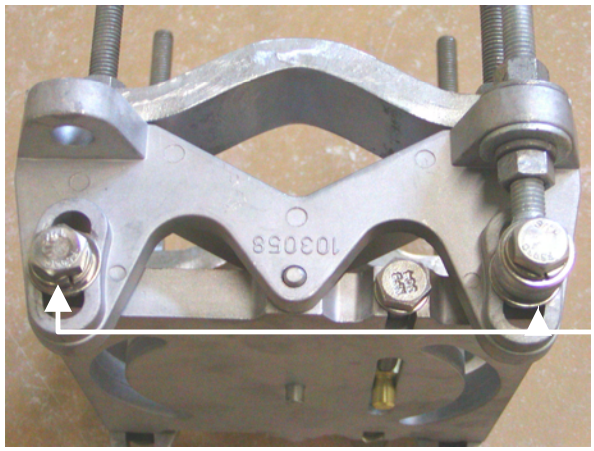
Confirm that the mount is centered as shown.
Tighten bolts securely

Figure 3-2

2. Attach the lower pole mount as shown.

Hardware: Flat washer, bushing (inside eye), flat washer, lock washer, bolt.

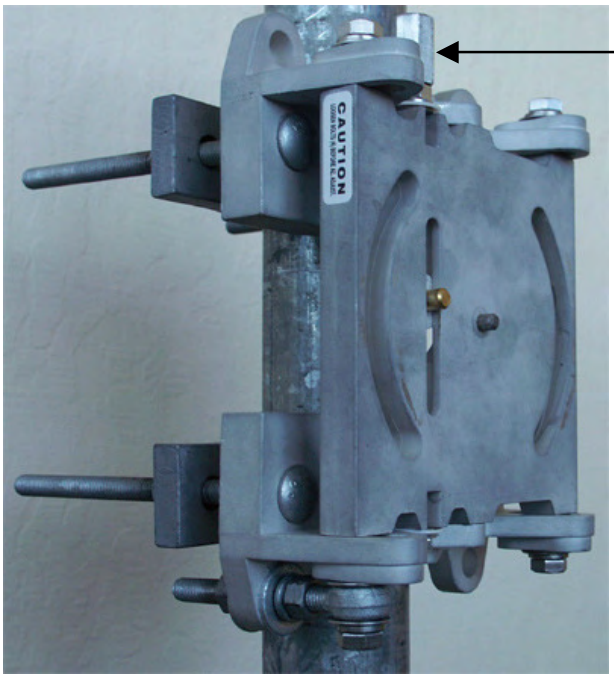




Confirm that the Mount is centered as shown.
Tighten bolts securely

Figure 3-3 and 3-4

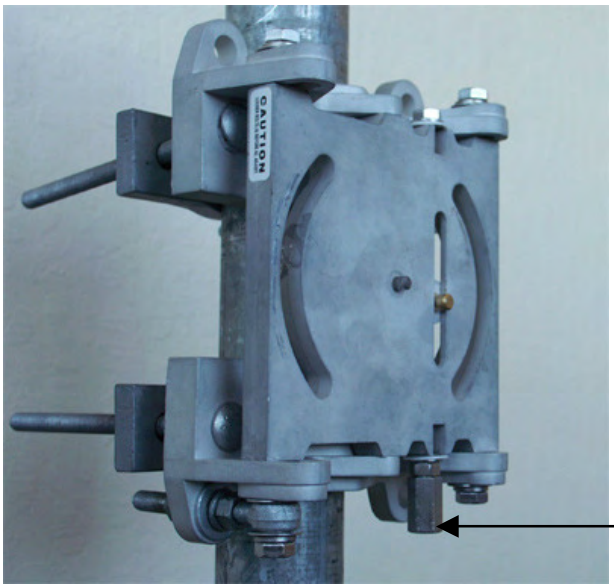
3. Completed installation of pole mount with right hand offset for the antenna.



Note the position of the elevation adjust hex nut.

Figure 3-5

4. Optional left hand antenna offset mount preparation.



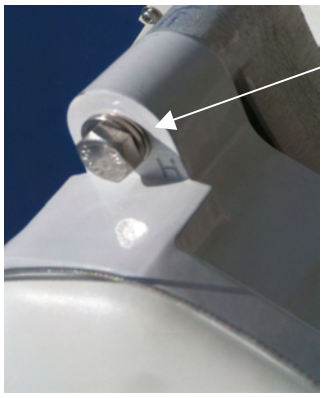
- Remove bolts
- Rotate the antenna mounting plate 180º
- Replace bolts
- Tighten bolts securely

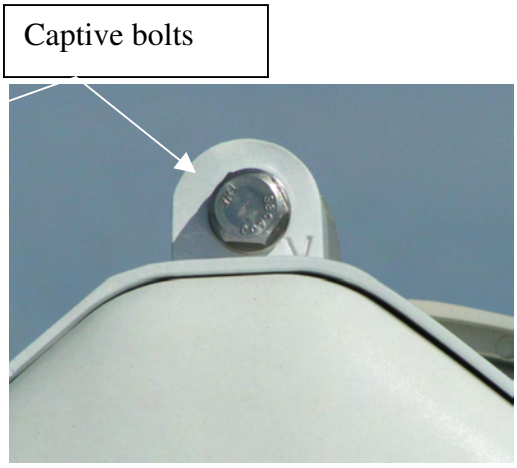
Note the new position of the elevation adjust hex nut.

Figure 3-6

3.6 Antenna and Radio Installation

1. Install – Antenna and Radio





Figures 3-7 and 3-8: The first letter of the designated Polarization is stamped onto each unit to identify orientations when the polarity mark is positioned on top: illustrations above are for Horizontal (left) and Vertical polarity right).

CAUTION!

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.

Further, 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).

2. Verify that the four (4) captive 3/8-16 bolts with lock and flat washer are in place. A 9/16-inch open-end wrench is required to tighten them. It is important that all four screws are tightened evenly (hand tight, 1 to 2 turns each until the lock washer is flattened)
3. Adjust azimuth illustration (Side to Side)

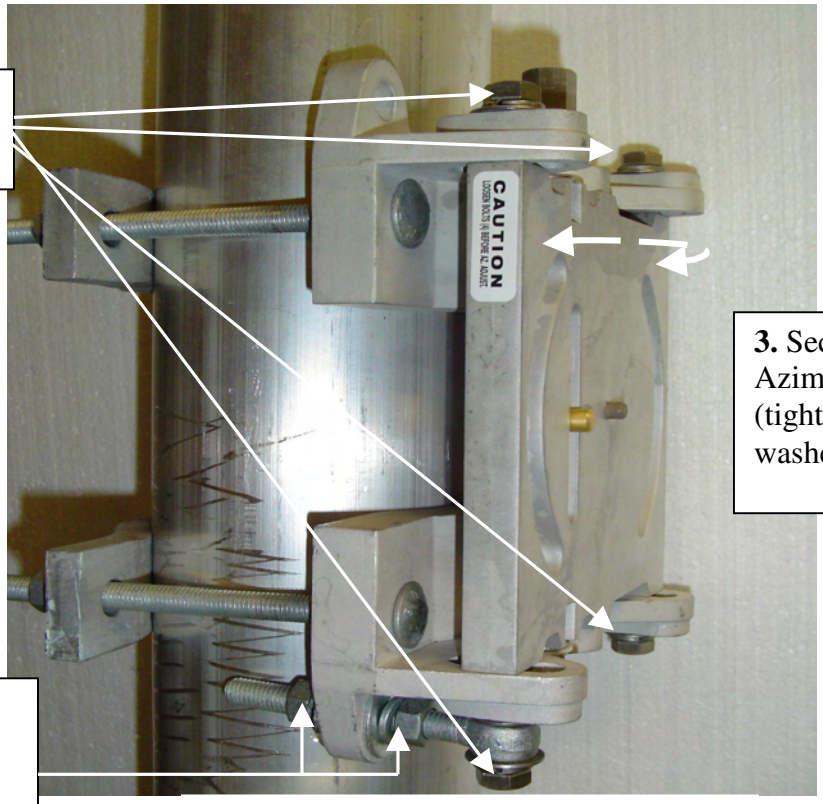


Figure 3-9 Azimuth adjustments bolts detail

CAUTION!
It is very important that the azimuth bolts are tightened before any elevation adjustment is done. The very narrow beamwidth of this antenna (0.9º) makes it necessary to completely tighten the bolts of the azimuth adjustment while adjusting the elevation and vice versa.

4. Adjust elevation (up - down)

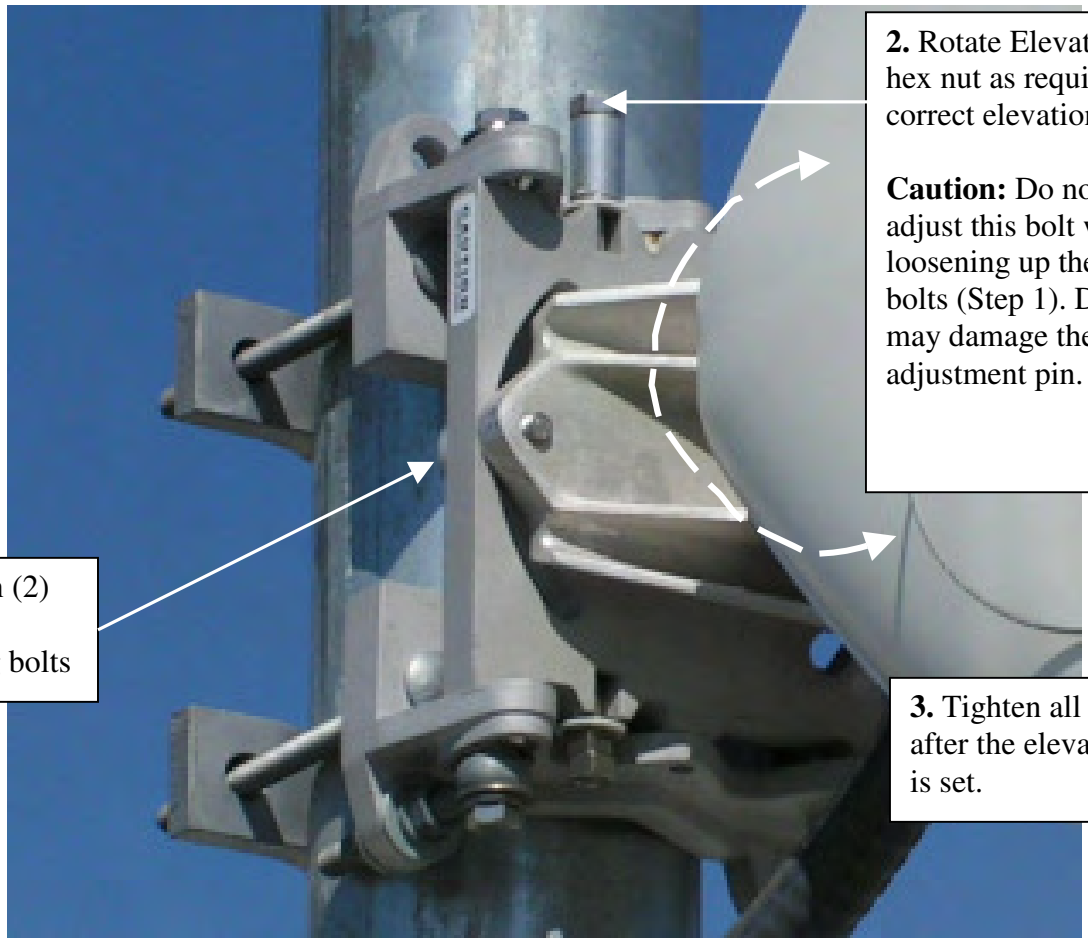


Figure 3-10 Elevation adjustment

3.7 Cable Installation

Fiber Cabling

1. Install a duplex multi-mode fiber from the radio to the network termination equipment (switch or router with 1000Base-SX port). The cable should be looped around the inside of the enclosure to provide strain-relief. Do not connect the fibers to the radio's fiber ports at this time.

   The connectors on the radio end of the fiber require **simplex** LC connectors; the connectors on the switch/router end should mate to the network equipment.

   Note: The simplex LC connectors for the radio need to be inserted individually through the 3/4" conduit water tight connector fitting on the radio, as there is not sufficient room for both to fit through at the same time if connected with a duplex clip. If a duplex clip is used, it can normally be temporarily removed to complete the installation.

2. Connect fibers at the network equipment. ***It is important not to connect the fibers to the radio until after aligning the radio as the radio performs an automatic calibration once the fiber is inserted into the radio and this calibration will not operate properly if the radio is not properly aligned.***

Power Cabling

1. Select indoor location, with easy cable routing to the radio, for the AC power adaptor. Normally it is convenient, but not required, to place the adaptor near the network termination equipment.
2. Ensure the DC wire used is 14-gauge type and no longer than 125 meters; or 12-gauge and no longer then 200 meters.
3. Connect the provided DC Connectors onto the 14-guage wire using a splicing/crimping tool. For the use of 12-gauge wire it may be necessary to trim a few strands from the ends of thicker stranded cables to more easily fit the crimp connectors.
4. Install the DC power cable and attach to the AC adaptor using the supplied crimp connectors. Do not connect the power jack to the radio at this time.
5. **IMPORTANT:** Be sure to first connect the DC power crimp connectors before inserting the power plug into the power jack in the radio. No sparks should be expected with the new two conductor (green) power connector.

Figure 3-11: Back view of fiber and power cable installed on a vertically polarized unit. Notice that the cable conduit is on the left hand side when the radio is in (V) polarization.

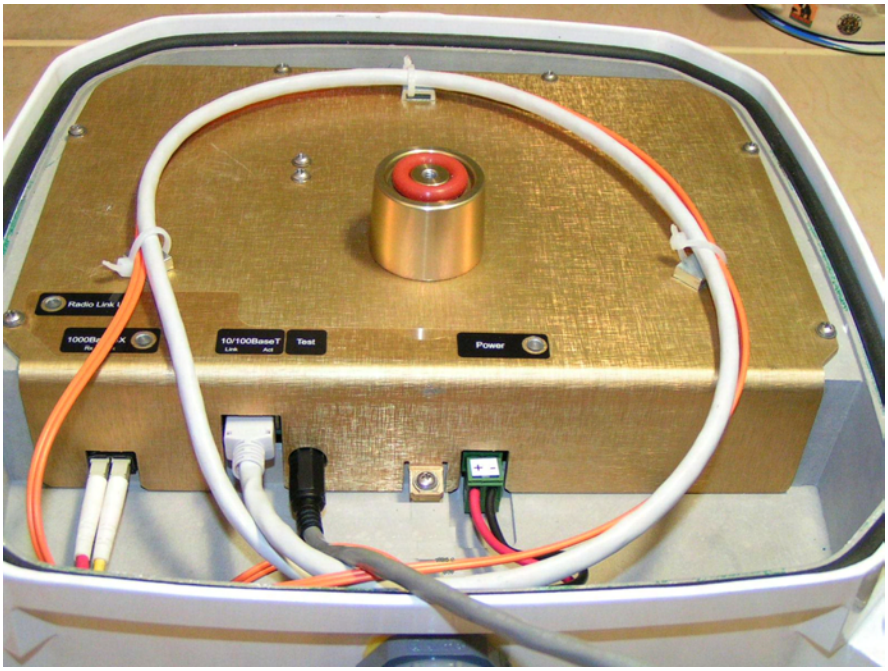


Figure 3-12: Inside view of fiber and power cable connected

Note: The fiber and power cables are inserted through the straight through fitting, before the conduit is connected to the fitting. Ensure that the cables do not get pinched when the conduit is pushed onto the fitting. Both cables have been looped around the inside of the enclosure to minimize tension on the cables when connected to the radio and to maintain proper bend-radius of the fiber cable.

Ground Cabling

The preferred method for grounding the radio unit is to ground the mast 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 the ground cable (not provided) with the radio to one of the two #8 holes at the bottom of the radio using a #8-32 x ½" long bolt, #8 lock washer and #8 flat washers (not provided). Yes

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

10/100BaseT Surge Suppressor

If the 10/100BaseT port is permanently connected to other network equipment (not normally required), it should be connected using Cat5e cables rated for the outdoor and/or indoor environments where the cables will be run. It is essential that the cabling be connected to the radio unit through an Ethernet-rated surge suppressor inside of the plastic back cover of the unit, and a surge suppressor should also be used at the point where the cable enters a building or is connected to other outdoor equipment that does not already contain surge suppression hardware. BridgeWave recommends the **Dehn model DPA-M-CAT6- RJ45S-48** surge suppressor be used. See figure 3-15 below.

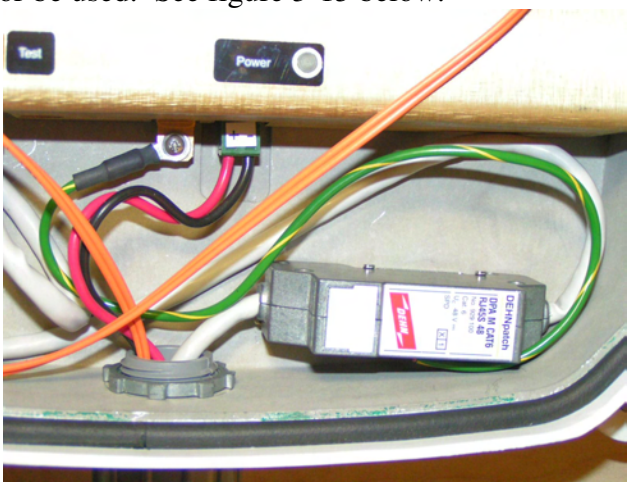


Figure 3-13: Inside view 10/100BaseT Surge Suppressor

3.8 Turning the System On and Alignment

1) Before Turning On the System

a) Finish the installation as described in Chapter 3.6 and 3.7
b) Ensure fiber cables are still disconnected!
c) Connect DC power to the radio.
d) Verify that the Power LED is lit. If the Power LED is not lit, use voltmeter to verify correct voltage and polarity at radio. To reverse the power polarity, unplug the power jack and swap the crimp connectors for the two conductors.
e) Repeat steps 1 through 4 on the far-end of the link.

2) Prepare to Rough Align the Radio

a) Connect RSL test lead cable to radio and place voltmeter with readings in view
b) Loosen the pole mount brackets enough to allow you to swing the unit horizontally.
c) Reference Chapter 3.6 for illustration of antenna mount bolts and their purpose.

3) Rough Align the Radio Antennas

a) Set the radio terminal to the pre-defined azimuth if available. If not, you may utilize binoculars or mirror to locate the far end radio location.
b) If you can see the far-end radio terminal estimate the alignment visually and tighten the pole mount brackets with fine adjustment bolt set to the middle of adjustment range.

c) Ensure the horizontal adjustment bolts are snug; only tighten bolts one quarter of a turn.
d) Slightly rotate each antenna up/down for best vertical alignment and left/right for best horizontal alignment by finding the maximum RSL voltage reading.
e) To ensure that the antennas are not aligned on a side-lobe, they must be rotated at least ten degrees on each side of the visually-perceived alignment center to ensure that the true maximum RSL voltage is found; note that the width of the center beam is only 0.9 degrees and the first side-lobe beam is only 1 degree off from center.
f) Set the antenna in the position that results in the highest RSL voltage reading.
g) Repeat these steps on far end radio.

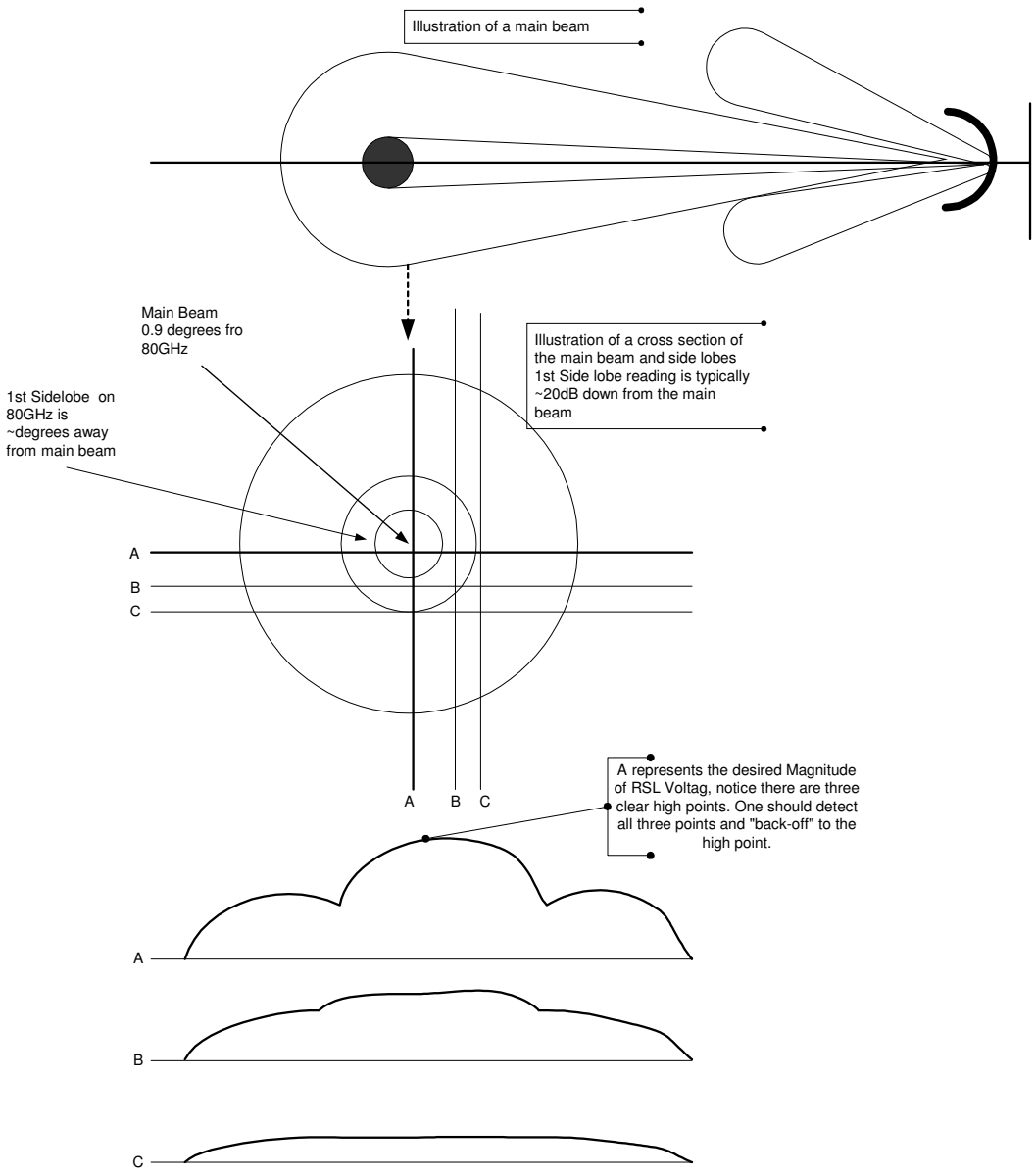
4) Fine Adjustment

a) Ensure to loosen the “fine adjustment” bolt (the small eye bolt)
b) Pan antenna slowly from left to right and capture the highest RSL voltage peak
   i) See Figure 3-15 below to help guide you in obtaining the highest RSL voltage reading.
c) Tighten down the Horizontal control bolts.

d) Loosen the two vertical control bolts holding the antenna to the antenna mount
e) The Vertical Fine adjustment is not designed to be tightened; use the "hex nut" to fine (and rough) adjust the elevation (vertical position) to highest RSL value.
f) While monitoring the Voltmeter, begin to align the Vertical position of the antenna to obtain the highest RSL voltage level.
g) Once completed, this fine adjustment must be repeated at the remote end of the system, if you have not obtained the "target" RSL voltage for the given path distance (see RSL Vs. distance chart on Chapter 6).
h) If you are have not obtained the "target" RSL voltage for the given path distance (or you want to further improve it), you will need to re-align the antenna, go back to the original site you started with and restart steps (a-f) and re-align again. See Figure 3-15 below of a conceptual illustration of and antenna beam to keep in mind while you perform a re-alignment.
i) Once again, the very narrow beamwidth of this antenna (0.9º) makes it necessary to completely tighten the bolts of the azimuth adjustment while adjusting the elevation and vice versa.

Note: Verify that the RSL voltage falls within the expected range based on the graph in Appendix A.

Figure 3-14: The illustration below is an exaggerated cross section of a beam to exemplify a horizontal RSL level voltage reading against relative locations with an assumed fine tuned vertical position.



5) Locking Down Radio Antenna
   a) After the target RSL level has been achieved, ensure all bolts are tightened evenly, securely and ensure the RSL voltage remains unchanged after tightening is completed.
   b) The very narrow beamwidth of this antenna (0.9º) makes it necessary to completely tighten the bolts of the azimuth adjustment while adjusting the elevation and vice versa.

c) Always evenly tighten bolts in small fractions at a time to ensure minimum change to your completed alignment.

6) Connecting the Fiber

a) Connect the fiber cable to one of the radios at a time. The fibers should already be connected to active network equipment.
b) Verify the fiber LED's on each of the radios are illuminated solid

Note: The fiber integrity indication on the network equipment could show up or down independent of the link status.

7) Auto Calibration

a) Once the fiber is connected to the radio, the radio will begin an internal link calibration.
b) During this time the Link Up LED will blink for approximately 120 seconds.
c) Wait until the Link Up LED is lit solid
d) Verify the Link Quality voltage is 3.0-3.3V (i.e., error free). Repeat steps (a-c) for the far-end radio. For more details on Auto Calibration see section 3-9 below

8) **Removing the Test Cable**

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

The most important alignment "tools" for these models are care and patience! It is recommended that these models be aligned with personnel present at both ends of the link, and the installers should allow up to 90 minutes to optimally align these units. The GE/AR80 links have a narrower beamwidth (0.9 degrees) than the GE/AR60 radio beamwidth (1.4 degrees) and operate at much farther distances.

3.9 Auto Calibration

The Auto Calibration feature scans the RSL level of the system (after the system is aligned) on each radio terminal where the level is calibrated against an internal calibration table that corresponds to an expected receive power level. The radio system is said to be in Alignment Mode when it is first powered up and no fiber is connected. Once the alignment is completed; the Auto Calibration mode is triggered ON as soon as the fiber cable is connected. You will know the radio terminal has initialized the Auto Calibration when the Link LED is flashing on/off - this lasts for up to 120 seconds. The radio terminal needs to detect an optical signal of the appropriate Wavelength. For this, one would require having the fiber optic cables terminated to a fiber port on a switch or this can be accomplished with a fiber optic jumper cable by connecting the fiber output of the radio into the fiber input of the radio. Loopback should only be connected long enough for auto-calibration to start and should be removed immediately.

Losing RF connectivity

When a system loses the RF connection for more than 5 minutes it will trigger the system to enter an Auto Calibration mode. You can disable this function on the AR80 units via the NMS. Please review the NMS Manual for further details on disabling this function.

Force Calibration

You can induce a force calibration at anytime by disconnecting DC power and fiber optic cables from the radio. Powering up the radio terminal while the fiber connectors are disconnected will induce a Force Calibration, as soon as the fiber optic cables are reconnected to the radio terminal will.

Also, if using a loop back fiber connector at one end of the link for test purposes, note that the radio connected to actual network equipment must complete auto calibration prior to connecting the loop back cable at the other end.

Power Cycling a Radio

When a radio is power cycled and it's fiber cable is disconnected, it will re-execute the calibration process. After this, the link will be functioning.

3.10 Test Cable

The alignment procedure is optimized through the use of the provided test cable. This test cable is designed for use with a digital voltmeter (not provided) to read the Link Quality and Receive Signal Level (RSL) voltage generated by the radio's receiver.

1. To read the RSL value of the radio, insert GND (ground) and RSL banana plugs into the voltmeter. Note the RSL voltage. The voltage may be fluctuating; in this case, note the maximum value seen.

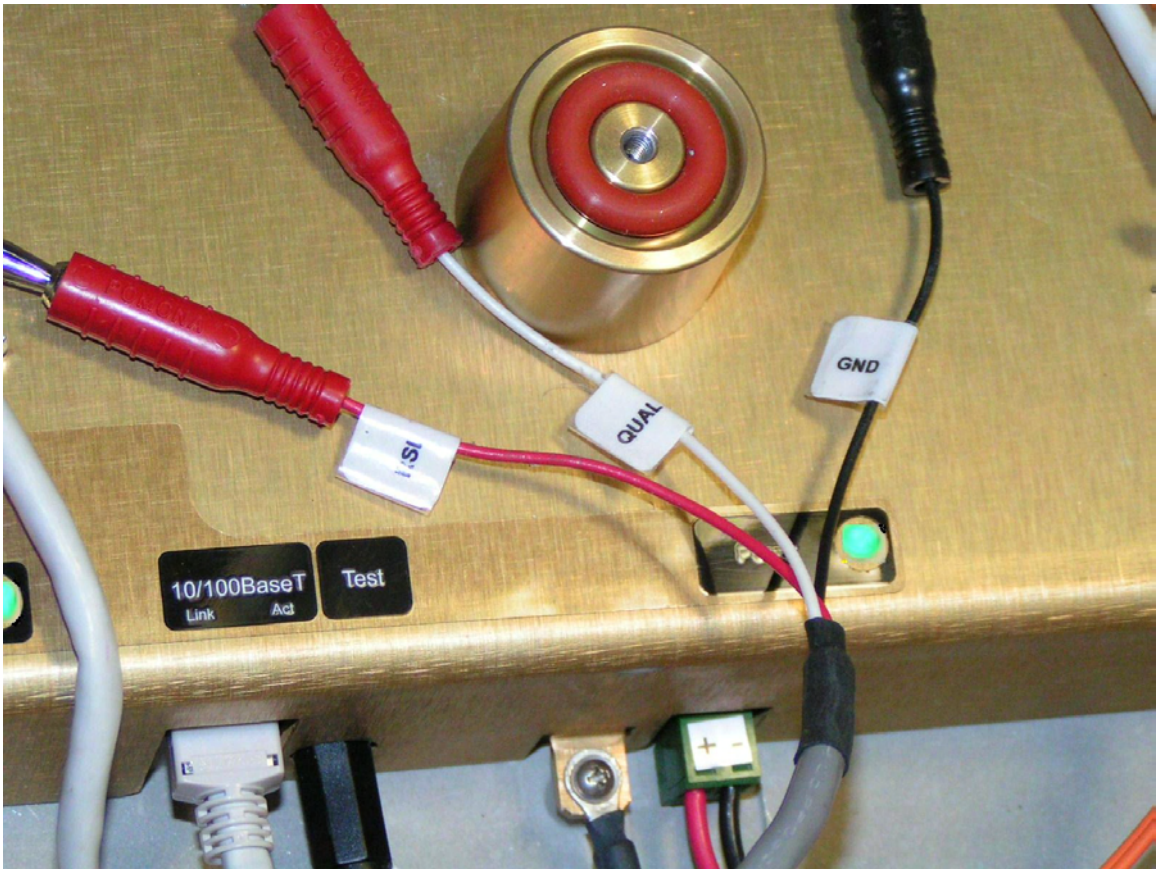


Figure 3-15: Top view of test cable provided to check Link Quality & Receive Signal level

2. To read the Link Quality value of the radio, insert GND (ground) and QUAL banana plugs into the voltmeter. Note the Link Quality voltage. After the radios have performed an auto calibration the quality voltage should read 3.0-3.3v if the link is aligned on the main antenna beam and there are no obstructions (i.e., trees, buildings, etc…) in the path, the link distance is within the operating parameters of the radio (see Section 2.4 above), and it is not raining heavily.

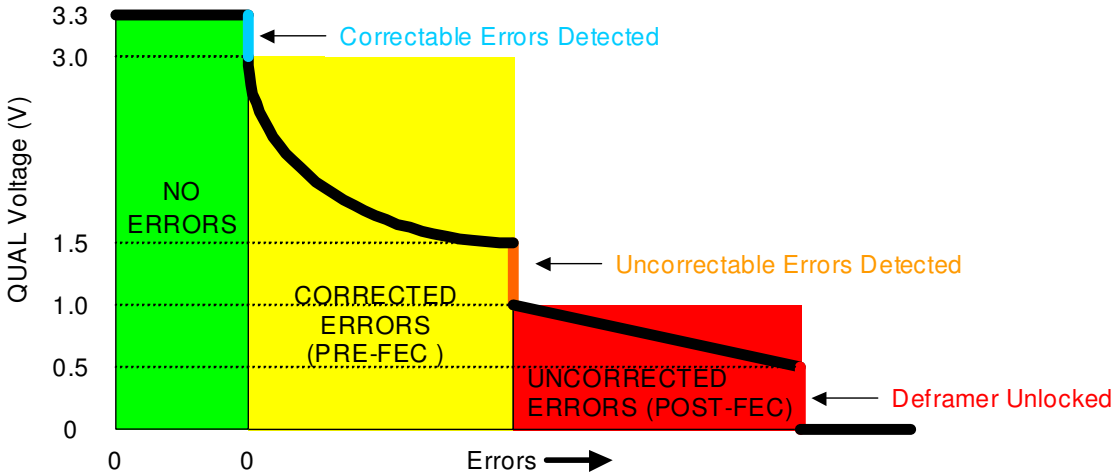


Figure 3-16 Quality Voltage Graph

- 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 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.

4 Operation of GE/AR80 & configuration of network equipment

During normal operation, the following conditions should exist at the radio:

1 The power LED should be lit—solid green;
2 The fiber LED should be lit—solid green;
3 The Link Up LED should be lit—solid green; and
4 The Link Quality BER voltage normally should be 3.0-3.3v when it is not raining.

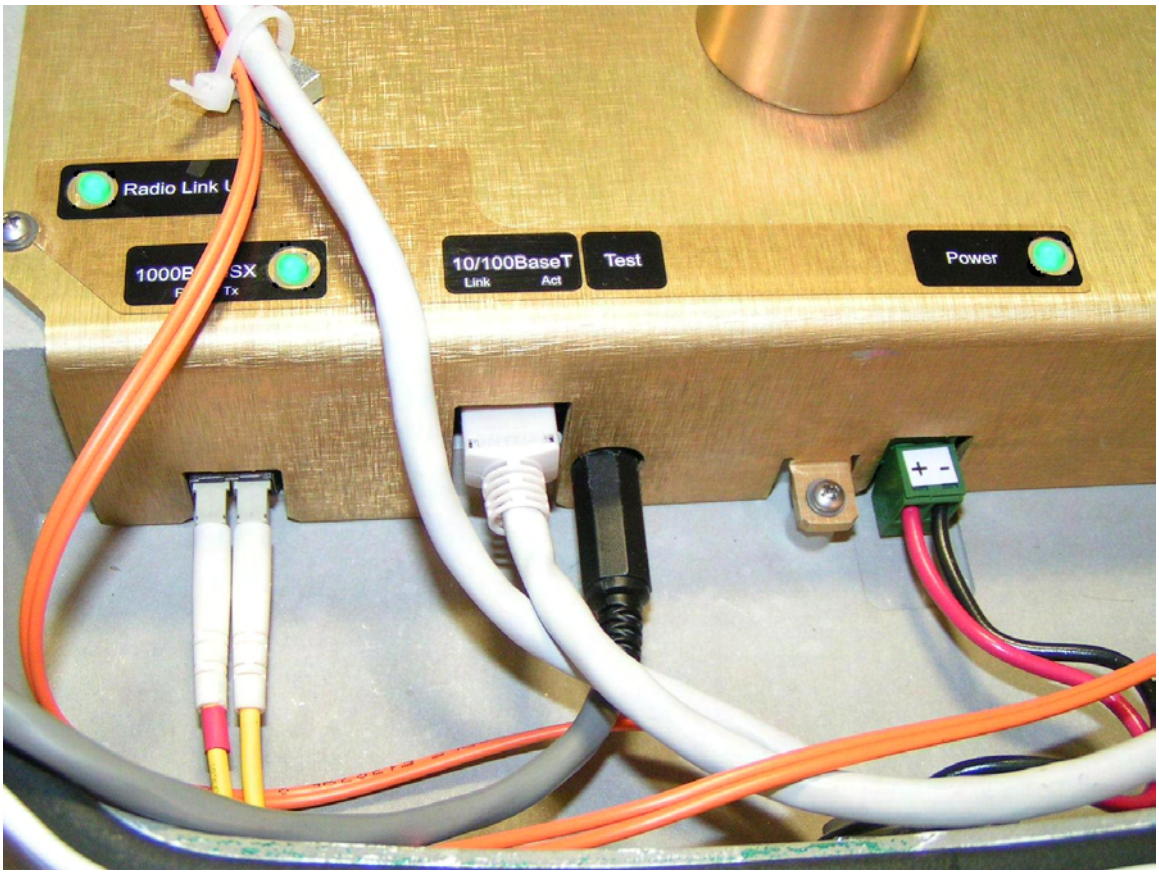


Figure 4-1: LEDs indicating link is up and operational

The GE80 radio does not require periodic maintenance. However, each end of the link should be periodically inspected for visible damage or excessive accumulation of dirt on the antenna's radome.

4.1 Configuring Network Equipment

The networking equipment that is connected to the GE/AR80 should be checked to ensure it operates properly over a wired connection. Once this has been confirmed it will save troubleshooting steps after the radio is installed and connected to the network equipment.

We strongly recommend the network equipment on both sides of the link be configured as follows:

- 1000Mbps full-duplex
- Port configured not to enter ***error-disable*** state due to link up/down transitions (since these may occur during periods of very heavy rain)
- For AR model only, ensure to ***disable*** the, ***Installation Auto-Calibration*** selection via Set Up GUI section, post installation.

4.2 Check Port Statistics on the Network Equipment

In the event the network equipment connected to the GE/AR80 offers the capability below, we recommend you verify the following on the network equipment:

- Link integrity
- There are no receive errors on the link
- Network traffic is flowing in both directions

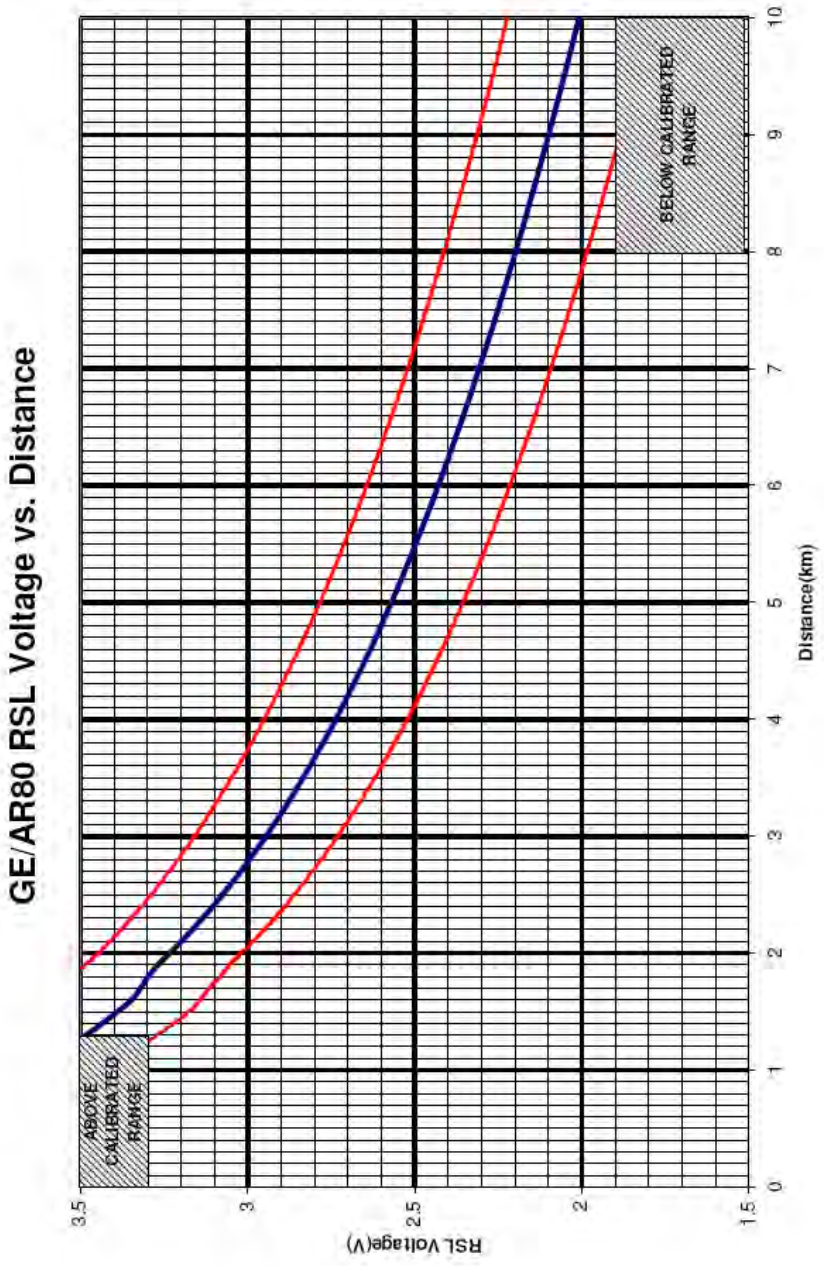
5 Troubleshooting

The following table provides a summary of possible problems you might encounter while installing a BridgeWave GE/AR80 link, along with possible causes and their solutions.

Problem	Possible Cause	Resolution
No power to radio	Wrong polarity of supply voltage	Use a DVM to determine the polarity and voltage on the DC cable. (See page12)
	The supply voltage measured at the radio (when connected) is below 15VDC	The cable run is too long or the cable gauge is too small. Shorten the length of the cable or use larger gauge cable. (See page 12)
Fiber light lit at radio but not on network equipment	Radio link is down and/or fiber not connected between remote radio and network equipment.	This is normal behavior. Complete end-to-end installation and re-check.
	TX and RX fiber 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: Port is turned on and set to 1000Mbps Full Duplex and auto negotiation is turned off.
	One or both of the fibers have been damaged	Use a loopback connector at the radio to verify the radio is OK, repeat at the networking equipment. Visually inspect the fiber cable.
Radio Link Up LED is off	Units are not properly aligned	The two units are not set to the same polarization. Verify and if necessary correct the polarization setting. (See section 3.6)
	Obstacle in link	Verify the Line of Sight conditions and check for required clearance (See page 8 for clearance distances).

RSL voltage lower then expected	Incorrect calculation of link distance	Verify that the calculation tool used and the GPS used both have the same annotation system (degree hours minutes seconds or degree with a decimal value)
	Antennas aligned on side lobes	Realign antenna to main lobe. Keep in mind that the first side lobe is only 1 degree from the main lobe.
	Antennas set to different polarizations	Verify that both radios are set to the same polarization. (see section 3.6)
	Installed two high or two low band radios in one link	Verify that one end of the link is high and the other end is a low band radio
	Excessive loss through glass	Verify RF loss of glass if you are transmitting from a window.
Low link quality voltage	Obstruction	Verify you have a clear line of site, look for tree and/or other foliage growth
	Antennas are not aligned for maximum RSL	Verify antenna alignment, use instructions provided in sections 3.6.-3.8
	Auto calibration not completed	Power cycle units to force auto calibration cycles. (see chapter 3.9)
	Self Interference	Check for possible interference if you have multiple systems on the same rooftop.

6 RSL Vs Distance Chart



Note: Readings for path distances below one (1) Kilometer should expect RSL level of 3.3Vdc.

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