# 3. Grounding and Lightning Requirements

Proper lightning protection requires the use of external primary protectors to complement the secondary protection built into the PureWave equipment. The primary protectors offer the surge currents a direct path to earth ground versus the undesirable “sneak” paths it may find through the equipment.

Properly installed and grounded primary protectors will dramatically increase the surge withstanding capabilities of the PureWave equipment. Surges that exceed the maximum ratings of the primary protector devices will eventually cause them to fail, however these devices are generally designed to fail short or open, as the application warrants, such that further surges will not damage the end equipment. While a failed primary protector still results in a service outage, it does prevent further damage to the more expensive end equipment.

A Base Station that is installed outdoor on the tower or mast (ODU) is especially vulnerable to lightning surges. Good surge mitigation practice starts with the lightning rod and its connection to a proper sized down conductor.

The ground down conductor should be as straight as possible and avoid incidental contact with other conductors such that it represents the path of least resistance to earth ground from the lightning rod. The tower/mast is also earth grounded to keep its conductive elements at earth potential (0V) for personnel safety, and generally presents a less desirable path to ground to surge currents. ODU equipment and external primary protection devices are mounted to the tower/mast and should be bonded to earth ground at the same point on the down conductor. This practice is intended to avoid ground loop currents that may flow from differences in potential between the tower/mast structure and down conductor while large surge currents are flowing in them respectively. Good surge mitigation practice also makes use of shielded cables with peripheral shield grounding to minimize potentials induced on circuit conductors.

These cables should also be secured to the tower/mast at regular intervals to create physical separation from conductors which are carrying surge currents. This practice avoids incidental contact or possible insulation breakdown from high surge potentials.

A Base Station that is installed indoor units (IDU) requires similar protection as the outdoor installation (ODU). Primary protection devices are installed on all cables just prior to entry of the facility and bonded to an earth ground stake. Likewise, the cable shields are grounded at the entry panel which should be bonded to the same earth ground stake.

IDU equipment may also be vulnerable to surges entering via the AC power connection and steps should be taken to install a proper AC Surge Suppressor device to complete a well protected installation.

## 3.1 Lightning Protection Installation Components

The following are considered to be the main elements that constitute the components of a lightning protection scheme.

- Lightning Rod
- Base Station and Antenna Grounding
- Down Conductor
- Coaxial and/or Cat 5 Cable Shield Grounding

Figure 41, demonstrates graphically how these elements are applied to an overall lightning design. Please note that this is simply a generic diagram and that each individual installation may have its own specific requirements which may differ from the diagram. The key point to note is the overall concept.

The main items will be outlined in more detail in the following sections.

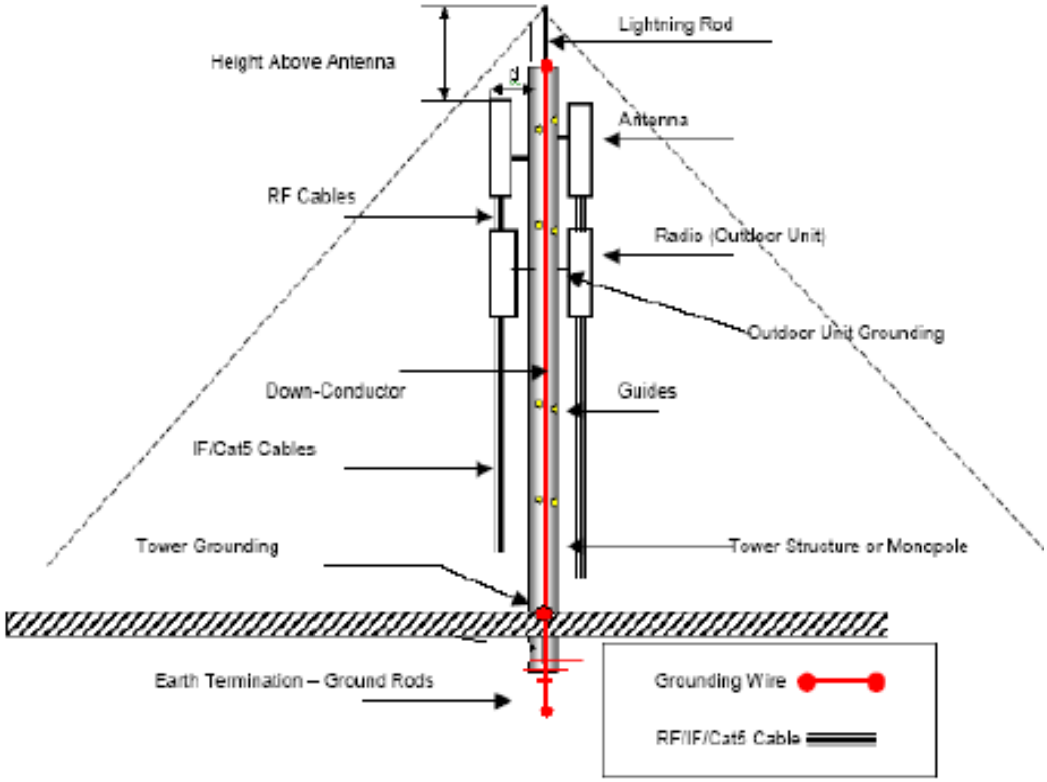



Figure 41 - A Typical Lightning Protection Design

## 3.2 Lightning Rod

The Lightning Rod must be welded to the mast structure and to a down conductor. This should be constructed of a steel pointed tip and is in general installed at the highest point of the tower. It operates to intercept the downward moving lightning strike by launching an upward going attachment spark. Once the attachment is achieved, the bulk of the lightning current follows the ionized path. In this way, the lightning rod diverts the lightning away from equipment on the tower.

If the lightning rod is not installed at the highest point on the tower, the equipment that is connected to the highest point (usually a radio) is the most likely attachment point.

A Class I lightning rod (air terminal) is 3/8-inch copper or 1/2-inch aluminum, while Class II calls for 1/2-inch copper or 5/8-inch aluminum. Conductor sizes vary accordingly, also depending on their composition (stranded or strips) and materials (aluminum or copper). Since most soils contain acid or alkaloid compounds that react with aluminum, any aluminum used must not come in contact with the soil. Lightning rods (air terminals) 24 inches or higher should be used.

Referring to figure 41 above, the “Height Above Antenna” above the highest item of equipment (generally the antenna) must be at least twice the distance (2 x d) between the outer surface of the item and the tower. This will ensure a “protection cone” of 60 degrees around the tower (30 degrees each side from the lightning rod). In areas of high lightning activity, the “Height Above Antenna” should be increased to up 5 times the distance.

## 3.3 Down Conductor

The purpose of the Down conductor is to provide the shortest and most direct path to the earth. The grounding of the down conductor to earth must be of ground resistance no more than 5 ohms.

## 3.4 Co-axial and/or Cat 5 Cable Shield Grounding

The purpose of the Shield grounding is to minimize the potentials induced on circuit conductors plus keep the cable shields at earth potential (0V) for personnel safety.

All ground lugs must be properly bonded to the grounding system of the protected components along with all Antenna cables. Prior to entry into any facility, the cables must be properly grounded to the building primary ground system at the building entrance panel.

In case of an indoor installed Base Station then this will apply to the co-axial cables that connect the Base Station to the Antenna. This is because these co-axial cables provide the only inter-connection between the indoor and the outdoor.

In the case of an outdoor installed Base Station, then this will apply to the Cat 5 cable and power connection to the Base Station. In the case of an installation of the Base Station, it is the Cat 5 cable and the power that provide the inter-connections between the indoor and the outdoor.

## 3.5 Grounding and Bonding

The National Electric Code requires that any accessible metallic surface of electronic equipment be connected to earth ground for personnel safety. Earth ground connections are achieved by direct connections to the AC power ground at the IDU and by a grounding lug on the ODU. A Craftsperson must attach a proper size wire to the ODU ground lug during installation, else the ODU chassis will float at whatever potential appears at the shield connection of the coax.

## 3.6 Recommended Connection of a Bonded Ground

We will now examine the concept of a bonded ground. Bonded connections for reliable, gas tight joints between conductors require removal of all paint from both contact surfaces and holding them together under high pressure such as with a bolt or screw. The use of toothed washers is also recommended to cause the conductive surfaces to bite into each other for improved connectivity and eliminate movement of the conductors due to vibration.

## 3.7 Single Point Grounding Concept

Extensive analysis and investigation of installations has led to the belief that the root cause at the heart of the majority of the failures is likely to be the presence of multi-point grounding of equipment on the towers and in the huts. Single point grounding these elements will eliminate ground voltage differentials and this will dramatically increase the equipment survivability during surges.

Single point grounding requires that the grounding leads from the antenna, Base Station and Surge Protection devices for a particular sector, are bonded together at the same point on the tower down conductor. It is not necessary to bond all the sectors together but to ensure the components of any individual sector have the same ground point on the tower.

In the equipment hut, in the event of an indoor installation of the Base Station then the chassis ground of the Base Station and all the Surge Protection Devices grounds must be grounded at the same point (see figure 42).

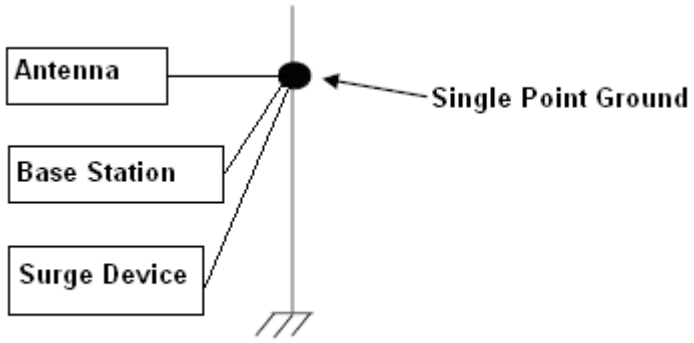



Figure 42 - Single Point Grounding Concept

It is important to note that the following ground guidelines are followed during installations:

1. Surge Protection devices generally connect to ground by using a ground wire. Cut any extra ground wire length when finished connecting it to the single point earth ground
2. Never loop or coil up the ground wire, always connect it straight to ground.
3. A good earth ground impedance is less than 1.0 ohm.
4. Measure ground impedance at the point where the protector ground wire is connected and not at the ground rod.
5. Avoid sharp bends. Connect the ground wire as straight as possible.
6. Connect the protector ground wire and equipment ground (both power ground and telecomm. ground) to a single common ground.
7. Make sure all connections are fastened securely and are tight.
8. Never install protectors during a storm and always follow your local safety codes.

## 3.8 Lightning and Surge Protection

PureWave recommends that Surge Protection Devices are installed to protect the Base Station.

For an indoor installation of the Base Station these “Surge Protectors” devices would be installed at the entrance to the building that “houses” the Base Station (see figure 43).

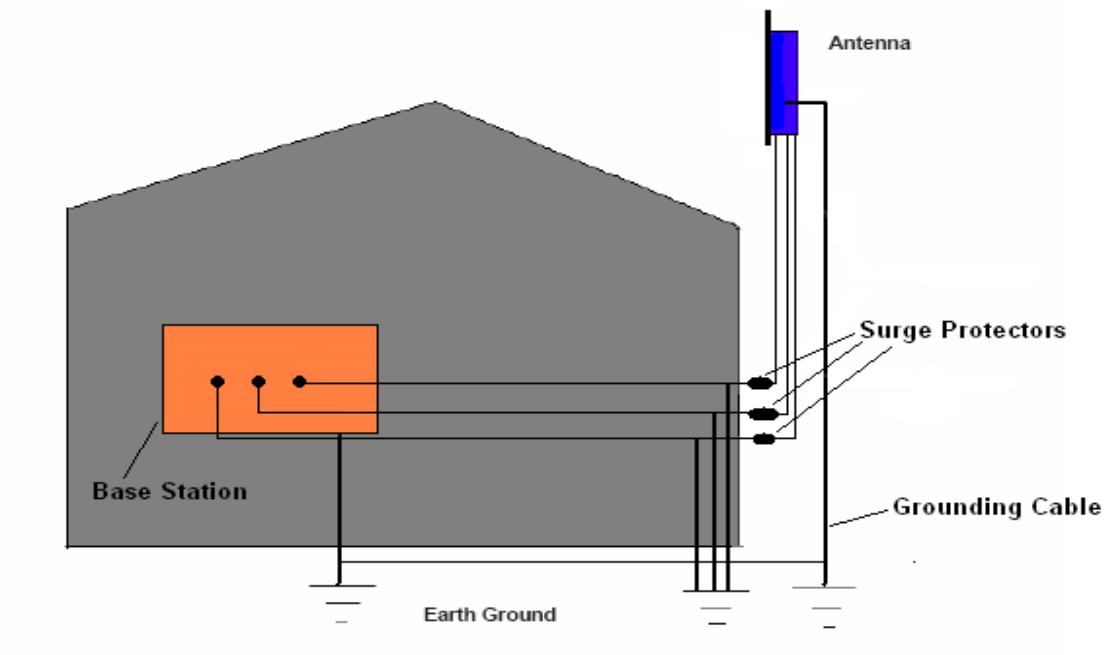



Figure 43 - Indoor Installed Base Station Relative to Position of Lightning Protectors

Such a device will provide protection to the Base Station in the event of a “surge event” entering the Base Station through the RF port.

Two recommended devices are:

- PolyPhaser Model AL-LSXM-ME (see figure 44). This is a 2GHz to 6GHz in-line surge filter with a DC block. This is a uni-directional device.
- Altelicon Model AL-NMNFB-9 (see figure 45). This is a DC to 6GHz in-line surge filter. This is a bi-directional device.

Figure 44 - PolyPhaser Model AL-LSXM-ME Surge Protector (with ground lug)


Figure 45 – Altelicon Model AL-NMNFB-9 Surge Protector (with ground lug)

Care must be undertaken when installing the surge protectors. If the device is bi-directional then it is irrelevant as to the direction of installation. If the device is uni-directional therefore it must be installed to ensure that the protected side of the surge protector is connected to the Base Station. In the case of the Polyphasor the N-type male connection is connected directly to the Base Station output and the N-type female connection is connected to the Base Station to Antenna cable. The male to female design of the surge protector means that it is very difficult to incorrectly connect. In addition it is recommended that a ground wire is connected to the ground lug that is provided with the surge unit (see figure 46).

Figure 46 - PolyPhaser Surge Protector Connected to Cable with Ground Cable Attached

Actual installation will depend upon the tower specifics. General tower installation practices would have a large ground bar or plate just at the cable entrance to the building and the Surge Protectors would be either attached directly or via the ground wire to this plate/bar. Alternatively the Surge Protectors can be directly attached to the Base Station and then appropriate ground connections can be made.

In the event that the Base Station Radio is installed outside then it is recommended to install the surge protection unit(s) between the Base Station and the Antenna.

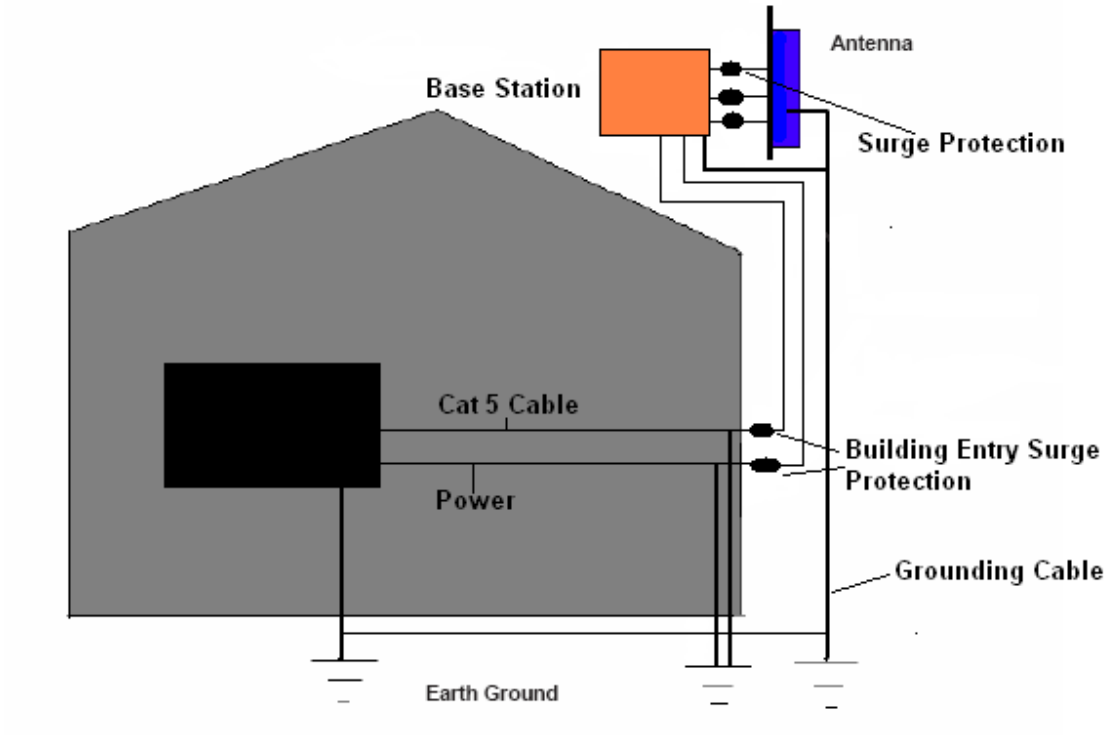



Figure 47 - Outdoor Installed Base Station Relative to Position of Lightning Protectors

These “RF” surge protection devices will provide the Customer with two advantages (see figure 47).

1) To protect the Base Station in the event of a “surge event” entering the Base Station through the RF port.
2) It provides a mechanism to effectively “ground” together the Base Station, the RF surge protector and the antenna.

In the case of an outdoor installation, it is recommended that suitable building entry surge protection is considered and the equipment installer may want to consider based upon individual installation requirements.

**Note: Please ensure that appropriate weather protection is applied to all outdoor Surge Protection devices.**

Surge protection devices for both the Cat 5 and the power connections to the Base Station are already built into the unit. No further devices are required to protect the unit. In addition, for an appropriate fee, PureWave provides a RF lightning surge protection kit. This includes the RF surge protection devices and a “ground bar” which acts as a means to ground all the devices. Please refer to figure 48 for an example of this kit when installed.

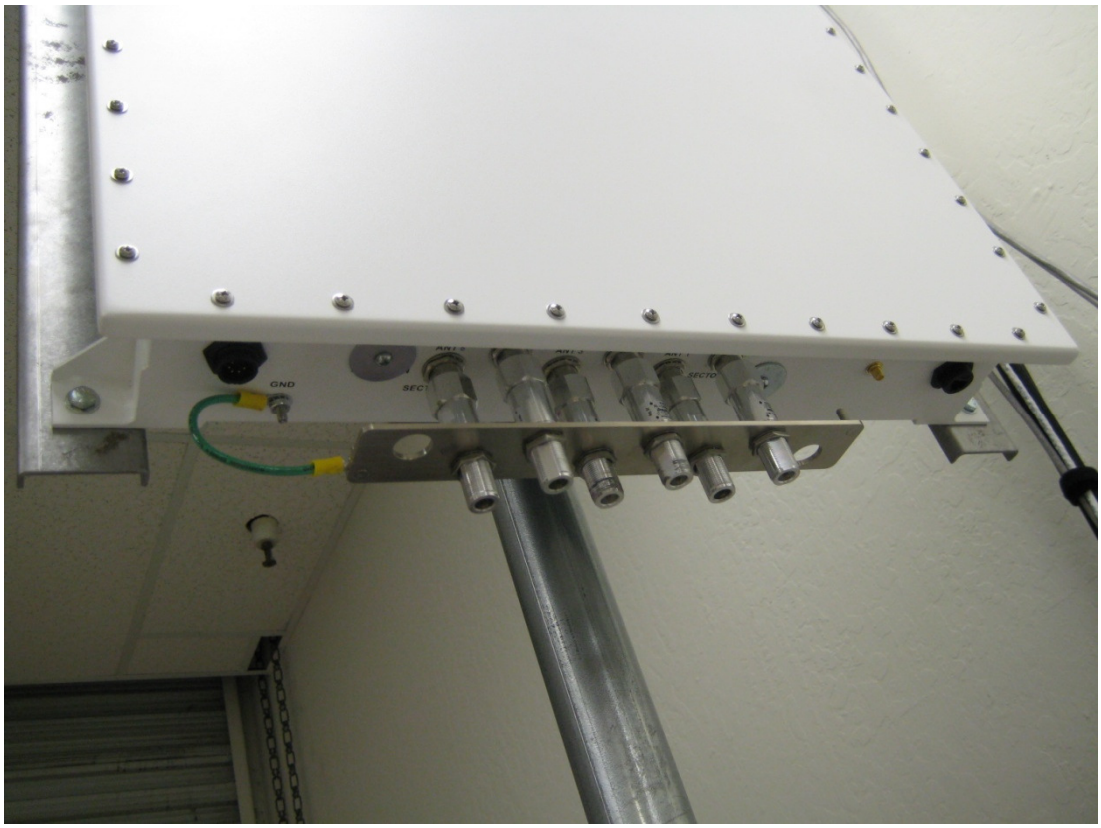


Figure 48 - Installed PureWave provides a RF lightning surge protection kit

# 4. Weather Protection

PureWave recommends that appropriate weather protection sealing and the application of an anti-seize material is applied to all “outdoor” installed elements of the system. Weatherproofing tape kits flawlessly seals the junction between two connectors. It not only protects the connection from water damage, it also prevents vibrations from loosening the interface.

## 4.1 Weather Sealing

There are a range of commercially available weather protection “kits” that provide all the necessary components in addition to full instructions on “how to” weather protect. A generic weather sealing concept will be adopted rather than a specific one.

The following universal weatherproofing kit was used:

| | |
|---|---|
| Name: | Universal Weatherproofing Kit |
| Part #: | 488136 |
| Descripton: | Weatherproofing tape kit. Each kit contains (6) rolls of 2-1/2" x 24" butyl tape, (2) rolls of 3/4" x 66' black electrical tape & (1) roll of 2" x 20' black electrical tape. |
| Manufacturer: | Andrew Networks (P/N 221213) |
| Distributor: | Tessco (http://www.tessco.com) |

The butyl tape is shown below in figure 49.

Figure 49 - Butyl Tape Weather Protection

The general procedure to install is:

1) Completely wrap the connection with the smaller 3/4inch smaller electrical (plastic) tape. Ensure that the tape extends back up the cable to cover the entire connector and that the tape overlays itself by approximately half a width (figures 50 and 51).

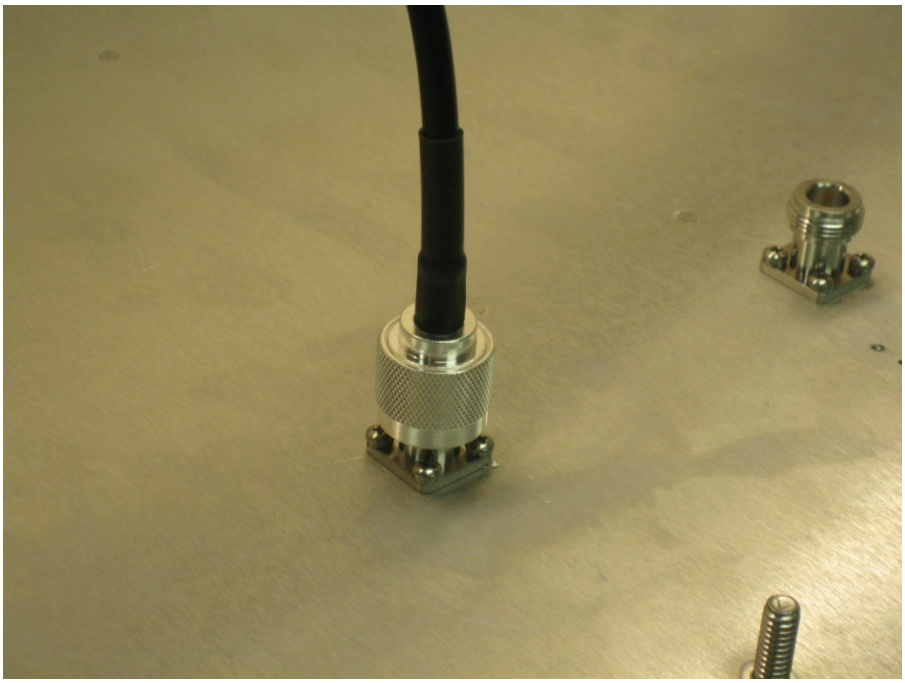


Figure 50 - Connection to Antenna

Figure 51 - Plastic (Electrical) Tape Applied

2) Cut a length of the butyl such that it will completely cover the connection. Wrap the tape around the connector and press into place. Ensure that there are no gaps (figures 52 and 53).

Figure 52 - Butyl Tape Being Applied

Figure 53 - Butyl Tape Applied

3) Completely wrap the “wrapped assembly” with the larger 2 inch electrical (plastic) tape. Ensure that the tape extends back up the cable to cover the entire butyl tape and that the tape overlays itself by approximately half a width (figure 54).

Figure 54- Second Plastic Tape Applied

## 4.2 Anti-Seize

It is also suggested that a suitable anti-corrosion lubricant is applied to all exposed metal surfaces. A suitable lubricant is recommended below.

| | |
|---|---|
| Name: | NEVER-SEEZ® Regular Grade Lubricant 1OZ (figure 55) |
| Part #: | V057940-8A |
| Descripton: | NEVER-SEEZ® regular grade lubricant is an anti-seize compound and extreme pressure lubricant in a 1 ounce tube. Protect metal parts against rust, corrosion and seizure up to 1800ºF. |
| Distributor: | Ellsworth Adhesives (http://www.ellsworth.com) |


Figure 55 - Anti-Seize Lubricant

To apply the material then the exposed metal surface is simply “painted” with the lubricant such that all exposed metal surfaces are completely covered (see figure 56).

**Note: These types of lubricants tend to be “messy” and “sticky” to apply due to the nature of their intended application. Always read the labels or instructions provided and take necessary pre-cautions during application**.

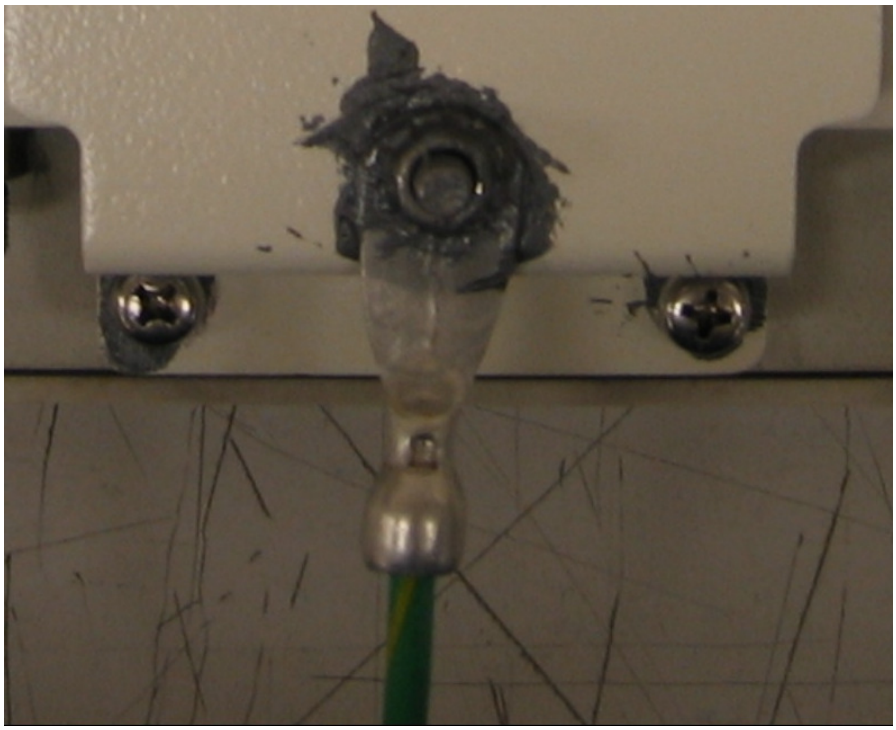


Figure 56 - Anti-Seize Applied

# 5. Base Station Bring-up

## 5.1 Overview

This section describes how the operator may power-up the PureWave Base Station and verify proper system initialization. The PureWave Base Station CLI (Command Line Interface) will be used to configure and ensure general system integrity.

## 5.2 Connect to the Base Station

There are three RJ45 Ethernet ports to connect and hence access the Base Station.

RS232: This is the serial interface to the Base Station. This interface will be primarily used for “out of the box” configuration and debug purposes.

E-NET 1: This Gigabit Ethernet port provides the data traffic backhaul interface that should be connected to the Service Provider’s network equipment. This port allows in-band management of the Base Station.

E-NET 2: This Gigabit Ethernet port provides an out-of-band management interface. In addition, this port can be used for daisy chaining to another base station or to connect to an external device such as a web Camera.

The procedure to connect to the Base Station is:

- Terminate the antenna ports ANT 1 and ANT 2 as directed.
- Connect and Power on the Base Station.
- Connect a “straight” Cat 5 Ethernet cable between the E-NET 1 port on the Base Station and the directly to your PC or to your switch.
- To get access to Base Station CLI (Command Line Interface) you will need the following hardware that come with the install kit. These are as follows:
  - RJ45 cable.
  - DB9 male connector (Modem Adapter).
  - DB9 female to DB9 female adapter.

Optional: Serial to USB connector. Most laptop nowadays comes with USB connection instead of serial connection. If your PC/laptop has serial connection then you won’t need this adapter. If not, then you will need to get serial to USB adapter to access the BS CLI (figure 57).

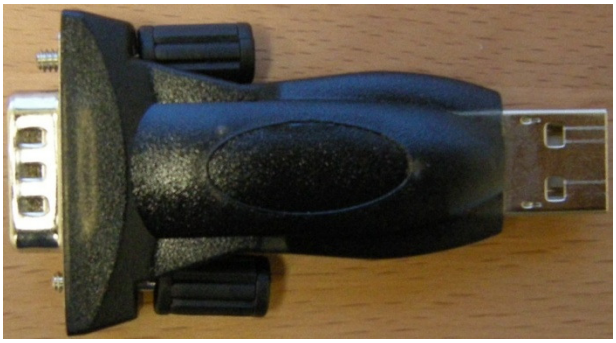


Figure 57 – Serial to USB adapter (DB9 Male)

Plug one end of a “straight” Cat 5 Ethernet cable into the RS232 port on the Base Station and the other end into the RJ45 to Modem adapter. Connect the other end of this Modem adapter to a DB9 serial cable and connect this DB9 serial cable to a USB adapter that connect to your laptop. Please refer to figure 58 for the physical layout.

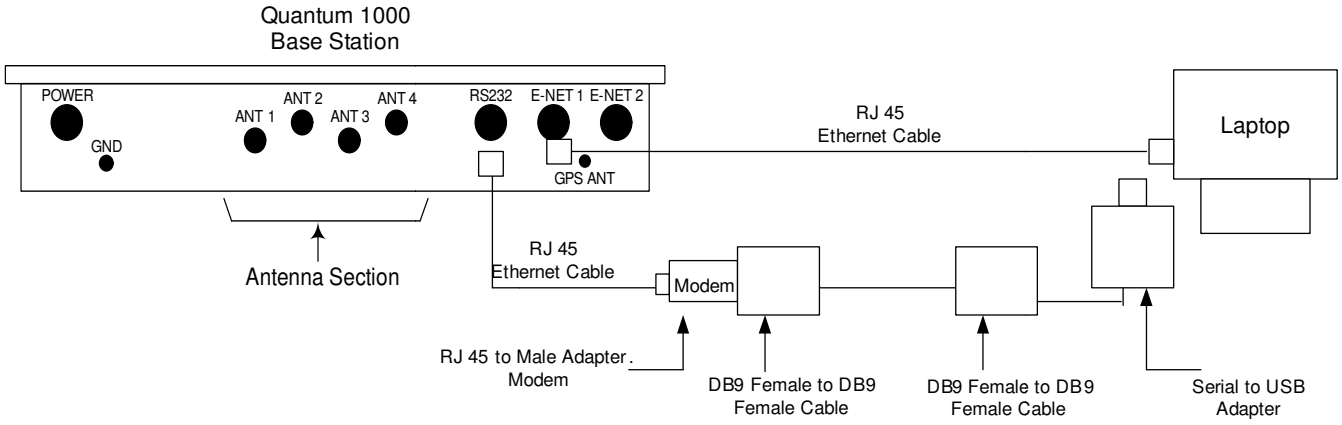



Figure 58 – Base Station Serial Connection

## 5.3 Configure the Base Station

The Base Station can be configured using its CLI. To access the CLI then connection is made via any standard serial communications protocol, such as Hyper Terminal.

To access the Base Station CLI through Hyper Terminal Setup please follow the steps as outlined below. This assumes a PC that is operating on Windows 2000/XP.

1) Start HyperTerminal by clicking on ‘Start -> Programs -> Accessories -> Communications ->HyperTerminal’.
2) In Hyper Terminal create a "new connection" this can be done by clicking the Hypertrm.exe icon or via the menu within HyperTerminal "File: NewConnection".
3) Type in a name for the connection (for example, test).
4) Under "connect using" select "Direct to Com 6" if the available com port is com 6 otherwise select the appropriate com port.
5) Set "Bits per second" to 38400.
6) Set "Data Bits" to 8.
7) Set “Parity” to None
8) Set "Stop Bits" to 1.
9) Set "Flow control" to Xon / Xoff
10) Click OK - the hyper terminal screen should appear.

To login into the Base Station CLI then use the following information:

Login: **customer**
Password: **12345**

After you successfully login, you will see "*PUREWAVE MANAGEMENT UTILITY*" Dialog box (figure 59).

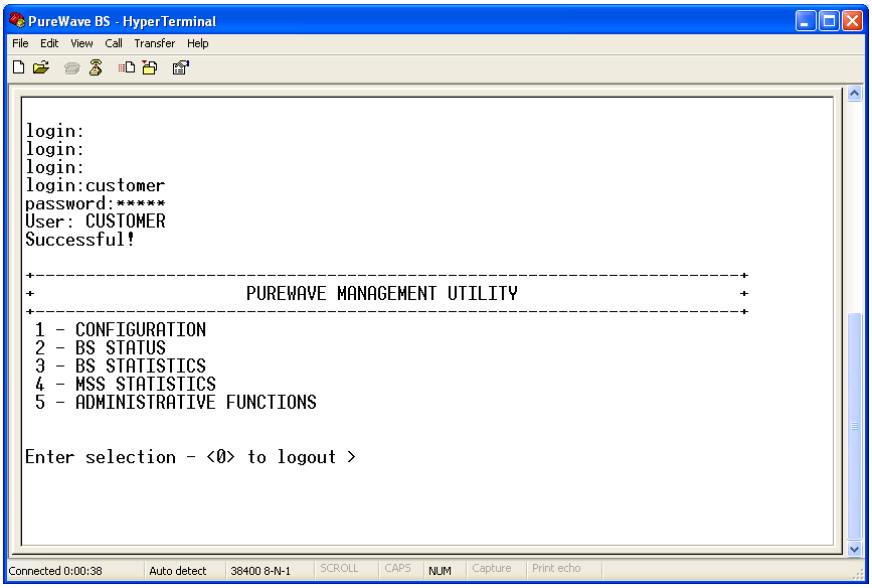



Figure 59 - Hyper Terminal Login window to Base Station CLI

1) Select *1 (CONFIGURATION)* from the menu and follow the steps carefully to configure the Base Station (figure 60).

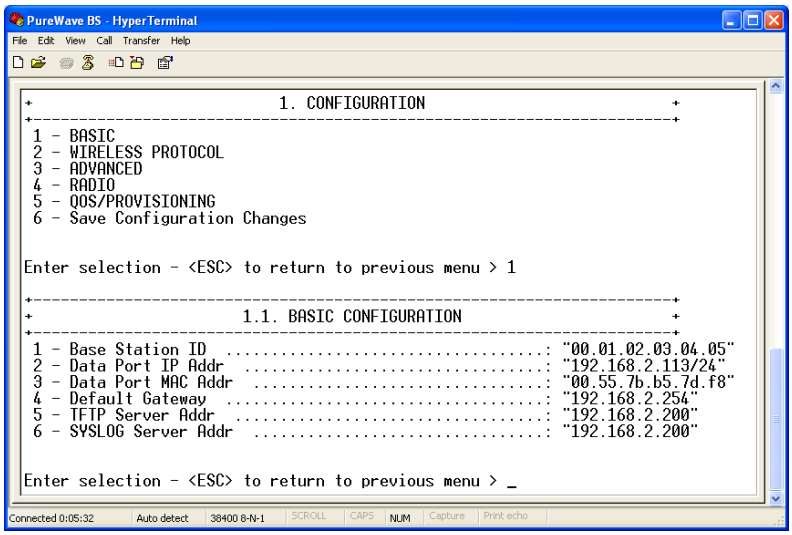



Figure 60 - Base Station CLI Basic Configuration

2) From the *1.1 BASIC CONFIGURATION* menu, select 2 *(DATA PORT IP Addr). T*his is Base Station IP address for Management purposes. You must use "Quotations" when changing the IP address and specify the class of the subnet mask after the slash.

The default BS IP Address is 192.168.2.101/24

For example to change the BS IP address to 192.168.2.113/24, then enter the information as figure 61.

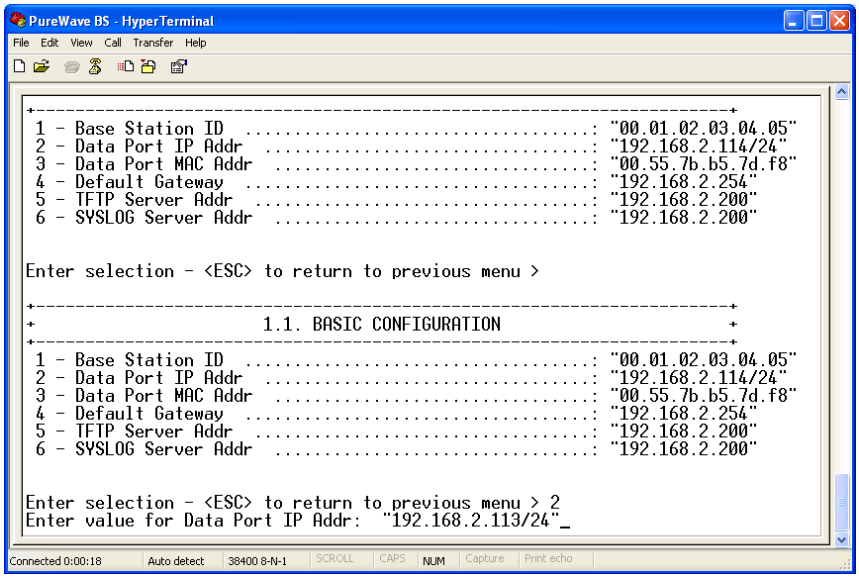



Figure 61 - Base Station CLI IP Address Change

3) The User is free to change the *Default Gateway* (option #3), *TFTP Server Addr* (option #5), and *SYSLOG Server Addr* (option #6). These will depend upon the Customer's own network configuration.

4) Please note that you will not be able to change the *Base Station ID* (option #1) and *Data Port MAC Addr* (option #3) addresses.

5) Hit the <ESC> to return to the *1.1 BASIC CONFIGURATION* menu. You will be prompted to "Save" any changes.

6) Select 2 (*WIRELESS PROTOCOL*) from the *1.1 BASIC CONFIGURATION* menu and verify the following two settings (figure 62). You cannot change the variables so this is simply for verification purposes.
   - *UL Automatic TX Power Control* should be set to 1 (enabled)
   - *Power Control Mode* should be set to 1 (Open-loop)

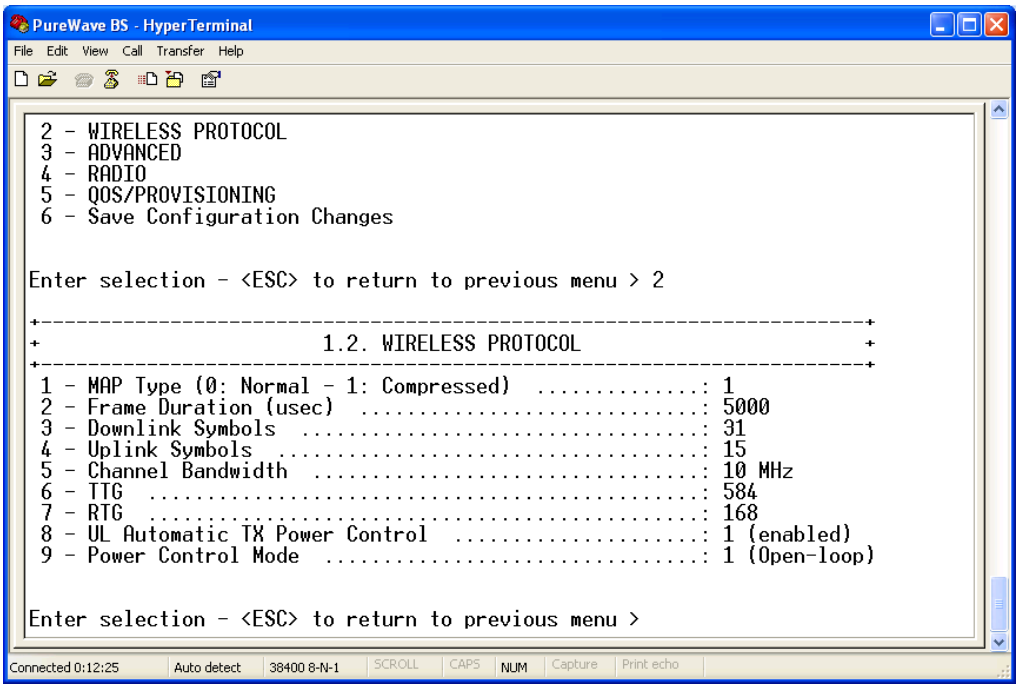



Figure 62 - Base Station CLI IP Wireless Protocol Check

7) Hit the <ESC> to return to the *1.1 BASIC CONFIGURATION* menu. You will be prompted to "Save" any changes.

8) Select #3 (*ADVANCED CONFIGURATION*) from the *1.1 BASIC CONFIGURATION* menu and verify the following two settings (figure 63).

- *Auto Default Provisioning* is set for 1 (enabled)
- *Auto Start* is set for 1 (enabled)

If these variables are not set as expected then select the relevant option and change these to the enabled state.

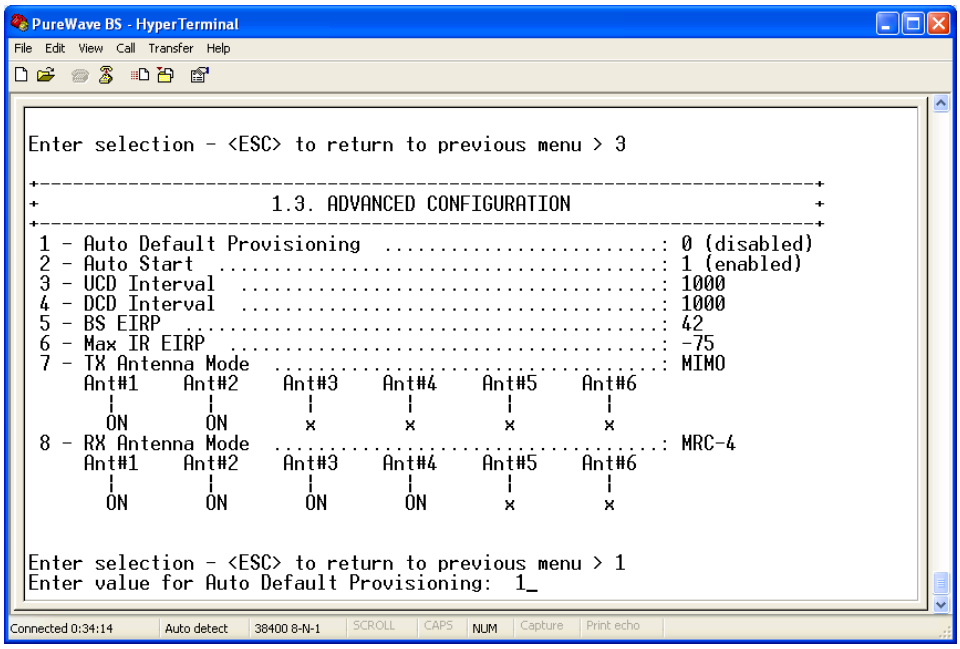



Figure 63 - Base Station CLI Advanced Configuration

9) Hit the <ESC> to return to the *1.1 BASIC CONFIGURATION* menu. You will be prompted to "Save" any changes.

10) Select #4 (*RADIO*) from the *1.1 BASIC CONFIGURATION* menu and assign the following radio parameters. It is important that you set all 4 parameters especially the Frequency (this much match with the CPEs) and the Output Power (figure 64).

- 1 (*Center Frequency (KHz)).* This is the frequency of the Base Station and it must match with the CPEs. If the User wishes to change this then please provide the required frequency is KHz.
- 2 (*Antenna Gain (dB)*). This is the gain (in dB) for the antenna that is being used.
- 3 (*Cable Loss (dB)*). This is a loss of the cable (in dB's) from the Base Station to the Antenna.
- 4 (*Output Power (dBm)*). This is the output power in dBm. By default it is set at 6. Maximum output power should be set to 36.

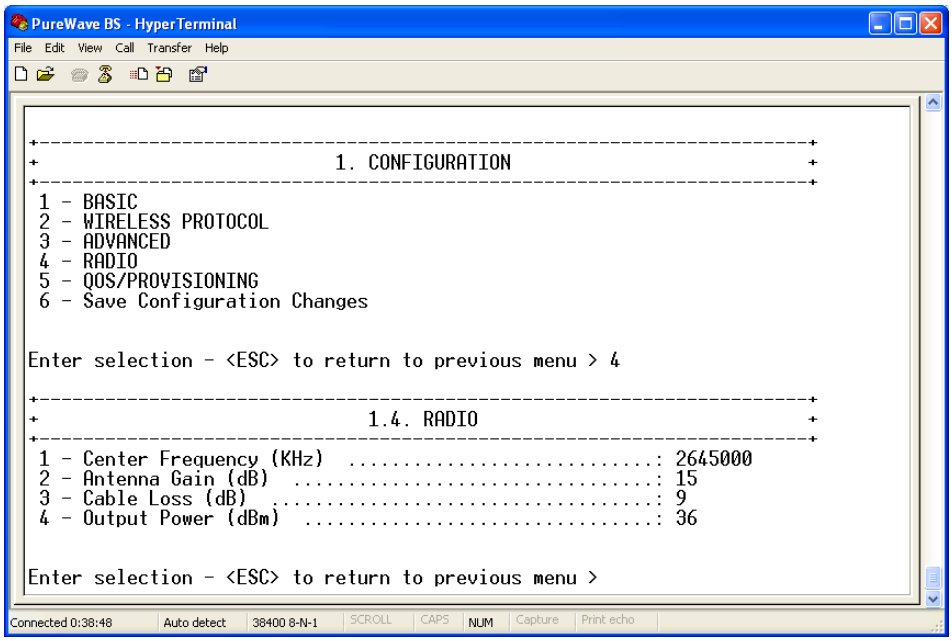



Figure 64 - Base Station CLI Radio Configuration

11) Hit the <ESC> to return to the *1.1 BASIC CONFIGURATION* menu. You will be prompted to "Save" any changes.

# Appendix A

Quantum 1000
Base Station
Data Sheet

# Specifications

## General

**Standards Compliance**
IEEE 802.16e-2005

**Frequency Bands**
2.3-2.7 GHz, 3.3-3.7 GHz
(subject to regional regulations)

**Channel Size**
3.5, 5, 7, 10 MHz

**Duplex Method**
TDD

**Number of Tx/Rx Antennas**
2x2, 2x4

**Tx Power per Antenna**
33 dBm

**Simultaneous Connections**
200+

**QoS**
BE, UGS, rtPS, ErtPS, nrtPS

**Convergence Sublayer**
Ethernet_CS, IP_CS, Multi Host CPE, IPv4, IPv6 pass through

**Security**
EAP Authentication and Encryption

**Traffic Classification**
Layer 2 IEEE 802.1p, 802.1Q, IP DiffServ

**Backhaul Interconnect**
2 x GigE RJ-45, Inter-sector daisy-chain support

**Inter BS Synchronization**
GPS

## Throughput

**Peak Throughput / Sector**
DL: up to 40 Mbps; UL: up to 23 Mbps

- TCP/IP Application-Layer "goodput" typically 15-20% lower.
- CPEs may not support all modulations or throughputs.

## Networking

**Data**
IEEE 802.3 CSMA/CD

**Management**
Remote CLI, Standard SNMP v2c

## Mechanical, Electrical, and Environmental

**Dimensions**
24.6" (H) x 17.4" (W) x 4.5" (D)
62.5 cm (H) x 44.2 cm (W) x 11.4 cm (D)

**Weight**
23 pounds

**Power**
-48 VDC, 65 Watts

**Temperature**
-33 to +55 degrees C

**Humidity**
5 to 95% non-condensing

**Surge Protection**
UL497B

**Lightning Protection**
10kA IEC 6100-4-5
(*optional via external kit)

**Weatherproofing**
IP67

## Power Cable

**Cable Type**
4 conductor 14-18AWG gauge copper wire (2 power, 2 return)

**Connector**
Tyco 796095-2

**Grounding**
Bulkhead mounting screw

## System Antenna

**Connector**
N-Type Female

## GPS Antenna (Provided)

**Connector**
SMA, 50 ohms

## Ethernet

**Connector**
RJ-45 Ethernet 568-B Straight Connection

## RS-232

**Connector**
RJ-45

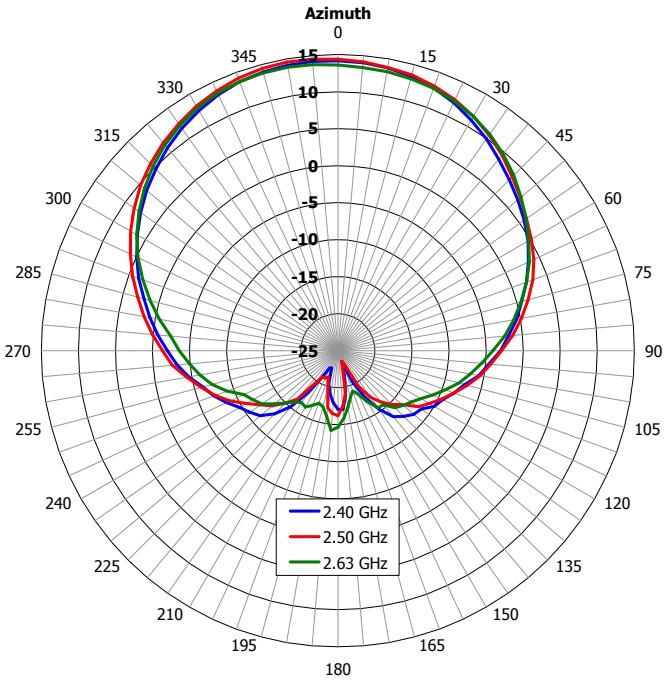
# Appendix B

## 4 (Quad) Antenna Panel Data Sheet

| | |
|---|---|
| **Electrical** | |
| Polarization | Vertical |
| Input Impedance | 50 ohm |
| **Mechanical** | |
| Dimensions (LxWxD) | 25.54” x 20.33” x 1.75” |
| Weight | 12.1 lbs |
| Antenna Elements | 4 |
| Connectors | N-Type Female x 4 |
| Radome | Kydex T Plastic, Light Grey |

| Model | Frequency (GHz) | Azimuth | | Elevation | |
|---|---|---|---|---|---|
| | | Peak Gain (per antenna) (dBi) | Beamwidth (3 dB) | Peak Gain (per antenna) (dBi) | Beamwidth (3 dB) |
| 2.5A | 2.40 | 14.2 | 63° | 14.4 | 14° |
| | 2.50 | 14.6 | 68° | 14.6 | 13° |
| | 2.63 | 13.9 | 72° | 14.7 | 12° |
| 2.5C | 2.40 | 14.3 | 112° | | |
| | 2.50 | 14.0 | 117° | | |
| | 2.63 | 14.3 | 117° | | |
| 3.5A | 3.5 | 17.5 | 68° | 17.4 | 8° |
| | 3.6 | 17.3 | 71° | 17.3 | 8° |
| | 3.7 | 17.2 | 60° | 17.1 | 8° |

# Model 2.5A


Azimuth
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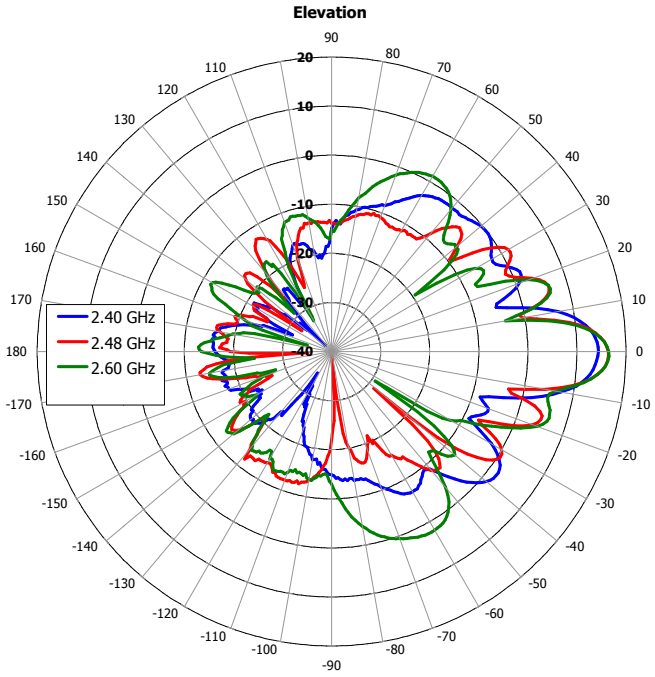
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
330
345
15
10
5
0
-5
-10
-15
-20
-25
2.40 GHz
2.50 GHz
2.63 GHz


Elevation
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80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
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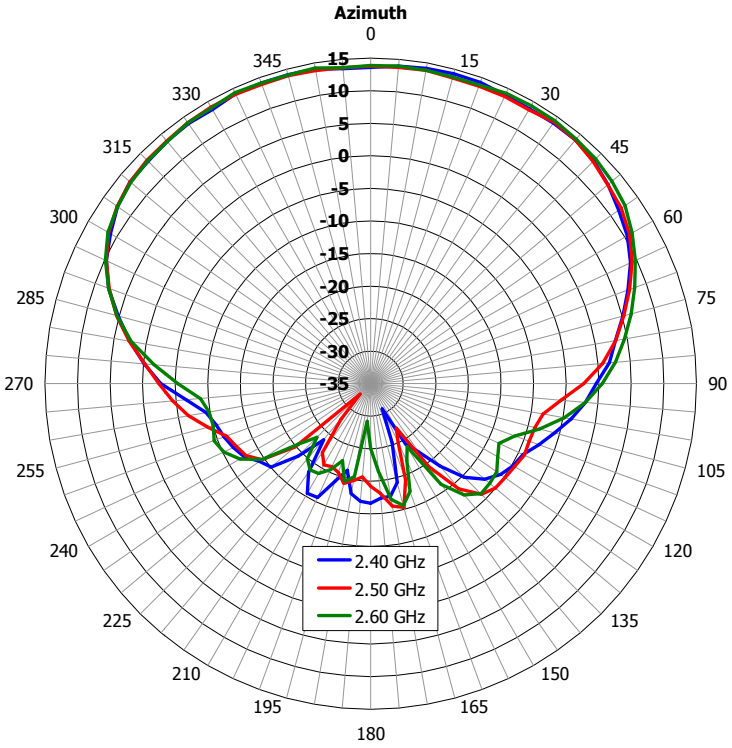
-90
-100
-110
-120
-130
-140
-150
-160
-170
180
170
160
150
140
130
120
110
20
10
0
-10
-20
-30
-40
2.40 GHz
2.48 GHz
2.60 GHz

# Model 2.5 C


Azimuth
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45
60
75
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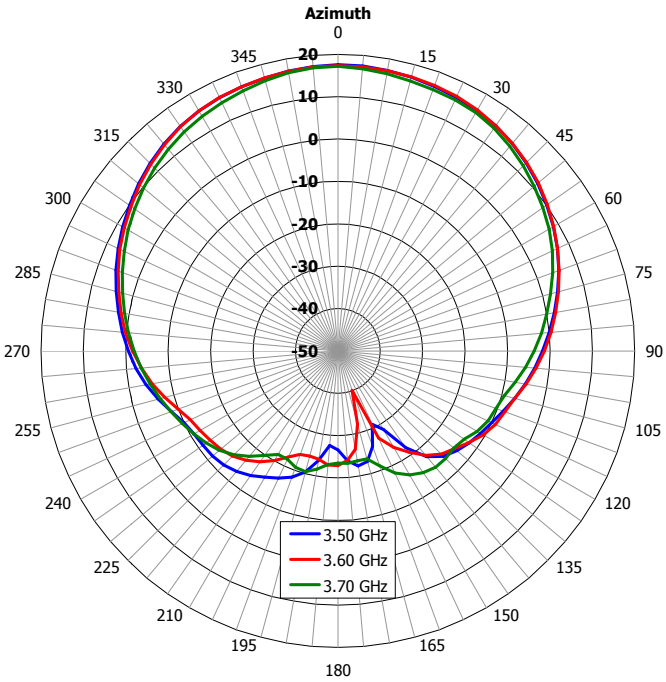
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
330
345
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
2.40 GHz
2.50 GHz
2.60 GHz

# Model 3.5 A


Azimuth
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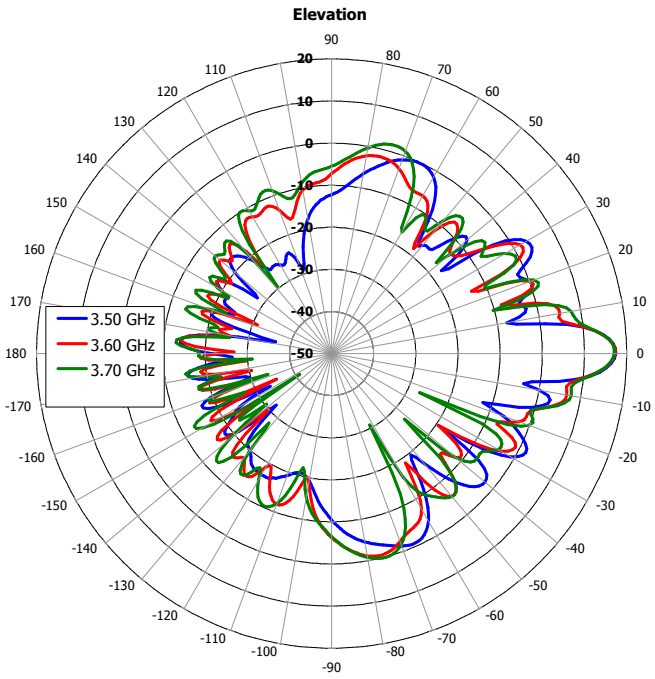
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
330
345
20
10
0
-10
-20
-30
-40
-50
3.50 GHz
3.60 GHz
3.70 GHz


Elevation
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80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
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-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
180
170
160
150
140
130
120
110
3.50 GHz
3.60 GHz
3.70 GHz

# Appendix C

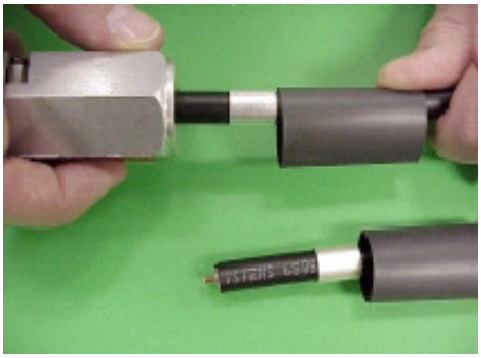
## Cable Terminations

## EZ-400-NMH Connector Installation Procedure on Times Microwave Cable LMR-400

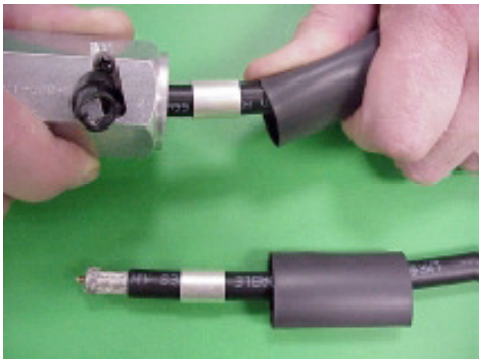
This installation procedure has been re-produced in its entirety from the Times Microwave website.

1. Flush cut the cable squarely.

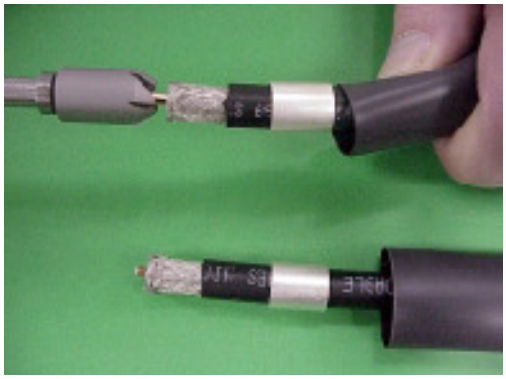
2. Slide the heat shrink boot and crimp ring onto the cable. Strip the cable end using the ST-400-EZ prep/strip tool by inserting the cable into End 1 and rotating the tool. Remove any residual plastic from the center conductor.



3. Insert the cable into End 2 of the ST-400-EZ prep/strip tool and rotate the tool to remove the plastic jacket.



4. Debur the center conductor using the DBT-01 deburring tool.



5. Flare the braid slightly and push the connector body onto the cable until the connector snaps into place, then slide the crimp ring forward creasing the braid.

6. Temporarily slide the crimp ring back, and remove the connector body from the cable to trim the excess braid at the crease line, then remount the connector and slide the crimp ring forward until it butts up against the connector body

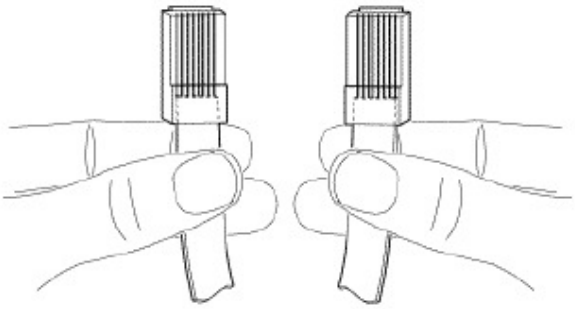
7. Position either the heavy duty HX-4 crimp tool with the appropriate dies (.429” hex) or the CT-400/300 crimp tool directly behind and adjacent to the connector body, and crimp the connector. The HX-4 crimp tool automatically releases when the crimp is complete.

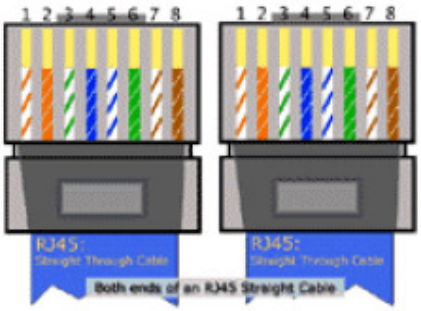
8. Position the heat shrink boot as far forward on the connector body as possible, without interfering with the coupling nut and use a heat gun to form a weather tight seal.

# Ethernet Cat 5 Cable

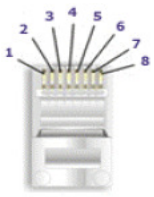
## Identifying the RJ-45 Cable Type

To identify the RJ-45 cable type, hold the two ends of the cable next to each other so you can see the colored wires inside the ends, as shown. In a straight-through cable, the colored wires are in the same sequence at both ends of the cable.



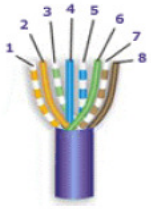



When making a straight-through cable using Cat 5E, it is mandatory that you follow the 568-B standard shown below. Otherwise, you risk the possibility of damaging the equipment.

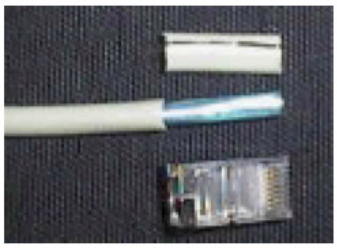
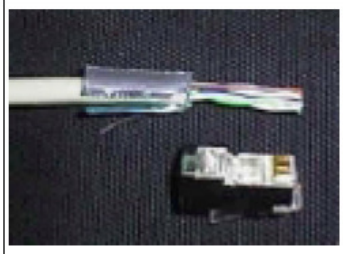
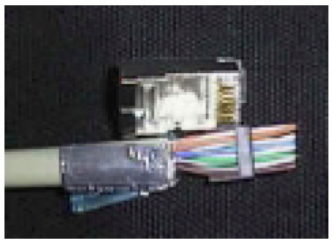



| Pair # | Wire | Pin # |
|---|---|---|
| 1 - White/Blue | White/Blue | 5 |
| | Blue | 4 |
| 2 - White/Orange | White/Orange | 1 |
| | Orange | 2 |
| 3 - White/Green | White/Green | 3 |
| | Green | 6 |
| 4 - White/Brown | White/Brown | 7 |
| | Brown | 8 |

568-B Diagram



**Termination of the Cat 5E Shielded Cable**

| | |
|---|---|
| 1. Loosen the tape from the jacket by rolling and pinching the cable between the fingers. This breaks the bond between the tape and jacket. Cut the jacket in two directions, around the cable, and along the tape fold. The fold is generally located by a slight indentation along the length of the jacket. Do not cut through the tape if at all possible. |  |
| 2. Place the rubber boot over the cable, which will be used to cover the RJ-45 connector. Cut the shield on the opposite side of the fold. Gently fold the foil back over the jacket. Fold the drain wire back over the center of the foil that will make the most contact with the connector's metallic shield. This is generally the side with the key latch. |  |
| 3. Due to the cable's large diameter some pre-forming may be necessary to assist in inserting the cable into the RJ-45 connector. Gently squeeze the cable into an oval shape and spread the pairs into their appropriate position. Take care not to crush the insulation. |  |
| 4. Align the pairs into the appropriate termination orientation. Please note, not all connectors have an insert, however, you may find that those that do will help with this step. Try to maintain the twist as far as possible. It is better to tighten the twist rather than loosen it to orient the pair for termination. |  |
| 5. Trim the pairs as needed to insert into the connector. Align the drain wire in the center of the foil making the most contact with the connector's shield. The drain is located on the underside of the cable in this shot. |  |
| 6. After crimping the connector, remove the excess shield. Cut the drain wire flush with the end of the connector |  |
| 7. Repeat the process on the other end. For a straight through cable, use the pinout table above<br>8. Put the rubber boot in position to protect the RJ-45 connection and secure it in place with a cable tie. Make sure the longer side of the rectangular boot is parallel to the top lid of the radio.<br>9. Use a cable tester to test for proper continuity. |  |

**Please Note:** You must use shielded Cat 5e cables and make certain that the drain wire has a good contact with the metal RJ-45 connector.