



# Antenna Installation Guide

**Tsunami MP.11**

**Version 2.1**

**Antenna Installation Guide**

# NOTICES

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## REGULATORY INFORMATION

The Tsunami outdoor antenna solution must be installed and used in strict accordance with the instructions as described in this *Antenna Installation Guide*.

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**Note:** Radio approvals for the Tsunami outdoor antenna solution are valid only when using the exact combination of outdoor antenna cabling components and antennas as listed in this *Tsunami MP.11a Antenna Installation Guide*.  
Using other combinations of parts and components in outdoor antenna solutions voids the radio type approval and may be in violation of local radio regulations.  
Proxim Corporation and its authorized resellers or distributors are not liable for any damage or violation of government regulations that may arise from failing to comply with these guidelines.

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This document provides regulatory information for the following wireless products:

- Tsunami MP.11a Base Station Unit, Subscriber Unit, Residential Subscriber Unit

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by Proxim Corporation could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

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

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

This product must be fixed/mounted on permanent structures with a separation distance of at least two meters from all persons during normal operation.

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## About This Book

This *Tsunami MP.11 Antenna Installation Guide* explains how to install and set up an outdoor antenna with the Tsunami MP.11 hardware.

This guide does not explain how to erect antenna masts or how to install a safety grounding system. These prerequisites must be in place before installing the directional antenna.

## WHO SHOULD USE THIS GUIDE

The installation of outdoor wireless links requires technical expertise. At the very least, you should be able to:

- Install and configure the network components, such as the Tsunami MP.11 hardware
- Understand, or have a working knowledge of, installation procedures for network operating systems using Microsoft Windows
- Mount the outdoor antenna and surge arrestor. Proxim Corporation recommends the installation is performed by a qualified antenna installation service

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### **WARNING!**

*The Tsunami outdoor antennas are intended for mounting on an antenna tower, a roof, or on the side of a building. Anyone not trained or experienced in this type of work must not attempt this installation. The antenna must be installed by a suitably trained professional installation technician or by a qualified antenna installation service. A person familiar with the national electrical code and other regulations governing this type of installation must check the site prerequisites.*

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As radio regulations differ between the various worldwide countries, it may be that not all of the outdoor solutions described in this Tsunami Outdoor Antenna Installation Guide are allowed in the country in which you plan to install this equipment.

Local radio regulations or legislation may impose restrictions on the use of specific combinations of:

- Low-loss antenna cables and outdoor antennas
- Radio channels selected at the radios that are connected to specific outdoor antennas

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**Note:** A basic rule for selecting a combination of cables and antennas is that no combination is allowed unless explicitly approved in this *Tsunami Antenna Installation Guide*. Therefore, always use this Appendix in combination with “Chapter 2. Determining Range and Clearance” on page 20 of this document to select the correct type of antenna equipment and to inform your antenna installer and LAN administrator about the impact of regulatory constraints on their job or activities.

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**CAUTION** *At all times, it is the customer’s responsibility to ensure that an outdoor antenna installation complies with local radio regulations.<sup>1</sup> The customer must verify that:*

- *The antenna installer is aware of these regulations*
- *The correct cable type and surge arrestor have been used, according to the instructions described in this document*

*Proxim Corporation and its resellers or distributors are not liable for any damage or violation of government regulations that may arise from failing to comply with these guidelines.*

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<sup>1</sup> In case you are not certain about the regulations that apply in your country, consult your local Proxim Corporation Sales Office.

## FINDING ADDITIONAL INFORMATION

### Installing Tsunami MP.11 Hardware

Tsunami outdoor antennas typically are used in combination with Tsunami MP.11 systems. The hardware installation of these devices is described in the installation guide included with each product.

### Configuration and Management

Configuration and management of outdoor wireless links is accomplished with management tools that come with the Tsunami MP.11 systems. Some examples of management tools are:

- Web-based management
- Telnet
- Wireless Network Manager

### Hardware Specifications

Tsunami MP.11 hardware and radio frequency specifications are described in the documentation that comes with the product. Hardware specifications for the outdoor antennas, the cabling system, and the surge arrester are listed in Chapter 4 of this guide.

### Additional Files on Your Software CD-ROM

All software CD-ROMs that come with your Tsunami products, include a **readme.txt** file. This file contains information about the software version and drivers. You are advised to print and read the **readme.txt** file prior to installing your Tsunami products, as it may contain additional information that was not available when this document was printed.

### Other Sources of Information

All documentation listed above can be downloaded from the Proxim support website:  
<http://support.proxim.com>. Visit the website regularly for the latest available information and documentation, software updates and other Proxim news.

## ABOUT THE TSUNAMI MP.11

The Tsunami MP.11 lets you set up a wireless system based upon two basic topologies:

A point-to-point link lets you set up a connection between two locations as an alternative to:

- Leased lines in building-to-building connections
- Wired Ethernet backbones between wireless access points in difficult-to-wire environments

If you want to connect more than two buildings, you can set up a single point-to-multipoint network with a single Base station and multiple Subscriber Units

A link between two locations always consists of a Base Unit and a Subscriber Unit. A Base Unit can, depending upon its configuration, connect to one or more Subscriber Units; a Subscriber Unit, however, can connect to only one Base Unit.

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**Note:** Depending upon local radio regulations and legislation, the outdoor antenna solutions described in this document may not be available in all parts of the world.

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## SAFETY PRECAUTIONS

Read this section carefully before beginning the installation. All of the following requirements should be satisfied prior to starting installation of your outdoor antennas.

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### **DANGER!**

*The Tsunami outdoor antennas are intended for mounting on a roof or on the side of a building. Any person not trained or experienced in this type of work should not attempt this installation. A suitably trained professional installation technician must install the antenna. The site prerequisites must be checked by a person familiar with the national electrical code, and with other regulations governing this type of installation.*

*Outdoor antennas and antenna cables are electrical conductors. Transients or electrostatic discharges that may occur at the antenna (for example a lightning strike during thunderstorms) may damage your electronic equipment and cause personal injury or death to persons touching the exposed metal connectors of the antenna cable.*

*When installing, disconnecting or replacing one of the cabling components, you must ensure at all times that each exposed metal connectors of the antenna cabling system are grounded locally during the work.*

*Do not install this antenna where there is any possibility of contact with high-voltage arc-over from power cables or service drops to buildings. The antenna, supporting mast or tower must not be close to any power lines during installation, removal or in the event of part of the system should accidentally fail. Apply a 'Danger' label to a plainly visible area of the antenna support structure.*

*Do not climb rooftops in wet or windy conditions, during a thunderstorm or when the area at which the equipment is to be installed is covered with ice or snow.*

*Do not touch antennas, surge arrestors and antenna cables during a thunderstorm.*

*The antenna installation location must be at a safe distance from power lines or telephone lines. The safe distance should be at least twice the height of the antenna mast plus the height of the antenna.*

*Antennas shall be mounted in such a manner as to minimize the potential for human contact during normal operation. To avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 1.12 meters during normal operation.*

*The low-loss antenna cable that is to connect the antenna with the surge arrestor must be at least 1 m (3 ft) away from any high voltage or high current cable.*

*Check whether the antenna mast and its guy wires or wall bracket are positioned correctly and secured properly to the roof or walls.*

*Check whether the grounding system for the antenna mast, the Tsunami MP.11a hardware, and the surge arrestor have been installed. The grounding system must comply with the requirements as described in "Grounding the Antenna."*

*Always consult a qualified electrician if you are in doubt as to whether the antenna mast, the surge arrestor, and Tsunami MP.11a hardware are properly grounded.*

*The antenna cable between the antenna and the surge arrestor must be grounded at all times. If the cable is disconnected at one end for some reason (for example, to replace the surge arrestor), you must ensure that the exposed metal connector of the cable is grounded locally during the work.*

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# Chapter 1. Preparing for Installation

## PLANNING ANTENNA INSTALLATION

Plan the day for your outdoor antenna installation carefully. Do not install the antenna in wet or windy conditions, during a thunderstorm, or when the area in which the equipment is to be installed is covered with ice or snow.

The grounding system for the antenna mast, Tsunami MP.11 hardware, and surge arrestor should be installed before the cable from the antenna is connected to the surge arrestor. This protects your system against lightning strikes during installation.

Familiarize yourself with the antenna and the antenna-specific mounting instructions prior to climbing any roof or ladder. Installing and testing all equipment before beginning the actual rooftop installation helps you determine whether all required equipment and items are available and are functioning properly.

To verify the equipment prior to installation, first follow the guidelines described in the documentation that comes with the Tsunami MP.11a.

## INSTALLATION PROCESS OVERVIEW

The installation process can be summarized in the following steps:

1. Verify that the support structure for the antenna has been connected to the grounding system. If this is not the case, you should do so now.
2. Connect the exposed metal connectors of the low-loss antenna cable to the grounding system.
3. Mount the antenna to the support structure, following the guidelines as described for your antenna.
4. Connect the antenna cable to the antenna.
5. Route the antenna cable to the surge arrestor that has been installed indoors.
6. Connect the antenna cable to the surge arrestor.
7. Attach the surge arrestor to the N-type male connector pigtail hanging from the cable opening in the Tsunami MP.11. For the outdoor MP.11, connect the surge arrestor to the external antenna connection of the BSU.
8. Run the Link Test diagnostics of the management tools that come with the Tsunami MP.11 to aim the antenna and verify optimal placement.

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**Note:** For the outdoor MP.11, you can use the Antenna Alignment Display utility. See “Aligning the Antenna” on page 17.

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9. Once the antenna is correctly positioned, and you have verified the installation works properly, secure all cables and use weatherproofing tape to seal all outdoor connectors.

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**Note:** When you must remove or relocate the antenna, follow the Safety Precautions at the beginning of this chapter and follow the steps listed above in exactly the reverse order.

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## SITE PREREQUISITES

Review all requirements outlined in this chapter before starting the installation procedure. Prior to climbing on the roof or any other area where you intend to install the outdoor antenna, you are advised to:

- Verify that you have arranged all safety measures for outdoor installation or rooftop installation
- Verify that you have all equipment and tools required to install the outdoor antennas
- Install and verify proper operation of the equipment

## INSTALLATION

The following items are required on each end of the wireless link:

- A Tsunami MP.11 Base Station (outdoor MP.11) or a Tsunami MP.11 Base Station and Subscriber Unit (indoor MP.11)
- A low-loss antenna cable to connect the indoor installation to the surge arrestor (optional)
- A surge arrestor to protect your sensitive Tsunami MP.11 equipment from static discharge and transients
- A low-loss antenna cable to connect the surge arrestor to the outdoor antenna
- Female-female converter connector (optional)
- Two outdoor antennas
- A grounding system, as described in “Grounding the Antenna” on page 16.

### Tsunami MP.11 Hardware

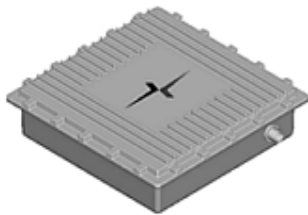
The following three types of hardware devices are used for setting up a wireless link with the indoor MP.11:

- Tsunami MP.11 Base Station Unit (BSU)
- Tsunami MP.11 Subscriber Unit (SU)
- Tsunami MP.11 Residential Subscriber Unit (RSU)

For these indoor radios, the antenna cable is connected to the connector pigtail extending from the MP.11a radio.



The outdoor MP.11's Subscriber Unit contains an integrated antenna; only the outdoor MP.11 Base Station Unit has an external antenna connection, as shown in the following illustration.



## Cable Setup for the Outdoor Antenna

The following figure shows an overview of the cable setup for the outdoor antenna. When the MP.11 is not mounted close to where the antenna cable enters the building (where the surge arrestor must be mounted), an additional cable between the MP.11 and the surge arrestor is required, plus a female-female converter connector. If the MP.11 is mounted close to the surge arrestor, the MP.11 can be connected directly to the surge arrestor.

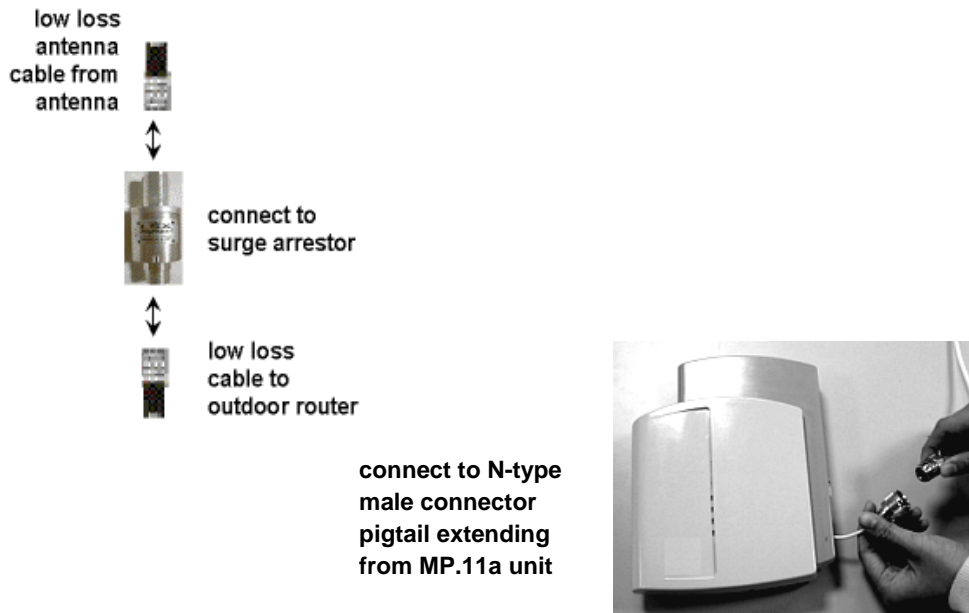


Figure 1. Cable Setup for Antenna Installation

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**Note:** The exception to the rule is the indoor MP.11 RSU when the window antenna is installed in an indoor location. This installation does not require the use of a surge arrestor. The antenna can be connected directly to the MP.11.

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## Indoor MP.11 Hardware Placement

The electronics (power supply and radio) are designed for indoor mounting and operation.

The ideal location must satisfy the following requirements:

- The location provides a connection to a grounding type AC wall outlet (100-240 VAC), using the standard power cord supplied with the unit. (Alternative power can be provided through Power over Ethernet.)
- The ground of the AC wall outlet must be connected to the same grounding system as the surge arrestor and antenna mast (see “Grounding the Antenna” on page 16).
- The location must allow for easy disconnection of the Tsunami MP.11 hardware from the AC wall outlet.
- The location provides a connection to the network backbone (an Ethernet LAN cable that is connected to a hub, bridge, or directly into a patch panel)
- The location is as close as possible to the point at which the antenna cable is to enter the building (see “Placement of the Surge Arrestor” on page 11).
- The ideal location has a temperature of 0–55° C and a maximum relative humidity (non-condensing) of 95%.

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**CAUTION!** *The Tsunami MP.11 hardware, the surge arrestor, and the antenna mast must be connected to the same grounding system.*

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## Cable System

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**CAUTION!** *The location of the indoor Tsunami MP.11 radio and power supply must be indoors at all times to protect the unit from extreme weather conditions, excessive heat and humidity, and to keep the unit free from vibration and dust. The antenna and surge arrestor can be placed outdoors.*

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Prior to mounting the Tsunami MP.11, you are advised to calculate carefully:

- The distance between the intended location of your Tsunami MP.11 and the location of the antenna mast
- The height of the antenna on the mast

If the low-loss antenna cable is not long enough to cover this distance you can select either another cable length from the Proxim Systems low-loss cable offering, or another location that satisfies the requirements listed previously to mount your Tsunami MP.11.

Because the length of the antenna cable can affect the actual range of your outdoor antenna installation, Proxim recommends selecting another location.

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**WARNING!** *You must not change the length of the low-loss antenna cable to a length shorter than allowed by the radio's certifications. Shortening the cable voids the Proxim Corporation warranty and can conflict with radio certifications or approvals.*

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Installing the Tsunami MP.11 hardware is described in *Tsunami MP.11/a Installation and Management* manual as well as the *Tsunami MP.11/a Quick Install Guide*, which come on the Tsunami MP.11 product CD.

## Surge Arrestor Placement

The surge arrestor is an indispensable part of your outdoor antenna installation. It protects your sensitive electronic equipment from transients or electro-static discharges at the antenna.

For optimal protection, the surge arrestor must be installed at a location that satisfies the following requirements:

- A location as close to the location where the antenna cable will enter the building (see "Hardware Placement" on page 10).
- The location allows for easy disconnection of the surge arrestor from the cable connected to the unit.
- The location provides a connection to the same grounding system as the Tsunami MP.11 hardware and the outdoor antenna mast (as described in "Grounding the Antenna" on page 16).

## Antenna Cable Route

The antenna cable must be connected from the antenna through the surge arrestor to the pigtail connector of the MP.11 unit or to the external antenna connection of the outdoor MP.11 Base Station. To plan the route of the antenna cable, consider the following:

- Does the cable route require drilling through a wall or ceiling?
- Do you have a building plan of the desired location showing other cabling routes like electricity, telephone or networking?
- Does the type of building materials require special drilling tools?

The cable should not be installed into tight positions, as bending or applying excessive force to the connectors can damage the antenna cable. Always allow the cable to bend naturally around corners. The recommended bend radius is at least 100 mm (4 in) or more for the low-loss cable of 10 mm (0.4 in) and 15 mm (0.6 in) diameter.

The cable must be secured along the complete distance between attachment points. No part of the antenna cable should be allowed to hang free. This is particularly important for outdoor cable parts.

**CAUTION!**

- **The antenna cable and cable connectors are not designed to withstand excessive force:**
  - **Do not use the connectors as 'cable grips' to pull cable through raceways or conduits.**
  - **Do not use the cable connector to support the weight of the cable during or after installation.**
  - **Do not use any tool to tighten the connectors.**
- **Always seal the connectors using weatherproofing tape.**
- **Avoid any water or moisture entering the cable as that impacts the performance of the wireless link.**
- **Prior to sealing the outdoor connectors and permanently securing the cable to the wall with cable ties and wall hooks, you may want to verify whether the installation and all components functions properly.**

## OUTDOOR INSTALLATION

The outdoor installation of the link (point-to-point or point-to-multipoint) requires the following:

- An antenna
- A low-loss antenna cable (available in three lengths)
- Antenna mast or wall bracket for the antenna
- A grounding system that meets the requirements described in "Grounding the Antenna" on page 16
- Waterproofing of all connections

**Note:** All outdoor cable connectors must be sealed with weatherproofing stretch tape to make the coax connectors permanently waterproof. See "Sealing the Cable Connectors" on page 16.

**DANGER!** *For your own safety, the antenna mast and the grounding system should be installed only by experienced installation professionals who are familiar with local building and safety codes and with the national electrical codes.*

*Read carefully the instructions described in "Grounding the Antenna" and verify that your installation complies with the appropriate regulations and codes before installing the antenna.*

## Placing the Antenna

To achieve maximum performance of your wireless outdoor link, the outdoor antenna must have clear line-of-sight to the antenna of the other Tsunami MP.11 unit. Although the radio signal can work well without line-of-sight in urban environments, in which the signal is transported by reflection instead of being direct, the best results are achieved in line-of-sight conditions.

Line-of-sight can be defined as:

- No obstacles in the direct path between the antennas (antenna beam)
- No obstacles within a defined zone around the antenna beam

You should be aware that the shape of an antenna beam is not straight and narrow like a laser beam. The antenna beam, also known as Fresnel<sup>2</sup> Zone, is rather "bulged" in the middle, such as, for example, a rugby ball.

The exact shape and width of the Fresnel Zone is determined by the path length and frequency of the radio signal. The width as distance from the direct antenna beam is approximately 6 m (21 ft) in the middle of the wireless link for a distance of 6.5 Km (4 mi) and a frequency of 5.8 GHz. This width also is the required clearance of the antenna beam from obstacles in its path, to avoid loss of radio signal.

<sup>2</sup>Pronounced as 'Fray-Nell'

When any significant part of this zone is obstructed, a portion of the radio energy is lost, resulting in reduced performance. Reduced performance also can occur when obstacles close to the antenna beam cause signal reflections or noise that interfere with the radio signal.

The following figure shows some typical examples of obstacles that you must avoid for the directional antenna to operate effectively:

- a. Neighboring buildings
- b. Trees or other obstructions
- c. Power lines

For optimal performance, you must ensure that the type and placement of the antennas leave sufficient clearance of the Fresnel Zone at the maximum width of the bulge, which is typically at the mid-point between the antennas.

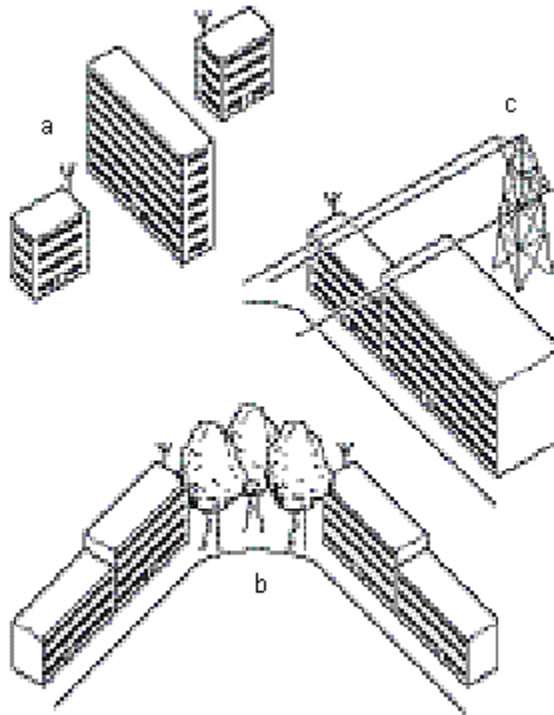


Figure 2. Potential Obstacles for a Directional Antenna

To minimize the influence of obstacles, signal interference, or reflections, note the following:

- Mount the antenna as high as possible above the “ground” to allow maximum clearance:
  - In open areas, “ground” is the actual surface of the earth.
  - In dense urban areas, “ground” is to be interpreted as the height of the highest obstacle in the signal path between the two antenna sites.
- Avoid trees in the signal path to avoid signal absorption due to seasonal changes (leaves or ice).
- Install the antenna at least 2 m (6 ft) away from all other antennas.

Other situations, in which reflections of the radio signal may cause interference, are environments in which large reflecting surfaces exist in parallel or partly perpendicular to the antenna beam.

Environments with large reflective surfaces include:

- Mirror-glass buildings
- Crowded parking lots
- Water surface or moist earth and moist vegetation
- Above ground power and telephone lines

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**Note:** The use of reflective surfaces can be used to improve a link, especially if the direct line-of-sight is impaired or absent.

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Weather conditions such as rain or snow usually do not have much impact on the performance of your Tsunami MP.11 product, provided you have sealed all cable connectors with weatherproofing tape.

Seasonal influence on signal propagation can occur in the following situations:

- A marginal communications quality in late fall (with no leaves on the trees in the signal path) might fail in the summer
- In winter, a wireless link can fail when the antenna is exposed to ice buildup, or when the antenna elements are covered with snow

Radio paths over water or extremely flat ground may require optimization of antenna height at one end. This is due to in-phase or out-of-phase reflections. Adjustment of antenna height by 1 to 3 meters may move the signal from a null to a peak.

Long distance links may be obstructed by earth curvature, so the antenna height requirements must not only take the height of obstructions and Fresnel Zone into account, but also earth bulge. The earth bulge is approximately 5 m (16.4 ft) at a link distance of 16 Km (10 mi).

In these cases consult your supplier to take appropriate steps to maintain or optimize wireless link performance.

## Mounting the Antenna

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*As the mounting procedures for the various antennas differ from one another, consult the documentation you received from the antenna manufacturer for mounting procedures.*

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Proxim Corporation offers multiple antennas to set up a wireless link.

When mounting multiple antennas on a single mast, use the following methods to minimize the influence of cross-talk interference between the antennas:

- Place your antennas as far apart as you can
- Alternate the mounting of directional antennas for vertical and horizontal polarization

There are two frequently used methods to erect an antenna mast:

### Tripod Mount

The tripod mount is used primarily on peaked and flat roofs. The antenna mast must be secured to the roof using 3 or 4 guy wires equally spaced around the mast. When the height of the antenna mast is more than 3 meters (10 ft), you should use at least three guy wires for each 3-meter (10-foot) section of the mast.

### Wall (Side) Mount

A wall (side) mount allows for mounting an antenna (mast) on the side of a building or on the side of an elevator penthouse. This provides a convenient mounting location when the roof overhang is not excessive or when the location is high enough to provide a clear line-of-sight.

In most situations mounting an antenna directly to the wall does not let you align the antenna properly with the corresponding antenna at the opposite end of your wireless link. As poor alignment typically results in poor performance, Proxim recommends always mounting the antennas to a mast. An exception to this rule is the wide-angle window antenna that can be mounted on a window or wall facing the nearest Base Station with line of sight.

### **Antenna Mast Requirements**

To accommodate the antennas, the antenna mast must satisfy the following requirements:

- The construction of the mast must consist of sturdy, weatherproof, and non-corrosive material (for example, galvanized or stainless steel construction pipe).
- Typical diameter of the mast should be between 35 mm (1.4 in) and 41 mm (1.6 in). Depending upon the type of antenna you intend to install, other diameters also may be possible.
- The height of the antenna mast must be sufficient to allow the antenna to be installed at least 1.5 m (5 ft) above the peak of the roof. If the roof is of metal, the height of the antenna should be at least 3 m (10 ft) above the roof.
- The mast or wall bracket must be free from any substance that may prevent a good electrical connection with the antenna (for example, paint).

### **Connecting the Antenna Cable**

Once the antenna is properly installed, you can connect the antenna to the MP.11 by way of the surge arrestor:

1. Connect the antenna cable to the antenna.
2. Secure the antenna cable to the mast so that the cable connectors do not support the full weight of the cable.
3. Connect the opposite end of the antenna cable to the surge arrestor.

---

**CAUTION!** *To avoid damage to the antenna cable and connectors, refrain from using tools to tighten the cable connectors.*

---

4. Prior to securing the cable along its complete length, run the Link Test diagnostics of the management tools that comes with Tsunami MP.11 to analyze wireless performance and optimal placement of the outdoor antenna. Using this tool is described in the documentation that comes with the Tsunami MP.11 and also can be downloaded from the Proxim support website at <http://support.proxim.com>.
5. If required, adjust the direction of the antenna.
6. Once the installation has been fully tested, tighten the nuts of the antenna to “lock” the antenna into its position.

---

**CAUTION!** *Avoid over-tightening of the connector, and nuts and screws used to mount the antenna, to prevent damage to your antenna and Tsunami MP.11 hardware.*

---

7. Secure the cable along its complete length with cable ties or electrical tape to relieve strain on the antenna connector properly. No part of the cable should be allowed to hang free. This is especially important for those parts that are routed outside the building.
8. Proceed as described in the next section to weatherproof all outdoor coax connectors.

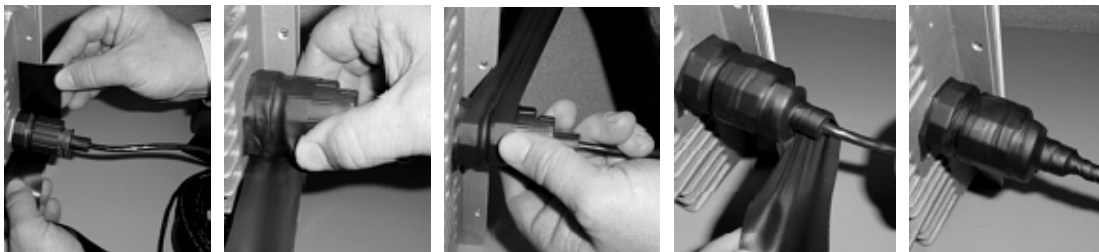
## Sealing the Cable Connectors

Most problems associated with wireless outdoor installations are related to degrading performance due to corrosion of the antenna cable and cable connectors. To avoid this type of problem, you must always seal the cable connectors that are located outdoors using the weatherproofing tape provided.

You are advised to seal the connectors only after you have verified optimal alignment of the antennas using the Link Test as described in the documentation that comes with the Tsunami MP.11. Doing so lets you adjust antenna placement and cable routing without removing the tape.

To weatherproof the connectors:

1. Prepare the cable and connectors so that they are free from dust, dirt and grease.
2. Attach the tip of the weatherproofing tape to the cable just above the connector. Holding the tape in its position, now stretch the tape and wind it half-overlapped around the cable and connectors to form a void-free joint. The degree of stretch may vary in different sections of the joint, as long as the overlaps accomplish a void-free application.



3. To protect the weatherproofing stretch tape from the effects of Ultra-Violet (UV) radiation (for example, from direct sunlight), you should protect the joint with two half-overlapped layers of any vinyl plastic electrical tape. Alternatively, you can apply silicone sealer to protect the weatherproofing tape from sunlight, rain and other weather conditions.

## Grounding the Antenna

Direct grounding of the antenna mast, Tsunami MP.11 hardware and surge arrestor is extremely important.

---

**Note:** A safety grounding system is necessary to protect your Tsunami MP.11 hardware from lightning strikes and the build-up of static electricity.

---

**WARNING!** *The antenna mast, Tsunami MP.11 hardware, and surge arrestor must be connected to the same ground, using an equi-potential bonding conductor.*

*A good electrical connection should be made to one or more ground rods, using at least a 10AWG ground wire and non-corrosive hardware.*

*The grounding system must comply with the National Electrical Code and safety standards that apply in your country. Always check with a qualified electrician if you are in doubt whether your Tsunami MP.11a hardware installation is properly grounded.*

---



## Aligning the Antenna

For optimal performance of your wireless link, make sure the antennas are properly aligned (facing one another “eye-to-eye”). Antenna alignment is a process to physically align the antenna of the radio receiver or the transmitter to have the best possible radio link established between them. The antenna alignment process usually is performed during installation and after major repairs.

To align the antennas:

- Use a pair of binoculars or a map of the area and a compass to point the antennas to one another.
- Use the **Antenna Alignment Display** feature (AAD) to display a measurement of signal quality at the CLI and serial ports.
- You also can use the **Link Test** option of the management tools that come with the Tsunami MP.11 to analyze the radio link quality.

### Antenna Alignment Display Feature (Outdoor MP.11 Only)

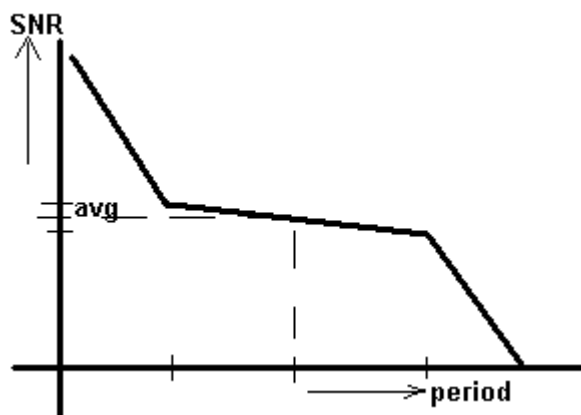
Antenna alignment is a process to physically align the antenna of the radio receiver or the transmitter to have the best possible radio link established between them. The antenna alignment process usually is performed during installation and after major repairs.

The outdoor MP.11 has an audible antenna alignment tool that can be activated by plugging in the supplied serial dongle (supplied with every Base Station) or by issuing the CLI command for antenna alignment. The CLI command causes both audible and numerical feedback as the CLI shows the running SNR values twice a second.

The output from the beeper for antenna alignment consists of short beeps with a variable interval. The interval changes with the SNR level to assist in correctly aligning the antenna. An increase in signal level is indicated by a shorter interval between beeps; a reduction in signal level results in beeps further apart.

To allow for precise antenna alignment, small changes in SNR result in large changes in the beep period. The alignment process averages the SNR, which is represented by an average length beep. When a higher SNR is received, the beep period is made shorter, dependent upon the difference to the average. A lower SNR results in a longer period between beeps.

The first five steps are represented by a large change and all following steps are a small change. This acts as if a magnifying glass is centered around the average SNR and the values next to the average are significantly different.



When the antenna is aimed, the beep can easily be heard if the SNR is rising (shorter period, higher frequency) or falling (longer period). When the position of the antenna has been changed, the SNR averaging settles at the new value and the beeping returns to the average length so the antenna can again be aimed towards rising SNR.

Aiming is complete if moving in any direction results in a falling SNR value, which can be heard as longer periods between beeps.

---

#### Notes:

- Antenna alignment for the Base Station is useful only for a point-to-point link.
  - The range of the average SNR must be limited to values from 0 to 48. Anything over 48 is capped at 48.
  - AAD is automatically disabled 30 minutes after it is enabled to remove the load of extra messages on the wireless interface. The default telnet timeout is 900 seconds (15 minutes). If AAD must run for the entire 30 minutes, change the default telnet timeout value greater than 30 minutes (greater than 1800 seconds). This restriction is for telnet connections only and not for the serial interface. The serial interface never times out.
- 

#### Antenna Alignment Commands

**set aad enable local**

Enables display of the local SNR. Local SNR is the SNR measured by the receiver at the near end.

**set aad enable remote**

Enables display of the remote SNR. Remote SNR is the SNR as measured by the receiver at the far end.

**set aad enable average**

Enables display of the average SNR. The average SNR is the average of the local and remote SNR.

**set aad disable**

Disables Antenna Alignment Display (Ctrl-C also disables AAD).

#### Link Test

You also can use the **Link Test** option of the management tools that come with the Tsunami MP.11 to analyze the radio link quality. The Link Test option lets you display the radio signal strength in relation to the noise in the signal path. If required, you can interactively optimize the antenna alignment with the Link Test, by making small modifications in the antenna orientation.

The “AudioTune” tool can be used to read out loud the Link Test values, allowing direct feedback when aligning the antenna. Run the Link Test diagnostics of the management tools that come with the Tsunami MP.11 with the **Signal** and **Noise** fields selected.

You can download AudioTune from [http://www.computron-usa.com/wireless\\_utilities.htm](http://www.computron-usa.com/wireless_utilities.htm).

Alternatively, consult a professional Antenna Installation Service to optimize the antenna alignment.

#### Antenna Polarization

Tsunami outdoor antennas are standard mounted for vertical polarization.

In some cases, you might consider mounting the antenna for horizontal polarization. For example, to minimize the influence of cross-talk between antennas when:

- You plan to mount multiple directional antennas to the same mast.
- Your wireless link receives interference from a vertically polarized neighboring installation.

Mounting for horizontal polarization is not supported for omni-directional grid antennas.

---

**Note:** For optimal wireless link performance, you must always verify that the antenna polarization on both ends of the wireless link is the same. Consult the corresponding instruction appendixes for changing the antenna polarization.

---

### **Antenna Cable Routing**

The antenna cable must be routed and fixed in such a way that installation technicians have a clear passage area.

All connectors that are located outdoors must have a weatherproof seal. You are advised to seal connectors only after you have completed the final radio tests.

### **BEFORE CLIMBING THE ROOF...**

Before you start the installation, check whether you have all the required components to set up an outdoor wireless link.

For each side of a wireless outdoor wireless link you need:

- One or two low-loss antenna cables
- A female-female converter N-connector in case you want to use two antenna cables
- Tools and material to mount the antenna
- Tape or wraps to attach the antenna cable, for example to the mast
- Grounding material such as cable and connector

If an item is missing or damaged during shipment, inform your supplier.

## Chapter 2. Determining Range and Clearance

When you read about wireless outdoor products, you often encounter the terms *output power* of the radio and *gain* of the antenna equipment as measures for the strength of the transmitted signal.

- Output power of radio equipment often depends upon maximum limits defined by local radio regulations; consequently, output power is, by definition, not the way to enhance wireless performance.
- High gain antennas are larger in size than low gain antennas, and are characterized by a narrow focus of the antenna beam. These two characteristics make it more difficult to aim the antennas and adjust antenna alignment to optimize the performance of the wireless point-to-point link.

The Tsunami outdoor solution is based upon the following principles:

- Output power and antenna gain that comply with the maximum limits defined by local governing bodies concerning radio transmissions.
- Enhanced radio sensitivity for optimal receive quality of radio signals transmitted by remote antennas.

### DETERMINING THE OUTDOOR RANGE

The range of your outdoor antenna installation is closely related to a number of different factors. To let you determine the range of the Tsunami MP.11 antenna system in your situation, we have defined the following formula:

**Range = Maximum Range x Cable Factor x Clearance Factor**

where:

<b>Maximum Range</b>	Identifies the theoretical maximum that could be achieved under optimal circumstances using the available Tsunami MP.11 products according to their specifications and in compliance with local radio regulations. This value can be read from Table 1 on page 22 or Table 2 on page 23, according to the country in which the antenna system is to be installed.
<b>Cable Factor</b>	Identifies a correction value (in percentage) that compensates for additional cable losses related to the type of cables used at both ends of the wireless link. The Cable Factor value can be read from Table 4 on page 26.
<b>Clearance Factor</b>	Identifies a correction value (in percentage) that should be used in case the signal path of your wireless link does not provide the minimum clearance as listed in the Maximum Range table. The Clearance Factor can be read from Figure 6 on page 28.

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**Note:** You also can use a calculation sheet provided by Proxim to generate an estimate of link distance and reliability.

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An example of using this formula is described in “Examples” on page 31. This formula should be used only as a rule-of-thumb to assess the possible range that could be achieved in your situation, or to select the type and height of the antenna installations. Always perform on-site measurements to validate the results from the range calculation. To perform these measurements, you can use the **Link Test** option of the management tools that come with the Tsunami MP.11 product.

## Maximum Range

The maximum range of your Tsunami MP.11 system is based upon:

- The type of outdoor antenna equipment
- The data speed of the wireless link
- The clearance of the signal path (see “Clearance Factor” on page 27)

The values in this section are based upon calculations that assume optimal radio conditions. They do not represent a guarantee that the same maximum distance can be achieved at your location. Differences in performance figures can result from:

- Incorrect alignment of antennas (see “Aligning the Antenna” on page 17)
- Polarization mismatch of the antennas
- Sources of interference or unexpected reflections in the signal path that affect the communications quality (see “Antenna Placement” on page 12)
- Severe weather conditions such as heavy rain or snow fall, or strong winds
- Seasonal influences such as leaves on trees, or icing on the antennas

The length of the antenna cable also has an impact on the maximum range that can be achieved with the antenna combination (see “Cable Factor” on page 26).

Depending upon local radio regulations in a number of countries that limit the maximum output power, Proxim Corporation offers different outdoor antenna products in the various countries around the world. Therefore, you must consult the table that matches the radio regulations as they apply in your country:

- Table 1 on page 22 and Table 2 on page 23 for the USA and Canada and any other country that adheres to the radio regulations as defined by the US Federal Communications Commission (FCC).
- Table 3 on page 24 for all European countries, Japan, and any other country that adheres to the radio regulations as defined by the European Telecommunications Standards Institute (ETSI) and MPT.
- Table 5 on page 29 and Table 6 on page 30 show the ranges in case of obstruction, where only 10 meters (33 feet) of clearance is available in the path of the link.

The following tables show calculated ranges with a link budget of 10 dB (fading margin) and unlimited clearance. The clearance is the average antenna height; it also incorporates earth bulge. Lower link budget results in longer links, but less reliable communication.

On very short links, the link budget can be lower than 10 dB, while at longer links more fading occurs and a high fading margin is needed.

Antenna	Antenna Speed Mbps	24 dBi Directional Parabolic Grid Antenna*		14 dBi Directional Antenna		12 dBi Directional Wide Angle Antenna	
		Range	Clearance	Range	Clearance	Range	Clearance
24 dBi Directional Parabolic Grid Antenna	1	112 km 70 mi	285 m 936 ft	35 km 22 mi	47 m 156 ft	28 km 17 mi	36 m 118 ft
	2	79 km 49 mi	157 m 515 ft	25 km 16 mi	32 m 104 ft	20 km 12 mi	25 m 82 ft
	5.5	50 km 31 mi	76 m 250 ft	16 km 9.8 mi	20 m 67 ft	13 km 7.8 mi	17 m 55 ft
	11	28 km 17 mi	36 m 118 ft	8.9 km 5.5 mi	13 m 43 ft	7.1 km 4.4 mi	11 m 37 ft
14 dBi Directional Antenna	1	35 km 22 mi	47 m 156 ft	11 km 7.0 mi	15 m 51 ft	8.9 km 5.5 mi	13 m 43 ft
	2	25 km 16 mi	32 m 104 ft	7.9 km 4.9 mi	12 m 40 ft	6.3 km 3.9 mi	10 m 34 ft
	5.5	16 km 9.8 mi	20 m 67 ft	5.0 km 3.1 mi	9.2 m 30 ft	4.0 km 2.5 mi	8.0 m 26 ft
	11	8.9 km 5.5 mi	13 m 43 ft	2.8 km 1.8 mi	6.7 m 22 ft	2.2 km 1.4 mi	5.9 m 19 ft
12 dBi Directional Window Antenna	1	29 km 18 mi	38 m 124 ft	9.3 km 5.8 mi	14 m 44 ft	7.4 km 4.6 mi	12 m 38 ft
	2	21 km 13 mi	26 m 86 ft	6.6 km 4.1 mi	11 m 35 ft	5.2 km 3.3 mi	9.4 m 31 ft
	5.5	13 km 8.2 mi	17 m 57 ft	4.2 km 2.6 mi	8.2 m 27 ft	3.3 km 2.1 mi	7.3 m 24 ft
	11	7.4 km 4.6 mi	12 m 38 ft	2.3 km 1.5 mi	6.0 m 20 ft	1.9 km 1.2 mi	5.3 m 18 ft
<p>*The maximum range for the 24 dBi Grid antennas is a calculated value. Maximum ranges were only tested up to 110 km.</p> <p>Values in this table are based upon the use of normal power Tsunami MP.11 and 6m (20 ft) low-loss antenna cables with a diameter of 10 mm (0.4 in) on both ends of the antenna link, except the Window Antenna which is connected by the attached 2m (6 ft) cable.</p>							

Table 1. Maximum Outdoor Range for FCC Products, Part 1

Antenna	Antenna Speed Mbps	10 dBi Omni-Directional Base Station Antenna		7 dBi Omni-Directional Base Station Antenna	
		Range	Clearance	Range	Clearance
24 dBi Directional Parabolic Grid Antenna	1	22 km 14 mi	28 m 92 ft	17 km 11 mi	22 m 71 ft
	2	16 km 9.8 mi	20 m 67 ft	12 km 7.5 mi	16 m 54 ft
	5.5	10 km 6.2 mi	14 m 46 ft	7.7 km 4.8 mi	12 m 40 ft
	11	5.6 km 3.5 mi	9.8 m 32 ft	4.3 km 2.7 mi	8.4 m 28 ft
14 dBi Directional Antenna	1	7.1 km 4.4 mi	11 m 37 ft	5.4 km 3.4 mi	9.6 m 31 ft
	2	5.0 km 3.1 mi	9.1 m 30 ft	3.8 km 2.4 mi	7.9 m 26 ft
	5.5	3.2 km 2.0 mi	7.1 m 23 ft	2.4 km 1.5 mi	6.3 m 20 ft
	11	1.8 km 1.1 mi	5.2 m 17 ft	1.4 km 0.8 mi	4.6 m 15 ft
12 dBi Directional Window Antenna	1	5.9 km 3.6 mi	10 m 33 ft	4.5 km 2.8 mi	8.6 m 28.3 ft
	2	4.2 km 2.6 mi	8.2 m 27 ft	3.2 km 2.0 mi	7.1 m 23.3 ft
	5.5	2.6 km 1.6 mi	6.4 m 21 ft	2.0 km 1.3 mi	5.6 m 18.3 ft
	11	1.5 km 0.9 mi	4.7 m 16 ft	1.1 km 0.7 mi	4.1 m 13.6 ft
Values in this table are based upon the use of normal power Tsunami MP.11 and 6m (20 ft) low-loss antenna cables with a diameter of 10 mm (0.4 in) on both ends of the antenna link, except the Window Antenna which is connected by the attached 2m (6 ft) cable.					

Table 2. Maximum Outdoor Range for FCC Products, Part 2

Antenna	Speed Mbps	14 dBi Directional Antenna <sup>1</sup>		12 dBi Directional Wide Angle Antenna <sup>1</sup>		10 dBi Omni-Directional Base Station Antenna <sup>1</sup>		7 dBi Omni-Directional Base Station Antenna <sup>2</sup>	
		Range	Clearance	Range	Clearance	Range	Clearance	Range	Clearance
14 dBi Directional Antenna	1	5.0 km 3.1 mi	9.1 m 30.0 ft	4.0 km 2.5 mi	8.0 m 26.3 ft	3.2 km 2.0 mi	7.1 m 23.2 ft	2.4 km 1.5 mi	6.1 m 20.1 ft
	2	3.5 km 2.2 mi	7.5 m 24.7 ft	2.8 km 1.7 mi	6.6 m 21.8 ft	2.2 km 1.4 mi	5.9 m 19.3 ft	1.7 km 1.1 mi	5.1 m 16.8 ft
	5.5	2.2 km 1.4 mi	5.9 m 19.3 ft	1.8 km 1.1 mi	5.2 m 17.1 ft	1.4 km 0.9 mi	4.6 m 15.2 ft	1.1 km 0.7 mi	4.0 m 13.3 ft
	11	1.3 km 0.8 mi	4.4 m 14.3 ft	1.0 km 0.6 mi	3.9 m 12.7 ft	0.8 km 0.5 mi	3.5 m 11.3 ft	0.6 km 0.4 mi	3.0 m 9.9 ft
12 dBi Directional Window Antenna	1	4.2 km 2.6 mi	8.2 m 27.0 ft	3.3 km 2.1 mi	7.3 m 23.8 ft	2.6 km 1.6 mi	6.4 m 21.0 ft	2.0 km 1.3 mi	5.6 m 18.3 ft
	2	2.9 km 1.8 mi	6.8 m 22.3 ft	2.3 km 1.5 mi	6.0 m 19.8 ft	1.9 km 1.2 mi	5.3 m 17.5 ft	1.4 km 0.9 mi	4.7 m 15.3 ft
	5.5	1.9 km 1.2 mi	5.3 m 17.5 ft	1.5 km 0.9 mi	4.7 m 15.6 ft	1.2 km 0.7 mi	4.2 m 13.8 ft	0.9 km 0.6 mi	3.7 m 12.1 ft
	11	1.0 km 0.6 mi	4.0 m 13.1 ft	0.8 km 0.5 mi	3.5 m 11.6 ft	0.7 km 0.4 mi	3.2 m 10.3 ft	0.5 km 0.3 mi	2.8 m 9.0 ft

<sup>1</sup>Values in this table are based upon the use of low power Tsunami MP.11 and 6m (20 ft) low-loss antenna cables with a diameter of 10 mm (0.4 in) on both ends of the antenna link, except the Window Antenna which is connected by the attached 2m (6 ft) cable.

<sup>2</sup>Values in the table for the 7 dBi omni antenna are limited by the use of the low power Tsunami MP.11 at the side of the directional antenna. The 6m (20 ft) low-loss antenna cables with a diameter of 10 mm (0.4 in) are used on both ends of the antenna link, except with the Window Antenna which is connected by the attached 2m (6 ft) cable.

Table 3. Maximum Range for ETSI/FR/JP Products

## DISTANCE ASSUMPTIONS AND EXPECTATIONS

### Indoor Tsunami MP.11a

#### Assumptions

- Point-to-multipoint configuration using USA regulations for L and U bands, ETSI regulations for M bands
- Clear line-of-sight with no unusual multipath
- Sector antenna (17 dBi, 60°) at Base Station with 20 feet LMR-600 cable
- Three-foot parabolic dish (31.4 dBi) at Subscriber Unit with 20-foot LMR-600 cable
- With a fade margin minimum of 10 dB to 2 miles, and 0.2 dB additional fade margin for every 0.1 miles, to 15 dB, availability is greater than 99.99%.

#### Expectations

5.25 – 5.35 GHz	0.9 miles at peak performance (36 Mbps mode) Up to 2.8 miles maximum (6 Mbps mode)
5.47 – 5.725 GHz	0.85 miles at peak performance (36 Mbps mode) Up to 2.65 miles maximum (6 Mbps mode)
5.725 – 5.850 MHz	4.0 miles at peak performance (36 Mbps mode) Up to 11.2 miles maximum (6 Mbps mode)



## Outdoor Tsunami MP.11a

### Assumptions

- Point-to-multipoint configuration using USA regulations for L and U bands, ETSI regulations for M bands
- Clear line-of-sight with no unusual multipath
- Sector antenna (17 dBi, 60°) at Base Station with short 1 dB jumper cable
- Standard integrated antenna for Subscriber Unit
- With a fade margin minimum of 10 dB to 2 miles, and 0.2 dB additional fade margin for every 0.1 miles, to 15 dB, availability is greater than 99.99%.

### Expectations

5.25 – 5.35 GHz	0.5 miles at peak performance (36 Mbps mode) Up to 1.7 miles maximum (6 Mbps mode)
5.47 – 5.725 GHz	0.4 miles at peak performance (36 Mbps mode) Up to 1.6 miles maximum (6 Mbps mode)
5.725 – 5.850 MHz	2.8 miles at peak performance (36 Mbps mode) Up to 7.6 miles maximum (6 Mbps mode)

## MP.11

### Assumptions

- Point-to-multipoint configuration using USA regulations for L and U bands, ETSI regulations for M bands
- Clear line-of-sight with no unusual multipath
- Sector antenna (17 dBi, 60°) at Base Station with 20-foot LMR-600 cable
- Three-foot parabolic dish (31.4 dBi) at Subscriber Unit with 20-foot LMR-600 cable for USA
- 14 dBi panel antenna at Subscriber Unit with 20-foot LMR-600 cable for ETSI
- With a fade margin minimum of 10 dB to 2 miles, and 0.2 dB additional fade margin for every 0.1 miles, to 15 dB, availability is greater than 99.99%.

### Expectations

6.8 miles at peak performance (11 Mbps) for FCC  
 0.9 miles at peak performance (11 Mbps) for ETSI  
 Up to 1.73 miles maximum (1 Mbps) for FCC  
 Up to 3 miles maximum (1 Mbps) for ETSI

## DATA SPEED OF THE WIRELESS LINK

By default, the family of Tsunami MP.11 products transmits at the highest available transmit rate.

Because data transmissions at lower speeds can travel greater distances than transmissions at the highest transmit rate, the system lets you choose a lower data rate to increase the maximum range. For information about customizing the transmit rate of your system, consult the *Tsunami MP.11/a Installation and Management* manual.

To assist you in determining the appropriate tuning settings, we have listed the range values that apply to the various transmit rates in Tables 1, 2, and 3.

## CABLE FACTOR

The range value calculations listed in Table 1 on page 22 and Table 2 on page 23 were based upon antenna installations in which both antennas were connected to a 6 m (20 ft) cable.

If this is the case in your situation, the Cable Factor for your installation is 100%.

If you are using different cables, you must determine the Cable Factor from Table 4 below to calculate the probable range for your installation.

One side of link	Other side of link	Cable Factor
6 m (20 ft) / 10 mm (0.4 in)	6 m (20 ft) / 10 mm (0.4 in)	100%
	6 m (20 ft) / 5 mm (0.2 in)	81%
	15 m (50 ft)	81%
	22 m (75 ft)	67%
6 m (20 ft) / 5 mm (0.2 in)	6 m (20 ft) / 5 mm (0.2 in)	66%
	15 m (50 ft)	66%
	22 m (75 ft)	54%
15 m (50 ft)	15 m (50 ft)	66%
	22 m (75 ft)	54%
22 m (75 ft)	22 m (75 ft)	45%

Table 4. Cable Factor

**Note:** When Table 4 is used for countries that adhere to the ETSI regulations, note that the maximum ranges as listed in Table 3 do not always use cable factor 100%. This is due to local radio regulations and legislation that do not allow the use of the 6 m (20 ft)/10 mm (0.4 in) cables in ETSI countries France and Japan.

The 6 m (20 ft) cables with a diameter of 5 mm (0.2 in) can be used with all antenna types. The cable loss of these cables equals the value of the 15 m (50 ft) cables. Use of the 6 m (20 ft) cables with a diameter of 10 mm (0.4 in) depends upon local radio regulations.

## CLEARANCE FACTOR

For optimal performance of your outdoor wireless link, the signal path between the two Base Unit and Subscriber Unit must provide sufficient clearance.

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**Note:** An outdoor wireless link that lacks sufficient clearance can suffer from poor performance, which is typically perceived as slow network response times. Although your Tsunami MP.11 equipment automatically retransmits every lost data frame due to an out-of-range situation or frame collision, the larger the number of retransmissions, the lower the throughput efficiency of your wireless link.

---

This section explains how to determine the clearance that applies in your environment and (if applicable) the effect of insufficient clearance on the range of your outdoor wireless link.

In “Chapter 1. Preparing for Installation” on page 8, we described the shape of the antenna beam as being “bulged” in the middle.

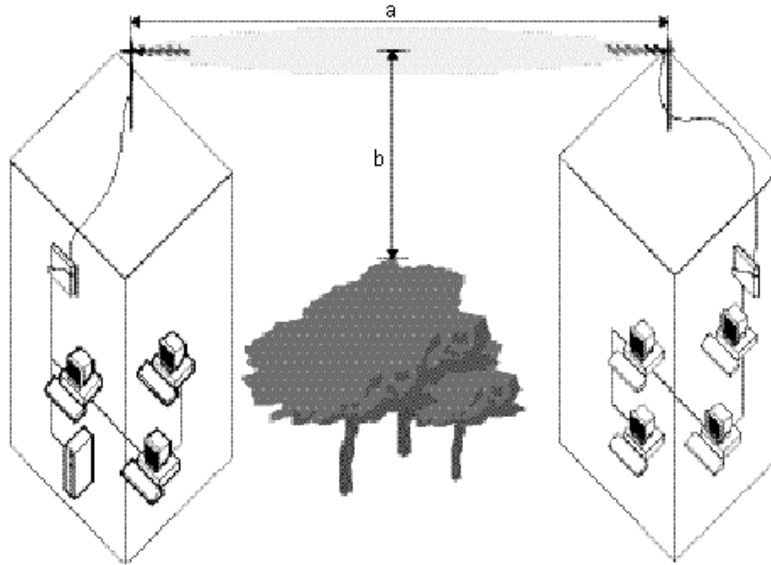


Figure 3. Fresnel Zone

If any significant part of this bulged zone is obstructed, a portion of the radio energy is lost, which can affect the performance of your wireless link in terms of maximum range and transmit rate.

In Figure 3, you see two variables that determine the shape of the antenna beam, also referred to as Fresnel Zone:

- a. The distance between the antennas
- b. The clearance required for optimal performance, where clearance should be interpreted as:
  - Vertical clearance above the ground and the highest buildings or objects in the signal path
  - Horizontal clearance from neighboring buildings and objects in the signal path.

For optimal range and throughput performance, you must ensure that your antenna installation provides maximum clearance in both horizontal and vertical direction.

The minimum clearance for the various antenna combinations and distances is listed in the gray-shaded columns of Tables 1 and 2, where clearance should be interpreted as follows:

- In open areas without obstacles in the signal path, clearance is measured as height above the surface of the earth. For example, if the antenna is mounted on the roof, this height includes the height of the building plus the height of the mast above the rooftop.

- In areas with obstacles in the signal path between the two antennas, clearance should be measured as height above the highest obstacle in the signal path.
- In dense urban areas, the clearance should be measured as height above the highest rooftop or any other obstacles in the signal path between the two antennas.

Looking at the minimum clearance requirements as identified in Table 1 on page 22 and Table 2 on page 23, it may be that local authorities, the proprietor of the premises, or other reasons may prevent you from setting up an antenna mast that lets you meet the listed clearance requirement.

In such situations, you may be unable to achieve a full line-of-sight clearance. At the same time, however, you may not even need full clearance, when the distance that your wireless outdoor installation must cover is less than the listed maximum range.

To determine the effect of insufficient signal path clearance, you must determine the Clearance Factor as described below, and calculate its effect on the range for your antenna installation using the formula described in “Determining the Outdoor Range” on page 20.

- If the clearance for your antenna installation is equal to or better than the minimum clearance requirement identified in Tables 1, 2, and 3, the Clearance Factor for your installation is 100%.
- If your actual clearance is less than the minimum clearance identified in Tables 1, 2, and 3, you should use the diagram depicted in the following figure to determine the actual range that applies in your situation.

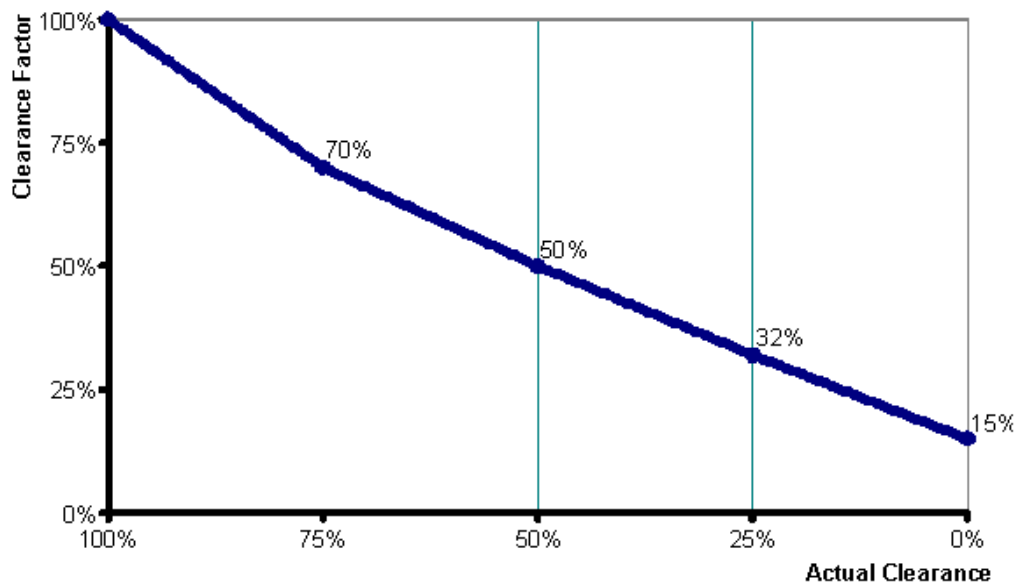


Figure 4. Clearance Factor Diagram

**Note:** Use the Clearance Factor diagram as a rule-of-thumb for estimating the probable range in case the clearance requirements are not fully met. In real life, using FCC-approved products, it is almost impossible to achieve the level of clearance for maximum range. For your convenience, we have included Table 5 on page 29 and Table 6 on page 30 to provide an example of conditions in which the more typical clearance is 10 m (33 ft).

Antenna	Antenna Speed Mbps	24 dBi Directional Parabolic Grid Antenna		14 dBi Directional Antenna		12 dBi Directional Wide Angle Antenna	
		Range	Clearance	Range	Clearance	Range	Clearance
24 dBi Directional Parabolic Grid Antenna	1	26.2 km 16.3 mi	10 m 33 ft	19.0 km 11.8 mi	10 m 33 ft	17.3 km 10.7 mi	10 m 33 ft
	2	24.5 km 15.2 mi	10 m 33 ft	16.9 km 10.5 mi	10 m 33 ft	15.4 km 9.6 mi	10 m 33 ft
	5.5	21.8 km 13.5 mi	10 m 33 ft	14.4 km 8.9 mi	10 m 33 ft	13.1 km 8.1 mi	10 m 33 ft
	11	19.4 km 12.0 mi	10 m 33 ft	12.8 km 8.0 mi	10 m 33 ft	11.2 km 7.0 mi	10 m 33 ft
14 dBi Directional Antenna	1	19.0 km 11.8 mi	10 m 33 ft	12.0 km 7.5 mi	10 m 33 ft	10.9 km 6.8 mi	10 m 33 ft
	2	16.9 km 10.5 mi	10 m 33 ft	10.2 km 6.3 mi	10 m 33 ft	9.3 km 5.8 mi	10 m 33 ft
	5.5	14.4 km 8.9 mi	10 m 33 ft	8.7 km 5.4 mi	10 m 33 ft	7.6 km 4.7 mi	10 m 33 ft
	11	12.8 km 8.0 mi	10 m 33 ft	7.1 km 4.4 mi	10 m 33 ft	6.1 km 3.8 mi	10 m 33 ft
12 dBi Directional Window Antenna	1	17.3 km 10.7 mi	10 m 33 ft	10.9 km 6.8 mi	10 m 33 ft	10.9 km 6.8 mi	10 m 33 ft
	2	15.4 km 9.6 mi	10 m 33 ft	9.3 km 5.8 mi	10 m 33 ft	8.2 km 5.1 mi	10 m 33 ft
	5.5	13.1 km 8.1 mi	10 m 33 ft	7.6 km 4.7 mi	10 m 33 ft	6.7 km 4.2 mi	10 m 33 ft
	11	11.2 km 7.0 mi	10 m 33 ft	6.1 km 3.8 mi	10 m 33 ft	5.4 km 3.3 mi	9.5 m 31 ft

Table 5. FCC Outdoor Range with 10 m (33 ft) Clearance, Part 1

Antenna	Antenna Speed Mbps	10 dBi Omni-Directional Base Station Antenna		7 dBi Omni-Directional Base Station Antenna	
		Range	Clearance	Range	Clearance
24 dBi Directional Parabolic Grid Antenna	1	15.8 km 9.8 mi	10 m 33 ft	14.1 km 8.8 mi	10 m 33 ft
	2	14.1 km 8.8 mi	10 m 33 ft	12.0 km 7.5 mi	10 m 33 ft
	5.5	12.0 km 7.5 mi	10 m 33 ft	10.2 km 6.3 mi	10 m 33 ft
	11	10.2 km 6.3 mi	10 m 33 ft	8.7 km 5.4 mi	10 m 33 ft
14 dBi Directional Antenna	1	9.5 km 5.9 mi	10 m 33 ft	8.1 km 5.0 mi	10 m 33 ft
	2	8.1 km 5.0 mi	10 m 33 ft	6.6 km 4.1 mi	10 m 33 ft
	5.5	6.6 km 4.1 mi	10 m 33 ft	5.5 km 3.4 mi	10 m 33 ft
	11	5.5 km 3.4 mi	10 m 33 ft	4.0 km 2.5 mi	10 m 33 ft
12 dBi Directional Antenna	1	km mi	10 m 33 ft	km mi	10m 33 ft
	2	km mi	10 m 33 ft	km mi	10 m 33 ft
	5.5	km mi	10 m 33 ft	km mi	10 m 33 ft
	11	km mi	10 m 33 ft	km mi	10 m 33 ft

Table 6. FCC Outdoor Range with 10 m (33 ft) Clearance, Part 2

## EXAMPLES

In the following sections, you find some examples of range and clearance calculations for point-to-point links and for a point-to-multipoint network.

### Point-to-Point Links

Suppose you are installing a wireless point-to-point link between a Base Unit and a Subscriber Unit, where:

- Both sites have been equipped with a 24 dBi Directional Parabolic Grid Antenna, connected via 6 m (20 ft)/10 mm antenna cables.
- The distance between site a and site b is 25 km (15.3 mi).
- The site is located in the US, which allows the use of FCC approved equipment.

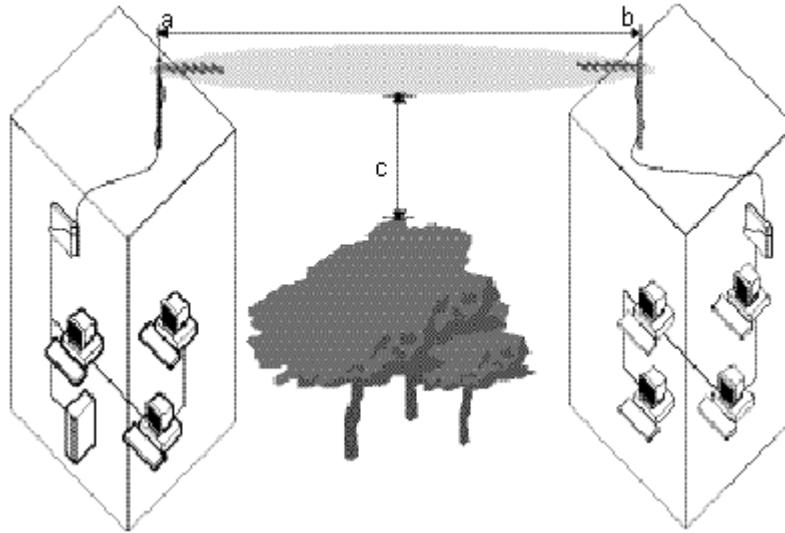


Figure 5. Calculating Point-to-Point Range

Looking at Table 1, we learn that a high speed link between two 24 dBi Directional Grid Antennas may cover a maximum distance of 85 km (52 mi), provided that the signal path clearance is 180 m (590 ft) or better.

The probable range for this example can be calculated using the introduced formula:

$$\text{Range} = \text{Maximum Range} \times \text{Cable Factor} \times \text{Clearance Factor}$$

#### Calculating the Clearance Affect on Range

In the example depicted in Figure 5, we see a set of trees in the signal path. Suppose that the clearance (c) between these trees and the signal path is only be 45 m (148 ft).

- Using a calculator, we can easily determine that this 45 m (148 ft) is about 25% of the required 180 m (590 ft) clearance for maximum range.
- Looking at the “Clearance Factor Diagram,” we can see that 25% actual clearance equals a Clearance Factor of 32%.
- If we apply this Clearance Factor to the range calculation formula, your probable range would become:

$$\text{Range} = 85 \text{ km (52 mi)} \times 32\% \times 100\% = 27.2 \text{ km (16.6 mi)}$$

This might satisfy your requirements for high-speed data transmissions between the two units. However, this range is very close to the required range of 25 km. The margin should be higher to deal with bad weather conditions.

If we base the calculation on transmissions at medium speed, your range calculation would look as follows:

- Looking at Table 1, we learn that a medium speed link between two 24 dBi directional parabolic grid antennas may cover a maximum distance of 120 km (74 mi), provided the signal path clearance is 320 m (1050 ft).
- As mentioned above however, our actual clearance is only 45 m (148 ft); 14% of the required 320 m (1050 ft).

$$\text{Range} = 120 \text{ km (74 mi)} \times 25\% \times 100\% = 30 \text{ km (18.6 mi)}$$

This result indicates that you have a better margin and can set the transmit rate of your system to medium speed for reliable wireless communications.

Optionally, you can run Link Test to determine whether the high-speed option might provide reliable wireless links as well.

### **Calculating the Cable Affect on Range**

We presumed that the antennas were connected by 6 m (20 ft) cables with a diameter of 10 mm (0.4 in) at both sites.

If we replaced this cable at building **b** with a longer 22 m (75 ft) cable, we must look at the Cable Factor effect of this longer cable.

Table 4 tells us that this new cabling combination would result in a Cable Factor of 67%.

If we apply this Cable Factor to the range calculation formula again, the probable range would become:

$$\text{Range} = 120 \text{ km (74 mi)} \times 25\% \times 67\% = 20.1 \text{ km (12.5 mi)}$$

This result indicates that the effect of this cable can prevent your wireless link from operating at both high and medium speed. In such situations you are advised to:

- Relocate the unit to a location that lets you use a shorter cable length.
- Increase the height of the antenna on the mast, or install taller antenna masts, to increase the signal path clearance.
- Trade-off data speed versus range and recalculate the ranges that could be achieved at lower transmit rates.

Alternatively, you can perform on-site diagnostic measurements to validate the results of this calculation.

Consult the *Tsunami MP.11/a Installation and Management* manual for information about using the Link Test feature to perform on-site diagnostic measurements.



## Point-to-Multipoint Network

Suppose you are installing a wireless point-to-multipoint network between one Base Unit and two Subscriber Units, as shown in the following figure, where:

- The Base Unit in building **c** is connected to a 7 dBi Omni-Directional Base Unit Antenna
- The two remote sites **a** and **b** have been equipped with a 14 dBi Directional Antenna
- All sites have been connected via 15 m (50 ft) antenna cables
- The site is located in the Europe, which requires you to use ETSI approved equipment<sup>3</sup>.

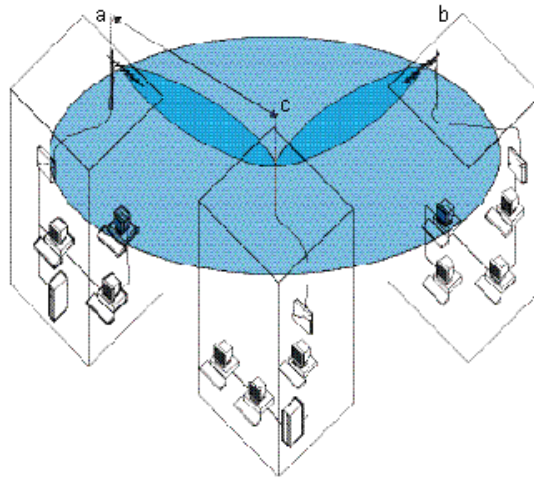


Figure 6. Calculating Point-to-Multipoint Range

For this type of outdoor antenna installation, you must determine the range for each link individually; that is, the range from building **c** to building **a**, and from building **c** to building **b**.

---

**Note:** In this example we demonstrate only the calculation for the link between building **a** and **c**; however, as different clearance factors may apply for each of these links, you are advised to calculate the actual range for each link individually when designing a “real” outdoor wireless link.

---

In this example we assume that:

- The antenna installation is to be installed in a dense urban area, where the distance between building **a** and building **c** is 0.5 km (0.3 mi).
- The actual clearance is 3 m (9.9 ft), being the height of the antennas on the mast.

The probable range for this example can be calculated using the introduced formula:

**Range = Maximum Range x Cable Factor x Clearance Factor**

Looking at Table 3, we learn that a high-speed link between a 7 dBi Omni-Directional Base Unit Antenna and a 14 dBi Directional Antenna may cover a maximum distance of 1.4 km (0.9 mi), provided the signal path clearance is 5.6 m (18 ft) or better.

Using a calculator, we can easily determine that the actual clearance of 3 m (9.9 ft) is about 75% of the required 5.6 m (18 ft), which equals a Clearance Factor of 70% (see Figure 5).

The maximum range calculation in Table 2 was based on the use of:

- 6 m (20 ft) cables with a diameter of 5 mm (0.2 in) for the site with the 14 dBi Directional Antenna
- 6 m (20 ft) cables with a diameter of 10 mm (0.4 in) for the 7 dBi Omni-Directional Base Unit Antenna.

---

<sup>3</sup>In France you may only use equipment based on the FR channel-set.

In other words, the Cable Factor for the maximum range calculation, already represents a value of 81%.

However, because the site as depicted in Figure 3 actually is using two 15 m (50 ft) cables, Table 3 identifies the Cable Factor as being 66%.

Your actual Cable Factor is 66% Cable Factor divided by the maximum range cable factor:  $66\% \div 81\% = 81\%$ .

If we import all this information into the range calculation formula, your probable range for high-speed transmissions would become:

**Range = 1.4 km (0.9 mi) x 70% x (66% ÷ 81%) = 0.8 km (0.5 mi)**

For campus type environments, this range is probably sufficient to connect multiple buildings; however, if you must cover a larger distance, you can either:

- Relocate the unit to a location that lets you use a shorter cable length.
- Increase the height of the antenna on the mast or install taller antenna masts to increase the signal path clearance.
- Trade-off data speed versus range and recalculate the ranges that could be achieved at lower transmit rates.

Alternatively, you may decide to perform on-site diagnostic measurements to validate the results of this calculation. Consult the documentation that comes with the Tsunami MP.11 for information about using the Link Test feature to perform on-site diagnostic measurements.

## Chapter 3. Antenna Cabling System

### SELECTING THE CORRECT CABLES

To comply with local radio regulations, Proxim Corporation offers two types of Base and Subscriber unit that can be used to connect to an outdoor antenna installation: A 15 dBm Transmit power system and an 8 dBm Transmit power system

The low-loss antenna cables are also available in various lengths and diameters:

- 6 m (15 ft) with a diameter of 5 mm (0.2 in) (The cable-loss of this cable equals the loss of the 15 m (50 ft) cable.)
- 6 m (15 ft) with a diameter of 10 mm (0.4 in)
- 15 m (50 ft) with a diameter of 10 mm (0.4 in)
- 22 m (75 ft) with a diameter of 10 mm (0.4 in)

When you order the Tsunami MP.11 antenna equipment, make sure that you order cables that comply with the regulations that apply in your country. In case of doubt, consult the Proxim Corporation Sales office for more information.

### ETSI Regulated Countries

The 24 dBi Directional Parabolic Grid Antenna is not allowed in ETSI countries, such as France.

All other antennas and all channels 1...13 are allowed in ETSI countries, with some exceptions. Check the regulatory information to find the allowed channels in a specific region.

### FCC Regulated Countries

Antenna	Antenna Cable Type			
	6 m (20 ft) 5 mm (0.2 in)	6 m (20 ft) 10 mm (0.4 in)	15 m (50 ft) 10 mm (0.4 in)	25 m (75 ft) 10 mm (0.4 in)
7 dBi Omni-Directional Base Station Antenna	Yes	Yes	Yes	Yes
10 dBi Omni-Directional Base Station Antenna	Yes	Yes	Yes	Yes
12 dBi Directional Wide Angle Antenna	Yes	Yes	Yes	Yes
14 dBi Directional Antenna	Yes	Yes	Yes	Yes
24 dBi Directional Parabolic Grid Antenna*	Yes	Yes	Yes	Yes
* consult the following table for restrictions on channel selection				

Table 7. Certified Cable and Antenna Combinations FCC

Antenna	Frequency Channels										
	1	2	3	4	5	6	7	8	9	10	11
7dBi Omni-Directional Base Station Antenna	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10 dBi Omni-Directional Base Station Antenna	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12 dBi Directional Wide Angle Antenna	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14 dBi Directional Antenna	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24 dBi Directional Parabolic Grid Antenna	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No

Table 8. Certified Channel and Antenna Combinations FCC

## Japanese Regulated Country

The use of a Directional Antenna is not allowed in channel 14 in Japan.

## REGULATORY INFORMATION

The Tsunami outdoor antenna solution must be installed and used in strict accordance with the instructions as described in this *Tsunami Outdoor Antenna Installation Guide*.

---

**Note:** Radio approvals for the Tsunami outdoor antenna solution are valid only when using the exact combination of outdoor antenna cabling components and antennas as listed in this *Tsunami MP.11 Antenna Installation Guide*.

Using other combinations of parts and components in outdoor antenna solutions voids the radio type approval and may be in violation of local radio regulations.

---

Proxim Corporation and its authorized resellers or distributors are not liable for any damage or violation of government regulations that may arise from failing to comply with these guidelines.

## SELECTING THE CORRECT CONNECTOR TYPE

All cabling components of the Tsunami outdoor antenna system come with standard-N type connectors as depicted in the following table.



Cabling Component	Standard-N Cabling Systems
a Pigtail attached to MP.11	1 Proprietary connector 2 Stand-N male
b Surge arrestor	Reverse polarity-N female on both ends
c Low-loss cable	Reverse Polarity-N male on both ends
d Outdoor antenna	Reverse polarity-N female

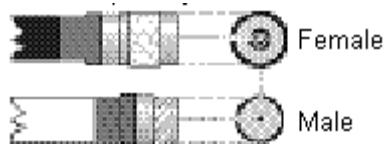


Table 9. Standard N-Type Connector Diagram

Note that the gender of the connector is not determined by the connector's thread, but by its center pin; a solid center pin = male, a hollow pin = female.

**Note:** Previously marketed Tsunami outdoor antenna systems in FCC regulated countries (such as the USA and Canada) were shipped with a different cabling system, identified by reverse polarity-N connectors (depicted in the following table).



Cabling Component	Reverse Polarity-N Cabling Systems
a Pigtail attached to MP.11	1 Proprietary connector 2 Reverse polarity-N male
b Surge arrestor	Reverse polarity-N female on both ends
c Low-loss cable	Reverse Polarity-N male on both ends
d Outdoor antenna	Reverse polarity-N female



Table 10. Reverse Polarity-N Cabling Diagram

Note that the gender of the connector is not determined by the connector's thread, but by its center pin; a solid center pin = male, a hollow pin = female.

---

**DANGER!**

***Outdoor antennas and antenna cables are electrical conductors. Transients or electrostatic discharges that may occur at the antenna (for example a lightning strike during thunderstorms) may damage your electronic equipment and cause personal injury or death to persons touching the exposed metal connectors of the antenna cable.***

***To avoid damage and personal injury, the entire antenna cabling system must be grounded at all times.***

***When installing, disconnecting, or replacing one of the cabling components, ensure at all times that each exposed antenna cabling system metal connector is grounded locally during the work.***

---

For example when mounting or replacing the surge arrester:

1. First connect each of the connectors of the low-loss antenna cables to the grounding system.
2. Next connect the cable connector to the grounding system.
3. Finally connect the surge arrester to the grounding system.

Before you proceed, verify that each of the items is properly grounded and that the ground is not interrupted when disconnecting one of the antenna system components.

Check with a qualified electrician if you are in doubt whether the surge arrester and cable connectors are properly grounded.

Only after you have verified that each of the items is properly grounded, replace the surge arrester and disconnect the cables from the grounding system in exactly the reverse order of the previous steps.

## OUTDOOR CABLING COMPONENTS

To connect your Tsunami MP.11 hardware to an outdoor antenna installation, the following cabling components are required:

- Surge arrestor
- Low-loss antenna cables
- One of the outdoor antennas described “Chapter 4. Recommended Antennas” on page 41.

When purchasing new Tsunami MP.11 products, each of these components is equipped with standard N-type connectors.

When ordering separate components, for example as a spare part or replacement to previously purchased Tsunami outdoor antenna equipment, carefully read the note on the following page to ensure that you order components with an N-type connector that matches the other parts of your outdoor antenna cabling system.

### Surge Arrestor

The surge arrestor (sometimes referred to as a lightning protector) can protect your sensitive outdoor router equipment from high-voltage surges caused by discharges and transients at the antenna.

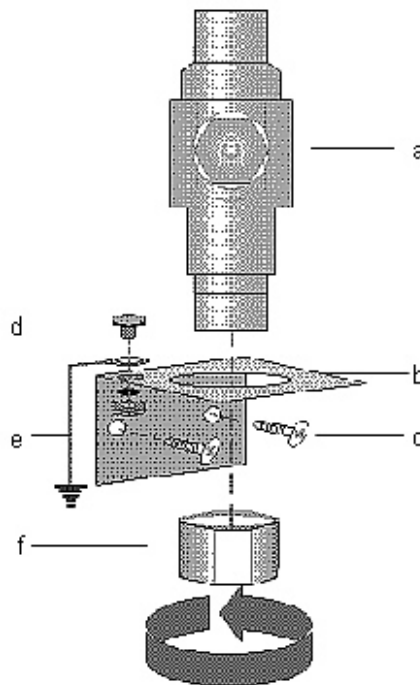


Figure 7. Surge Arrestor

To mount the surge arrestor:

1. Determine a suitable location for the bracket (item b) as described in “Chapter 1. Preparing for Installation.”
2. Use the screws (item c) to attach the bracket to the wall.
3. Apply a ring-terminal to the ground wire. Use the bolt, lock-washer, and nut (item d) to connect the ground wire (item e) to the mounting bracket.

4. The ring-terminal and ground wire are not included, but must be installed by a certified electrician familiar with national electricity and safety codes, according to the instructions described in “Grounding the Antenna” on page 16.
5. Insert the surge arrestor (item a) into the bracket as depicted in the preceding figure.
6. Use the hex-nut (item f) to secure the surge arrestor in its position. Ensure that the surge arrestor is properly connected to the grounding system.

---

**CAUTION!**

***To avoid damage to electronic equipment and your Tsunami MP.11 equipment always apply the surge arrestor between the outdoor antenna installation and the Tsunami MP.11 hardware or other computing device that is connected to the outdoor antennas.***

---

See “Surge Protector” on page 71 for surge protector specifications.

## **Low-Loss Antenna Cable**

The low-loss antenna cable is available in three standard lengths:

- 6 m (20 ft)
- 15 m (50 ft)
- 22 m (75 ft)

To ensure that you order the right cable length, determine the distance between the intended locations of the Tsunami MP.11 hardware and outdoor antenna carefully.

See “LMR 600 Cable” on page 73 for cable specifications.



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## Chapter 4. Recommended Antennas

### TYPE OF OUTDOOR ANTENNA EQUIPMENT

As described previously, Proxim Corporation offers different types of outdoor antennas and cable lengths for your network design.

The **directional antennas** provide maximum range, but due to their narrow beamwidth, these antennas require precise antenna alignment to achieve optimal performance. The higher the antenna gain, the more precise the alignment should be. Directional antennas are typically used to connect:

- A Base Unit and a Subscriber Unit in a point-to-point link
- A Subscriber Unit in a point-to-multipoint network

The **omni-directional antennas** have, by nature, an omni-directional azimuth pattern that makes them easy to install. There is also a gain beamwidth relation for omni-antennas: The higher the gain of the omni-antenna, the narrower the vertical beamwidth. In a hilly terrain, a 7dBi omni-directional antenna can be a better solution than the 10 dBi omni-directional antenna.

The 12 dBi **wide-angle antenna** is a good Base Station antenna for hilly terrain. It combines a wide opening angle with relatively high gain. The mounting brackets allow tilting of the antenna. This antenna also is used when the amount of traffic in a cell is too high for a single Base Station with an omni-directional antenna. The wide-angle antenna lets you divide the cell into three sectors so that a Base Station can service each sector.

## 14 DBI DIRECTIONAL ANTENNA

### General Description

14 dBi Directional Antenna is a high-gain Tsunami antenna for the 2.4 GHz frequency band. This antenna is typically used in combination with a Subscriber Unit.

The 14 dBi Directional Antenna consists of a totally enclosed 16 element Yagi antenna that has been designed for point-to-point communications. It has a typical VSWR of 1.5:1 and is less than 2:1 over the entire frequency band. The gain is 14 dBi and the half-power beamwidth is 30 degrees. This antenna is normally mounted on a mast and is vertically polarized.

### Contents of the Antenna Box

- One encapsulated antenna
- Metal backing plate for the antenna
- 2 U-bolts, with 2 bolt heads (for mast mounting)
- 4 flat washers, and 4 nuts (to attach the antenna to the U-bolts or screws)

### Mounting the Directional Antenna

You can mount the Tsunami 14 dBi Directional Antenna to a mast or a flat vertical surface, such as a wall.

In most cases, mounting the antenna to a mast allows for more flexibility in adjusting the height and direction of the antenna to aim it at the opposite end of the wireless link.

---

**DANGER!** *When selecting an antenna location, ensure that the general precautions are met to avoid possible contact with electrical power lines. See the National Electrical Code for proper grounding of the antenna mast*

---

### Mounting to a Mast

To mount the antenna to a mast proceed as follows:

1. Verify if you have all the items listed below:
  - The Tsunami 2.4 GHz antenna
  - The 2 U-bolts and bolt heads provided
  - The 4 flat washers and 4 nuts provided
  - A socket wrench to tighten the nuts
2. Note the arrows on the mounting plate; mount the antenna with the arrows pointing up.
3. Attach the antenna to the mast as depicted in the following figure, using the U-bolts and bolt heads, the Metal Backing Plate and nuts.

---

**CAUTION!** *Always place flat washers between heads (or nuts) and the plastic mounting plate. Avoid over-tightening the nuts and screws to prevent damage to the mounting plate.*

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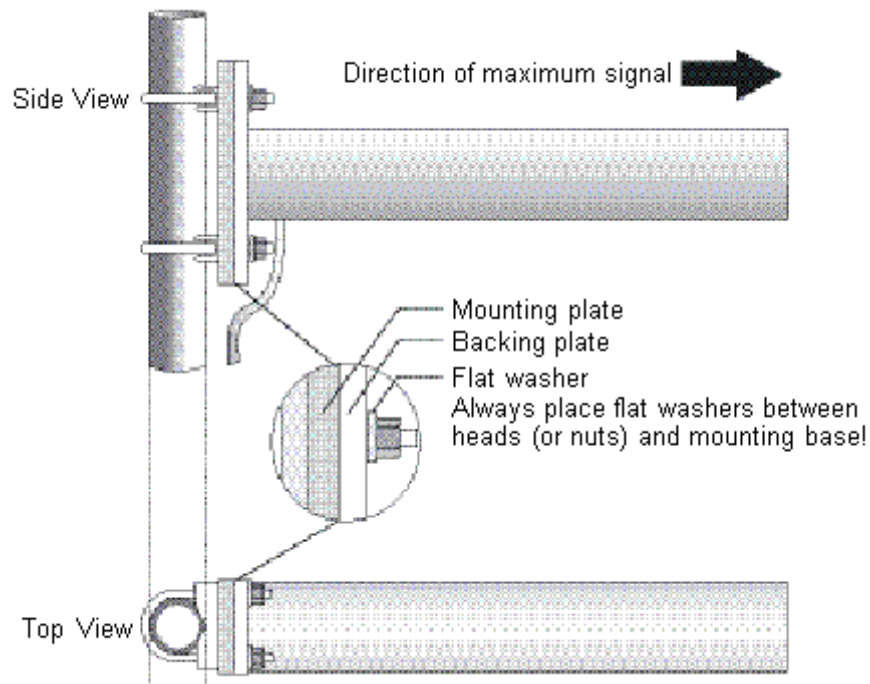


Figure 8. Mounting 14 dBi Antenna to a Mast

### Mounting on a Flat Surface

For mounting the antenna to a flat vertical surface, you must provide a smooth surface for the antenna mount. On wall surfaces such as brick, block or stucco, use an intermediate surface such as a plywood board or metal plate between the wall and antenna. The intermediate surface must be of sufficient strength to prevent distortion of the antenna base when the mounting hardware is tightened.

To mount the antenna proceed as follows:

1. Verify whether you have all the following items:
  - The 2.4 GHz antenna
  - (optional) an intermediate plate
  - 4 plugs and screws
  - 4 flat washers
  - An electric drill
  - A screwdriver to tighten the screws
2. Note the arrows on the mounting plate; mount the antenna with the arrows pointing up.
3. Attach the antenna using the intermediate plate, metal backing plate and flat washers.

---

**CAUTION!** *Always use flat washers between the screws and the plastic mounting plate. Avoid over-tightening nuts and screws to prevent damage to the mounting plate.*

---

## Technical Specifications

<b>Mechanical</b>	
Size	44.7 cm (18 in)
Mounting method	Vertical or horizontal mast with an outside diameter between 28 mm (1.102 in) and 41 mm (1.625 in) using U-bolts. Wall using plugs and screws
Connector <sup>1</sup>	Standard N (female)
<b>Cable</b>	
Type	RG58A/U, 50 ohms low-loss coaxial
Color	White
<b>Electrical</b>	
Frequency Range	2.4 GHz
VSWR	Less than 2:1, 1.5:1 nominal
Nominal Impedance	50 ohms
Gain	14 dBi
Front-to-back ratio	Greater than 20 dB
Half-Power Beamwidth	
Elevation Plane (vertical)	30.8 degrees
Azimuth Plane (horizontal)	31.4 degrees
Polarization	Linear vertical (standard mounting) Horizontal (when mounted differently; see “Mounting the Directional Antenna” on page 42).
<b>Antenna Environment</b>	
Operating temperature	-40 degrees C (-40 degrees F) to +60 degrees C (+140 degrees F)
Wind/survival	At least 200 km/h (124 mph) <sup>2</sup>
<sup>1</sup> See also “Selecting the Correct Connector Type” on page 37.	
<sup>2</sup> At least 100 km/h (62 mph) with 1.25 cm (0.5 in) ice.	

Table 11. Specifications 14 dBi Directional Antenna

## Pattern

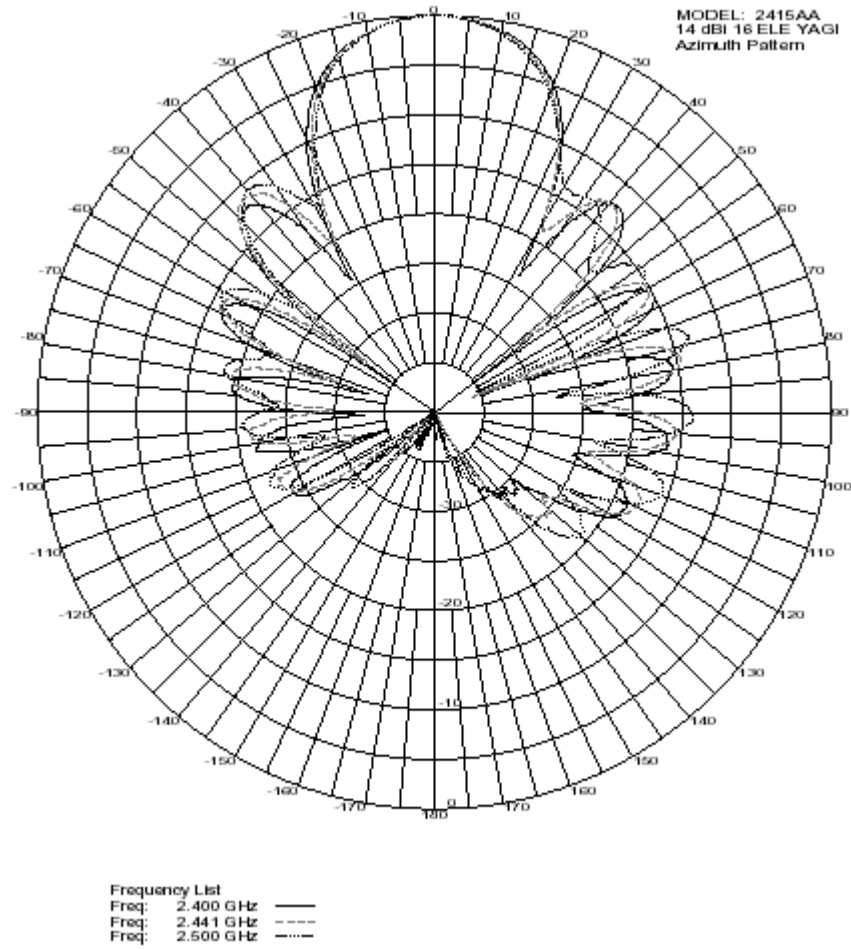


Figure 9. Azimuth Plane (Horizontal), 14 dBi Directional Antenna

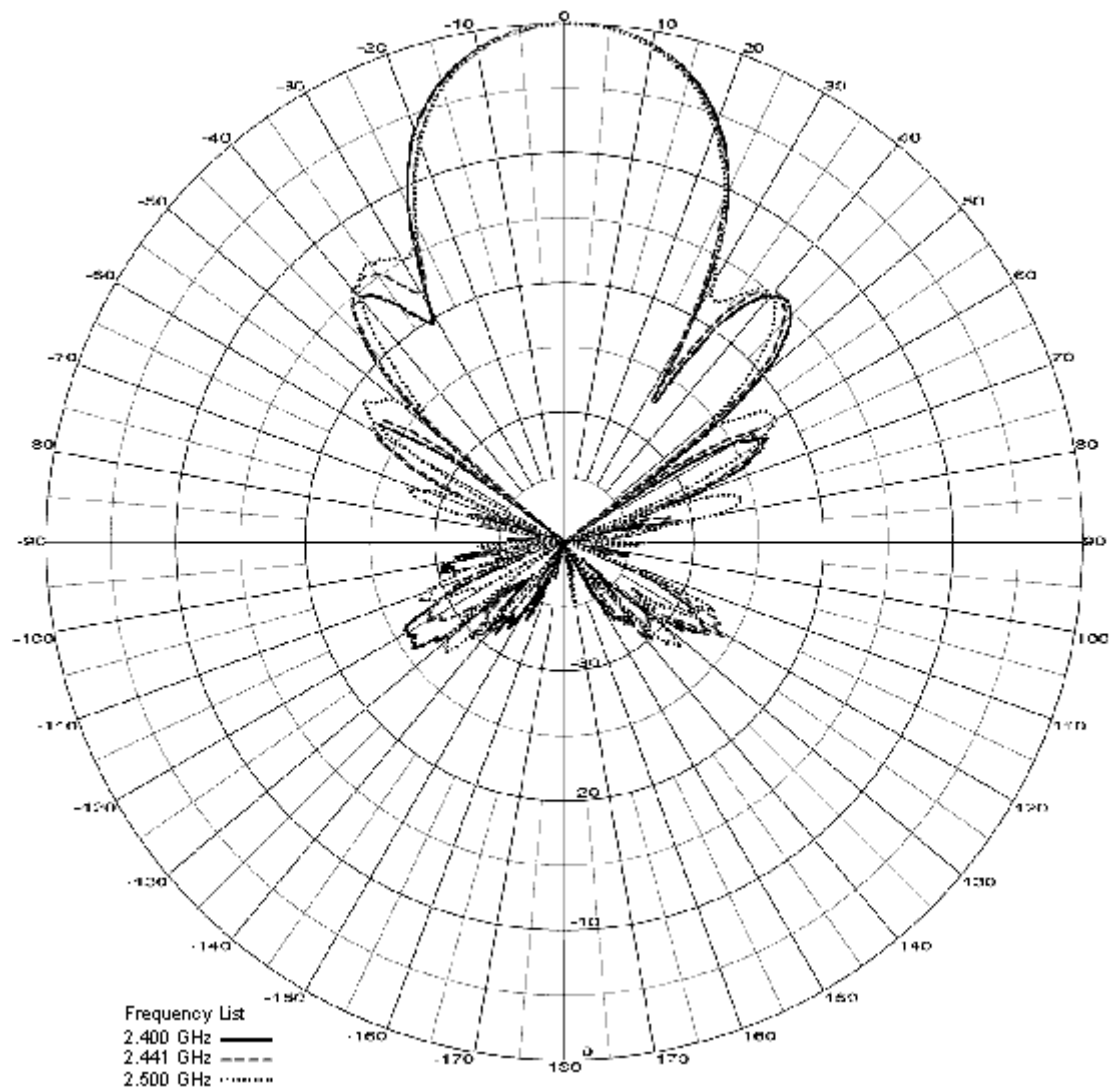


Figure 10. Elevation Plane (Vertical), 14 dBi Directional Antenna

## 7 DBI OMNI-DIRECTIONAL BASE UNIT ANTENNA

### General Description

The Tsunami 7 dBi Omni-Directional Base Unit Antenna is a broadband antenna for the 2.4 GHz frequency band featuring an omni-directional pattern with a nominal gain of 7 dBi.

The pole-type antenna is enclosed in a weatherproof protective covering (“radome”). This vertically polarized antenna can be mounted to an antenna mast with an outside diameter of up to 65 mm (2.5 in).

For detailed specifications see the table in this appendix.

---

**DANGER!** *When selecting an antenna location, ensure that the general precautions are met to avoid possible contact with electrical power lines. See the National Electrical Code for proper grounding of the antenna mast*

---

### Mounting the Omni-directional Antenna

You can mount the 7 dBi antenna to a mast only. This antenna uses vertical polarization, which is the most common type of polarization for omni-directional antennas.

#### Mounting to a Mast

To mount the antenna to a mast proceed as follows:

1. Verify that you have all the items listed below:
  - The 7 dBi Pole Antenna
  - The O-shaped metal bracket
  - The U-bolt, nuts and lock washers
  - A small wrench to tighten the nuts
2. Position the bracket (item d in the following figure) to the top of the antenna mast (item b).
3. Place the U-bolt (item c) around the antenna mast, and slide its ends through the corresponding holes of the bracket.
4. Use the lock-washers (item e) and nuts (item f) to secure the bracket to the mast. Use a wrench to tighten the nuts.
5. Next, feed the antenna cable of the 7 dBi Omni-Directional Base Unit Antenna (item a) through the hole of the mounting bracket.
6. As shown in the following figure, slide the antenna down until its metal base is enclosed by the mounting bracket.

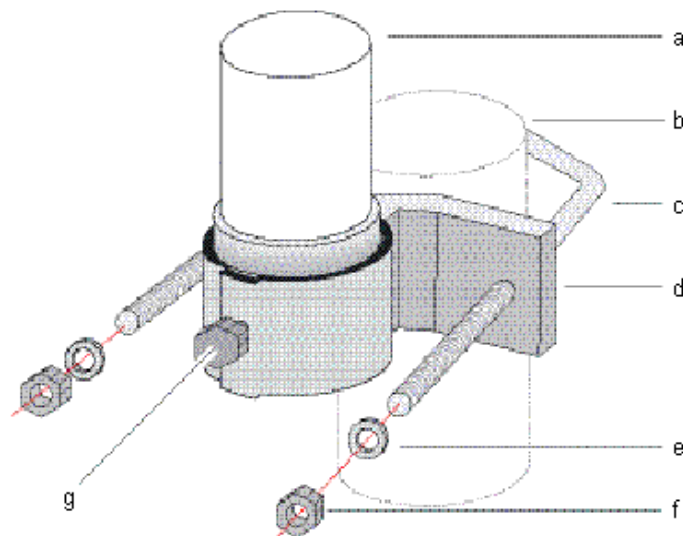


Figure 11. Mounting the 7 dBi Antenna to a Mast

7. Use a wrench to tighten the bracket bolt (item g) to fix the antenna into its position.

**CAUTION!** Avoid over-tightening the hose-clip nut to avoid damage to the clip and your antenna.

## Technical Specifications

Mechanical	
Size	43.2 cm (17 in)
Mounting method	Clamps to vertical mast with outside diameter between 35 mm (1.4 in) and 65 mm (2.55 in)
Connector <sup>1</sup>	Standard N (female)
Electrical	
Frequency Range	2.4 GHz
VSWR	Less than 2:1 nominal
Nominal Impedance	50 ohms
Gain	y dBi
Polarization	Linear vertical
Antenna Environment	
Operating temperature	-40 degrees C (-40 degrees F) to +60 degrees C (+140 degrees F)
Wind/survival	At least 200 km/h (124 mph) <sup>2</sup>
<sup>1</sup> See also "Selecting the Correct Connector Type" on page 37. <sup>2</sup> At least 100 km/h (62 mph) with 1.25 cm (0.5 in) ice.	

Table 12. Specifications 7 dBi Omni-Directional Base Unit Antenna



## Pattern

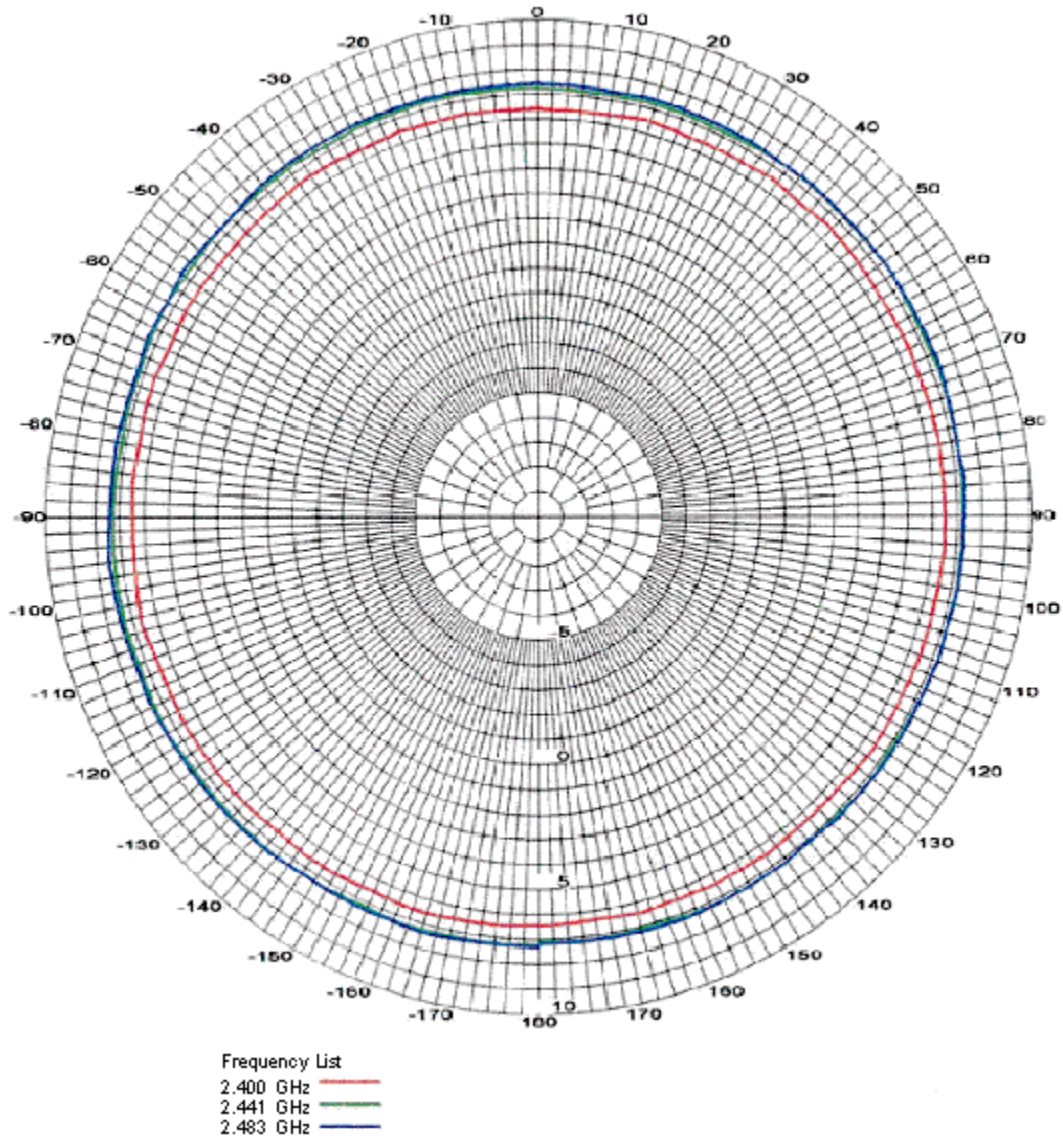


Figure 12. Azimuth Plane (Horizontal), 7 dBi Omni-Directional Base Unit Antenna

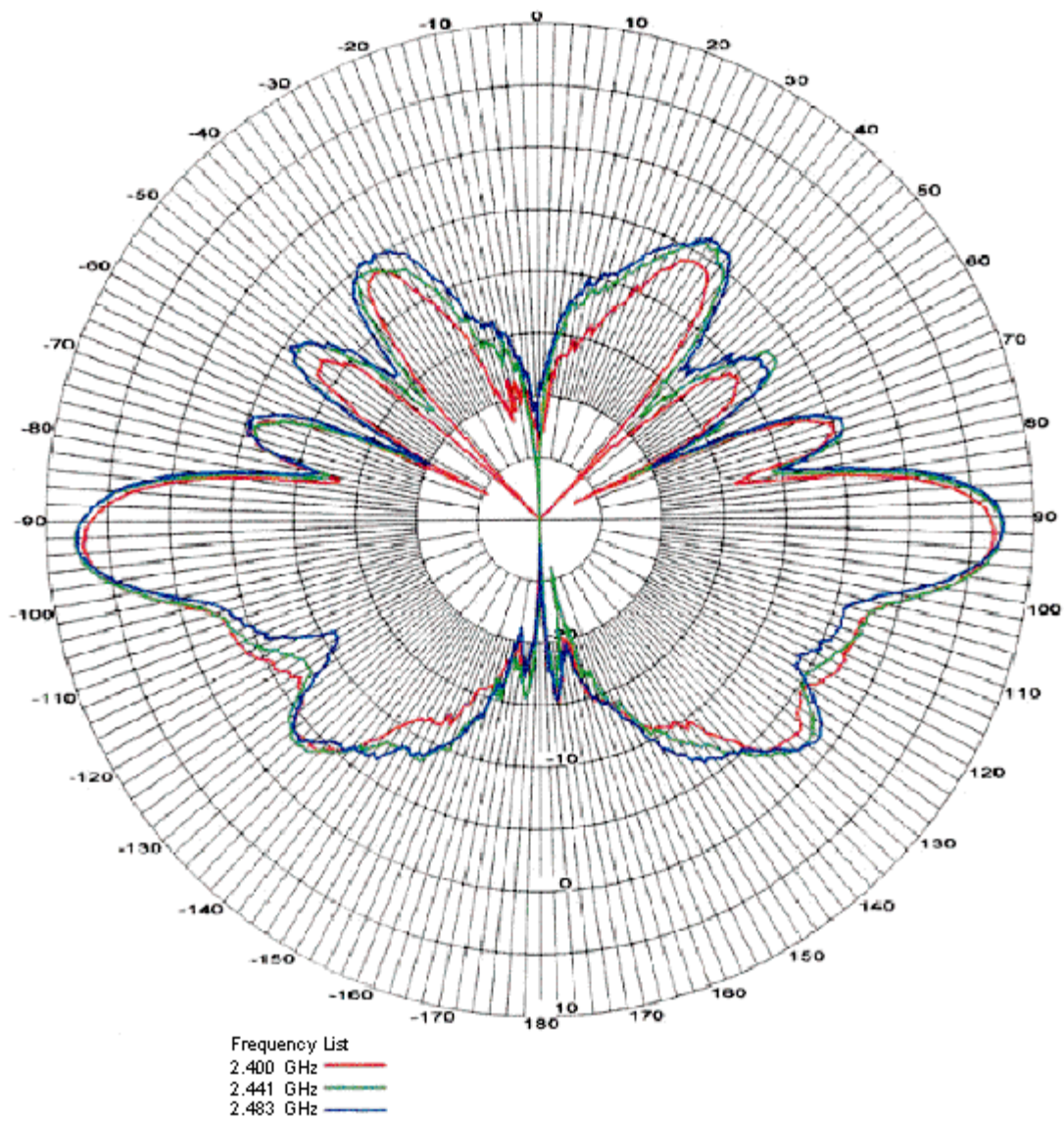


Figure 13. Elevation Plane (Vertical), 7 dBi Omni-Directional Base Unit Antenna

## 10 DBI OMNI-DIRECTIONAL BASE UNIT ANTENNA

### General Description

The Tsunami 10 dBi Omni-Directional Base Unit Antenna is a broadband antenna for the 2.4 GHz frequency band featuring an omni-directional pattern with a nominal gain of 10 dBi.

This antenna is typically used in combination with a Base Unit.

The pole-type antenna is enclosed in a weatherproof protective covering (“radome”). This vertically polarized antenna can be mounted to an antenna mast with an outside diameter of up to 51 mm (2.0 in).

For detailed specifications see the table in this appendix.

---

**DANGER!** *When selecting an antenna location, ensure that the general precautions are met to avoid possible contact with electrical power lines. See the National Electrical Code for proper grounding of the antenna mast*

---

### Mounting Instructions

1. Attach the ferrule of the antenna to the mounting bracket with two U-bolts as shown in the following figure.
2. Next use the remaining two U-bolts to attach the mounting bracket to the mast. Tighten nuts to 9 Nm (7 ft-lbs).

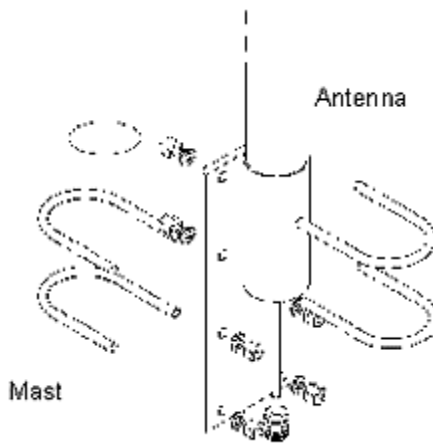


Figure 14. Mounting the 10 dBi Antenna

## Technical Specifications

<b>Mechanical</b>	
Size	91.4 cm (36 in)
Mounting Method	Clamps to vertical mast with outside diameter between 35 mm (1.4 in) and 51 mm (2.0 in)
Connector <sup>1</sup>	Standard N (female)
<b>Cable</b>	
Type	RG-303, 50 ohms low-loss coaxial
Length	25 cm (10 in)
Color	Tan
<b>Electrical</b>	
Frequency Range	2.4 GHz
VSWR	Less than 2:1 nominal
Nominal Impedance	50 ohms
Gain	20 dBi
Polarization	Linear vertical
<b>Antenna Environment</b>	
Operating Temperature	-40 degrees C (-40 degrees F) to +60 degrees C (+140 degrees F)
Wind/survival (mph)	At least 240 km/h (150 mph) <sup>2</sup>
<sup>1</sup> See also “Selecting the Correct Connector Type” on page 37.	
<sup>2</sup> At least 200 km/h (124 mph) with 1.25 cm (0.5 in) ice.	

Table 13. Specifications 10 dBi Omni-Directional Base Unit Antenna

## Pattern

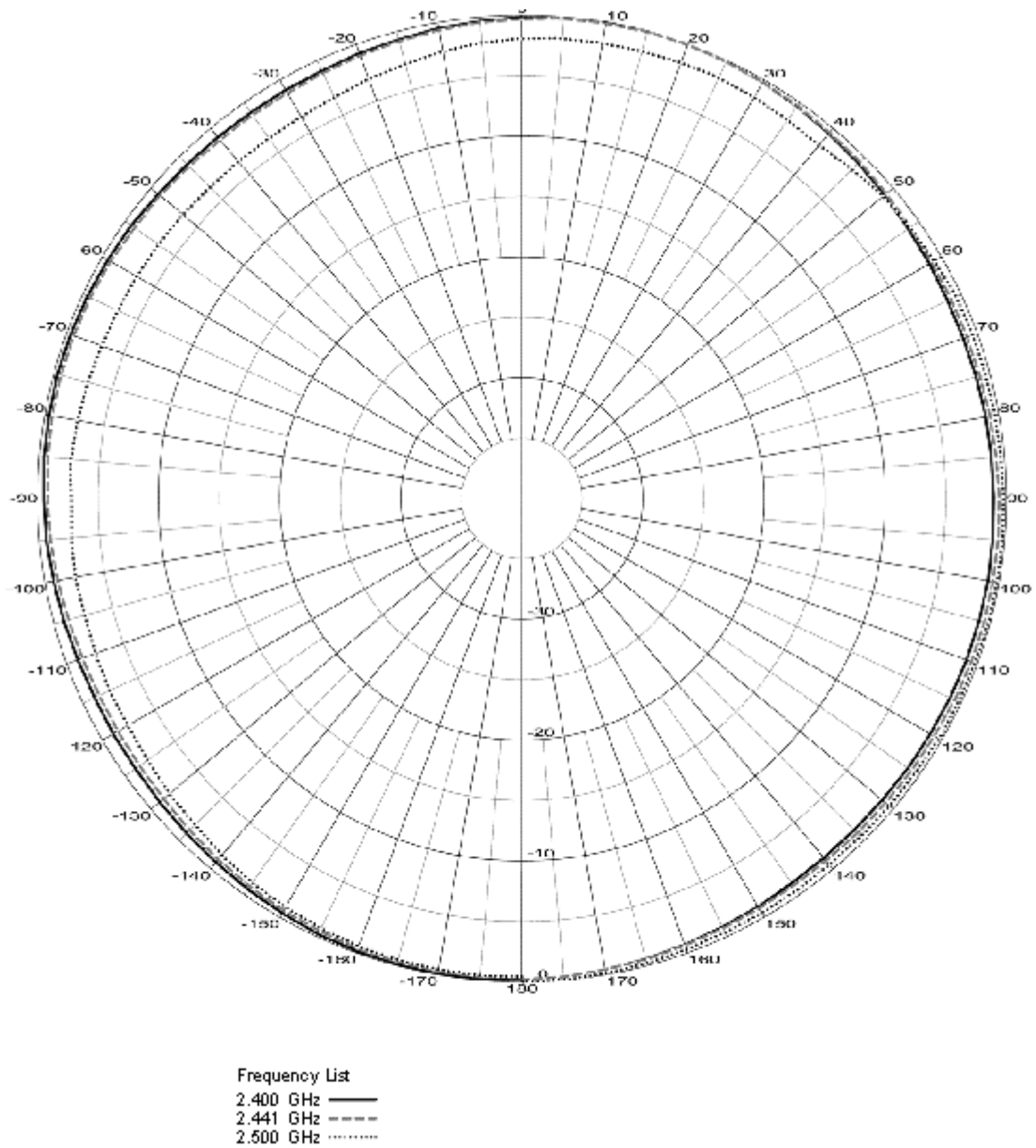


Figure 15. Azimuth Plane (Horizontal), 10 dBi Omni-Directional Base Unit Antenna

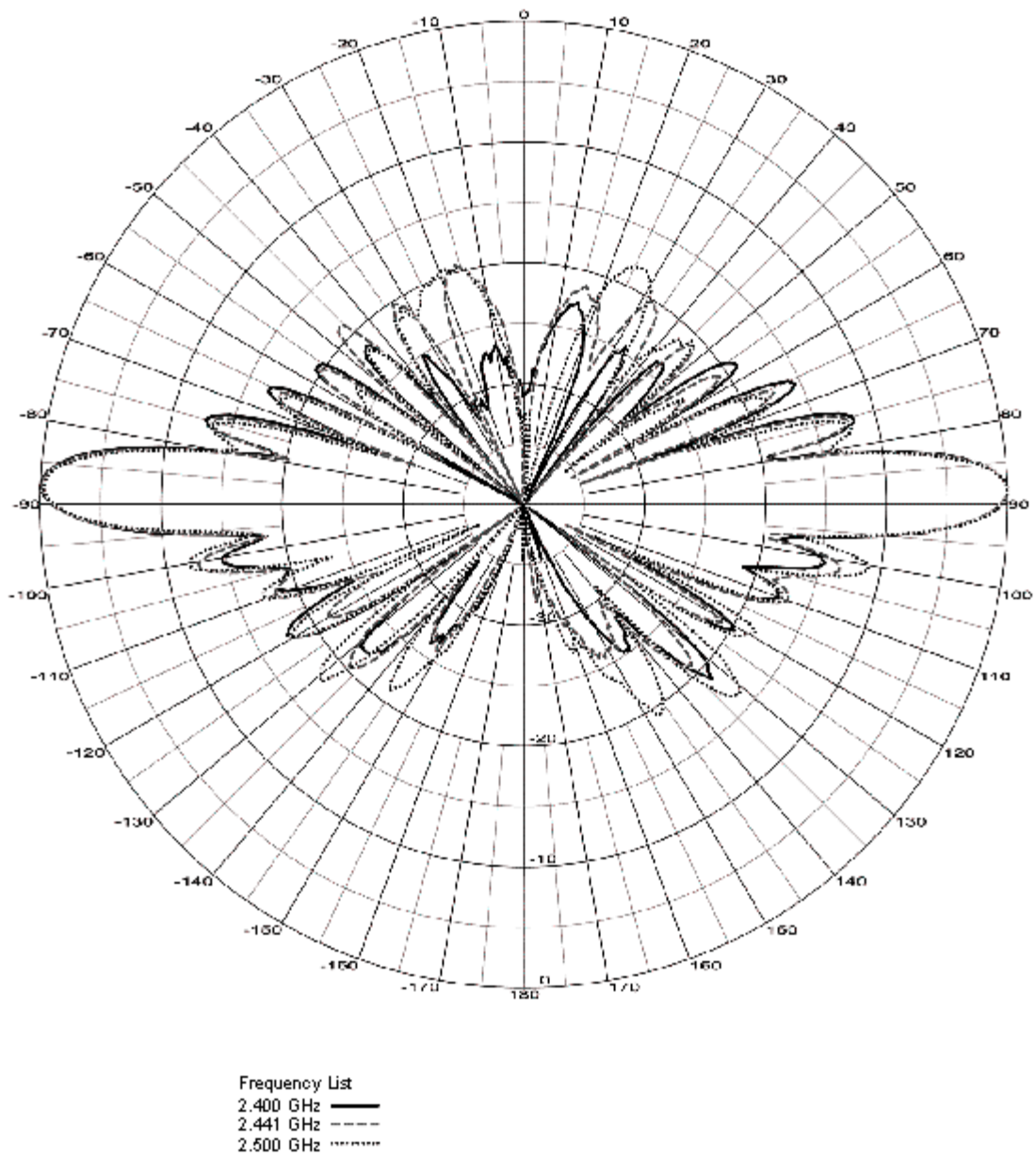


Figure 16. Elevation Plane (Vertical), 10 dBi Omni-Directional Base Unit Antenna



## 12 DBI DIRECTIONAL WIDE ANGLE ANTENNA

### General Description

The Tsunami 12 dBi Directional Wide Angle Antenna is for the 2.4 GHz frequency band is a perfect match between the features of the:

- Directional antennas
- Omni-directional antennas

Typically used in combination with a Base Unit, this antenna can be mounted to an antenna mast with an outside diameter of up to 51 mm (2.0 in).

### Mounting Instructions

---

**DANGER!** *When selecting an antenna location, ensure that the general precautions are met to avoid possible contact with electrical power lines. See the National Electrical Code for proper grounding of the antenna mast.*

---

1. Attach the U-bolts, tube mounting bracket, upper mounting bracket, and lower mounting bracket to the mast and spaced as shown in the following figure.

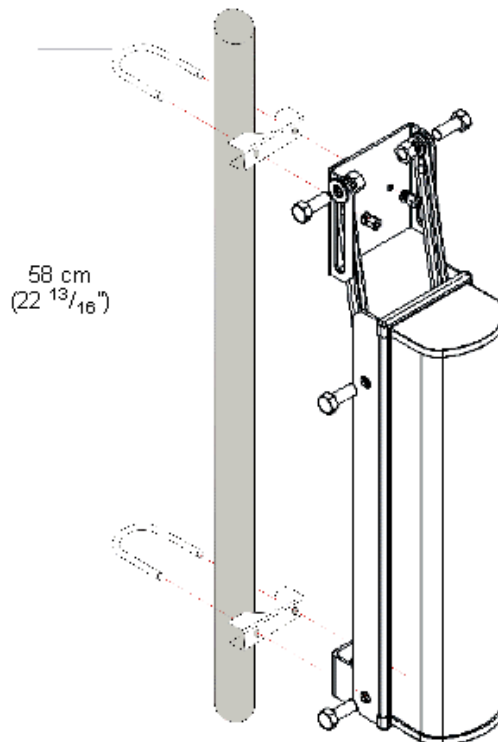


Figure 17. Mounting the 12 dBi Wide Angle Antenna

2. Assemble the angle adjustment brackets to the upper mounting bracket with 1/2 inch bolts, lock washers, flat washers and nuts.
3. Next assemble the angle adjustment brackets and lower mounting brackets to the antenna base plate with 1/2 inch bolts, lock washers, and nuts.
  - This adjustment is for 0 degree mounting. To adjust from 0 to -20 degrees, loosen the hardware at both ends of the angle adjustment bracket and slide it in the slot to the preferred angle.
4. Tighten hardware securely. The U-bolts should be tightened to 9 Nm (7 ft-lbs).

## Technical Specifications

<b>Mechanical</b>	
Size (LxWxD)	181 x 53.7 x 76 cm (21.1 x 7.1 x 3.0 in)
Mounting Method	Clamps to vertical mast with outside diameter between 35 mm (1.4 in) and 51 mm (2.0 in)
Connector <sup>1</sup>	Standard N (female)
<b>Electrical</b>	
Frequency Range	2.4 GHz
VSWR	Less than 2:1 nominal
Nominal Impedance	50 ohms
Gain	12 dBi
Polarization	Linear vertical
<b>Half-Power Beamwidth (at vertical polarization)</b>	
Elevation Plane (vertical)	13 degrees
Azimuth Plane (horizontal)	125 degrees
<b>Antenna Environment</b>	
Operating Temperature	-40 degrees C (-40 degrees F) to +60 degrees C (+140 degrees F)
Wind/survival (mph)	At least 200 km/h (124 mph) <sup>2</sup>
<sup>1</sup> See also “Selecting the Correct Connector Type” on page 37. <sup>2</sup> At least 100 km/h (62 mph) with 1.25 cm (0.5 in) ice.	

Table 14. Specifications 12 dBi Directional Wide Angle Antenna



## Pattern

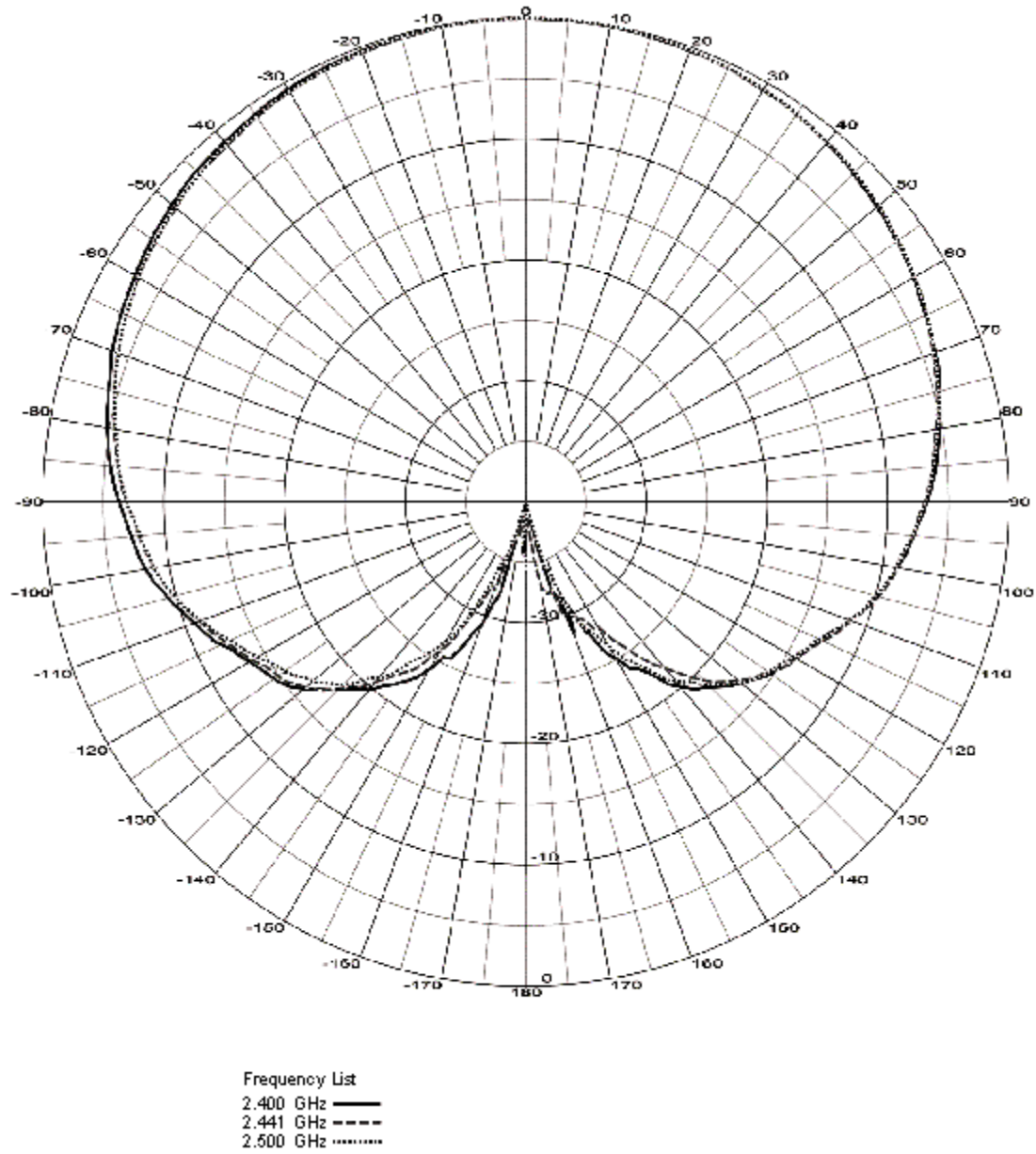


Figure 18. Azimuth Plane (Horizontal), 12 dBi Directional Wide Angle Antenna

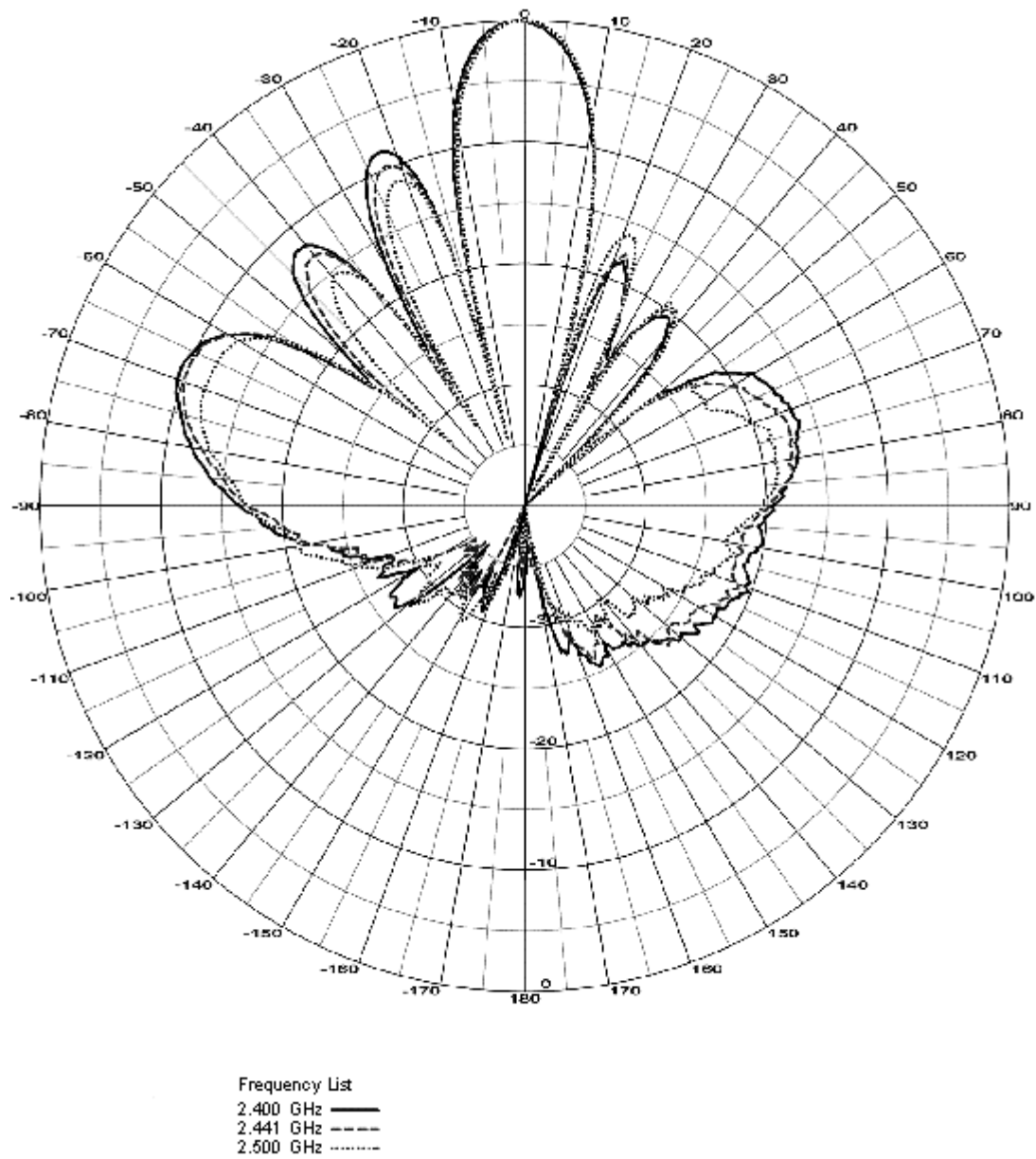


Figure 19. Elevation Plane (Vertical), 12 dBi Directional Wide Angle Antenna

## 24 DBI DIRECTIONAL PARABOLIC GRID ANTENNA

### General Description

The Tsunami 24 dBi Directional Parabolic Grid Antenna is a broadband antenna for the 2.4 GHz frequency band.

The grid-type antenna allows either horizontal or vertical mounting on an antenna mast with an outside diameter of up to 51 mm (2 in).

This antenna typically is used in combination with a Subscriber Unit.

---

**Note:** The 24 dBi Directional Parabolic Grid Antenna is not allowed in countries that adhere to the ETSI radio regulations (also France).

In countries that adhere to the FCC regulations, use of this antenna is allowed only when operated with specific radio channels that can be set on the Tsunami MP.11.

---

### Kit Contents

The 24 dBi Directional Parabolic Grid Antenna comes in two boxes with the following contents

Feed Box:

- 1 Feed assembly
- 1 Sub-reflector
- 1 #6 x 1/2 inch stainless screw
- 2 Stainless 1/4 x 20 hex nuts
- 2 Stainless lock washers
- 2 Stainless carriage bolts

Reflector Box:

- 2 Reflector halves
- 2 Stainless U-bolts
- 2 Mast clamps
- 1 Mounting 'L' shaped bracket
- 4 Keps nuts (4) #8-32 machine screws
- 6 Stainless 1/4 x 20 hex nuts
- 6 Stainless lock washers
- 2 Stainless carriage bolts
- 1 Stainless flat plate washer

---

**Note:** Prior to installation, or climbing the roof, verify if all parts and components are included. If any part is missing or appears to be damaged, consult your authorized Proxim Tsunami reseller.

---

## Assembling the Antenna

1. Assemble the two reflector halves inserting the four #8-32 machine screws through the front. Secure with the keps nuts on the back.

---

**Note:** Loosely tighten all hardware until completely assembled and then tighten securely.

---

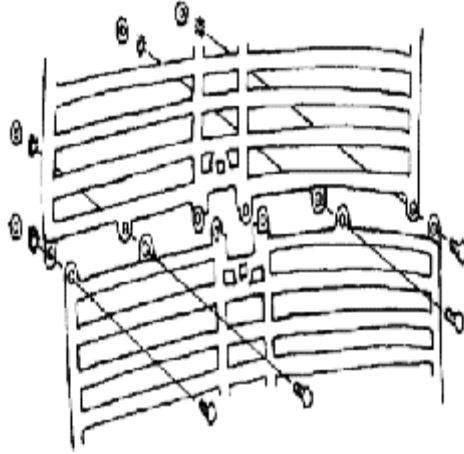


Figure 20. Assemble the Reflector

2. Place the sub-reflector on the front of the feed and secure with the #6 x 1/2 inch stainless screw.
3. Determine the polarity of the antenna (see the following figure).
  - Horizontal polarity, (the reflector ribs and the sub reflector at the front end of the antenna are aligned horizontally).
  - Vertical polarity: (the reflector ribs and the sub reflector at the front end of the antenna are aligned vertically).

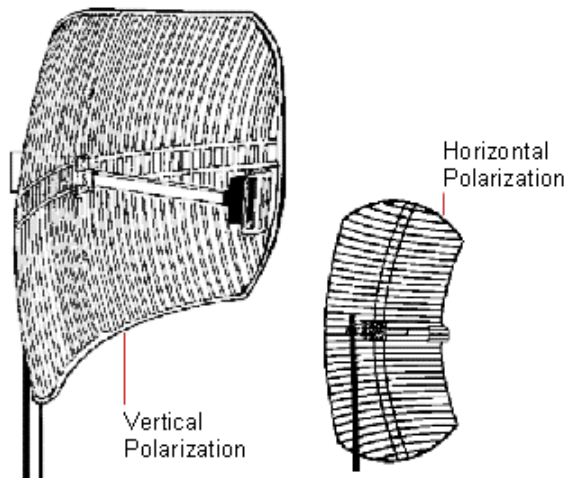


Figure 21. Determine Polarization

Polarity of the antenna must always be the same as the polarity of the antenna on the opposite side of the link!

4. Place the 'L' bracket on the back of the antenna.
5. Insert two carriage bolts from the front to attach.

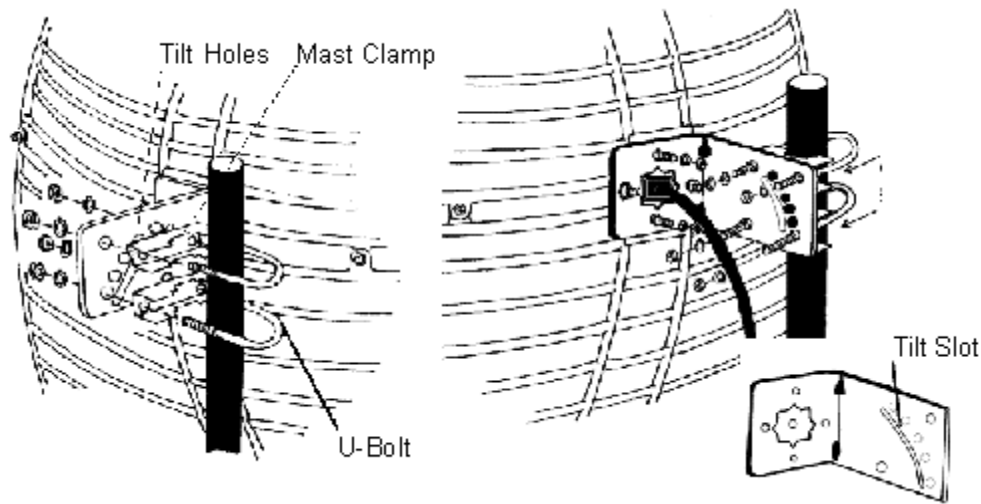


Figure 22. Attach Mounting Bracket

6. Secure on the back with the lock washers and nuts.
7. Recheck the dipole feed assembly for the proper polarity.
8. Attach the feed on the front with 2 carriage bolts. Secure on the back with the lock washers and nuts.

## Mounting the Antenna

---

**DANGER!** *Installation of antenna near power lines is dangerous! Before you proceed, make sure you have read and understood the safety precautions.*

---

1. Before climbing the roof, make sure you have:
  - The assembled antenna.
  - The U-bolts and mast clamps to mount the grid antenna to the mast.
2. Determine the desired alignment of the antenna:
  - For horizontal alignment you need both U-bolts and the 4 lock washers and nuts.
  - For tilted alignment, you use only a single U-bolt and two lock washers and nuts. This mounting method lets you mount the antenna with an elevation in 10 degrees increments.

---

**CAUTION!** *Tilted alignment is not suitable for environments where the antenna is subject to high wind conditions.*

---

3. Place the U-bolt(s) around the mast as depicted in the previous figure.
4. Slide the mast clamps over the U-bolts.
5. Slide the 'L' bracket over the U-bolts and fasten the grid antenna to the U-bolts using the lock washers and nuts.

---

**Note:** For tilted elevation mounting, use the flat plate washer on the adjustable tilt slot to mount and secure the antenna to the desired elevation angle.

---

## Technical Specifications

<b>Mechanical</b>	
Size (HxWxD)	61.0x91.4x38.1 cm (24x36x15 in)
Mounting method	Clamps to vertical mast with outside diameter between 26 mm (1.102 in) and 51 mm (2.0 in)
Cable Type	RG-8A/U, 50 ohms low-loss coax
Cable Length	60 cm (24 in)
Cable Color	Black
Connector <sup>1</sup>	Standard N (female)
<b>Electrical</b>	
Frequency Range	2.4 GHz
VSWR	Less than 2:1 nominal
Nominal Impedance	50 ohms
Gain	24 dBi
Polarization	Linear vertical for standard mounting Horizontal when mounted differently (see “Mounting the Antenna” on page 61)
<b>Half-Power Beamwidth (at vertical polarization)</b>	
Elevation Plane (vertical)	10 degrees
Azimuth Plane (horizontal)	6.5 degrees
<b>Antenna Environment</b>	
Operating Temperature	-40 degrees C (-40 degrees F) to +60 degrees C (+140 degrees F)
Wind/survival (mph)	At least 200 km/h (124 mph) <sup>2</sup>
<sup>1</sup> See also “Selecting the Correct Connector Type” on page 37.	
<sup>2</sup> At least 100 km/h (62 mph) with 1.25 cm (0.5 in) ice.	

Table 15. Specifications 24 dBi Directional Parabolic Grid Antenna

## Horizontal Pattern

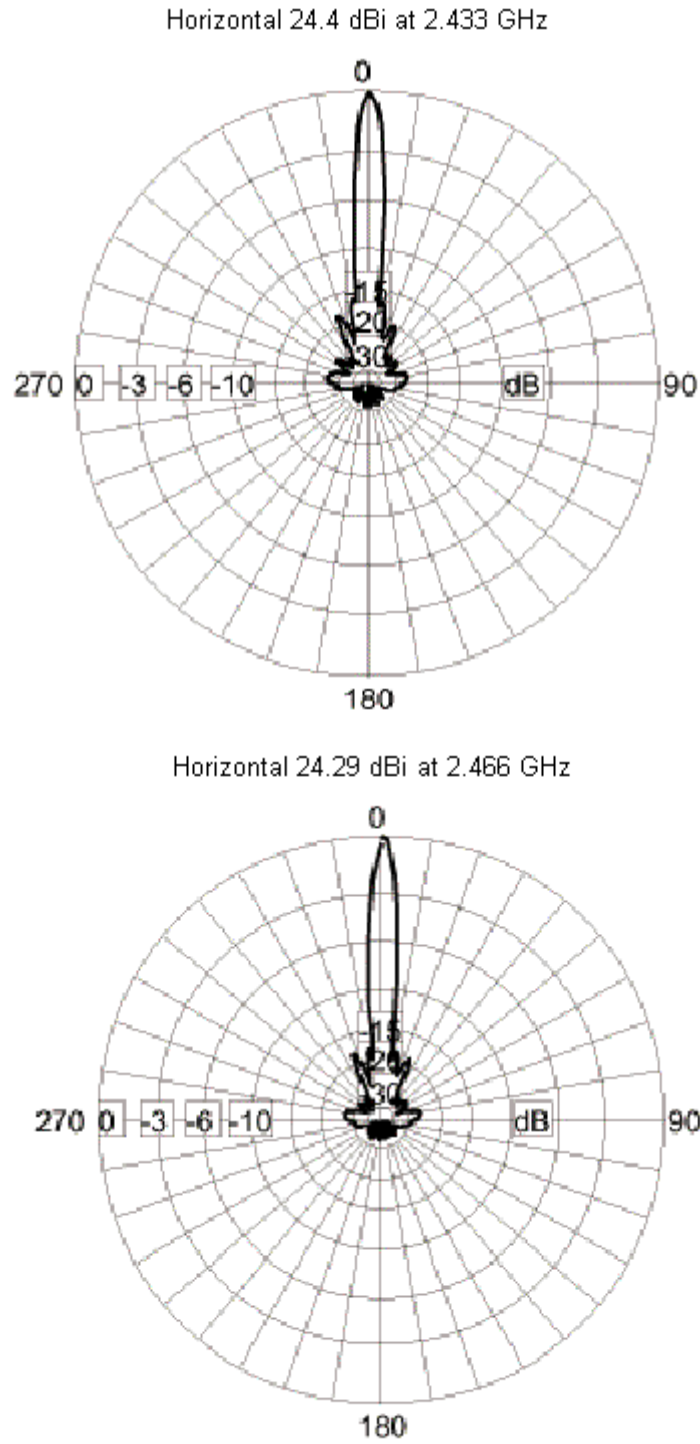
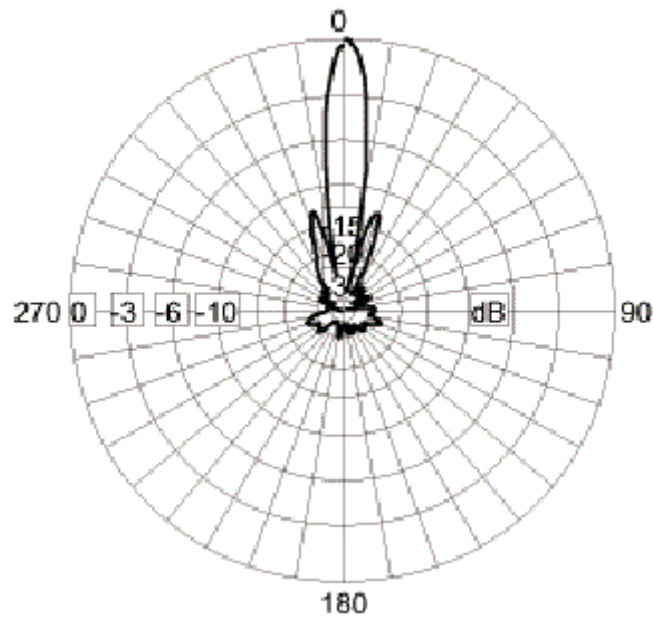


Figure 23. Azimuth Plane (Horizontal), 24 dBi Directional Parabolic Grid Antenna

## Vertical Pattern

Vertical 24.52 dBi at 2.433 GHz



Vertical 24.42 dBi at 2.466 GHz

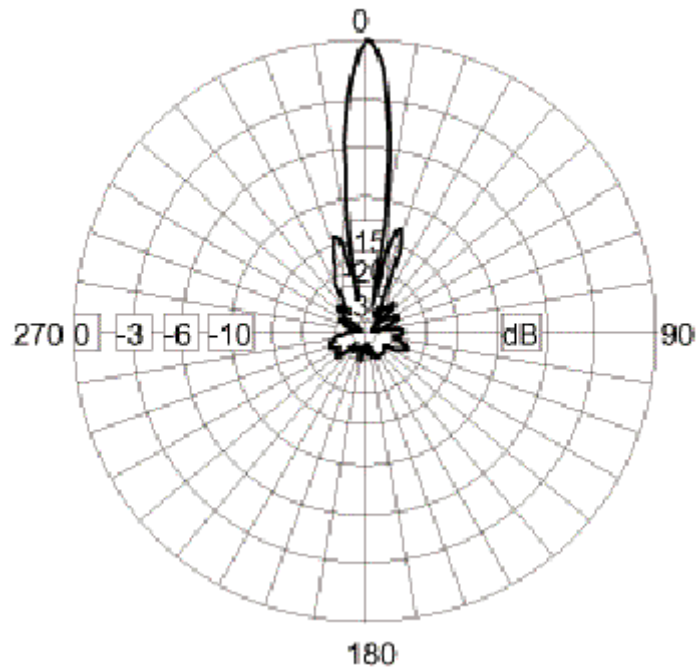


Figure 24. Elevation Plane (Vertical), 24 dBi Directional Parabolic Grid Antenna



## 5 DBI OMNI-DIRECTIONAL ANTENNA

### General Description

The Tsunami 5 dBi Omni-Directional Antenna is designed for use in rugged environments. The antenna operates in the frequency range from 2400 to 1500 MHz. It is supplied with a special proprietary FCC plug and a low-loss cable.

This antenna uses vertical polarization, which is the most common type of polarization for omni-directional antennas.

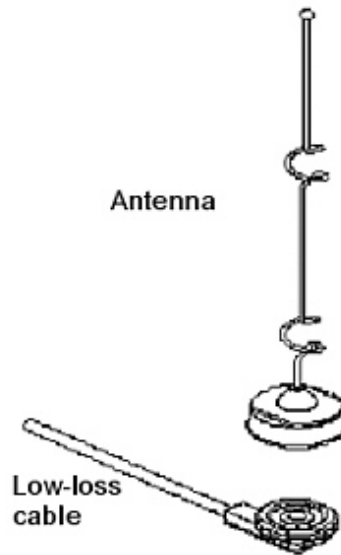


Figure 25. 5 dBi Omni-Directional Antenna

## Technical Specifications

<b>Mechanical</b>	
Size	24 cm (9.5 in)
Mounting Method	Through a 19 mm (0.75 in) M-type hole using a mounting plate.
Connector	Standard N female <sup>1</sup> snap-on with 100% captive pin
<b>Cable</b>	
Type	50 ohms low-loss cable
Length	2.5 m (8 ft.)
Color	White
<b>Electrical</b>	
Frequency Range	2.4 GHz
VSWR	Less than 2:1 nominal
Nominal Impedance	50 ohms
Gain	5 dBi
Polarization	Linear vertical
<b>Antenna Environment</b>	
Operating Temperature	-40 degrees C (-40 degrees F) to +60 degrees C (+140 degrees F)
Wind/survival	At least 200 km/h (124 mph) <sup>2</sup>
<sup>1</sup> See also “Selecting the Correct Connector Type” on page 37.	
<sup>2</sup> At least 100 km/h (62 mph) with 1.25 cm (0.5 in) ice.	

Table 16. Specifications 5 dBi Omni-Directional Antenna

## Pattern

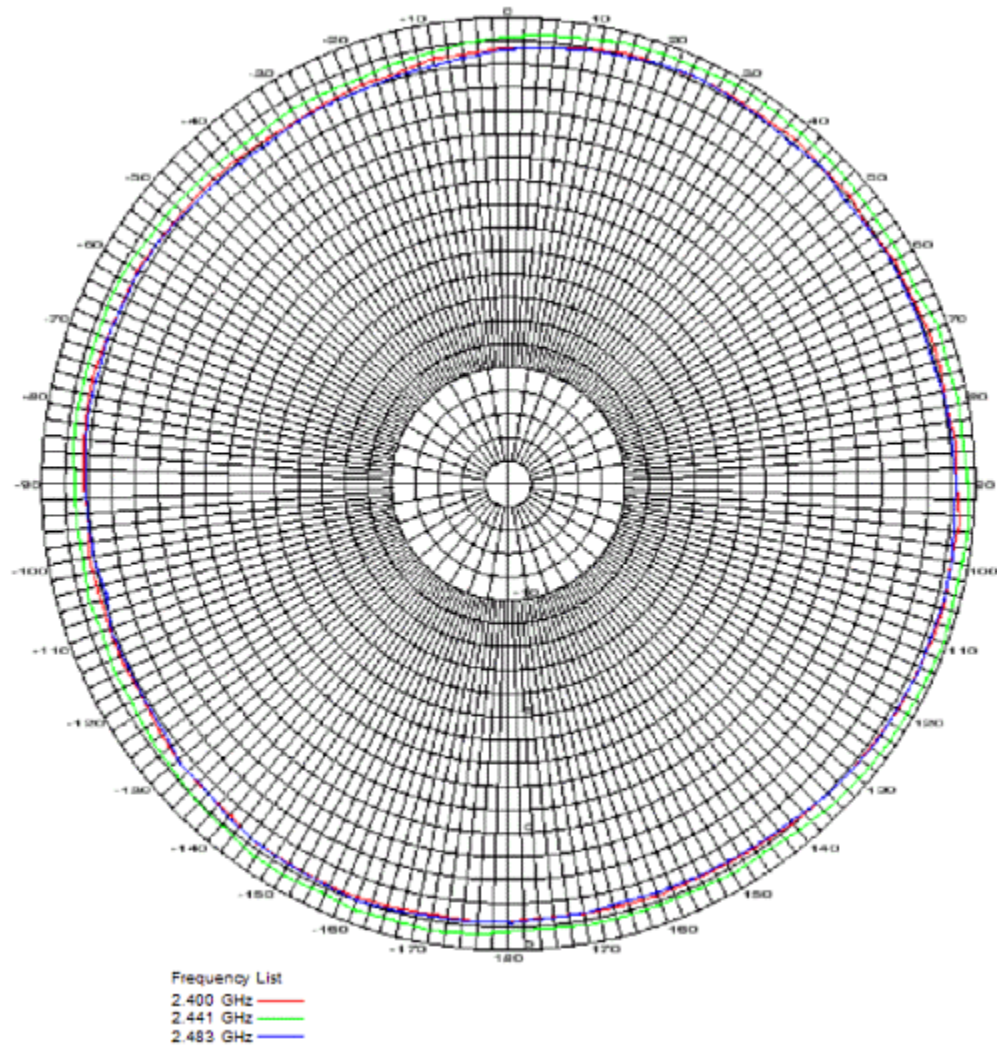


Figure 26. Azimuth Plane (Horizontal), 5 dBi Omni-Directional Antenna

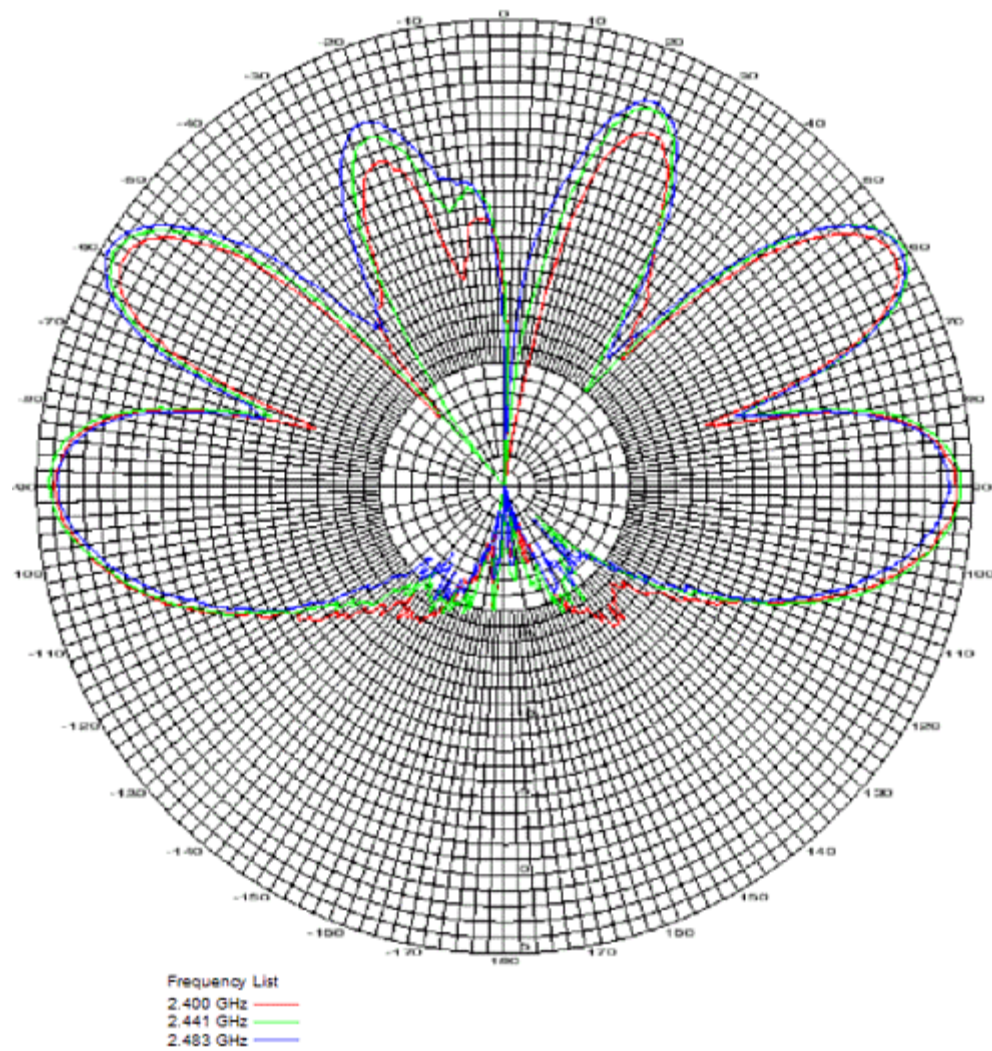


Figure 27. Elevation Plane (Vertical), 5 dBi Omni-Directional Antenna

## HIGH GAIN PANEL DIRECTIONAL ANTENNA FOR 2.4 GHZ

### General Description

The 12 dBi window antenna is a high-gain antenna for the 2.4 GHz frequency band. This antenna is typically used in combination with a Subscriber Unit.

### Mounting Instructions

Package contents:

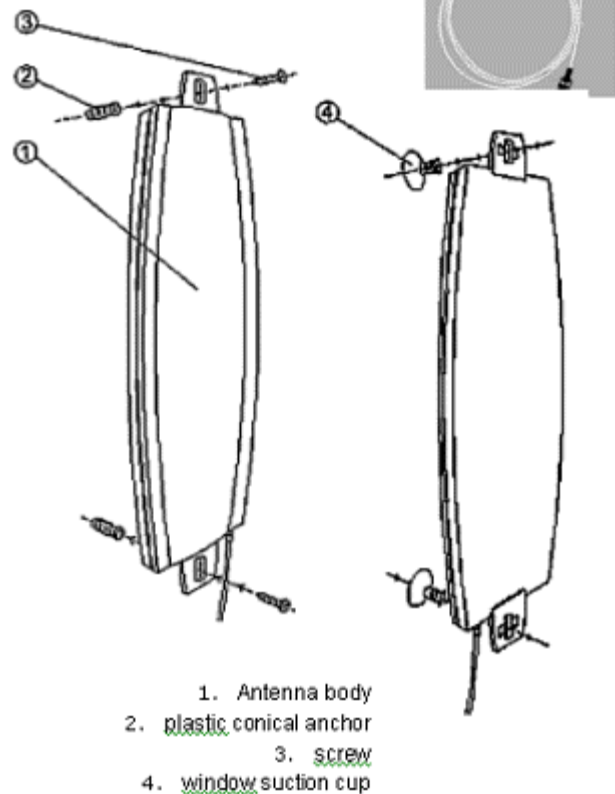
- ANT24-1200 Antenna
- Extension Cable (3m)
- Mounting Kit
- Quick Installation Guide

#### Wall Mount for Outdoor/Indoor Application

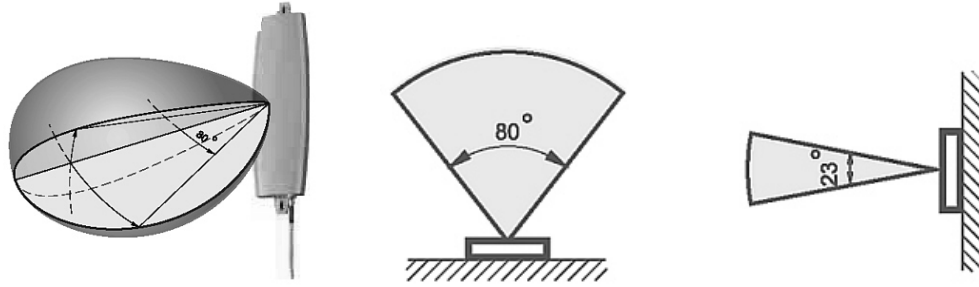
- A. Insert the plastic wall plug (2) into the wall
- B. Insert the screw (3) into the plastic wall plug through the antenna mounting hole and tighten

#### Window Suction Mount for Indoor Application

- A. Insert the window suction cup through the antenna mounting hole.
- B. Turn the suction cup one quarter to lock it into position.
- C. Press the window suction cup onto the window glass.



## Coverage



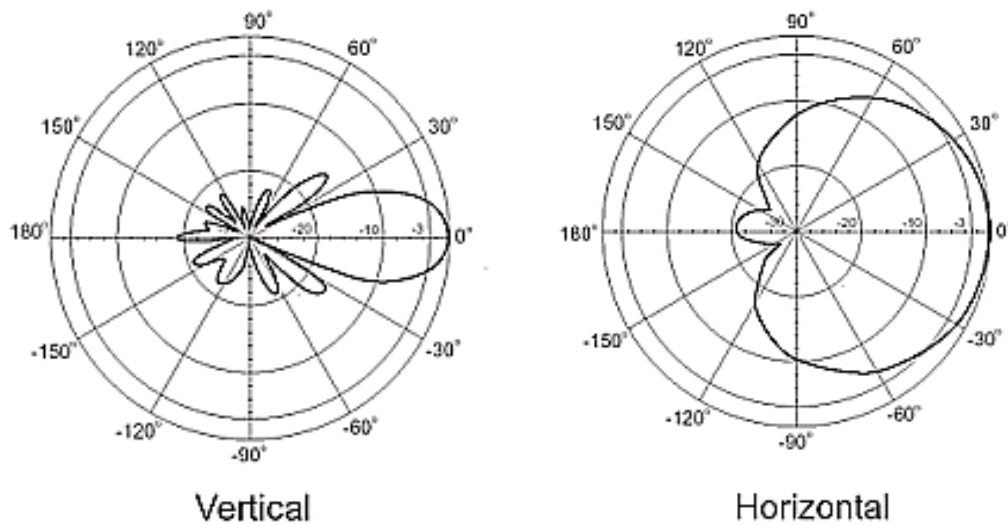
**Note:** The bulged side of the antenna must point to the Base Station.

## Hardware Specifications

Electrical Specification	
Frequency range	2400 MHz – 2700 MHz
Gain	12 dBi
VSWR	2.0 : 1 Max.
Polarization	Linear, vertical
HPBW / horizontal	84 degrees
HPBW / vertical	23 degrees
Front to back ratio	18 dB
Downtilt	0 degrees
Power handling	20 W (cw)
Impedance	50 Ohms
Connector	N-Jack
Cable	ULA-168; 200 cm
Cable loss	1.3 dB
*Exclusive of cable loss	

Environmental & Mechanical Characteristics	
Survival wind speed	180 km/hr
Temperature	-40° C to +80° C
Humidity	95% @ 25° C
Lightning Protection	DC ground
Radome color	white
Radome material	ABS, UV resistant
Weight	0.6 kgw
Dimensions	330 x 93 x 21 mm

## Pattern



## SURGE PROTECTOR

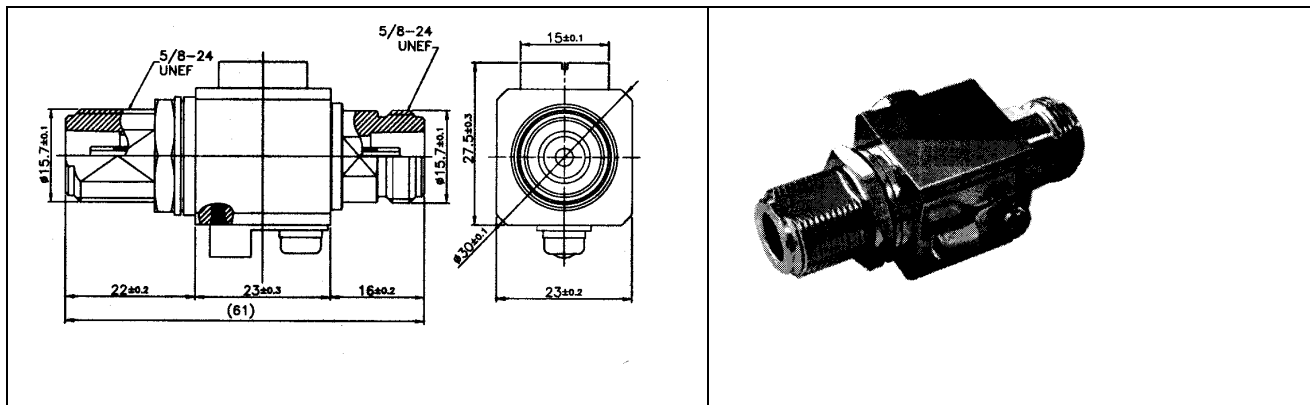
### Electrical Specifications

Part number	5054-SURGE
Frequency range	DC~ 5.875 GHz
VSWR	1.25 : 1 Max.@ DC~4 GHz 1.45 : 1 Max.@ 4~5.875 GHz
Insertion loss	0.5 dB Min.@ DC~5.875 GHz
Impedance	50 $\Omega$
DC breakdown voltage	90 V +/- 15%
Impulse breakdown voltage	1000 V
Insulation resistance	10000 M $\Omega$
Maximum withstand current	5 KA
<b>Connector</b>	
Connector type	N-Female to N-Female

### Mechanical and Environmental Specifications

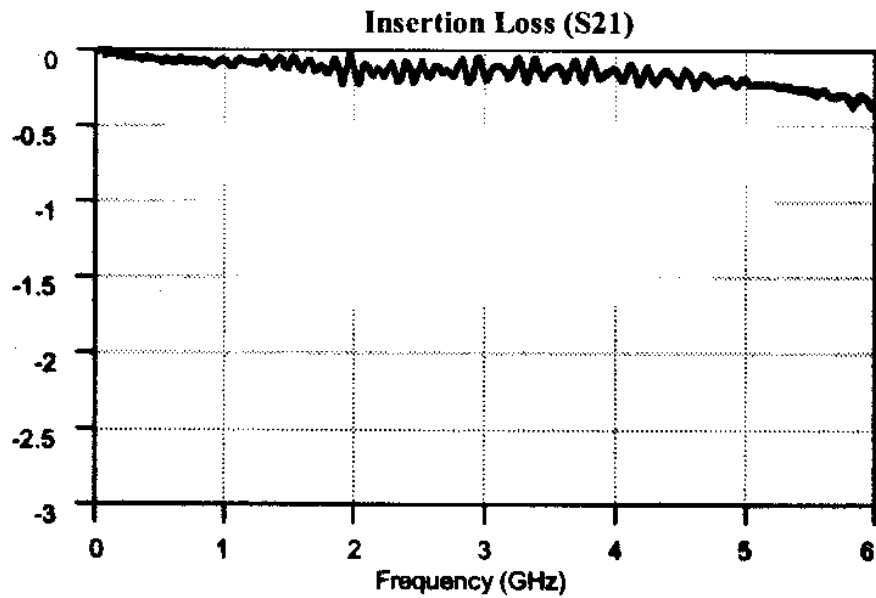
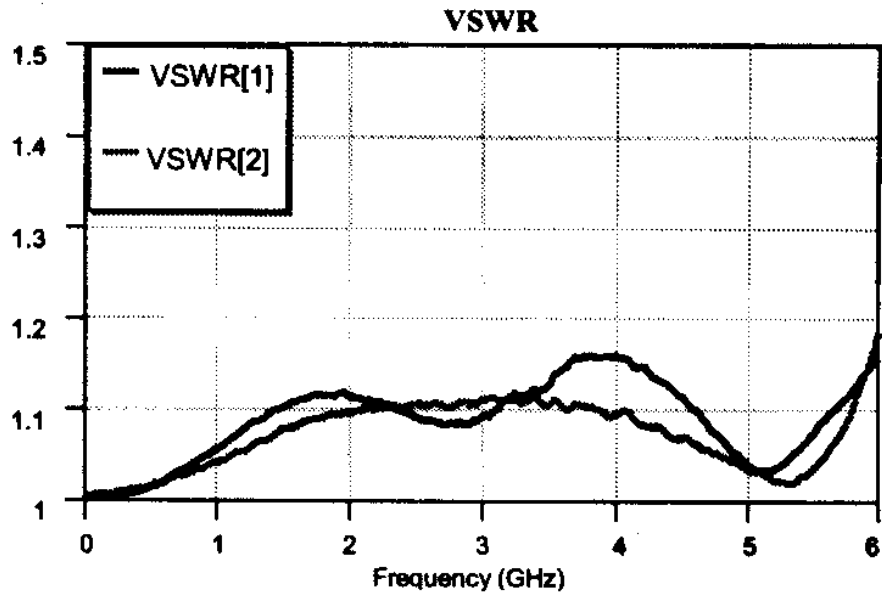
Size	61 x 27.5 x 23 mm
Weight	105 gw
Temperature range	-40~ +90 C
Salt Spray	MIL-STD-202 method 101D

### Mechanical Layout





## VSWR and Insertion Loss





## LMR 600 CABLE – 50 FT

### Electrical Specifications

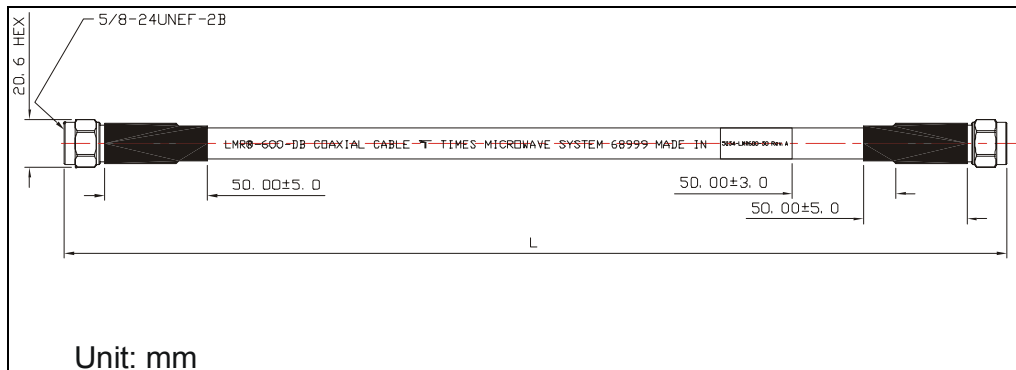
Part number	5054-LMR600-50
Frequency range	DC~ 5.875 GHz
Insertion loss	4.5 dB Max@ DC~5.875 GHz
Impedance	50 $\Omega$
<b>Connector</b>	
Connector type	N-Male to N-Male

### Mechanical and Environmental Specifications

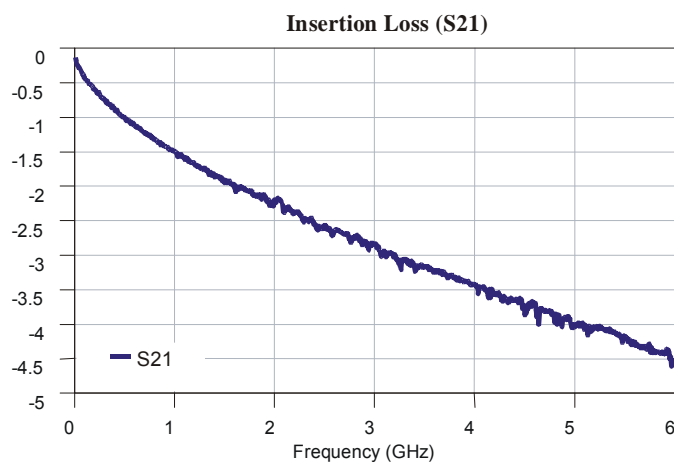
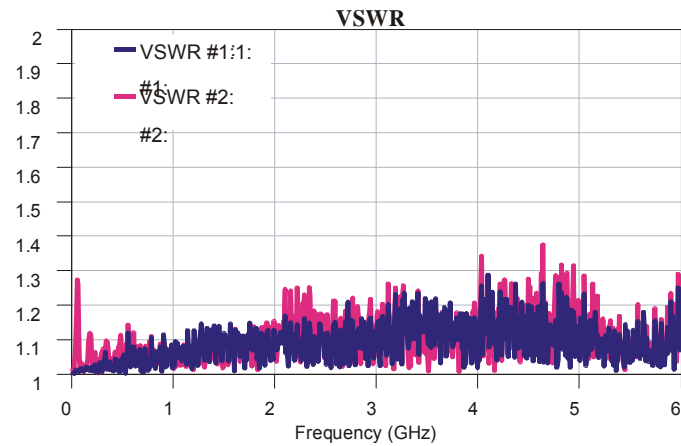
Size of carton	115 x 375 x 375 mm
Cable length	50 ft

For more detailed specifications, see Times Microwave LMR-600 specification.

### Mechanical Layout



## VSWR and Insertion Loss



## Attenuation

50 ft Times LMR-600 Typical Attenuation	
Frequency (MHz)	Attenuation (dB)
500	1.00
1000	1.49
1500	1.93
2000	2.29
2500	2.61
3000	2.92
3500	3.21
4000	3.45
4500	3.76
5000	4.04
5500	4.22
6000	4.61

---

# Support and Warranty

## TECHNICAL SUPPORT

If you encounter problems when installing or using this product, consult the Proxim website:  
<http://support.Proxim.com/> for:

- The latest software, user documentation and product updates
- The Frequently Asked Questions (FAQ)

Alternatively, contact your local authorized Tsunami MP.11 reseller for Technical Support.

Help us to help you by completing the problem report form and include it with your e-mail or fax when contacting Technical Support.

You can find the problem report form (**report.txt**) on the CD-ROM, and on the support pages of the Proxim website.

Addresses of authorized Tsunami MP.11 resellers are listed in the “Contact & Ordering” section of the Proxim website.

## WARRANTY AND REPAIR

If it appears that your unit needs a repair or replacement, return the unit to your Dealer or Distributor in its original packaging.

When returning a defective product for Warranty, always include the following documents:

- The Warranty Repair card (last page of this appendix)
- A copy of the invoice or proof of purchase
- Problem Report Form

Proxim Corporation extends a limited warranty from date of purchase of:

- Twelve (12) months for the Tsunami MP.11 hardware
- Twelve (12) months for the media on which the software is furnished and the reproduction of the software on the media.

Upon proof-of-purchase Proxim Corporation shall, at its discretion, repair or replace the defective item at no cost to the buyer.

Defective items shall be returned to the dealer or distributor:

- Freight prepaid.
- Accompanied by a copy of proof-of-purchase.
- Accompanied by a filled out Warranty and Repair card.

This warranty is contingent upon proper use in the application for which the products are intended and does not cover products which have been modified without the seller's approval or which have been subjected to unusual physical or electrical demands or damaged in any way.

This Warranty constitutes the sole and exclusive remedy of any buyer or seller's equipment and the sole and exclusive liability of Proxim Corporation in connection with the products and is in lieu of all other warranties, express, implied or statutory, including, but not limited to, any implied warranty of merchantability of fitness for a particular use and all other obligations or liabilities of Proxim Corporation.

In no event is Proxim Corporation or any other party or person to be liable to you or anyone else for any damages, including lost profits, lost savings or other incidental or consequential damages, or inability to use the software provided on the software media even if Proxim Corporation or the other party person has been advised of the possibility of such damages.

**TO BE FILLED OUT BY USER:**

Product Description \_\_\_\_\_

COMCODE (Product ID) \_\_\_\_\_

Serial Number \_\_\_\_\_

Invoice Date (mm/dd/yyyy): \_\_\_\_\_

Name: \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip Code \_\_\_\_\_

Country \_\_\_\_\_

Telephone \_\_\_\_\_

Fax \_\_\_\_\_

**TO BE FILLED OUT BY THE DEALER OR DISTRIBUTOR**

Dealer Name \_\_\_\_\_

City/State/Zip Code \_\_\_\_\_

Country \_\_\_\_\_

Telephone \_\_\_\_\_

Fax \_\_\_\_\_

Warranty (Yes / No) \_\_\_\_\_

Comment \_\_\_\_\_

Return Approval Reference \_\_\_\_\_

Reported Problem		Problem Description