SKYWAY-GB-60 SERIES
60GHz Gigabit Ethernet
PTP Microwave Radio System
User Installation Guide

February, 2014
Rev 1.1
About this Guide

This user’s guide provides information required for features, configuration and testing of Solectek SkyWay-GB Series Licensed Microwave PTP links.

Contents of this Guide

This Guide is structured as follows:

Chapter 1: Product Overview
This chapter provides introductory information on the GB Series that includes a brief description of the radio’s features, the contents of its packaging, and the radio’s general specifications.

Chapter 2: Connections and Setup
This chapter identifies the main radio ports and their functions, and provides cautionary information on polarity, Interchangeability and cable gland connection.

Chapter 3: Configuring the Radio
This chapter provides configuration procedures using the radio’s Web GUI. These procedures include setting up network management and configuring the optional serial connection.

Chapter 4: Testing the Radio on the Air
This chapter provides information on configuring the allowable parameters according to each of the 4 user selected radio transmitting modes.

Chapter 5: Alarms and Troubleshooting
This chapter provides basic information on identifying and resolving potential equipment alarms.

Typographical Conventions
Typographical conventions used in this user’s guide convey the following messages/alerts:

NOTE. Text accompanying this icon provides useful information and general tips.

WARNING/STOP. Text accompanying this icon alerts the user to imminent dangers of injury and/or damage to equipment. The user is asked to stop any related operation.

CAUTION. Text accompanying this icon cautions the user about potential hazards of injury and/or damage to equipment.
## Contents

1. Product Overview
   1.1 SkyWay-GB-60 Main Features
   1.2 Applications
2. Installation Overview
   2.1 General
   2.2 Equipment Checklist
   2.3 Line of Sight
   2.4 Link Distance
   2.5 Antenna Location
   2.6 Cabling
     2.6.1 Fiber and Power
     2.6.2 Conduit
   2.7 Grounding & Lightning
   2.8 Environmental
   2.9 Cabling Diagram
3. Installation
   3.1 General Overview
   3.2 Unpacking Equipment
   3.3 Equipment Inventory
   3.4 Installation Tools
   3.5 Radio Mount Installation
   3.6 Radio Installation
   3.7 Cable Installation
     3.8.1 Introduction
     3.8.2 Optional Kit
     3.8.3 Installation Instructions
   3.9 Antenna Alignment
   3.10 QUAL & RSL Test Cable
4. Radio Link Status Indicators
5. Configuring Network Equipment
   5.1 Network Port Statistics
This user’s guide describes the operation of the SkyWay-GB-60 Series, 60GHz Gigabit Ethernet PTP microwave radio system. The SkyWay-GB Series is part of Solectek’s broadband wireless product line, including backhaul, last mile access and enterprise and video surveillance wireless transport.

A separate Quick Start Guide is available for a quick overview of the installation steps. It is recommended that the installer reviews both the quick start guide and installation user manuals for complete understanding of guidelines for installation, configuration, and commissioning of the radio link.

1.1 SkyWay-GB-60 Main Features

The SkyWay-GB radio’s main features are as follows:

- Operates in the unlicensed 60GHz frequency band
- Full Duplex 1 Gbps data rate
- BPSK Modulation for robust links
- 10 inch integrated or 2 ft external antennas
- Web GUI and SNMP management
- 1000Base-SX fiber interface with LC connectors
- 24V DC input (power supply included)
- Wall or pole mount kits (both included)
- Weatherized enclosure for outdoor operation.

1.2 Applications

- Cellular base station interconnection and backhaul
- Corporate/campus network
- Government backbone network
- LTE base station backhaul
- Backhaul of surveillance camera networks
- Connection of industrial/enterprise sites for voice and data
2. Installation Overview

2.1 General

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

2.2 Equipment Checklist

The survey team will need the following items:

- Binoculars
- GPS navigation device
- Tape measure

2.3 Line of Sight

SkyWay-GB-60 wireless links require line of sight (LOS) for proper operation. Because the links are relatively short, obstructions in the path can easily be identified. Binoculars can ease viewing in poor light conditions.

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

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

<table>
<thead>
<tr>
<th>Path Lengths (meters)</th>
<th>Minimum Clearance (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>0.56</td>
</tr>
<tr>
<td>500</td>
<td>0.79</td>
</tr>
<tr>
<td>750</td>
<td>0.97</td>
</tr>
<tr>
<td>1000</td>
<td>1.12</td>
</tr>
</tbody>
</table>

2.4 Link Distance

Measurement of the link distance is important in estimating the link availability and calculating the expected Receive Signal Level (RSL). This measurement can be performed using the Latitude and Longitude readings from a Global Positioning System (GPS) device, which is placed near the proposed locations of the antennas, or using a range finder device.
The Minimum Link Distances are as follows:

- GB-60 with integrated 10 inch (21 cm) antenna: 65 feet (20 meters)
- GB-60 with external 2 FT (60 cm) antenna: 330 feet (100 meters)

To estimate maximum distances and availabilities for a given product and region, Solectek’s Path Availability Calculator can be used. To obtain the latest version, contact Solectek Sales and Support.

2.5 Antenna Location

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

- Type of mounting—wall or pole
- Location where the fiber and DC power wiring will enter/exit the building
- Length of cable runs
- Grounding connection points
- Obstructions
- Accessibility

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

2.6 Cabling

2.6.1 Fiber and Power

The installation site should be inspected to determine the run paths for the fiber cable and power cable from the radio equipment to the termination point. Locations for roof penetration should be identified. The routing and securing of all cables should conform to all applicable codes and requirements. Depending on the likelihood of damage due to foot traffic or equipment movement, cabling conduit may be required. The maximum cable run length as specified for the equipment being installed must not be exceeded.

The radio requires a pair of simplex LC type connectors to be connected to a pair of multi-mode fibers to properly connect to the radio and the user’s network equipment. Single-mode fiber is not a current option supported by the radio. The user’s network equipment end of the fibers should be terminated with connectors that match the user’s network equipment fiber interface.
Each SkyWay-GB-60 radio includes a 100-240 VAC power adaptor suitable for indoor operation that converts the AC voltage from the standard electrical outlet in the wall to DC voltage. Our radio requires a minimum of 15.0 VDC (24.0 VDC maximum) up the power cable to the radio to function properly. When planning the cable run from the indoor mounted AC power adaptor to the radio unit, it is critical to use the cable gauge (AWG) indicated below to ensure adequate voltage at the radio. The electrical cable that is used outside the building must be outdoor rated (that is, weather-protected) providing a single pair of wires necessary to power the equipment. The required DC power cable is 12 or 14 gauge, 2 wire (that is, 12/2 or 14/2) rated for outdoor use.

![Image of DC cable](image)

**NOTE** - The DC cable must comply with local building and/or electrical codes in your area.

**Figure 2-1:** details a standard 14-gauge wire that has been fitted with the power connectors (provided) for the radio’s internal power supply necessary to mate with the provided power cord. A standard crimping/splicing tool (not provided) is required to terminate the power connectors onto the 14-gauge cable required for use with the unit.
2.6.2 Conduit

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

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

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

2.6.2.1 Installation

Conduit installation is done along with power and fiber/copper cabling installation as needed.

Before connecting the conduit to the fitting, insert the fiber and power cables through both the conduit and the straight-through fitting of the radio.

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

The radio is provided with a pre-installed liquid-tight connector for a water-tight seal at the entry to the radio.

The following shows the connector assembled and disassembled.

Unscrew the cap from the connector, push a watertight conduit onto the fitting, then screw the cap onto the threaded portion attached to the radio. Ensure that the cables do not get pinched when the conduit is pushed onto the fitting.
A drip loop should be created to ensure sufficient length to enable the radio to be moved during servicing and to prevent water from following the conduit down to any junction box or building entrance. A suggested length is 24 inches (60 cm) from the radio to the bottom of the loop. The opposite end of the conduit is inserted into the cable tray if on a tower or onto the NEMA or junction box.

The first tie provides the first anchor and strain relief. Gentle curves provide the necessary radius for the fiber to minimize signal loss and eliminate sharp angles lessening voltage potential from being induced during lightning storms.

With a short conduit, the radio's opening has been moved further away, and moisture is unable to migrate into the radio.

2.6.2.2 Tower Installation

Secure the conduit with suitable braces to ensure long-term performance. The total length is 10 feet (3 meters), but the length required to reach the cable tray is site-specific.
Once the cables are installed, seal the conduit opening for additional protection from insects using amalgamated tape or sealant.

All cables used should be outdoor-rated.

Below the conduit, secure the cables approximately every 1.6 feet (1/2 meter) onto the tower's cable tray. Running the cables to the cable tray is recommended to provide additional environmental protection.

2.6.2.3 Roof-Top Installation

Secure the conduit with suitable braces to ensure long-term performance. Terminate the network end of the conduit into a NEMA enclosure or junction box. Terminate the conduit at the NEMA enclosure by either:

- drilling a hole in the bottom of the NEMA box for the fitting; or
- removing one of the built-in conduit punch-outs if provided on the NEMA box.

Use amalgamated tape or sealant to create a watertight seal at that junction.

2.7 Grounding & Lightning

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

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

In addition to grounding the equipment, local building codes may require that the DC electrical cable be protected from lightning strikes by the use of a surge suppressor.

The surge suppressor must be installed at the point where the DC electrical cable exits/enters the building, however, use of a surge suppressor at the radio unit is optional because power cable surge suppression is built into the unit.

If a copper Cat5e Ethernet cable is permanently installed, it is necessary to install surge suppressors at both ends of this cable. A surge suppressor must be placed within the radio enclosure (to protect the radio electronics) and at the building exit/entrance (to protect the indoor equipment).

**NOTE** - For more information on recommended accessory devices and kits, contact Solectek Sales.
2.8 Environmental

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

2.9 Cabling Diagram

Following is a diagram detailing the equipment and cabling found on a typical installation of SkyWay-GB-60 radio equipment, where only the fiber or copper connection should go to the switch or router, unless the switch is spanning-tree capable.
3. **Installation**

3.1 **General Overview**

It is recommended that installation personnel read this section in its entirety prior to installing the SkyWay-GB-60 System. During a particular phase of installation, the user may refer directly to the applicable subsection.

The Installation section is comprised of the following subsections covering the procedures and guidelines for installing the radio.

3.2 **Unpacking Equipment**

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

**NOTE** - Unpacked radios can be identified by the color of their labels found on their front faces or inside the unit after removing the plastic back weather cover. The blue color label indicates a high-band radio and the red color label indicates a low-band radio. See Figure 3-5 for further details.

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

3.3 **Equipment Inventory**

Each carton is accompanied by a packing list. Verify the contents of the carton against the packing list. Following are inventory lists for a typical system.

**Qty Description**

- 2 ea. SkyWay-GB-60 radios (1 low-band & 1 high-band)
- 2 ea. Wall Mount Kits
- 2 ea. Standard Power Supply (Indoor rated, 100-240VAC input to 24VDC output)
- 2 ea. Pole Mount Kits (required only when mounting the radio onto a pole)
2 ea. DC power connection set. (Includes 2-prong DC plug and 2 ea slip fit plugs/receptacles)
1 ea. Hard reset box

SkyWay-GB-60 10-inch Antenna Wall Mount Kit Parts List

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mount Bracket</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Radio Yoke</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Teflon Shim</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>¾ Split Lock Washer</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>¾ Flat Washer</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>¾-16 x ⅝ bolts</td>
<td>4</td>
</tr>
</tbody>
</table>

SkyWay-GB-60 10-inch Antenna Pole Mount Kit Parts List

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pole Clamp</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>¾-16x9in Threaded Rod</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>¾ Split Lock Washer</td>
<td>14 (2 spare)</td>
</tr>
<tr>
<td>4</td>
<td>¾ Flat Washer</td>
<td>14 (2 spare)</td>
</tr>
<tr>
<td>5</td>
<td>¾-16 Hex Nut</td>
<td>13 (1 spare)</td>
</tr>
<tr>
<td>6</td>
<td>¾-16 x ¾ bolts</td>
<td>6 (2 spare)</td>
</tr>
</tbody>
</table>

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

3.4 Installation Tools

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

- Screwdriver, slotted 0.1 inch (2.5mm) wide
- Open-end wrench 11/32 (9mm)
- Open-end wrench 9/16 (14mm), 2 ea.
- Ratchet with 6 inch (15cm) extension and 9/16 inch (14mm) deep socket
- Wire stripper/cutter/crimp tool (10-16 gauge)
- Electrical tape
• Fish tape for pulling cable
• Cable tie wraps
• Hand-held DVM (digital voltmeter) with standard banana plug receptacles

3.5 Radio Mount Installation

Wall Mounting

1. Install 4 mounting bolts in the wall at the desired location using the template provided (see Figure 3-1 below). The bolts (normally ⅜-16) should extend 0.8 to 3.0 inches (2cm to 7.5cm) from the wall and be strong enough to secure the radio to the wall under foreseeable environmental conditions. The environmental conditions may include, but not limited to, wind, rain, ice, etc. Depending on the wall material the mount is being attached to, a different size bolt may be appropriate. In this case, bolts up to ¾ inch in diameter may be used.

2. Secure the mount to the bolts using the appropriate sized nuts, lock washers, and flat washers for the bolts used to mount the bracket.

3. Attach the radio yoke to the mount, with Teflon shim in-between, using 2 each of the supplied ⅜-16 x ¾ bolts, ¾ lock washers, and ¾ flat washers. Tighten the bolts just enough that the yoke can move back and forth without binding.
Pole Mounting

The pole mount kit can be used to secure the mount to a pole with diameter from 2.0 to 4.5 inches (50 to 115 mm).

1. Attach two of the pole clamps to the mounting bracket using 4 each ⅜-16 x ¾ bolts, ⅜ lock washers, and ⅜ flat washers. Attach the threaded rods to the pole clamps using 8 ⅜-16 nuts and 4 each ⅜ lock washers and ⅜ flat washers. Refer to Figure 3-3.

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

2. Secure the mount to the pole using two pole clamps and 4 each ⅜-16 nuts, ⅜ lock washers, and ⅜ flat washers.
3. Attach the radio yoke as described in the wall mount instructions (previous page).

Figure 3-2: Mount with Radio Yoke in ‘Pole Mount’ Configuration
Figure 3-3: Side view of mount in Pole Mount Configuration

6.25 inches
(15.9 cm)

3.13 inches
(8.0 cm)

Figure 3-4: Template to drill holes for wall mount
3.6 Radio Installation

1. Place the radio in the yoke; the two up/down pivot bolts should rest in the U’s cut in the yoke.

**NOTE** - When the radio comes from the factory, the mounting plates are in the vertical polarization position, that is, the diamond marking on the radio (see Figure 3-5) on the front of the radio housing is to the right when viewed from the front. For horizontal polarization, the mounting plates should be moved so that the diamond is at the top when viewed from the front. Verify that the flexible conduit entrance is on one of the lower sides of the radio.

![Figure 3-5: Polarization diamond orientations: horizontal (left) and vertical (right)](image)

**NOTE** - The blue-color label indicates a high-band radio and the red-color label indicates a low-band radio.

See Figure 3-5 for further explanation and visual image of horizontal vs. vertical polarization.

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

**WARNING** - It is critically important during installation to ensure the radios on each side of the link are in the same polarization (horizontal-horizontal or vertical-vertical). A link that has a radio on one side of the link set in the horizontal polarization and the other side of the link set in the vertical polarization will not operate properly.

It is also critically important that a high-band radio is paired with a low-band radio to ensure the system will operate properly. Prior to installation, check each radio to verify one is a high-band and the other is a low-band version. The label on the radio will indicate the band (blue for high or red for low).
2. Once the radio has been placed in the yoke mount, insert the bolt in the lower portion of the yoke to secure the radio to the yoke. Tighten both the pivot bolts and the lower yoke bolts enough such that the radio is secured in the mount, but is still able to be moved back and forth easily.

![Figure 3-6: Detail of radio in yoke with the up/down pivot bolt installed](image)

### 3.7 Cable Installation

**Fiber Cabling**

1. Install a pair of multi-mode fibers (850nm) from the radio to the network termination equipment (switch or router with 1000Base-X port). The cable should be looped around the inside of the enclosure to provide strain-relief. Do not connect the fibers to the radio's fiber ports at this time. The connectors on the radio end of the fibers require **simplex** LC connectors; the connectors on the switch/router end should be chosen to correctly mate to the network equipment sockets.

   **NOTE** - The simplex LC connectors for the radio must be inserted individually through the slip-fit connectors on the radio, as there is not sufficient room for both to fit through at the same time. If you have a duplex hood joining the LC connections, it should be temporarily removed during this process.

2. Connect fibers at the network equipment.

   **WARNING** - It is important not to connect the fibers to the radio until after aligning the radio as the radio performs an automatic calibration once the fiber is inserted into the radio, and this calibration will not operate properly if the radio is not properly aligned. If this inadvertently occurs while the radio is powered on, unplug the fibers and power cycle the radio.
Power Cabling

1. Select the indoor location for the AC power adaptor, with easy cable routing to the radio. Normally it is convenient, but not required, to place the adaptor near the network termination equipment.
2. Ensure that the DC wire used is 14-gauge and no longer than 125 meters; or 12-gauge and no longer than 200 meters. Ensure that a grounded surge suppressor is located at the building’s indoor/outdoor entry point.
3. Connect the provided DC connectors onto the 14-guage wire using a splicing/crimping tool. For the use of 12-gauge wire, it may be necessary to trim a few strands from the ends of thicker stranded cables to more easily fit the crimp connectors.
4. Install the DC power cable and attach to the AC adaptor using the supplied crimp connectors. Do not connect the power jack to the radio at this time.

NOTE - Be sure to first connect the DC power connectors before inserting the power plug into the power jack in the radio. Minor electrical sparks may be noticed if the sequence above is not followed; however, these sparks are normally harmless.

Optional Copper Ethernet Cabling

Normally, only the fiber cable is used to carry network traffic to the indoor network equipment. In special cases, it may be necessary to use a 10/100Base-T copper connection to the indoor equipment (or other outdoor network equipment), in which case special care must be taken to protect both the radio unit and the indoor equipment from electrical surges. Surge suppressors are not needed for temporary connections while installing or troubleshooting a link when lightning is not a risk.

1. Install a Cat5 or Cat5e type Ethernet cable from the radio to the network termination equipment (switch or router with 10/100Base-T port). The cable should be looped around the inside of the enclosure to provide strain-relief. Connect the Ethernet cable to the surge suppressor placed within the radio housing and then connect a cable from the other end of the surge suppressor to the radio’s 10/100Base-T port. Connect the grounding point on the surge suppressor to the grounding lug on the radio’s inside metal back cover.

NOTE - The RJ45 connector for the radio must be inserted separately from the fiber and DC cable through the ¾-inch conduit fitting on the radio, as there is insufficient room for all to fit through at the same time.

NOTE - Certain 60GHz radios internally contain an Ethernet-rated surge suppressor within the RJ45 copper interface of the unit. To determine if the radio has this feature, check for the label shown below, near the 10/100 copper interface.

2. Install a second surge suppressor at the building entrance/exit, and connect the surge suppressor to an outside grounding source. This may require the use of RJ45 Female/Female couplers. Connect the Ethernet cable to the network equipment used for network management.
Figure 3-7: Front view of installed ¾" conduit on a vertically polarized unit.

Figure 3-8: Inside view of fiber, power and Cat 5 cable connected. Ensure that the cables do not get pinched when the conduit is pushed onto the fitting. Both the cables have been looped around the inside of the enclosure to minimize tension on the cables when connected to the radio and to maintain proper bend-radius of the fiber cable.
**Ground Cabling**

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

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

**3.8 Ice Shield Canopy Installation**

**NOTE** - The Ice Shield assembly is an optional item and can be ordered in kit form. Contact Solectek Sales and Support for details.

**3.8.1 Introduction**

In northern climates, the buildup of ice or snow on antennas can be a problem for millimeter wave radio installations. These problems are twofold: the electrical effect of snow and ice built up on the antenna’s radome; and the mechanical impact of the additional weight of the snow or ice on the antenna and supporting structure.

The formation of ice or snow on the antennas radome can cause attenuation of the signal to the point where the link may become severely degraded or unusable. Uneven ice buildup can cause scattering of the signal, which in turn results in standing waves.

Ice layers are not likely to exist for extended periods, as ice tends to melt. In cold climates when the radome is below freezing temperature, ice does not stick to it, thus there is no issue. However in mixed rain-snow-ice storms, ice can stick to the radome, causing the link to operate at less than its optimal design.

Once the ice has hardened and freezes, the added weight of the ice on the antenna increases the wind load on the tower or mast, which may cause premature failure of the mounting structure. As ice breaks apart due to melting, or via its own weight, these large and heavy sheets falling down a tower or mast can cause damage to antennas or other objects mounted below.

Solectek provides an ice shield kit, designed to combat the buildup of ice on radio enclosure and antenna. These ice shields are easily fitted on the radios during the installation process.
3.8.2 Optional Kit

Refer to the table below for the kit required for your particular application. Each kit contains the necessary materials for the installation of the ice shield on one radio. Two kits are required per link.

<table>
<thead>
<tr>
<th>QTY</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 each</td>
<td>Ice shield canopy</td>
</tr>
<tr>
<td>2 each</td>
<td>8-32 x ½&quot; screw</td>
</tr>
</tbody>
</table>

3.8.3 Installation Instructions

1. Remove the protective liner from the canopy (if desired).
2. Remove the “O” bolt if equipped.
3. Use the supplied screws to attach the Ice Shield to the radio.
4. Re-install the “O” bolt.
3.9 Antenna Alignment

1. Place the radio in the mounting bracket and make sure both bolts slide to the bottom of the cutouts.
2. Tighten mounting bolts just enough to allow radio to pivot up/down and right/left with minimal effort.
3. Tilt the radio so that it is roughly points towards the other end of the link.
4. Ensure fiber cables are still disconnected and connect the DC power to the radio.
5. Verify that the Power LED is lit solid. If the Power LED is not lit, use a voltmeter to verify correct voltage and polarity at the radio. To reverse the power polarity, unplug the power jack and swap the crimp connectors for the two conductors.
6. Repeat steps 1 through 5 on other side of the link.
7. Verify the Link Up LEDs are lit solid on both radios.
8. Slightly rotate each radio up/down and left/right to find the maximum RSL voltage reading. Rotate the radios at least 10 degrees on each side of the visually-perceived alignment center to ensure that the true maximum RSL voltage is found; note that the width of the center beam is only 1.4 degrees and the first side-lobe beam is only 2.5 degrees off from center. Set the radio in the position that results in the highest RSL voltage reading. See Section 3.10 to determine the proper use of the supplied test cable in order to read the RSL voltage.

9. Begin to tighten the mounting bolts. It is important to tighten the bolts in the following order. First start with the bolts that control the left/right movement of the radio. These are the bolts on the yoke portion of the mount behind the radio. Start by tightening the bolt closest to the pole or wall. Once this is tightened, move to the bolt directly in front of the bolt you just tightened and slowly tighten this bolt. While tightening the bolts be careful that the radio does not move during the process. As these bolts are tightened, up/down movement of the radio may occur due to the seating of the mounting bracket and radio yoke. Check the RSL voltage reading to ensure it is still at its maximum level, and adjust vertical tilt if required. Next, tighten the bolts that allow the up/down movement of the radio. First
tighten the lower bolts on both sides of the yoke bracket. Once the lower bolts are tightened on both sides of the radio, tighten the upper bolts.

10. Connect the fibers to one of the radios. The fibers should already be connected to active network equipment. If the unit is not to be connected using fiber cabling, a temporary loopback fiber must be temporarily installed to initiate the auto calibration process. Remove the loopback after completion of the auto calibration process.

11. Verify the Fiber LEDs on each radio are lit solid.

   **NOTE** - The fiber integrity indication on the network equipment could show up or down independent of the link status. Once the radio link is up and network equipment connected on both sides of the link, the network equipment should indicate fiber integrity.

12. Once the fiber is connected to the radio, the radio will begin an internal link calibration. During this time, the Link Up LED will blink for approximately 60 to 120 seconds.

13. Wait until the Link Up LED is lit solid.

14. Repeat steps 8 to 13 for the peer radio.

15. Verify the Link Quality voltage is 3.3V (that is, error free).

   **NOTE** - When a radio is power cycled, it will execute a limited version of the calibration process. After this time, the link should be functioning. This limited automatic calibration process is also activated if the link is down for more than 5 minutes.

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

### Auto Calibration States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit powered up, no fiber connected</td>
<td>Unit will be in alignment mode, there will be no automatic calibration event started until the fiber is connected.</td>
</tr>
<tr>
<td>Unit powered up and fiber cable connected</td>
<td>The radio will perform a single calibration scan and will then go into normal operation mode, regardless of the results of the scan. (Link up or down status has no influence on the scan.)</td>
</tr>
<tr>
<td>Normal operation mode</td>
<td>Disconnecting and reconnecting the fiber cables will not cause a recalibration. A recalibration will only happen if the link is down for more than 5 minutes.</td>
</tr>
<tr>
<td>Forced Recalibration</td>
<td>Power cycling the radios with the fiber cables disconnected and then reconnecting the fiber cables to the powered up radio will start the auto calibration routine again. If the fiber cables stay disconnected the radio will go back into alignment mode.</td>
</tr>
</tbody>
</table>
3.10 QUAL & RSL Test Cable

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

Figure 3-9 Quality Voltage Graph

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

1. To read the RSL value (between 0 and 3.3V), insert GND (ground) and RSL banana plugs into the voltmeter. Note the RSL voltage. The voltage may be fluctuating; in this case, note the maximum value seen.
Figure 3-10: Top view of test cable provided to check Link Quality & Receive Signal level

2. To read the Link Quality value of the radio, insert GND (ground) and QUAL banana plugs into the voltmeter. Note the Link Quality voltage. After the radios have performed an auto calibration the quality voltage should read 3.3V if the link is aligned on the main antenna beam and there are no obstructions (for example, trees, buildings) in the path, the link distance is within the operating parameters of the radio (see Section 2.4 above), and it is not raining heavily. Note that SkyWay-GB-A Series radios may have less than 3.3V Quality in 1000 Mbps mode and still operate normally; this would indicate that the radio link is operating near the distance limit for Gigabit Ethernet performance.
4. Radio Link Status Indicators

Solectek 60GHz radios have been designed such that they require only minimal user configuration. To perform the configuration of the Network Management System, follow the instructions in the Network Management manual.

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

- The power LED should be lit—solid green;
- The fiber LED should be lit—solid green;
- The Link Up LED should be lit—solid green;
- The Link Quality BER voltage should be 3.3v, although dips in voltage are acceptable during periods of significant rain.
- SkyWay-GB-A radios may have less than 3.3V Quality in 1000 Mbps mode and still be operating normally.
- Observe the 10/100Base-T LEDs (each side next to socket opening); the left one should be green if connected (link up), and the right one will be flashing yellow when there is data traffic. (The picture does not show the 10/100Base-T connector or LEDs.)

![Figure 4-1: Link Up, Fiber and Power LEDs indicating link is up and operating](image)
5. Configuring Network Equipment

The networking equipment that is connected to the Solectek radio should first be checked to ensure it operates properly over a wired connection.

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

- Port auto-negotiation and flow control turned on
- Port configured to not enter error-disable state due to multiple link up/down transitions (since these may occur during periods of heavy rainfall)

**NOTE** - It is possible to disable auto-negotiation on the radio’s fiber interface by use of the built-in Network Management interface. The radio’s 10/100Base-T port is permanently set to auto-negotiate.

5.1 Network Port Statistics

Verify, if possible, the following on the user’s network equipment (connected to the radios), in addition to verifying these values using the radio’s Network Management System:

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

**NOTE** - The radios support all standard Ethernet frame sizes, up to 1632 bytes for un-tagged or 802.1q VLAN-tagged frames.
### Appendix A: Troubleshooting

The following table provides a summary of possible problems you might encounter while installing a SkyWay-GB-60 radio, along with possible causes and their solutions.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No power to radio</td>
<td>Wrong polarity of supply voltage</td>
<td>Use a DVM to determine the polarity and voltage on the DC cable. (See Section 2.6)</td>
</tr>
<tr>
<td></td>
<td>The supply voltage measured at the radio (when connected) is below 15Vdc.</td>
<td>The cable run is too long or the cable gauge is too small. Shorten the length of the cable or use larger gauge cable. (See Section 2.6)</td>
</tr>
<tr>
<td>Fiber light lit at radio but not on network equipment</td>
<td>LSP is enabled and radio link is down.</td>
<td>This is normal behavior.</td>
</tr>
<tr>
<td></td>
<td>TX and RX fibers are swapped.</td>
<td>Try swapping the TX and RX fibers at one/both ends of the connection.</td>
</tr>
<tr>
<td></td>
<td>Error in the configuration of the networking equipment</td>
<td>Verify the configuration of the network equipment is consistent with radio unit’s fiber port settings (auto-negotiation and flow control).</td>
</tr>
<tr>
<td></td>
<td>One or both of the fibers have been damaged or is not connected at both ends.</td>
<td>Try swapping the TX and RX fibers at one/both ends of the connection. Visually inspect the fiber cable.</td>
</tr>
<tr>
<td>Cannot establish the wireless link</td>
<td>Obstacle in link</td>
<td>Verify the line of sight conditions and check for required clearance. (See Section 2.3 for clearance distances)</td>
</tr>
<tr>
<td>RSL voltage lower than expected</td>
<td>Incorrect calculation of link distance</td>
<td>Verify that the calculation tool used and the GPS used both use the same annotation system (degree hours minutes seconds or degree with a decimal value).</td>
</tr>
<tr>
<td></td>
<td>Antennas aligned on side lobes</td>
<td>Realign antenna to main lobe.</td>
</tr>
<tr>
<td></td>
<td>Antennas set to different polarizations</td>
<td>Verify that both radios are set to the same polarization (see Section 3.6).</td>
</tr>
<tr>
<td></td>
<td>Installed two high or low band radios in one link</td>
<td>Verify that one end of the link is high and the other end is a low band radio (see Section 3.6).</td>
</tr>
<tr>
<td></td>
<td>Link exceeds maximum specified range.</td>
<td>Verify that maximum path length has not been exceeded</td>
</tr>
<tr>
<td>Low link quality voltage</td>
<td>Fibers are not connected.</td>
<td>Connect fiber and verify radio performs an auto calibration (see Section 3.9).</td>
</tr>
<tr>
<td>Issue</td>
<td>Recommendation</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Antennas are not aligned for maximum RSL.</td>
<td>Verify antenna alignment (see Section 3.9).</td>
<td></td>
</tr>
<tr>
<td>Auto-calibration not completed</td>
<td>Force an auto calibration operation (see Section 3.9).</td>
<td></td>
</tr>
<tr>
<td>Interference</td>
<td>Check for possible interference by turning off the radio at the other end of the link and verify the RSL voltage on the local site drops below 0.2V.</td>
<td></td>
</tr>
<tr>
<td>Wireless link established, but no data transfer over the link</td>
<td>Network equipment configuration and radio configuration incompatible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Verify settings on network equipment to be consistent with radio unit’s fiber port settings. Verify network equipment port configured not to enter error-disable state due to link up/down transitions (see Section 4).</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: RSL Voltage vs. Distance

Align the antenna to maximum voltage and confirm RSL is above the Min value shown in the graph below.