



R900[®] Gateway Installation and Maintenance Guide



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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 emit radio frequency energy, and if not installed and used in accordance with the instruction, 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 try 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 where the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



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This Class B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. Operation is subject to the following two conditions:

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2. This device must accept any interference received, including interference that may cause undesired operation.

Cet appareillage numérique de la classe B répond à toutes les exigences de l'interférence canadienne causant desrèglements d'équipement. L'opération est sujette aux deux conditions suivantes: (1) ce dispositif peut ne pas causer l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peutcauser l'opération peu désirée.

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- (2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

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The R900[®] gateway (gateway) is a fixed network data collector that collects meter reading data from Neptune's R900[®] endpoint and stores the data in the gateway until it synchronizes with the N_SIGHT[®] PLUS or Neptune[®] 360™ host software by means of web services. The data is uploaded to the host, used for analysis, and transferred to the customer information system (CIS) for billing purposes.

About This Guide

This guide describes how to install, maintain, and troubleshoot the gateway. This guide also provides information for configuring the cellular modem for the gateway, installing the solar power unit, and ordering information for cables and accessories.

General Product Overview

The gateway can operate on either solar power or standard AC power. It is easy to install and does not require an operating license.



Figure 1 – Solar Unit[®]



Figure 2 – AC-Powered Wall Unit

Before you set up the gateway, become familiar with the unit and its components. This guide is for installers to help with installation. In addition, this guide contains information on individual components, material specifications, site selection, and detailed installation instructions.

DeterminingHow to Install the Gateway



Neptune recommends using qualified professionals for installation and service.

Neptune provides a kit for five types of setups as detailed in the following table. The kits provide materials needed for indoor and outdoor installations. Install the gateway in the combinations shown in the following table.

Table 1 – Types of Gateway Installations

	Solar-Powered	AC-Powered
Wall		✓
Stand	✓	✓
Pole (ranging from 2" to 16" in diameter)	✓	✓

Choosing the Installation Site of the Gateway

Choose a location free of obstructions like trees, hills, mountains, or anything else that would block the RF communications from the endpoints in that area. You can install the gateway on:

- Top of a building where it is set higher than the endpoint it reads.
- A pole ranging from 2 inches to 16 inches in diameter.



Do not mount the gateway — antenna mast or antenna — to a pole or similar structure carrying open electric light, power wires, or trolley wires over 250 volts between conductors. (See NEC, Article 810).

The gateway mounts easily to a wall. However, for an indoor wall-mounted unit, choose a location that is easily accessible and where the antenna mast can be mounted outdoors.



Conduct RF propagation prior to site selection to ensure adequate RF communications. The antenna needs 10 feet of vertical separation from other antennas to minimize the interference between the systems. Locations that share space with multiple transmitting systems can require additional equipment to protect the systems from interfering with each other. See "Appendix C."

Mounting Configurations

Wall Mount

You can mount a gateway directly on a wall or to a strut channel that is affixed to a wall.

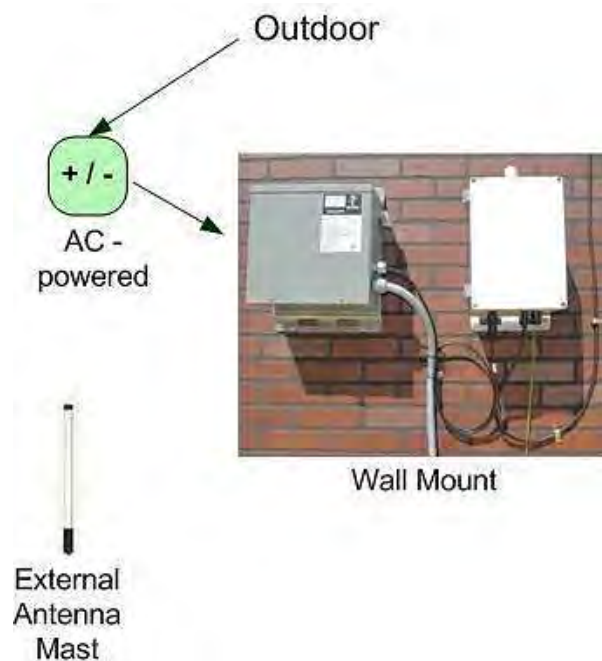


Figure 3 – Gateway Wall Mount Installation



The gateway allows for a cellular modem or Ethernet connection for backhaul communication.

Gateway Stand

The gateway mounted on a stand can be either solar-powered or AC-powered.

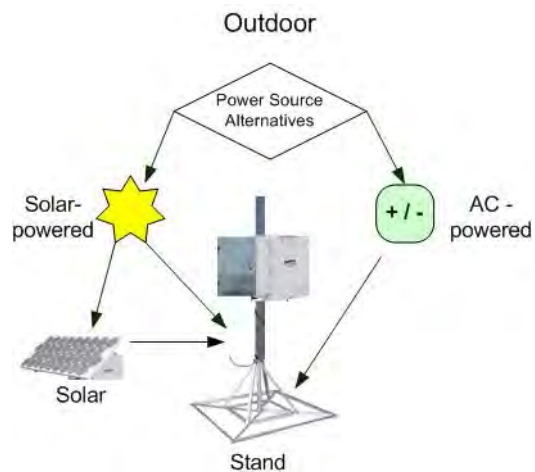


Figure 4 – Gateway Stand Installation

Pole Installation

Install the gateway outdoors on a free-standing pole ranging from 2 inches to 16 inches in diameter, such as a utility pole.

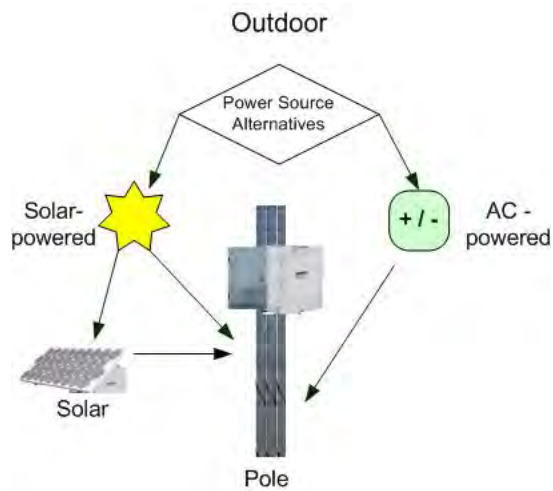


Figure 5 – Gateway Pole Installation



For backhaul communication, the gateway allows for a cellular modem or Ethernet connection.

Gateway Kits

The following sections describe the power source of the gateway and components for each of the gateway kits:

- Cellular modem.
- Ethernet.

Power Source

A 12 VDC powers the gateway. A solar power system or Uninterrupted Power Supply (UPS) can provide the power to the VDC.

Solar Unit

The solar version of the gateway uses a solar power source in conjunction with a cellular modem or Ethernet option. Solar panels are available in two different sizes depending on installation location. You can use the 160 W solar panel for Zones A, B, C, and D. You must use the 220 W solar panel for Zone E and Canada. If the utility is located near or along the boundary between Zones D and E, then the 220 W option is recommended. See "Appendix A" for more details. The kit is mounted on a stand or a 2-inch to 16-inch pole.

AC Unit

The AC version of the gateway uses the UPS in conjunction with a cellular modem or Ethernet option. Mount the kit on a wall, stand or a 2-inch to 16-inch pole.

Cellular Modem

The following table lists the parts needed for the gateway cellular modem installation.

Table 2 – Cellular Modem Parts List

Part No.	Description	Qty
13458-000	R900 gateway cellular modem. Accessories are available. Contact your Neptune sales representative for details.	1
13194-001	R900 Gateway Installation and Maintenance Guide.	1
N/A	SIM card with cellular service account (customer provided).	1
13147-000	External Cellular Antenna Mounting Kit, optional. Some installation sites have a weak cellular signal (–90 dBm or weaker). An optional external cellular antenna mounting kit (Neptune Part No. 13147-000) can increase the signal strength in these cases.	1
13566-001	Cellular to Ethernet Conversion kit, optional.	1
13458-200	R900 gateway cellular modem (Mexico)	

Ethernet

The following table lists the parts needed for the Ethernet connection.

Table 3 – Ethernet Parts List

Part No.	Description	Qty
13458-100	R900 gateway - Ethernet. Accessories are available. Contact your Neptune sales representative for details.	1
13194-001	R900 Gateway Installation and Maintenance Guide.	1
13939-000	Sierra wireless modem kit.	1
13939-100	Sierra wireless modem kit (Mexico).	1

Provisioning the Cellular Service to the Gateway

To activate the cellular service to the gateway, complete the following steps:

1. Select your preferred wireless service provider.



Choose a wireless service provider that provides service in the area of the installation site and is approved by your utility.

Neptune's gateway collector is compatible with either AT&T or Verizon cellular service.

2. Identify the modem identification numbers from the gateway International Mobile Equipment Identifier (IMEI) and Mobile Equipment Identifier (MEID).
3. After selecting the carrier, contact them to obtain a SIM card activated with an unlimited data plan.
4. After you activate the SIM card, turn off the unit before inserting it into the cellular modem.
5. After you complete steps 1 through 4, configure the cellular modem as described in "Configuring the Cellular Modem" on page 107.

Chapter 2: Activating the Gateway in the Host Software

This chapter provides information on how to activate the R900[®] gateway.

Step One

Log on to the N_SIGHT[®] PLUS application through your Web browser.

Step Two

Determine whether to use an existing gateway or add a new one to the host software.

If you want to use an existing gateway server, proceed to "Step Three" on page 9.

To add a new gateway to the N_SIGHT PLUS host software, complete the following steps.

1. Click **Settings**.

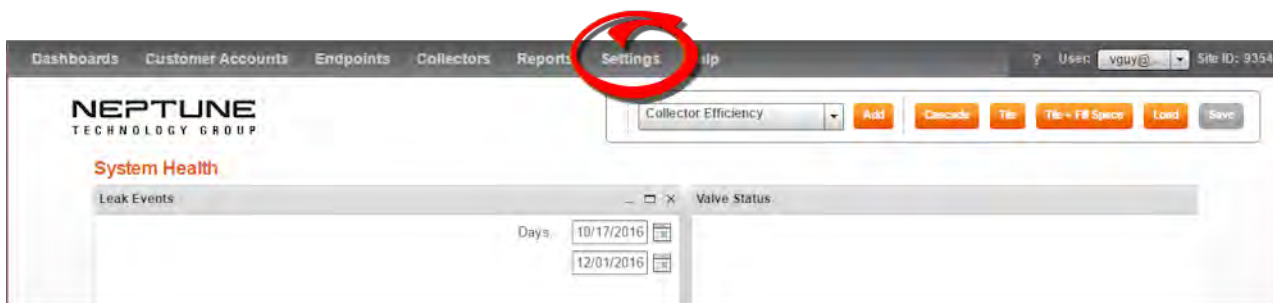


Figure 6 – N_SIGHT[®] Main Menu

2. Click **Table Maintenance** from the list.

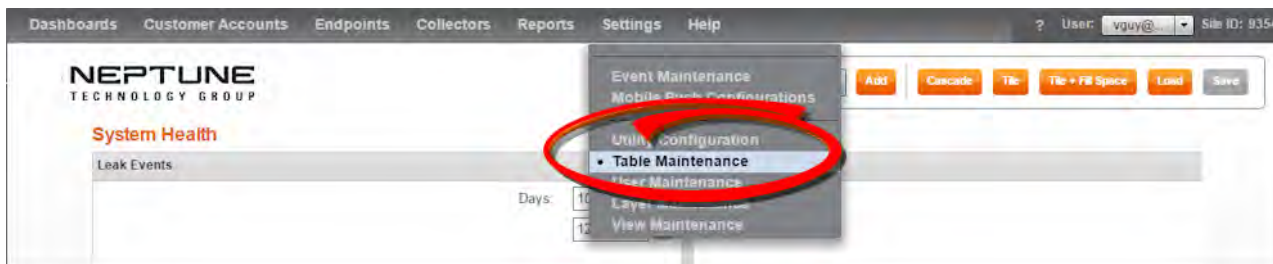


Figure 7 – Settings Menu

- 3. Select **Gateway Servers** from the Table Maintenance drop-down menu.

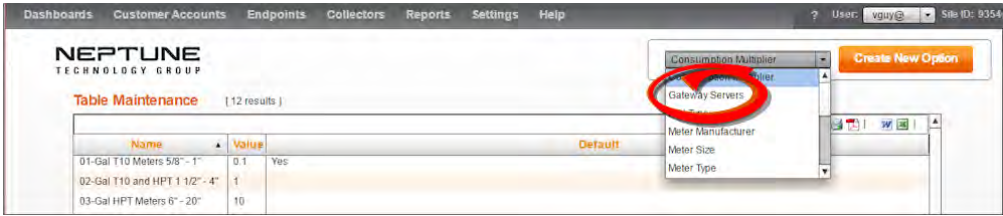


Figure 8 – Table Maintenance Window

The Table Maintenance window appears.

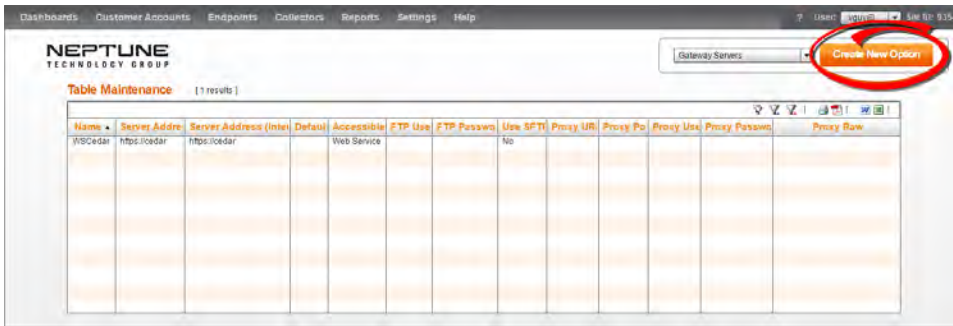


Figure 9 – Gateway Detail Window

- 4. Click the **Create New Option** button.

The following dialog box appears.



Figure 10 – Table Details



Although the server needed is already created, complete step 5.

- Complete the required fields on the **Table Details** tab. See "Table Details" on the previous page.

Field	Enter
Server Name	The server name.
Server Address	The Web address. Do not add http:// or https:// since the software does that automatically.
Server Address (Internal)	The internal Web address, if different from above.
Accessible	Select the Web service.

- Click **Save & Close**.

Step Three

Create a new gateway record, using an existing gateway, in the N_SIGHT PLUS host software.

To create a new record, complete the following steps.

- From the N_SIGHT PLUS main menu, click **Collectors**.

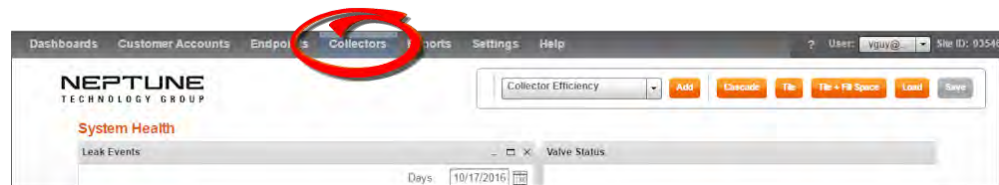


Figure 11 – Collectors Tab

- From the drop-down menu, click **Create Collector**.

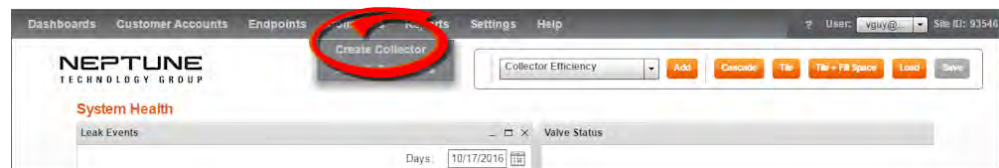


Figure 12 – Create Collector

The following dialog box appears.



Figure 13 – New Collector / Gateway Dialog

3. Click **Gateway** and the following dialog box appears.

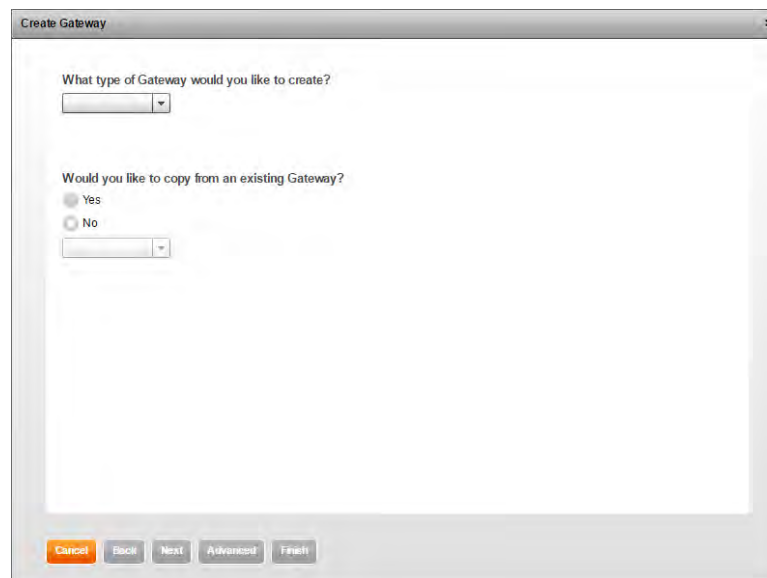


Figure 14 – Collector Type

4. Select **V4** from the drop-down menu.

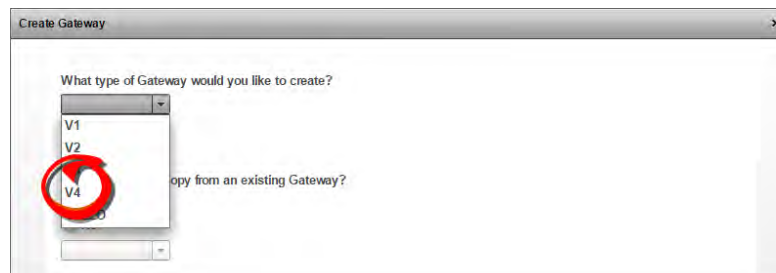


Figure 15 – Select Type

5. Select one of the following to copy an existing gateway.
 - **Yes** – Allows you to select the gateway to copy configuration settings.
 - **No** – Allows you to build a new configuration.

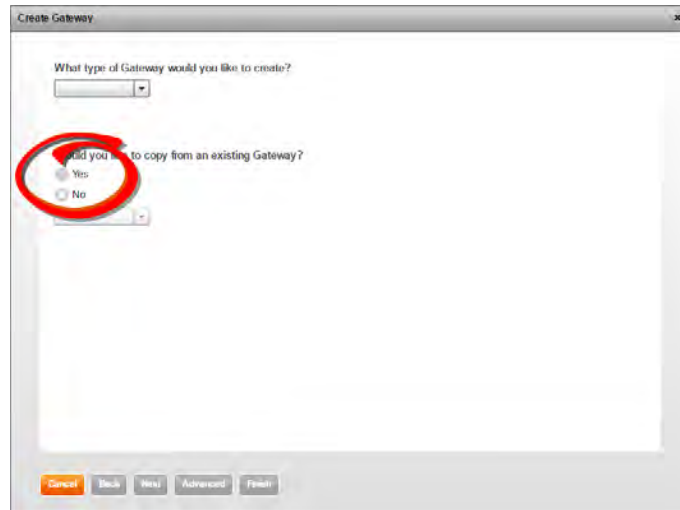


Figure 16 – Copy an Existing Gateway

Basic Information

1. Click **Next** and the following dialog box appears.

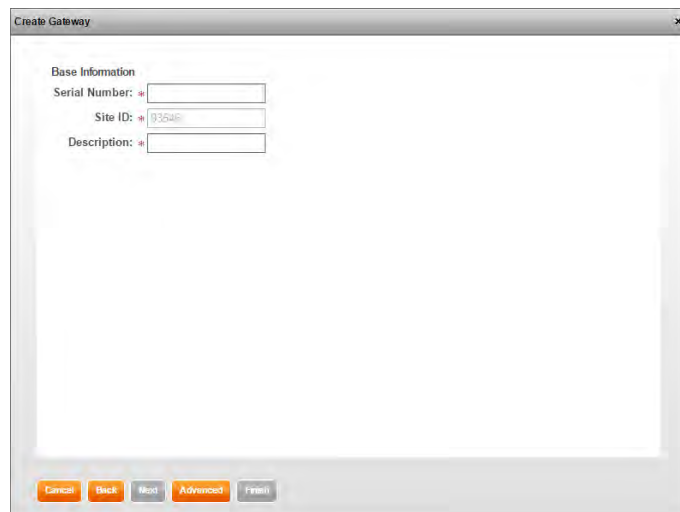


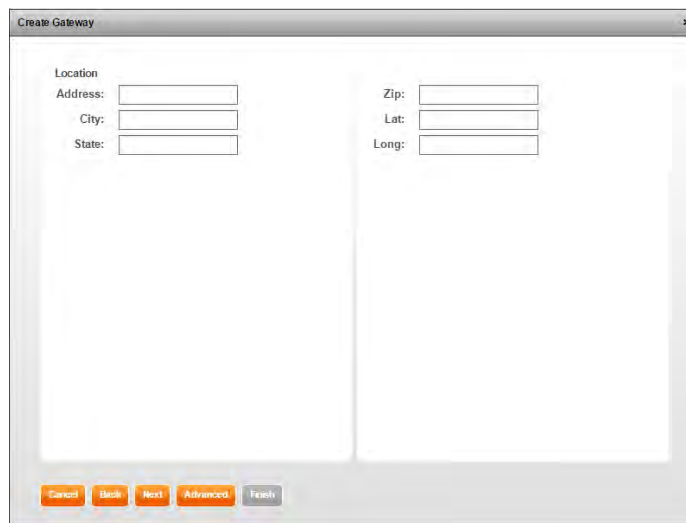
Figure 17 – Basic Information

2. Complete the required fields on the Basic Information dialog box. See "Basic Information" on the previous page.

Field	Enter
Serial Number	The serial number from the gateway (GPV4xxxxx).
Site ID	Completed by the host software.
Description	Type the reference name for location (5thStTank,WTP1).

Location

1. Click **Next** and the following dialog box appears.



The screenshot shows a 'Create Gateway' dialog box with a 'Location' tab. It contains two columns of input fields. The left column has 'Address:', 'City:', and 'State:'. The right column has 'Zip:', 'Lat:', and 'Long:'. At the bottom, there are five buttons: 'Cancel', 'Back', 'Next', 'Advanced', and 'Finish'.

Figure 18 – Gateway Location

2. Complete the required fields on the Location dialog box.
 - Address.
 - City.
 - State.
 - Zip.
 - Lat (decimal degrees).
 - Long (decimal degrees).

Static IP

1. Click **Next** and the Static IP dialog box appears.

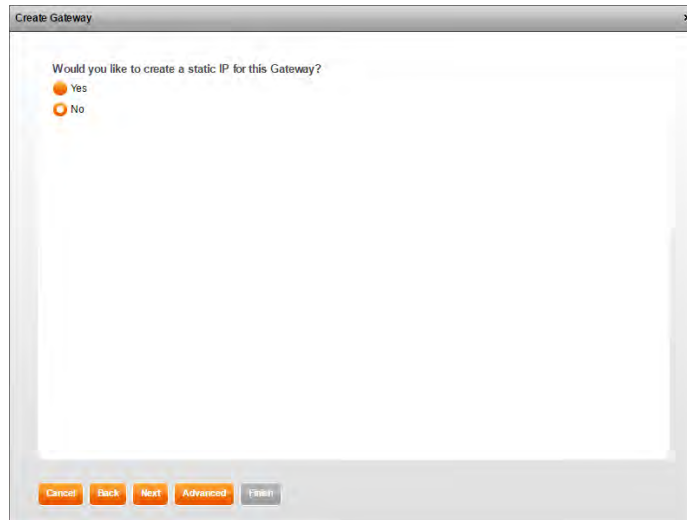


Figure 19 – Static IP Window

2. Select one of the following:
 - **No** and then go to "Web Service" on the next page.
 - **Yes** to create a static IP, and then click **Next**. The following dialog box appears.

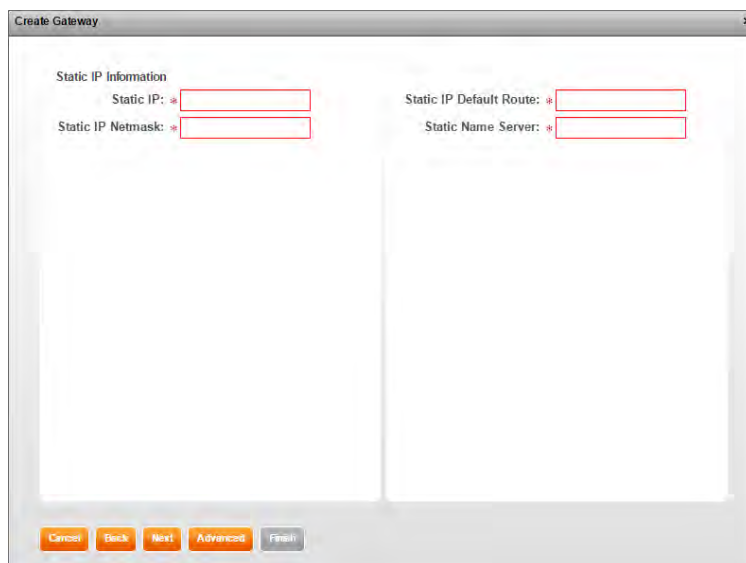


Figure 20 – Static IP Details

3. Complete the required fields on the Static IP Details dialog box. See Figure 20 on page 13.
- Static IP.
 - Static IP Network.
 - Static IP Default Route.
 - Static Name Server.

Web Service

1. Click **Next** and the following dialog box appears.

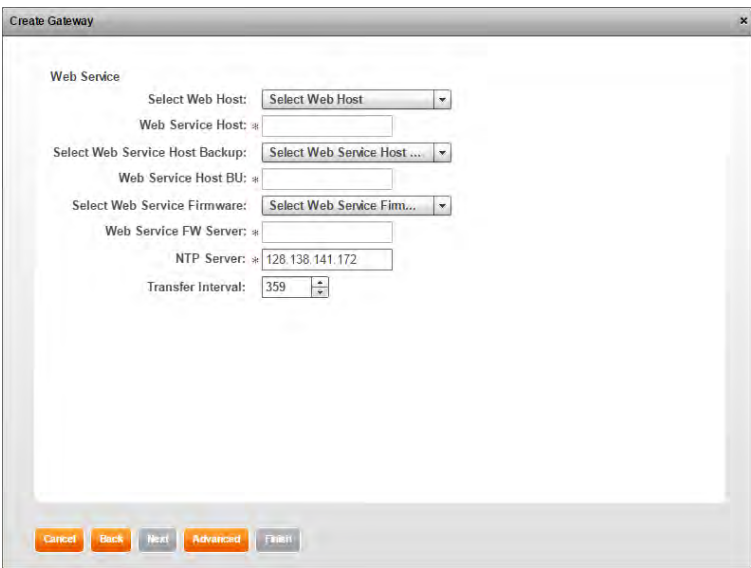


Figure 21 – Web Service

2. Select an option from the drop-down list for each of the following fields.

Field	Option
Select Web Host	Select Web server name.
Select Web Service Host Backup	Select Web server name.
Select Web Service Firmware	Select same Web server.
Network Time Protocol (NTP) Server	Provide the NTP server Web address. It can be a public NTP (ex: time.nist.gov) or a Neptune NTP.
Transfer Interval	Set to minutes between uploads (default: 359, six hours).

Read Reporting

1. Click **Next** and the following dialog box appears.

The screenshot shows the 'Create Gateway' dialog box with the 'Read Reporting (GMT/UTC)' tab selected. The dialog contains three columns of time settings. The first column is for 'First Reporting', the second for 'Second Reporting', and the third for 'Third Reporting'. Each column has three rows: 'Start Time', 'End Time', and 'Time Interval'. All time values are set to '0 : 00'. At the bottom, there are five buttons: 'Cancel', 'Back', 'Next', 'Advanced', and 'Finish'.

Read Reporting (GMT/UTC)		
First Reporting Start Time:	0 : 00	Second Reporting Start Time: 0 : 00
First Reporting End Time:	0 : 00	Second Reporting End Time: 0 : 00
First Reporting Time Interval:	0	Second Reporting Time Interval: 0

Figure 22 – Read Reporting

2. Leave all values set to zero.

Command Polling

1. Click **Next** and the following dialog box appears.

The screenshot shows the 'Create Gateway' dialog box with the 'Command Polling (GMT/UTC)' tab selected. The dialog contains three columns of time settings. The first column is for 'First Poll', the second for 'Second Poll', and the third for 'Third Poll'. Each column has three rows: 'Start Time', 'End Time', and 'Time Interval'. All time values are set to '0 : 00'. At the bottom, there are five buttons: 'Cancel', 'Back', 'Next', 'Advanced', and 'Finish'.

Command Polling (GMT/UTC)		
First Poll Start Time:	0 : 00	Second Poll Start Time: 0 : 00
First Poll End Time:	0 : 00	Second Poll End Time: 0 : 00
First Poll Time Interval:	0	Second Poll Time Interval: 0

Figure 23 – Command Polling

2. Leave all values set to zero.

Process Configuration

1. Click **Next** and the following dialog box appears.

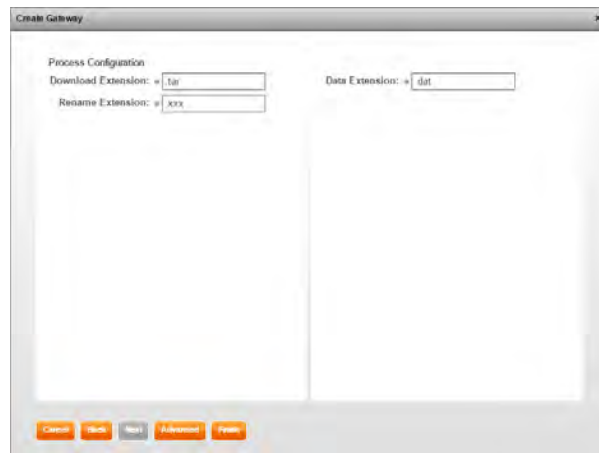


Figure 24 – Process Configuration

2. Verify that the fields have the following default values.
 - Download Extension – .tar.
 - Rename Extension – .xxx.
 - Data Extension – .dat.

Advanced Options

1. Click **Next** and the following dialog box appears.

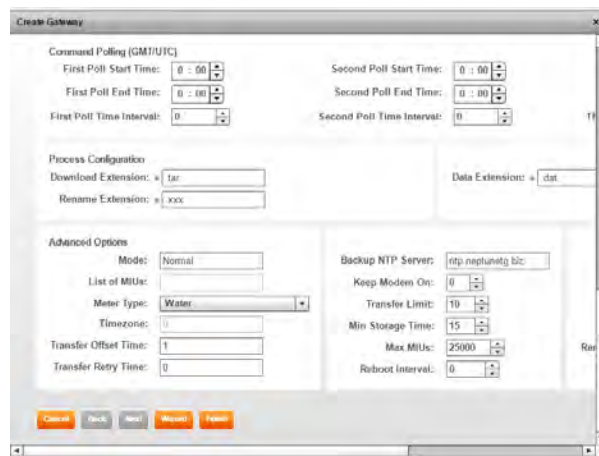


Figure 25 – Advanced Options

2. Scroll through the dialog box until you see the **Advanced Options**.
3. From the drop-down list next to the **Meter Type** field, select the meter type.
4. In the **Keep Modem On** field, Select **1** for the value.
5. In the **Max MIUs** field, Select **25000**.
6. Click **Finish** to create the gateway.

The Collectors Search window appears.



If the Finish button is not active, some of the fields could be invalid.

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Collectors Search [21 results]

Collector ID	Collector Name	Synchronized	System ID	Latitude	Longitude	Start Time	End Time	Type
5002	MDCE	93546_5002	0	0.0000000	0.0000000	22:44:00	23:01:00	Gateway
5003	BC000135	93546_5003	0	0.0000000	0.0000000	22:44:00	23:01:00	Gateway
5004	Integration test	93546_5004	0	0.0000000	0.0000000	22:44:00	23:01:00	Gateway V4
5005	MeterFarmV4	93546_5005	0	0.0000000	0.0000000	22:44:00	23:01:00	Gateway V4
5006	testv4	93546_5006	0	0.0000000	0.0000000			Gateway V4
5007	MeterFarmV4-5007	93546_5007	0	0.0000000	0.0000000			Gateway
5008	R900tstGW	93546_5008	0	0.0000000	0.0000000			Gateway V4
5009	qqq	93546_5009	0	0.0000000	0.0000000			Gateway V4

Collector Details: Commands Build USB Upload Test FTP

Site ID: 0
Collector ID: 0
Synchro User:
Collector Name:
Host IP Address:
Time Zone: 0
Sync Interval: 0
Transmit Frequency: 450
Receive Frequency: 450

Power: 0
Antenna Height: 0
NTP Server:
DNS Server (Primary):
DNS Server (Secondary):
Collector Static IP:
Gateway IP:
Network Prefix:
Broadcast IP:

Latitude: 0.0000000
Longitude: 0.0000000
Daily Reboot:
Start Time: 14:13:18
End Time: 14:13:18
Version:
Type:

Figure 26 – Collectors Search Window

Step Four

Transfer the configuration file to a USB drive.

1. Select the gateway you defined in the system.
2. Click **Build USB** and the following dialog box appears.



Figure 27 – Save USB Build

3. Click **OK** to transfer the R900_Configcfg file to your PC.

Step Five

Activate the gateway in the field.

1. Install the gateway and power source (UPS or Solar). See "Install the Gateway" on page 29 and "Solar Power Information" on page 79 in "Appendix A".
2. Open the gateway.



If cellular modem activation is required, see "Cellular and Ethernet Considerations" on page 107.

3. Insert the USB flash drive into the USB port on the gateway until the light turns green.
4. Remove the USB flash drive.
The gateway reboots and is configured.
5. Press the **Test Report** button on the top right to send data to the server.

Chapter 3: General Installation Information

This chapter provides general information on how to install the R900® gateway.

Preparation

This section describes the procedures to complete before you install the hardware. Verify that all of the items in the following checklist are installed and working as designed. This ensures a quick and easy implementation when you are ready to install the hardware.

✓	N_SIGHT PLUS host server.
✓	Firewall ports and IP addresses opened.
✓	User name and password for N_SIGHT PLUS (admin or supervisor level log on credential).
✓	Gateway configuration file folders uploaded to a USB flash drive.
✓	Timeout.
✓	Provisioned modems or SIM cards (obtained from cellular provider, if required) including modem setup instructions.

Gateway Specifications

This section describes the specifications for the gateway including the following:

- Electrical.
- Environmental.
- Mechanical.
- Gateway stand.
- UPS.
- Solar Power System.
- Battery.
- RF antenna.

Electrical Specifications

Table 4 – Electrical Specifications

Specification	Description
DC Power (solar or UPS)	12 VDC 0.58 A nominal.
Power Consumption	7.0 W nominal.

Environmental Conditions

Table 5 – Environmental Conditions

Condition	Description
Operating Temperature	–22° to 140°F (–30° to 60°C).
Storage Temperature	–40° to 185°F (–40° to 85°C).
Operating Humidity	0 to 95%.
Environmental Rating	NEMA 4X Enclosure.

Mechanical Specifications

Table 6 – Mechanical Specifications

Specification	Description
Maximum Weight	19 lbs. (8.61 kg), with mounting bracket.
Dimensions	9.0" W x 13.0" H x 7.5" D. or (22.8 cm x 33 cm x 19 cm).

Gateway Stand Specification

Table 7 – Gateway Stand Specification

Specification	Description
Manufacturer	ROHN.
Dimensions	5 ft. x 5 ft. square (1.5 m x 1.5 m).
Height	10 ft. (304.8 cm).
Pole Diameter	2.375 in (72.4 cm).
Weight (excluding ballast)	50 lbs. (22.6 kg).

UPS Specifications

Table 8 – UPS Specification

Specification	Description
Manufacturer	TSI Power.
Part No.	OUTDOOR-DC-UPS-8009 w/option BH-5.
AC Input	120V 60 Hz (100 - 140 VAC range).
Output	12 VDC.
Dimensions	10.0" W x 12.0" H x 6.0" D (25.4 cm x 30.5 cm x 15.2 cm).
Weight	30 lbs. (14kg).
Mounting	Pole or wall mountable.
Safety	ELT listed (U.S. and Canada).

Solar Power System Specifications

This section provides a description of the specifications for a solar power system.

Solar Panel

Two solar panel options are available for the gateway, depending on the solar power zone of the installation site.

- "160 W Option Specifications" below
- "" on the next page

To determine which option to use, see "Solar Power System Selection" on page 82.

160 W Option Specifications

Table 9 – Solar Power System Specification - 160 W Option

Specification	Description
Rated Power	160 W.
Rated Voltage (Vmp)	18.9 V.
Rated Current (Imp)	8.47 A.
Open Circuit Voltage (Voc)	22.9 V.
Short Circuit Voltage (Isc)	8.68 A.

Table 9 – Solar Power System Specification - 160 W Option (continued)

Specification	Description
Dimensions	26.0" x 57.7". or 66 cm x 146.6 cm.
Weight (PV array only)	28.6 lbs. (13 kg).
Mounting	Pole mount: 2.0" to 16.0" diameter (5.08 cm to 40.64 cm).
Mounting Bracket	23 lbs. (10.43 kg).

220 W Option Specifications

Table 10 – Solar Power System Specification - 220 W Option

Specification	Description
Rated Power	220 W.
Rated Voltage (Vmp)	17 V.
Rated Current (Imp)	13 A.
Open Circuit Voltage (Voc)	21.4 V.
Short Circuit Current (Isc)	14.2 A.
Dimensions	52.0" x 48.0" (132 cm x 121.9 cm).
Weight (PV array only)	42.8 lbs. (19.4 kg).
Mounting	Pole mount: 2.0" to 16.0" diameter. (5.08 cm to 40.64 cm).
Mounting Bracket	25 lbs. (11.33 kg).

Battery Specifications

Battery Enclosure

Table 11 – Solar Power System Specifications - Battery Enclosure

Specification	Description
Dimensions	20.8" H x 16.0" W x 9.4" D (52.8 cm x 40.6 cm x 23.8 cm).
Weight (excluding batteries)	25 lbs. (11.33 kg).
Mounting	Pole mount: 2.0" to 16.0" diameter (5.08 cm to 40.64 cm).

Battery

Table 12 – Solar Power System - Battery

Specification	Description
Manufacturer	Sun Xtender.
Part No.	PVX-1040T.
Battery Type	Sealed Lead Acid, AGM, maintenance free.
Voltage	12 V.
Nominal Capacity	104 Ah (C/24 rate).
Dimensions	12.0" L x 6.6" W x 8.75" H (30.5 cm x 16.8 cm x 22.2 cm).
Weight	63 lbs. (28.6 kg).

RF Antenna Specifications

Table 13 – RF Antenna Specifications

Specification	Description
Manufacturer	PCTEL.
Part No.	MFB9155NF.
Center Frequency (factory tuned)	915 MHz.
Frequency Range	902-928 MHz.
Gain	5 dB.

Table 13 – RF Antenna Specifications (continued)

Specification	Description
Normal Impedance	50 chms.
Bandwidth @ 1.51 Voltage Standing Wave Ratio (VSWR)	20 MHz.
Vertical Beam Width @ 1/2 Power	22°.
Maximum Power	150 watts.
Height	50.7" (128.9 cm).
Weight	1.75 lbs (0.79 kg).
Radome Material	1.0" Outer Diameter (OD pultruded white fiberglass).
Radiator Material	Coated steel wire.
ESD Protection	DC grounded.
Wind Survival	125 mph.
Bending Moment at Rated Wind	48.5 ft.-lbs.
Lateral Thrust at Rated Wind	23 ft.-lbs.
Equivalent Flat Plate Area	0.23 sq ft.
Termination	N Female.
Mounting Base Diameter	1.3125" (5/16").
Mounting Method	Mast or wall mounted.
Mounting Hardware	MMK4 heavy duty mast mount (sold separately). Optional wall mounting kit (Neptune Part No. 13145-000).

Storage



Upon receipt, inspect shipping containers for damage, and inspect the contents of any damaged carton.

After completing the inspection, store the cartons in a clean, dry environment. The temperature of the unit should remain between –40°F and 185°F (–40°C and 85°C). Keep in mind that the gateway solar unit has an external battery. Storing the equipment for more than one year affects product life.

Unpacking

As with all precision electronic instruments, handle the gateway with care. However, no special handling is required.

After unpacking the gateway, inspect it for damage. If any parts of the gateway appear damaged or prove defective upon installation, notify your Neptune representative.

If you are returning a damaged or defective item, use the original cardboard box and packing material.

Tools and Materials

Table 14 shows the recommended tools and materials needed to successfully install the gateway.



Some items may not apply to your specific installation or the list may not contain all required tools or materials.

Table 14 – Recommended Tools and Materials

Item	Description/Recommendation	Use
Tool Kit	Contains standard tools including: - Assorted screwdrivers (medium, flat head, Phillips). - Cordless electric drill / assorted bits. - Crescent wrench. - Standard socket wrench set. - Compass. - Protractor or Johnson Magnetic Angle Locator (Model: 700). - Hammer. - Channel locks. - T27 Torx Pin-Head Tool (Wiha Part No. 36283).	Various installation procedures performed by the installer.
Ultraviolet (UV) -stable cable ties	8" and 12" (20 cm and 30 cm).	Securing coaxial cable.
Coaxial ground kits	See Figure 28 on page 27	Grounding cable.

Table 14 – Recommended Tools and Materials - Continued

Item	Description/Recommendation	Use
Coaxial hoisting grips	See Figure 29 on page 27	Hoisting cable.
Cable clips	Various sizes.	Securing coaxial cable.
Concrete Blocks	8" x 8" x 12" (20 cm x 20 cm x 30 cm).	Ballast for the gateway stand.
Weatherizing Kit	Times Microwave Part No. WK-S-2, or PolyPhasor Part No. WK-1, or Scotch Part No. WK-101.	Weatherizing coaxial cable connections.
Additional Materials	3M Super 88 black electrical tape.	Weatherizing coaxial cable connections.
Corrosion inhibitor	NOCO Company's NCP-2 or Sanchem Inc.'s No-OxID Grease "A".	Apply to battery terminals for corrosion protection.
American Wire Gage (AWG)	Copper wire with a minimum temperature rating of 75° C.	#4 or #6.

The following images are examples of the coaxial ground kit and coaxial hoisting grips.

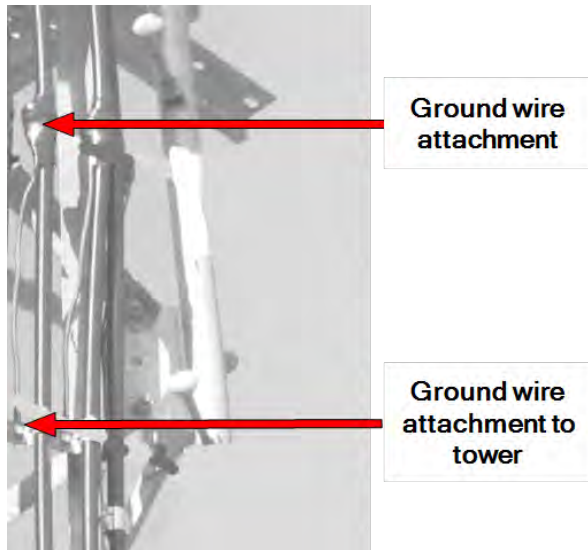


Figure 28 – Coaxial Ground Kit

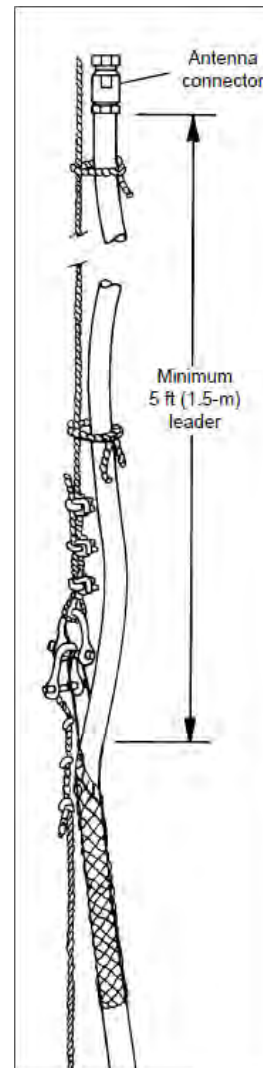


Figure 29 – Coaxial Hoisting Grips

Safety and Preliminary Checks



Always follow your company's safety practices and installation guidelines when installing your gateway unit. Never perform an installation during a lightning storm or under excessively wet conditions. Use only approved climbing equipment.

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This chapter contains sections detailing the installation options for the R900[®] gateway.

Mounting RF Antenna to a Pole or Stand

If mounting a two-inch round, SCH40, galvanized steel pole, seat the pole according to the recommendations from the solar-powered system's installation guide. In general, the pole used to support the solar panel must be designed for the local soil conditions and meet the following minimum requirements:

- Solar panel area base at a tilted angle.
- Typical sustained wind speed according to the recommended local building code.
- Pole must be seated against a firm, crushed-stone base and be on firm, compacted soil a minimum of six inches below the frost line.
- Pole must be encased in reinforced concrete per the American Society for Testing and Materials (ASTM) standards.
- Pole must be level and plumb.
- Pole diameter and wall thickness must be sized to withstand solar panel forces without damage.

Mounting the RF Antenna

To mount the RF antenna to a pole or a stand, complete the following steps.

1. Assemble the stand in accordance with the manufacturer's instructions.
2. Attach the antenna mounting brackets to the pole.

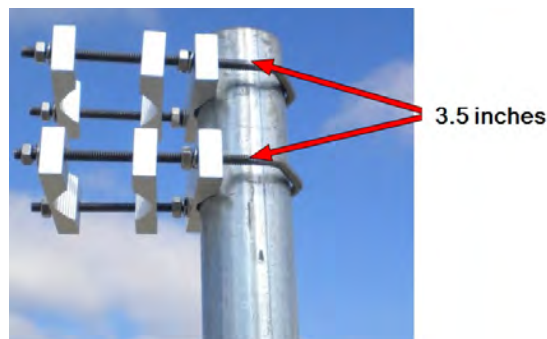


Figure 30 – Mounting Brackets

3. Attach the coaxial cable to the RF antenna.



Figure 31 – Attaching the Coaxial Cable



Verify that the coaxial cable type is correct for the run length. See "Coaxial Cable Lengths for the Gateway" on page 103 in Appendix C.



Do not hoist the antenna while it is attached to the coaxial cable. Doing so may damage the antenna connector. Attach the coaxial cable after the antenna is hoisted and mounted.

4. Weatherize the RF antenna connection using the weatherizing kit specified in "Recommended Tools and Materials" on page 25.



Figure 32 – Weatherizing the RF Antenna

5. Mount the RF antenna pole using antenna mounting brackets.
6. Secure the coaxial cable every 2 feet. along the pole using UV-stable wire ties.

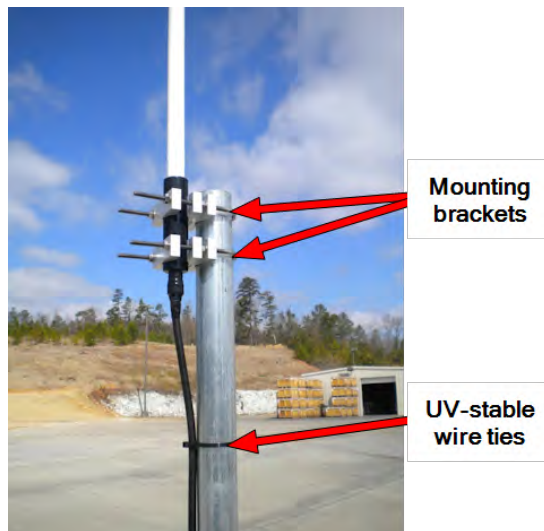


Figure 33 – Mounting Brackets



Secure larger 1/2" and 7/8" diameter coaxial cable according to the manufacturer's recommendations.

For more information go to "RF Antenna and Coaxial Installation" on page 101.

Mounting the Gateway - Solar Configuration

This section provides instructions for mounting the gateway with a solar configuration.

Mounting the Battery Box



Before installing a solar-powered unit, choose a non-shaded location that faces true south. Determine true south by using a magnetic compass corrected for magnetic declination. Refer to "Facing True South" on page 79 of Appendix A.

To install the battery box needed for the solar panel of a gateway solar-powered system, complete the following steps. If you are installing an AC-powered system, skip step 1.

1. Install the brackets onto the pole using the U-bolts provided. Be sure the U-bolts are spaced 12.75" (32.39 cm) apart and face the brackets true south.



Figure 34 – Installing Pole Brackets

2. Hang the battery box without batteries on the upper mounting bracket. See Figure 35 – on the facing page.
3. Attach the lower bracket to the battery box using the 5/16" carriage bolts.
4. Tighten bolts using a ½" wrench to 10-12 ft-lbs. torque.
5. Check alignment of all assembled parts and tighten all bolted connections.

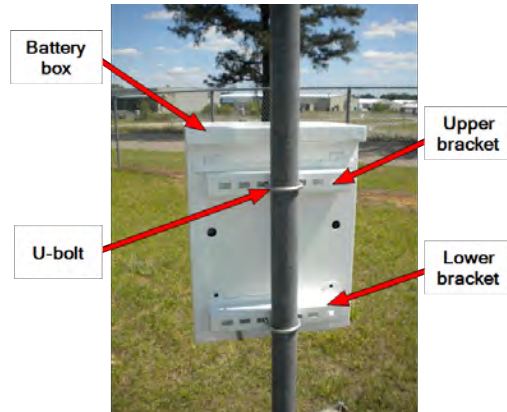


Figure 35 – Battery Box Installed



For more detailed instructions, see *SunWize® Installation, Operation, and Maintenance Manual*. (Part Number: PM296038)

6. Install the battery in the battery box leaving ventilation areas free of blockage.
7. Connect the B+ wire to the positive battery terminal. Connect the B- wire to the negative battery terminal.
8. Remove the two knockouts in the back of the battery box by tapping them with a flathead screwdriver and a hammer.

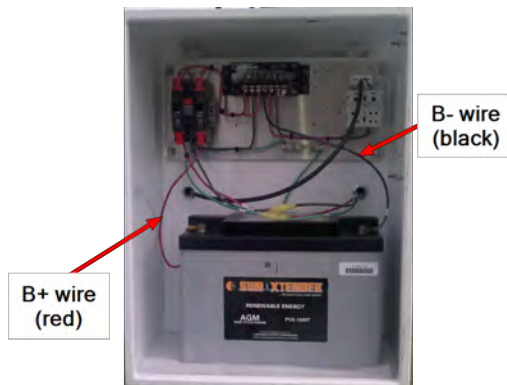


Figure 36 – Battery and Wiring



Apply corrosion inhibitor, for example NOCO Company's NCP-2® (Non Corrosion Product) or Sanchem Inc.'s No-OX ID® Grease "A", to the battery terminals.

Attaching the Solar Panel

The solar panel is mounted to the gateway stand or to a pole. This panel allows the gateway to operate using energy generated by the sun.



Figure 37 – Gateway Solar Panel



The solar panel comes with mounting brackets already attached, and is pre-terminated with 15 feet (#10 AWG) of wire in flexible non-metallic conduit.

To attach the solar panel to a pole, complete the following steps.

1. Place the solar panel on the pole immediately above the battery box.
2. Verify the mounting height clears any shadowing or partial obstruction to the cellular antenna.
3. Attach the solar panel to the pole using the U-bolts or bands provided.
4. Position the solar panel so that it faces true south. See "Facing True South" on page 79.



U-bolts

Figure 38 – Solar Panel Attached



See "Solar Power Information" on page 79 of Appendix A for more information.

5. Use a protractor or angle locator to set the tilt angle of the solar panel based on latitude. For latitude range between 25° and 45° , set the solar panel tilt angle for latitude plus 15° . Use solar panel hole:
 - "A" for 25° - 40° tilt.
 - "B" for 41° - 60° tilt.

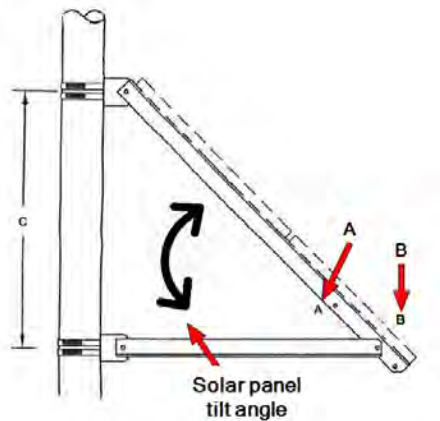


Figure 39 – Solar Panel Tilt Angle



Use a map, mapping software, or a Global Positioning System (GPS) device to find your location latitude. It is recommended that the solar panel tilt be limited to 15° minimum angle and 60° for maximum tilt angle. See "Specific Tilt Angle" on page 80 of Appendix A.

6. Tighten all the nuts and bolts.

Consider the following:



- In areas with potential for strong winds, add a bolt through the bracket and pole to secure the panel from rotation over time.
- The pole / wall mounting bracket is included with the gateway. Contact your Neptune sales representative to order the stainless steel clamps for mounting the gateway to a pole.

Mounting the Gateway

To mount the gateway to a pole or stand, complete the following steps.

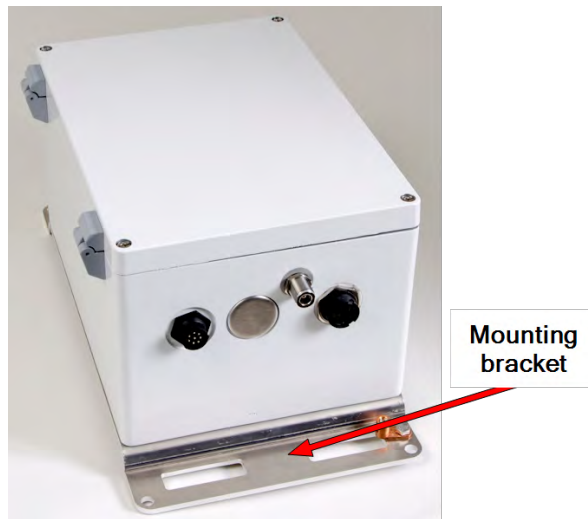


Figure 40 – Mounting Bracket

1. Position the gateway so that the top of the box is approximately level with the battery box.
2. Attach the gateway to the pole using two stainless steel clamps.

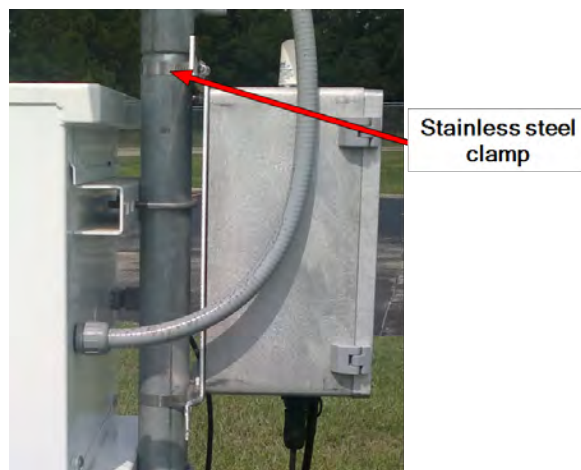


Figure 41 – Positioning the Gateway

Wiring the Solar Panel

To connect the solar panel to the battery box, complete the following steps.

1. Feed the flexible conduit wiring from the solar panel to the back of the battery box.
2. Connect the green ground (GND) solar panel to the green GND lead in the battery box.
3. Connect the red Photovoltaic (PV) (+) solar panel positive lead to the red PV (+) wire in the battery box.
4. Connect the black PV (-) solar panel negative lead to the black PV (-) wire in the battery box.

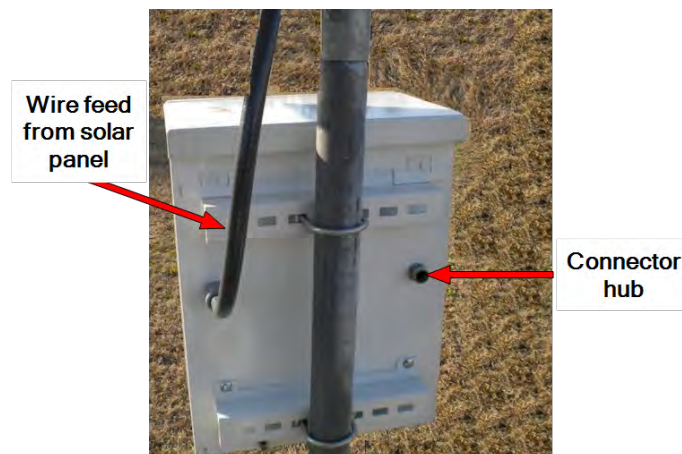


Figure 42 – Back of Battery Box

Wiring the Battery Box

Connect the gateway to the battery box by completing the following steps.



The following instructions are for wiring the battery box for the solar panel of a gateway solar-powered system. If you are installing an AC-powered system, skip this procedure.

1. Attach the connector hub to the back of the battery box. See Figure 43 on page 38.



Figure 43 – Feeding Conductor Wire

2. Insert the DC power cable through the connector hub.
3. Tighten the connector hub using a crescent wrench to secure the cable.

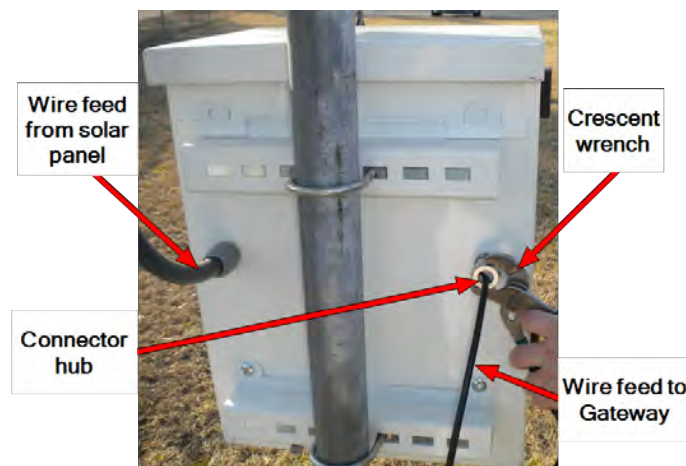


Figure 44 – Connector Hub



Insert enough cable so that it can be terminated to the load terminals inside the battery box. See "Battery Box Wires" on the facing page.

4. Strip $\frac{1}{2}$ inch of the insulation from both the red and black wires.
5. Attach the red (+) wire to the load (+) terminal inside the battery box.
6. Attach the black (–) wire to the load (–) terminal inside the battery box. See Figure 45 on page 39.

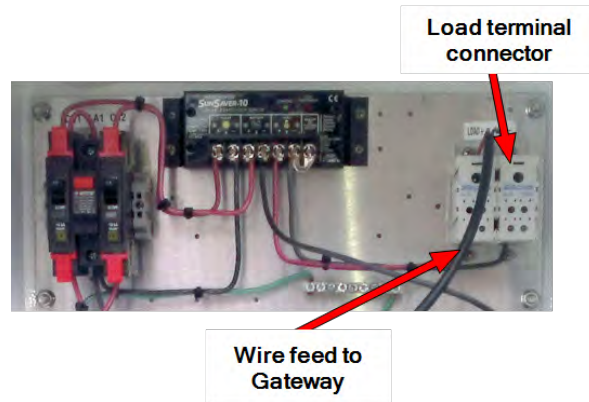


Figure 45 – Battery Box Wires

Wiring the Gateway

This section provides information on wiring the gateway.

Connecting the Ground Wire

Complete the following steps to attach the ground wire .

1. Locate the lightning protection system ground wire for the site.
2. Connect the external ground lug of the gateway to the lightning protection system ground wire for that site. Use #4 or #6 AWG copper wire with a minimum temperature rating of 74°C.
3. Tighten with a flathead screwdriver. Torque to 35 inch-lb. (4.0 Nm).



Figure 46 – Ground Wire

Attaching the RF Antenna Cable

Complete the following steps to attach the RF antenna cable.

1. Locate the RF antenna cable that extends from the RF antenna.
2. Connect the RF antenna cable to the RF antenna connector located on the bottom of the gateway.
3. Tighten the coaxial connector to 14 inch-lbs. (1.58 Nm).
4. Weatherize the RF antenna connection using the weatherization kit. Refer to "Recommended Tools and Materials" on page 25.

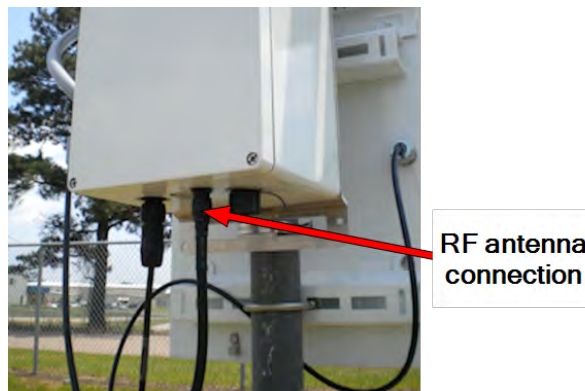


Figure 47 – RF Antenna Cable

Attaching the Power Cable

Attach the power plug to the gateway by pushing and rotating the circular power connector clockwise to engage it.

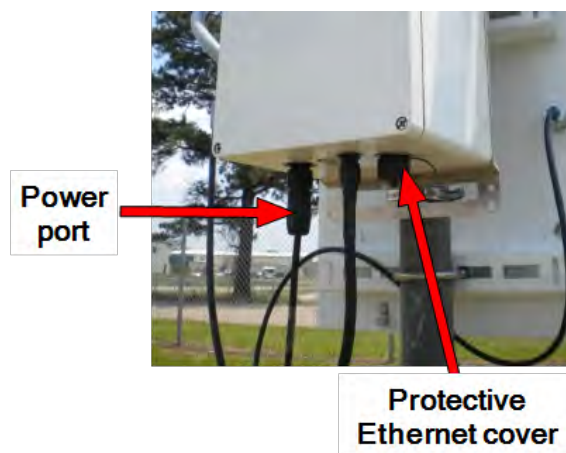


Figure 48 – Power Cable



Do not weatherize the power connection. The power connector is IP68-rated and does not require weatherization wrap.



The protective cover (CONEC P/N: 17-10002) should always cover the Ethernet port when the port is not in use. See "Power Cable " on the previous page.

Securing the Gateway

Secure the gateway cover with the tamper-resistant T27 Torx Pin-Head tool.

Applying the Ballast to the Stand



Install a roof pad between the stand and rooftop to protect the roof. See "Ballast Requirements" on page 99 of Appendix B.

Apply ballast according to applicable local code requirements. The installation must meet all applicable local, state, and federal requirements.

The stand and antenna mast must be grounded according to applicable NEC, CEC, and local codes. Refer to NEC Article 810 and CEC Section 54.

After the gateway is wired, apply the ballast material (for example, concrete blocks). Complete the following steps to apply the ballast to the stand.

1. Refer to "Ballast Requirements" on page 99 of Appendix B to determine the adequate amount of ballast for your installation.
2. Distribute the ballast material evenly as illustrated in Figure 49 – on the next page.
3. Secure the stand and ballast material in accordance with local code requirements.

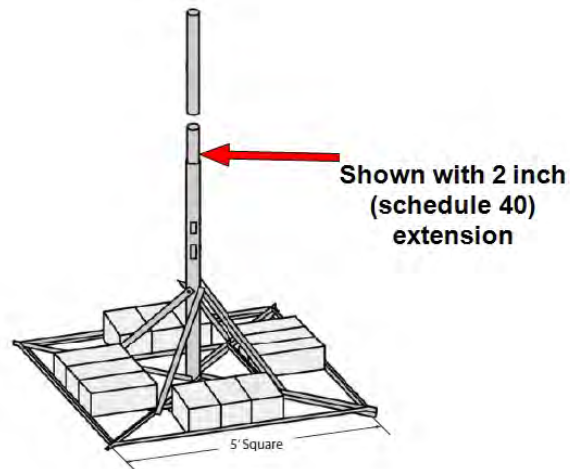


Figure 49 – Concrete Block Ballast

Activating the Gateway System

After all the kit items are in place, attached, and mounted, you can activate the gateway. Complete the following steps to activate the gateway.

1. Open the door of the battery box.
2. Turn the two breakers to the **ON** position.
3. Verify that the **CHARGING LED** on the charge controller is lit. See "Solar Power Information" on page 79 of Appendix A.
4. Close the battery box with the locking key.

The battery box and the gateway system are activated.

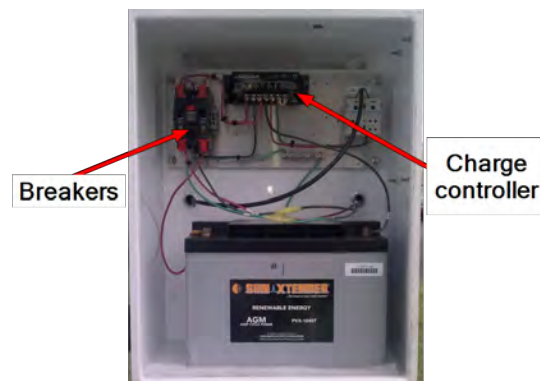


Figure 50 – Activating the Battery

5. Open the gateway.
6. Watch for LED activity. See "Installation Troubleshooting" on page 72 for definitions and status indications of LED lights.

There is approximately a three-minute delay before the gateway becomes fully functional.

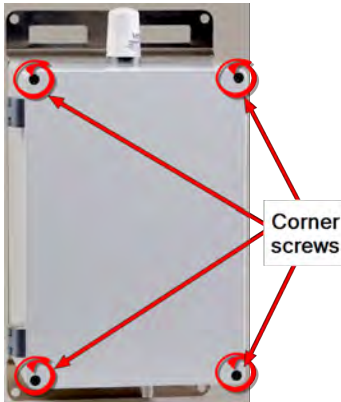


Figure 51 – Gateway Cover Screws



Loosen and tighten the gateway screws in this pattern:

- Loosen the left screws first, then the right.
- Tighten the right screws first, then the left.

Configuring the Cellular Modem

See "Configuring the Cellular Modem" on page 107 of Appendix D.



Before you begin, you need an active cellular account with the carrier of your choice.

Configuring the Gateway

Use a USB flash drive or the N_SIGHT® PLUS host software to configure the gateway, as delineated in Table 15

Table 15 – Determining the Configuration Options

If you have ...	Configure the Gateway using...
No internet access at the installation site prior to installing the gateway,	A USB flash drive. See the following section.
Internet access available at the installation site prior to installing the gateway,	Web services.

Configuring the Gateway with the USB Flash Drive

Complete the following steps to configure the gateway using a USB flash drive.

1. Configure a USB flash drive using the N_SIGHT PLUS host software.
2. Verify that the gateway is powered up.
3. Insert the configured USB flash drive into the gateway's USB port.
LEDs D500 and D501 should begin to alternate flashing red.
5. When both D500 and D501 begin flashing green, it is safe to remove the USB flash drive from the gateway.
6. After removing the USB Flash drive, the gateway reboots. Allow the gateway approximately three minutes to complete the boot-up sequence.
7. LED D501 (BF MIU Activity) should begin flashing green to indicate that the gateway has finished booting up and is receiving endpoint readings. However, in areas where the endpoint density is high, this green light may remain on constantly to indicate a high volume of endpoint RF traffic. See "System LEDs" on page 74.

Securing the Gateway

Secure the gateway cover with the tamper-resistant T27 Torx Pin-Head tool.

Installing a Large Pole Mount System

This section provides the steps to mount the gateway system on a large pole.



The instructions to mount the gateway system to a large pole are very similar to the instructions for installing a stand system.

- Refer to "Mounting RF Antenna to a Pole or Stand" on page 29.
- Note that information bullets, such as these, are included in each section for special considerations added for the large pole installation.

Mounting the RF antenna to a Large Pole

Complete the following steps to mount the RF antenna to a 5-inch to 16-inch (12.7 cm to 40.65 cm) diameter pole.

1. Mount the RF antenna bracket to the large pole using the two stainless steel Snaplock® clamps.



Figure 52 – Large Pole Bracket

2. Mount the RF antenna to the bracket.



Figure 53 – RF Antenna Bracket



Do not hoist the antenna while it is attached to the coaxial cable to avoid damaging the antenna connector. Always hoist the coaxial cable and antenna separately. Attach the coaxial cable after the antenna is hoisted and mounted.

3. Attach the coaxial cable to the base of the RF antenna.



Figure 54 – Coaxial Cable Attached



Verify that the coaxial cable type is correct for the run length. See "Coaxial Cable Lengths for the Gateway" on page 103.

4. Weatherize the RF antenna connection using the weatherization kit. Refer to "Recommended Tools and Materials" on page 25.
5. Secure the coaxial cable approximately every 3 feet.



Figure 55 – Weatherized Connection

Mounting the Gateway to a Large Pole

Complete the following steps to mount the gateway to a 5-inch to 16-inch diameter pole. See "Solar Power Information" on page 79 of Appendix A.

1. Mount the gateway to pole using two stainless steel clamps.

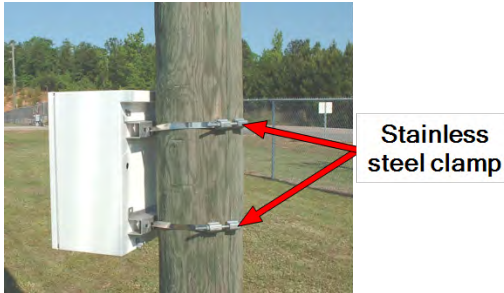


Figure 56 – Gateway Pole Hardware



The pole / wall mounting bracket is included with the gateway. Contact your Neptune sales representative to order the stainless steel clamps for mounting the gateway to a pole.

2. Insert the clamps through the slots on the mounting bracket.



Figure 57 – Slot on Mounting Bracket

Mounting the Battery Box to a Large Pole

Complete the following steps to mount the battery box to a 5-inch to 16-inch (12.7 to 40.64 cm) diameter pole.

1. Open the battery box and make sure the breakers are in the OFF position. See Figure 36 on page 33.

2. Mount the battery box to a large pole using the stainless steel clamps.



Figure 58 – Battery Box Clamps

3. Install the brackets onto the pole using stainless steel clamps. Space the brackets 12.75 inches (32.39 cm) apart.
4. Lift the battery box then lower it so that the flange on the top rear of the box slides over the flange of the top bracket and locks in place.

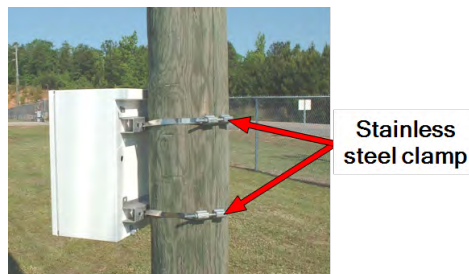


Figure 59 – Pole Hardware

5. Secure the box to the bottom bracket using the 5/16-inch carriage bolts.
6. Center the battery in the battery box leaving ventilation areas free of blockage.
7. Close the door of the battery box with the locking key.



Figure 60 – Mounted Battery Box



Prior to installing a solar unit, choose a non-shaded location that faces true south. Determine true south by using a magnetic compass corrected for magnetic declination. See "Facing True South" on page 79 of Appendix A.

Mounting the Solar Panel to a Large Pole

Complete the following steps to mount the solar panel to a 5-inch to 16-inch (12.7 cm to 40.64 cm) diameter pole. See "Solar Power Information" on page 79 of Appendix A.

1. Attach the solar panel to the large pole using stainless steel clamps.
2. Install the solar panel so that it faces true south.
3. Set the solar panel tilt angle based on latitude.



Figure 61 – Mounted Solar Panel

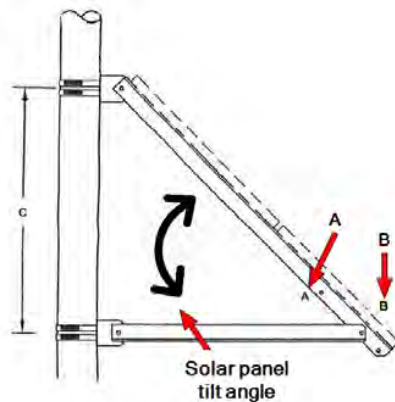


Figure 62 – Adjust Tilt Angle

Attaching Cables for the Gateway

This section provides details on how to attach the:

- Ground wire.
- "Attach Ground Wire" below

Attaching Ground Wire

Complete the following steps to attach the ground wire.

1. Locate the lightning protection system ground connection for the site.
2. Connect the external grounding lug of the gateway to the lightning protection system for that site. See Figure 63. Use #4 or #6 American Wire Gage (AWG).
3. Tighten with a flathead screw driver. Torque to 35 inch-lbs (40 Nm).



Figure 63 – Attach Ground Wire

Attaching the RF Antenna Cable

Complete the following steps to attach the RF antenna cable.

1. Locate the RF antenna cable that extends from the RF antenna.
2. Connect the RF antenna cable to the RF antenna connector located on the bottom of the gateway.
3. Tighten the coaxial connector to 14 inch-lb (1.5 Nm).

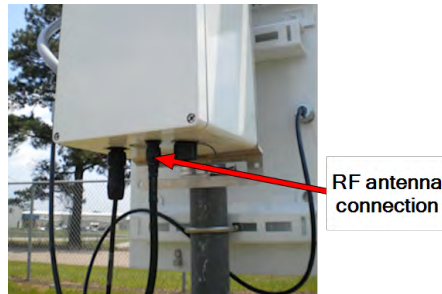


Figure 64 – RF Antenna Cable



Give special consideration when you install the gateway inside a building.

Connect the screen (shield) of the coaxial cable to the earth (grounded) at the entrance to the building. Make sure the connection meets applicable national electrical installation codes (Section 820.93 of the National Electrical Code, ANSI/NFPA 70).

Weatherizing the RF Antenna Connection

Complete the following steps to weatherize the RF antenna connection.

1. Use the weatherizing kit, as described in "Recommended Tools and Materials" on page 25.
2. Start the tape at the top of the RF antenna connection.
3. Wrap the tape around the connection several times and slowly work your way downward. Be sure to overlap the tape at least $\frac{1}{4}$ inch (0.635 cm).
4. When complete, the weatherized port should resemble the following figure.



Figure 65 – Weatherized RF Port

Connecting Power to the Gateway

This section covers connecting power to the gateway.

Attaching the Power Cable

To attach the power plug to the gateway:

- Push and rotate the circular power connector clockwise to engage it.



Figure 66 – Power Cable



Do not weatherize the power connection. The power connector is IP68-rated and does not require weatherization wrap.



When the port is not in use, the protective cover (CONEC P/N: 17-10002) included with the unit should always cover the Ethernet port.

Configuring the Cellular Modem

See "Configuring the Cellular Modem" on page 107 of Appendix D.

Configuring the Gateway

Using a USB flash drive or the N_SIGHT PLUS host software, configure the gateway as delineated in Table 16 .

Table 16 – Determining the Configuration Options

If you have ...	Configure the gateway using....
No internet access from the installation site prior to installing the gateway,	A USB flash drive. See the following section.
Internet access readily available at the installation site prior to installing the gateway,	Web services.

Configuring the Gateway with the USB Flash Drive

Complete the following steps to configure the gateway using a USB flash drive.

1. Configure a USB flash drive using the N_SIGHT PLUS host software.



Refer to "Building a USB Drive for Collector Configuration" in the Collectors topic of the N_SIGHT PLUS Help.

2. Verify the gateway is powered up.
3. Insert the configured USB flash drive into the gateway's USB port.
4. Observe LEDs D500 and D501, which begin to alternate flashing red.
5. When both D500 and D501 begin flashing green, it is safe to remove the USB flash drive from the gateway.
6. After removing the USB flash drive, the gateway reboots. Allow the gateway approximately three minutes to complete the boot sequence.
7. LED D501 (BF MIU Activity) begins flashing green to indicate that the gateway has finished booting and is receiving endpoint readings. However, in areas where the endpoint density is high, the green light can remain on constantly to indicate a high volume of endpoint RF traffic.

Installing the UPS to a Large Pole

This section provides instructions on how to install the UPS to a large pole.

Attach the UPS to a large pole using the two stainless steel clamps as shown in the following images.



Figure 67 – UPS Attached to a Large Pole



Figure 68 – UPS Attached with Clamps



The UPS is rated for indoor and outdoor use.

Connecting Power to the UPS

This section contains the instructions for connecting the UPS to the gateway. The UPS requires 120 VAC on the input and provides 12 VDC output to the gateway.



Connect the UPS according to the manufacturer's instructions. Install the UPS only in a well-ventilated area that is free from explosive or corrosive gases, vapor, or excessive dust, dirt, and moisture. Ensure a free flow of air around the UPS.

A licensed electrician is required to complete the wiring of the AC power for the UPS and gateway. Install in accordance with the National Electrical Code, Canadian Electrical Code, and local electrical codes.

Ensure the integrity of the protective earthing during installation.

The AC input to the UPS must have a readily accessible disconnect device installed.

Complete the following steps to connect power to the UPS.

1. Remove the two cover screws from the UPS cover, and then remove the cover.
2. Wire the 120 VAC input through the lower ½ inch (12 mm) diameter knockout hole.
3. Wire the 12 VDC output through the upper ½ inch (12 mm) diameter knockout hole.
4. Attach the circular power connector (12 VDC) to the gateway by pushing and rotating the connector clockwise to engage it.
5. Turn on the power switch inside the UPS to activate the system. See "UPS Power Switch" on page 60. See also "Checking UPS Status LEDs" on page 72.

6. Install the cover on the UPS and secure it with the two cover screws.

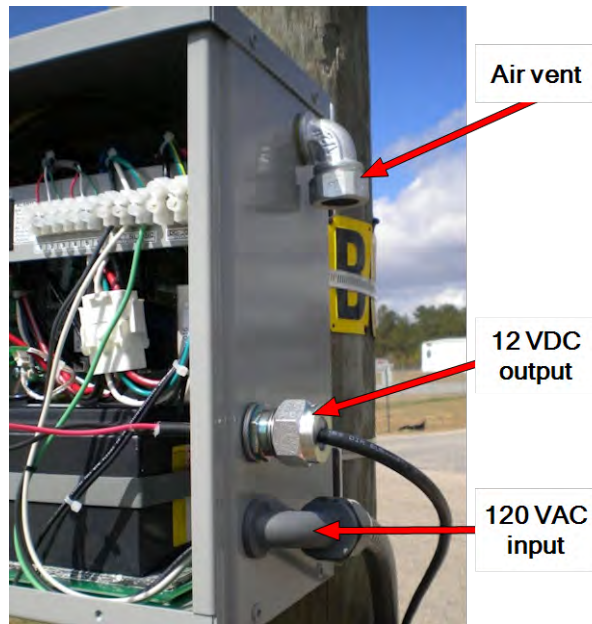


Figure 69 – Inside of the UPS

Installing a Wall Mount System

The following sections contain the instructions needed to install a wall-mounted system.

Table 17 – Installing a Wall Mount System

Complete	Instructions	Cellular	Ethernet
1	"Mounting the Gateway to a Wall" below	✓	✓
2	"Mounting the RF Antenna and Antenna Mast" on page 61	✓	✓
4	"Mounting the Antenna Mast to the Building" on page 61	✓	
	"Connecting the Ethernet Cable" on page 65		✓
5	"Troubleshooting" on page 71	✓	✓

Mounting the Gateway to a Wall

Mount the gateway to a wall, as illustrated in Figure 70, using one of the following methods. If mounting to:

- Wood – use #14 corrosion-resistant wood screws.
- Masonry – use 1 3/4-inch long, 3/16-inch diameter, corrosion-resistant masonry screws.
- Sheet metal – use #14 corrosion-resistant sheet metal screws.

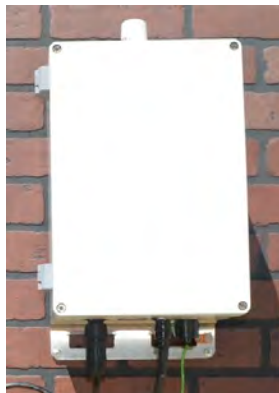


Figure 70 – Wall-Mounted Gateway

Installing the UPS

Complete the following steps to install the UPS.

1. Mount the UPS to a wall near the gateway and use corrosion-resistant hardware through the four holes provided in the mounting bracket.



Figure 71 – UPS Mounted on a Wall



The gateway and UPS can be mounted directly to a wall or strut channel that is attached to a wall.

The mounting brackets for the gateway and UPS have the same horizontal and vertical hole spacing. This allows you to mount both of them on the same two pieces of the strut channel. The two pieces of the strut channel can be mounted horizontally (gateway and UPS in a "side-by-side" arrangement) or the strut channel can be mounted vertically (gateway and UPS in a "stacked" arrangement).

Be sure to mount the UPS in close proximity (within 3 feet) of the gateway.

2. Remove the two screws from the cover on the UPS, and remove the cover.
3. Wire the 120 VAC input through the lower knockout hole.

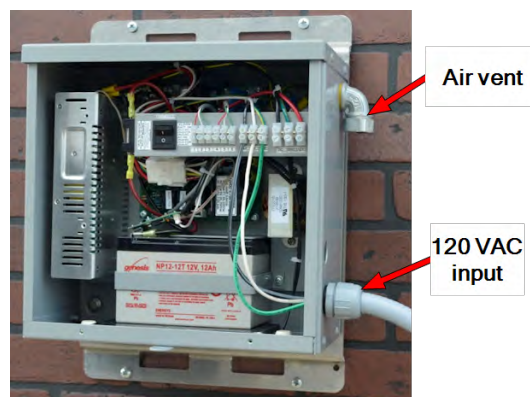


Figure 72 – UPS with VAC Input Wired



The AC input (to the UPS) must have a readily accessible disconnect device installed.

4. Wire the 12 VDC output through the upper knockout hole.
5. Install the cover on the UPS and secure with the two cover screws.

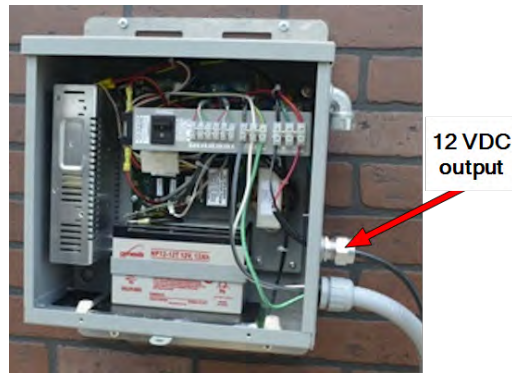


Figure 73 – 12 VDC Output Wired

Connecting the Ground Wire

Complete the following steps to attach the ground wire.

1. Locate the lightning protection system ground connection for the site.
2. Connect the external grounding lug of the gateway to the lightning protection system ground for that site. Use #4 or #6 AWG with a minimum temperature rating of 75° C.
3. Tighten with a flathead screwdriver. Torque to 35 inch-lb (4.0 Nm).



Figure 74 – Ground Wire

Connecting the Cables to the Gateway

The RF antenna is attached to an outside structure and is connected to the gateway. Complete the following steps to connect the cables.

1. Attach the RF antenna cable to the bottom of the unit.
2. Weatherize the RF antenna connection using the weatherization kit, as described in "Recommended Tools and Materials" on page 25.

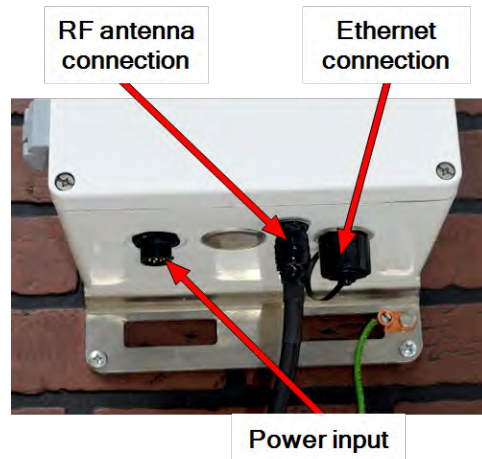


Figure 75 – Adding Gateway Cables



Do not weatherize the power connector. The power connector is IP68-rated and does not require weatherization wrap.

3. Attach the circular power connector to the gateway by pushing and rotating the connector clockwise to engage it.



Figure 76 – Power Connector

4. Turn on the power switch inside the UPS to activate the system. For more information go to "Checking UPS Status LEDs" on page 72 of the Installation Troubleshooting section.
5. Install the cover on the UPS and secure it with two screws.

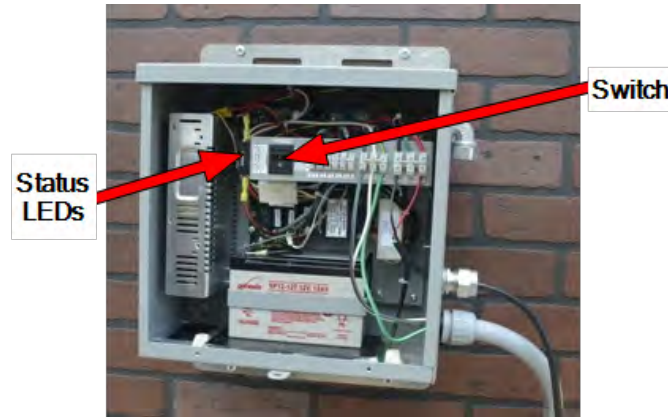


Figure 77 – UPS Power Switch



When the gateway's Ethernet port is not in use, cover with the protective guard (CONEC P/N:17-10002).

The image below illustrates the completed gateway and UPS wall installation.



Figure 78 – Wall Installation

Mounting the RF Antenna and Antenna Mast



Ground the RF antenna mast and stand to the same grounding electrode used for the building's electrical system to ensure that all exposed, non-current-carrying metal parts are the same potential (refer to NEC Article 810).

Antenna contact with high voltage wires may result in death. Watch for overhead electric power lines when erecting the antenna and mast.

Do not mount the antenna, antenna mast, or gateway on utility poles, electric service masts, or other structures carrying open electric light or power wires, or trolley wires of over 250V between conductors. Coaxial cable must maintain clearance of at least 2 feet (.61 M) from power or light wires of less than 250V, or at least 10 feet (3.048 M) from power wires of more than 250V, in accordance with NEC Article 810, CEC Section 64.



It is important to maximize the line-of-sight relationship between the RF antenna and R900 endpoints for optimum RF communications.

Mounting the Antenna Mast to the Building

With a wall mount installation, it is necessary to mount the RF antenna on the exterior of the building. Using antenna-pole brackets, complete the following steps to mount the antenna mast to the building.

1. Drill holes in the building for the first pole bracket.
2. Secure the antenna-pole bracket to the building. If mounting to:
 - Wood-constructed wall – use corrosion-resistant wood screws rated at a minimum of 20 pounds loading.
 - Sheet metal or masonry – use appropriate sheet metal, corrosion-resistant screws or masonry anchors rated at a minimum of 20 pounds loading.



Figure 79 – Securing Pole Bracket



The model of pole bracket shown can be different than what Neptune® supplies. Please contact Neptune Customer Support if you have any questions.

3. Place the antenna mast pole within the bracket.
4. Make sure the pole is vertical. Use a level if necessary.
5. Line up a second bracket a minimum of 2 feet from the first bracket.
6. Secure the second bracket similarly to the first.
7. Line up the pole in the two brackets.
8. Secure the pole with the bolts provided.



Figure 80 – Lining up Second Pole Bracket

Mounting RF Antenna to Antenna Mast

Complete the following steps to mount the RF antenna to the antenna mast.

1. Attach the antenna mounting brackets to the mast.

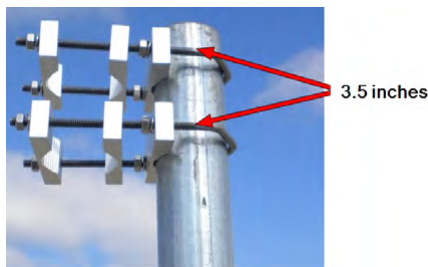


Figure 81 – Mounting Brackets

2. Attach the coaxial cable to the RF antenna.



Figure 82 – Coaxial Cable

3. Weatherize RF antenna connection using the weatherizing kit, as described in "Recommended Tools and Materials" on page 25.
4. Follow instructions in the weatherizing kit and the coaxial ground kits for proper installation.



Figure 83 – Weatherizing RF Antenna



Do not hoist the antenna while attached to the coaxial cable. Doing so may damage the antenna connector. Attach the coaxial after the antenna is hoisted and mounted.

5. Mount the RF antenna to the antenna mast using the antenna mounting brackets.



Figure 84 – RF Antenna to Mast

6. Secure the coaxial cable every 2 feet along the mast using UV-stable wire ties.



Figure 85 – Securing the Coaxial Cable



Secure larger 1/2-inch and 7/8-inch diameter coaxial cable according to manufacturer's recommendations.

Connecting the Ethernet Cable



This section is only for kits using the Ethernet backhaul. If you are using a cellular modem, skip this section.

Prior to connecting the Ethernet port, run an Ethernet cable to the location of the gateway. Use a shielded category 5e or better Ethernet cable that is rated for outdoor use, and is sunlight resistant. For example, a Belden cable (P/N 7919A). The Ethernet connector on the gateway is IP67 rated.

Complete the following steps to connect the Ethernet modem.

1. Locate the Ethernet port at the bottom of the gateway.

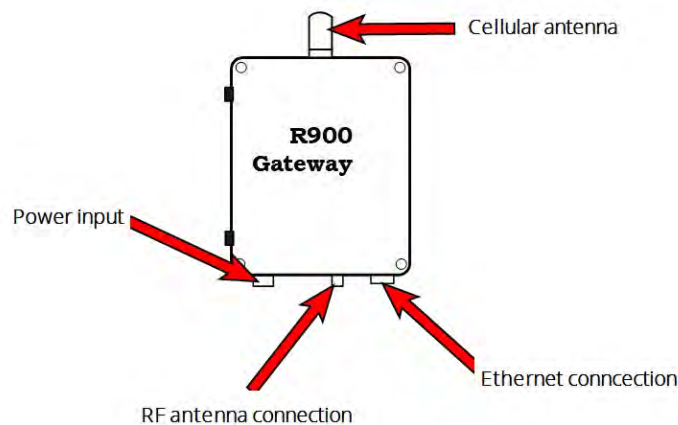


Figure 86 – Port Connection

2. Locate the Ethernet plug that's included with the gateway.

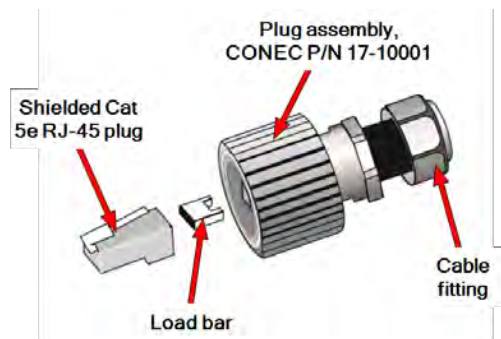


Figure 87 – Feed-Through Assembly

3. Assemble the Ethernet plug according to the instructions included.

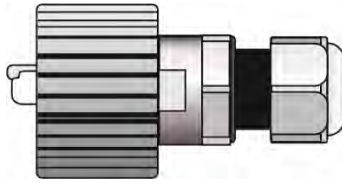


Figure 88 – RJ45 Ethernet Plug

4. Terminate the Ethernet jack to the Ethernet cable. Refer to "Ethernet Termination" on page 113 of Appendix D.



Figure 89 – Ethernet Plug Terminated

5. Insert the Ethernet plug into the Ethernet receptacle on the gateway.
6. Screw the entire Ethernet plug assembly into the RJ45 Ethernet housing which is already mounted at the bottom of the gateway.
7. Tighten the cable fitting until the gasket is tight around the RJ45 cable.



Figure 90 – Ethernet Plug Inserted



The Ethernet connector is weatherproof (IP67 rated) and does not require weatherization wrap.

Configuring the Gateway

See "Mounting the Gateway - Solar Configuration" on page 32.

Chapter 5: Gateway Monitoring

This section contains basic techniques used to diagnose and resolve unusual activity that you may notice when monitoring your gateway system.

Monitoring the Gateway

N_SIGHT® PLUS host software allows the user to monitor each gateway.

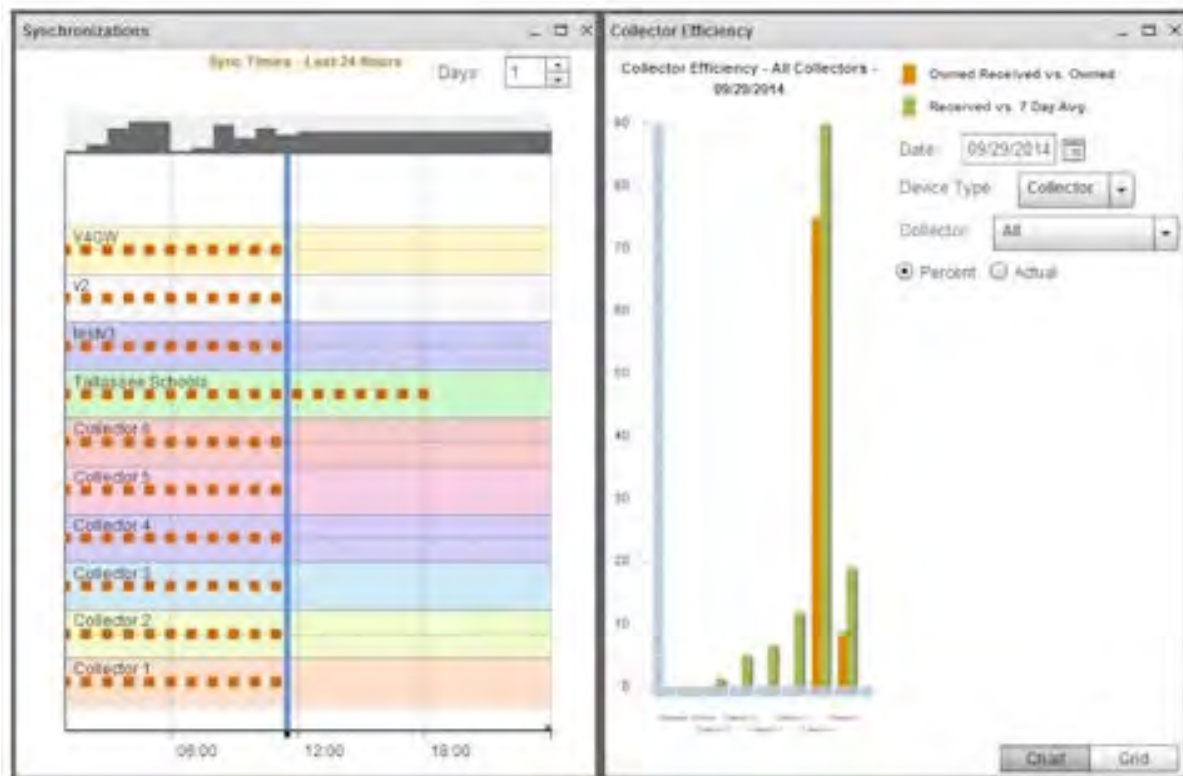


Figure 91 – Examples of N_SIGHT® PLUS Gateway Monitoring

Files Missing for Days



If files are missing for a number of days, there is a problem with cellular communication or the gateway has stopped operating.

If files are missing for a number of days, complete the following steps before calling Neptune Customer Support.

1. Reboot the gateway that has the missing files by disconnecting the black power connector from the bottom of the gateway unit.
2. Wait until all the LEDs are off, and then reconnect the power connector. See "Activating the Gateway System" on page 42.
3. Wait the appropriate amount of time, as defined by the transfer interval in the configuration file, which is the standard amount of time needed for the unit to configure and send packets. The packets should appear on the N_SIGHT PLUS host server.
4. After the appropriate amount of time, if there are still no files, call your cellular provider to be sure that the service is active.
5. If you complete the previous steps without success, call Customer Support at (800) 647- 4832, and then select **Option 2**. See "Contacting Customer Support" on page 77.

Using a USB Drive to Retrieve Gateway .TAR Files

If you are still unable to establish communications with a gateway, you can use a USB flash drive to retrieve the .TAR files.

Complete the following steps to retrieve the files directly from the gateway.



The USB flash drive that you use for this procedure must be blank.

1. Go to the gateway site.
2. Loosen the screws on the gateway cover.
3. Open the gateway.
4. Insert the USB flash drive in the gateway USB port.

The LED lights underneath the USB port begin to flash red alternately, in a railroad or wigwag pattern, indicating that the files are loading to the USB flash drive from the gateway.



The amount of data the gateway has stored determines the amount of time it takes to load the files to the USB flash drive. This could take up to 10 minutes, if needed.

When the data has completely loaded to the USB flash drive, the LEDs at the USB port begin to flash green simultaneously.

5. Remove the USB flash drive and the gateway reboots.
6. Close the gateway cover and secure the screws.
7. Take the USB flash drive back to your laptop or PC.
8. Insert the USB flash drive into your laptop or PC, and copy the .TAR files, or process them in the N_SIGHT PLUS host software. See topic "Importing a File" from the N_SIGHT PLUS Help file.
9. Safely remove (eject) the USB flash drive from the computer.

Processing Files

A web service is used to place files on the server in the "upload/data" directory so they can be processed. The file name follows this naming convention.

[CollectorNumber]_[CollectorName]_[NTP5digitDateCode]_[RecordedMMDD] with a file extension of .TAR or .DAT.

You can verify remotely that the collector was able to sync with an NTP site by completing the following steps.

1. Type the five-digit date code from the file name into a cell in Excel.
2. Format the cell as a date to verify when the collector is synced to the NTP site.

Files with a bad five-digit date process, but do not post.

Up-to-Date Files

If you see files that are up-to-date and have been processed but the file size is 0KB, this indicates that the gateway is communicating well with the N_SIGHT PLUS host software, but it is not receiving readings. This usually indicates there is a problem with the receiver.

To resolve this issue, reset the gateway. See "Files Missing for Days" on the previous page. If the next packet after the configured transfer interval time period is larger than 0KB, it is fixed. If not, call Customer Support and explain the issue you are experiencing. See "Contacting Customer Support" on page 77.

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This chapter provides symptoms and actions to troubleshoot your R900[®] gateway.

Performance Troubleshooting

Refer to the following table to troubleshoot performance or failure issues.

Table 18 – Performance Troubleshooting

Problem/Failure	Recommended Action
N_SIGHT PLUS host software	• Verify the database service is running. • Verify the cellular service is running. • Verify Cellular connectivity - Refer to "Checking Power and Receiver" on page 73 and "Cellular Modems Connectivity" on page 75 for further diagnosis.
All of the packets appear to be there but some packets are empty (0 bytes)	Refer to "Installation Troubleshooting" on page 72.
Poor endpoint read performance	Perform a VSWR check on the coaxial cable feeding the RF antenna. If it is bad, do the following: • Inspect the coaxial cable for damage. • Inspect the weatherproofing on the coaxial cable connections. • Check for moisture ingress inside the coaxial cable for the RF antenna. • Verify the RF antenna is good. • Verify the internal RF and cellular antenna coaxial connections are not swapped.

Installation Troubleshooting

This section discusses troubleshooting a gateway installation.

Checking UPS Status LEDs

Complete the following steps to check the UPS status.

1. Remove the two screws that secure the UPS cover.
2. Remove the cover.
3. Verify that the internal power switch is on.
4. Verify the status LEDs inside the UPS.

Table 19 – UPS Status LEDs

Description	LED Indicators
DC output is OK	Green LED turns on.
Battery is being charged (AC input ok)	Amber LED blinks slowly.
Battery is being discharged (AC input failure)	Amber LED blinks rapidly.
DC output is faulty	Red LED turns on.

5. Verify the UPS is producing the correct voltage at the output terminals by measuring across DC+ and DC–.

The voltage should measure 13.6 VDC to 14.4 VDC.



Verify that the AC input is present and the UPS's internal switch is on (for example, battery should be charging).

If the AC input voltage is not present, then the voltage across DC+ and DC– should measure 10.5 VDC to 12.8 VDC.

If the DC voltage is not present across DC+ and DC–, then:

- Measure the AC input voltage across L1 and N1. This voltage should measure 120 VAC (± 20 V).
- Verify that the UPS's internal switch is on.
- Verify the UPS status LEDs. See Table 19

6. Install the UPS cover again and secure it with the two screws.

Checking Power and Receiver

It is good practice to check the main power and make sure it is within specification. If there are no power indications on the gateway, complete the following procedures.

Verify Main Power



The gateway uses the same DC power cable (Part No. 13065-000) for both the solar power and UPS option.

Complete the following steps to check the power for the unit and the receiver.

1. Disconnect the power plug to the gateway.
2. Using a voltmeter, verify that there is 12 VDC present between pins C+ and D- on the power plug.
3. If voltage is not present on the power plug or is less than 11 VDC, there is something wrong with the wiring or the power source (solar power system or UPS). See "Solar Power Information" on page 79.



Figure 92 – Gateway Power Plug

Verify the RF Receiver

There are two LED lights on the RF receiver board that are illuminated when the system is on. See Figure 93 on page 74.

- RXMODE (red).
- LOCKED (green).

If the two LED lights are not illuminated, check that there is power to the unit.

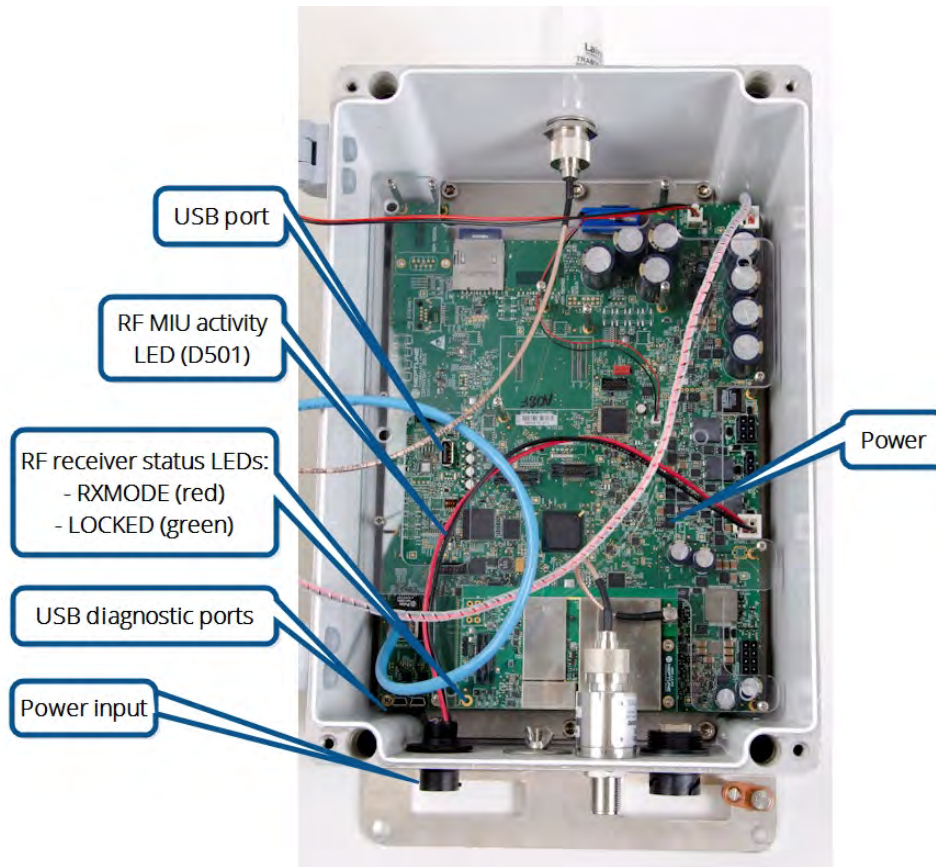


Figure 93 – System LEDs

Verifying the Digital Board

Complete the following steps to verify the digital board is powered on.

1. Turn on the gateway.
2. Wait approximately three minutes for it to complete the startup cycle.
 - The LED D514 displays green when power is applied.
 - Under normal operation LED D514 blinks green in a repeating pattern of eight seconds steadily-lit green.
 - Then one-half second off, indicating normal operations.
 - If it is red, this indicates an error and / or power issues.

In addition, the green LED D501 should begin flashing to indicate that the unit is receiving endpoint readings. However, in areas where the endpoint density is high, this LED can remain green constantly to indicate a high volume of endpoint RF traffic.

Cellular Modems Connectivity

Your gateway may include the Sierra Wireless RV55 modem or Cal Amp Vanguard 5530 MC modem. Complete the following steps according to the modem in your gateway.

Sierra Wireless RV55 Modem

This section provides instructions for checking the Sierra Wireless RV55 modem connectivity and configuring the modem.

Checking Connectivity

Complete the following steps to check the Sierra wireless modem connectivity.

1. Check that the power, signal, and network lights are illuminated. If the power light is not illuminated, there may be a problem with the modem or power source. See "Troubleshooting" on page 71.
2. Verify that the SIM card is installed and activated. A red or flashing red network LED indicates that there is an issue with the network.

Refer to the [ALEOS Software Configuration User Guide for AirLink RV55](#) for information on the LED indications and modem troubleshooting.

Cal AMP Vanguard 5530MC™ Modem

Complete the following steps to check for modem connectivity.

1. If any of the lights are not illuminated, check the Ethernet connection to the board.

The LED lights on the cellular modem should be illuminated. See Figure 94, Figure 95, and "Troubleshooting" on page 71. At power up, all LEDs display red, then amber, and then green. When the boot sequence is complete, the RSSI indicator is steadily green and the service (SVC) indicator is flashing green.



Figure 94 – Modem Front View

2. If the lights are off, this indicates that there is a power problem with the modem or the power source. See "Verifying Cellular Modem Power" on the next page.

3. Verify the cellular modem has a SIM card installed and the modem is configured. See "Configuring the Cellular Modem" on page 107 in Appendix D.



Figure 95 – Modem Back View



Refer to the Vanguard 5530MC manual for more information on the LED functions.

4. After you complete all of the steps and you are still having issues with the unit operating properly, call Neptune Customer Support at (800) 647-4832 for assistance with further diagnosis. See "Contacting Customer Support" on the facing page.

Verifying Cellular Modem Power

Remove the power plug from the cellular modem by pressing the latch to disengage it, and then remove the plug.

Measure between pins shown in Figure 96. There should be 12 VDC between the pins shown.

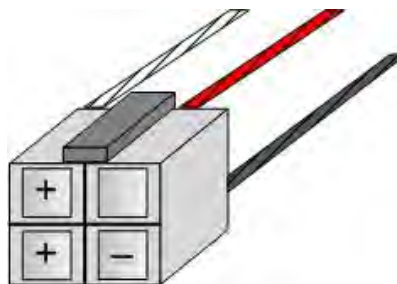


Figure 96 – Cellular Modem Power Plug

Report Now Function

The gateway can be forced to report back by momentarily pressing the SW1009 switch. See Figure 97.

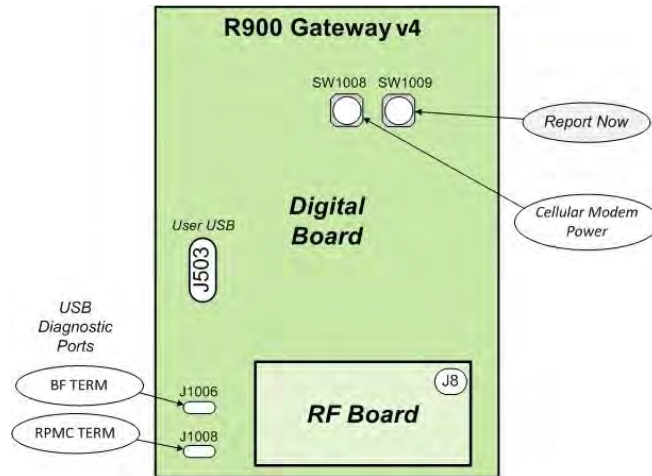


Figure 97 – Report Now Button

Contacting Customer Support

Within North America, Neptune Customer Support is available Monday through Friday, 7:00 A.M. to 5:00 P.M. Central Standard Time by telephone or email.

By Phone

To contact Neptune Customer Support by phone, complete the following steps.

1. Call (800) 647-4832.
2. Select one of the following options.
 - Press **1** if you have a Technical Support Personal Identification Number (PIN).
 - Press **2** if you do not have a Technical Support PIN number.
3. Enter the six-digit PIN number and press #.
4. Select one of the following options.
 - Press **2** for Technical Support.
 - Press **3** for maintenance contracts or renewals.
 - Press **4** for Return Material Authorization (RMA) for Canadian accounts.

You are directed to the appropriate team of Customer Support Specialists. The specialists are dedicated to you until the issue is resolved to your satisfaction. When you call, be prepared to give the following information.

- Your name and utility or company name.
- A description of what occurred and what you were doing at the time.
- A description of any actions taken to correct the issue.

By Email

To contact Neptune Customer Support by email, send your message to support@neptunetg.com.

Appendix A: Solar Power Information

Appendix A provides information on installing the solar panels.

Installation Considerations for Solar Panels

Install solar panels in a location where they receive maximum sunlight throughout the year. When choosing a site, avoid trees, buildings, or obstructions which could cast shadows on solar panels especially during the winter season when the arc of the sun is lowest over the horizon. See "Facing True South" on this page.

Magnetic Declination

Magnetic declination or variation is the angle on the horizontal plane between magnetic north (the direction the north end of a compass needle points, corresponding to the direction of the Earth's magnetic field lines) and true north (the direction along a meridian towards the geographic North Pole).

Correction for Magnetic Declination and Solar Panel Tilt

Facing True South

For optimum performance, your photovoltaic (PV) array (solar panel) should face true south in the Northern Hemisphere or true north in the Southern Hemisphere. However, when determining direction using a magnetic compass, indicated bearings vary from true bearings because of the difference between the location of the true magnetic north poles. This angular difference varies with location on the globe and is called the declination. Values of declination for the contiguous United States and portions of Mexico, Canada, and the Caribbean are shown on the map in Figure 98 on page 81.

Complete the following steps to correct for magnetic declination when sighting your solar panel.

1. Locate your site on the map shown in Figure 98 on page 81.
2. Interpolate the value for magnetic declination in degrees based on the lines of constant declination (isogonic lines) shown in Figure 98 on page 81. For example, the declination of Washington, D.C. is approximately -11° , for Chicago, IL, -1° , and for Los Angeles, CA, $+14^{\circ}$.
3. Determine magnetic south at your site using a magnetic compass.



If the local declination found in step two is negative, true south is that number of degrees added to magnetic south. For example, at Washington D.C., true south is the same as $180^\circ + 11^\circ = 191^\circ$ indicated.

If the local declination found in step two is positive, true south is that number of degrees subtracted from magnetic south. For example, at Los Angeles, true south is the same as $180^\circ - 14^\circ = 166^\circ$ indicated.

4. Orient your solar panel in direction of true south (or north if applicable) as determined above.
5. A declination chart for North America is provided in Figure 98 – on the facing page for assistance in determining the appropriate correction for other sites. Other suggested resources include World Aeronautical Charts (WAC), local airports, or government agencies, and the Internet site www.ngdc.noaa.gov/cgi-bin/, which calculates magnetic variation from an input of altitude, latitude, and longitude.

Specific Tilt Angle

For optimum performance, set your solar panel to a specific tilt angle.

Complete the following steps to determine the desired tilt angle of the solar panel.

1. Obtain a copy of an atlas.
2. Locate your site on the map.
3. Determine what latitude line closest intersects your region.
4. Take this value and add the factor based on the list in the following table.

This provides the optimum performance in the event of a worst case scenario, based on the winter months (Northern hemisphere). For example, if the solar panel location is at 32° latitude, take $32^\circ + 15^\circ = 47^\circ$. In this example, the solar panel tilt angle would be set for 47° .

Table 20 – Recommended Solar Panel Tilt Angle¹

Site Latitude Range (Degrees)	Recommended Fixed Tilt Angle
$45^\circ - 90^\circ$	60°
$25^\circ - 45^\circ$	Latitude + 15°
$15^\circ - 25^\circ$	Latitude + 5°
$0^\circ - 15^\circ$	15°

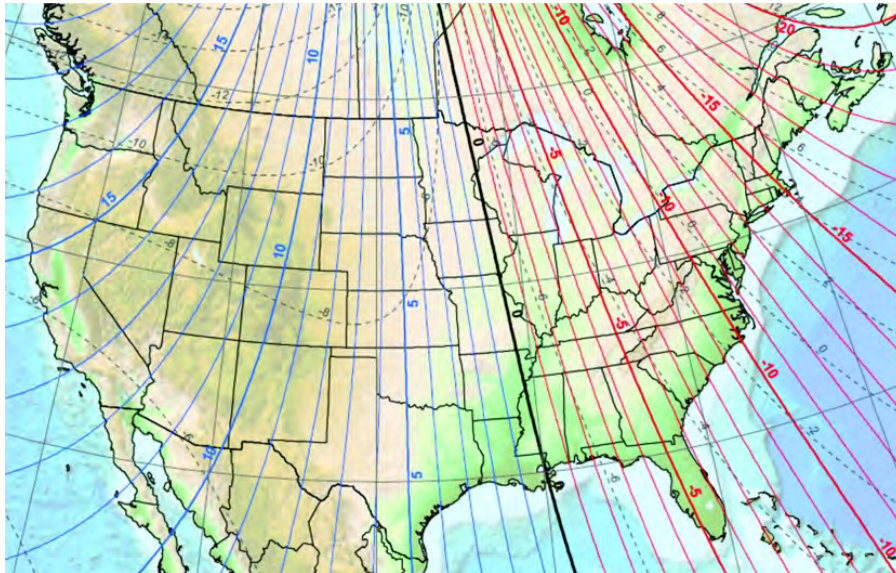
¹ Based on winter performance.



It is recommended that the solar panel tilt be limited to 15° for a minimum angle and 60° for a maximum tilt angle.

Magnetic Declination for the United States

The map of the United States in Figure 98 illustrates the magnetic declination of the United States. Magnetic declination refers to the angle between the Magnetic North (MN, compass north) and True North (TN) at any given latitude / longitude. The black contour line shows the imaginary line along which the declination is zero, where MN and TN converge. The magnetic declination increases as one moves east or west from this line. The red line shows the negative (west) declination contours, and the blue line shows the positive (east) declination contours. The degrees of declination required to orient the compass with the map is added east of this line and subtracted west of the line. Magnetic declination gradually changes with time and location. The dotted gray lines show the expected annual change in the magnetic declination in arc minutes. Figure 98 is produced from the World Magnetic Model (WMM).



Mercator Projection

<http://www.ngdc.noaa.gov/geomag-web>

Contours of Declination of the Earth's magnetic field, expressed in degrees.

Contour Interval: 1 Degree (Positive declinations in blue, negative in red)

Produced by National Oceanic and Atmospheric Administration's (NOAA) National Geophysical Data Center (NGDC), Boulder, Colorado

Figure 98 – Magnetic Declination U.S.

Selecting the Correct Solar Power System

Complete the following steps to select the correct solar power system for the gateway.

1. Determine the installation location.
2. Using Figure 99, determine in which zone the site is located.



Figure 99 – Solar Power Zones

3. Select the appropriate solar power system from the following table.

Table 21 – Solar Power System Selection

Zone	Solar Panel Wattage	Solar Power Dimensions	Solar Power System Selection Neptune Part No.
A, B, C, and D	160 W	26 inch x 58 inch	13068-200 (small pole / stand) 13068-400 (large pole)
E and Canada ¹	220 W	52 inch x 48 inch	13068-300 (small pole / stand) 13068-500 (large pole)

¹ If the utility is located near or along the boundary between Zones D and E, then the 220 W option is recommended.

- The small pole / stand version is for a 2-inch to 4-inch diameter schedule 40 galvanized steel pole or stand.
- The large pole version is for a 5-inch to 16-inch diameter pole.



When a site location is near a zone transition line, choose the larger size solar power system. For example, if the site location falls on transition line D and E, choose the zone E solar power system recommendation.

4. For accessories, contact your Neptune sales representative for the most current information.

Solar Power System Operation Summary

When the installation of the system is complete, you can expect the following typical performance.

- When sunlight is available, the system begins to charge. The amount of charging current available depends on the time of year and the position of the sun in the sky. There is low charging power in the morning, which gradually increases and reaches full potential during the middle of the day, then gradually decreases until the end of daylight. Usually, you can see both an increase in charging current and in battery voltage throughout the day.
- The charge controller, located inside the battery enclosure, regulates the charge.
- In the evening, the gateway runs strictly from battery. Throughout the evening, the battery discharges but remains at a safe operating level.
- The system battery is designed to carry the gateway through five continuous days of no sunlight availability. This allows the gateway to maintain operation without interruption through extended days without availability of sunlight.
- When the no-sun availability period exceeds five days, the system disconnects the gateway unit from the battery to prevent the battery from being discharged to the extreme. This happens when the battery voltage drops to 11.5 V, which is approximately 85% depth of discharge (DOD).
- Upon return of sunlight availability, the system recharges the battery and automatically reconnects the gateway when the battery voltage reaches 12.6 V. This does not happen immediately, because it must first allow the battery to reach a 50% state of charge (SOC) to ensure that the system does not cycle on and off repeatedly in a short time frame. Therefore, battery recharge can take one or more days, depending on the time of year and size of the system.

- The system voltage fluctuates throughout the year depending on outside air temperature. In cold weather, the system voltage can rise to 16 VDC (12 V battery); and in summer, it usually is 13.5 VDC (12 V battery). The range varies with specific controller type and battery configuration; however, this stated fluctuation can usually be expected. The load output tracks the battery voltage.

Troubleshooting the Solar Power System

The following table shows some of the issues you could experience with the solar power system and recommended actions to take.

Table 22 – Solar Power System Troubleshooting

Problem	Probable Cause	Recommended Action
No Charging Power	Overload solar / load	Verify that the load is not exceeding the system capability.
	High temperature disconnect	Allow the controller to cool down, and then verify continued operation.
	Reverse polarity	Configure the wiring terminations again to restore operation.
	Battery select fault	Verify that the jumper settings are correct for the system configuration.
	Solar panel is shaded	Confirm that the solar panel angle and direction are correct. Make sure there is no shade.
Load Disconnected	Load low voltage disconnect (LVD) trip on the load controller	Confirm that the battery voltage is above the LVD cutoff voltage of 11.5 V. If not, allow the battery to fully charge. LVD reconnects at 12.6 V.
	Load overload or short circuit	Check the wire terminations for proper configuration.
	LVD trip repeatedly	Verify that the load is not exceeding the system capability. Confirm that the battery depth of discharge (DOD) cycles have not exceeded the normal end of life.
Breaker Trip or Fuse Blown	Improper wiring	Confirm that wiring is correct and terminals are not corroded. Use an ohm meter to confirm the wire and terminal continuity.
	Short circuit	Confirm that the load end of the circuit breaker does not have a short circuit.
	Breaker damaged	Use an ohm meter to verify the breaker continuity out of circuit. Replace the breaker if necessary.

Troubleshooting the Solar Controller

You can measure load voltages at the designated terminal blocks.

- If the battery voltage is present at the load blocks, you can assume that the load fuse and the LVD are fully functional.



LVD occurs at 11.5 V. LVD reconnects at 12.6 V.

- If the battery voltage is above 12.8 VDC with the solar panel in the sunlight, and the load is attached and active, the controller is actively charging. During the daytime, the green charging LED should be illuminated.
- No further troubleshooting of the controller is required.

Solar Charge Controller

In general, two solar charge controllers (by Morningstar) are used in the solar power systems:

- SunSaver™-10L.
- ProStar-15.

The SunSaver™-10L charge controller has two topology generations: Gen 2 and Gen 3.

Both the SunSaver Gen 2 and SunSaver Gen 3 solar controllers ship with a jumper installed. This sets the controller for charging the sealed valve regulated lead acid (VRLA), and absorbent glass mat (AGM) batteries.

See Figure 100 on page 86 below and Figure 101 on page 87.

SunSaver™ Gen 2

The SunSaver Gen 2 solar controller is shown in the following figure.



Figure 100 – SunSaver™ Gen 2 Solar Controller

Green LED

The green LED indicator illuminates whenever sunlight is available for battery charging and turns off at night. Because the SunSaver uses a PWM constant voltage charging process, there is usually some amount of energy going into the battery at any given time. Although the charging current falls to very low levels when the battery reaches full charge, the green LED remains illuminated during the daytime, indicating that the controller is working, and energy is available from the solar panel for charging.

Red LED

The SunSaver Gen 2 includes an LVD feature indicated by a red LED. Whenever the battery charge state falls below the LVD set-point (11.5V), the load is disconnected, and the red LED illuminates. This indicates that the controller has disconnected the load to protect the battery from further discharge and possible damage. After some period of time recharging the battery—so that it recovers almost 40 to 50 percent of its rated capacity (12.6V)—the load automatically reconnects and the red LED is unlit.

SunSaver™ Gen 3

The SunSaver Gen 3 solar controller has different LED status lights than the SunSaver Gen 2.



Figure 101 – SunSaver™ Gen 3 Solar Controller

Charging Status LED

The charging status LED indicates controller state and any existing solar input error conditions. The charging status LED is on when charging during the day and off at night. The charging status LED flashes red whenever an error condition exists. "Charging Status LED Definitions" below lists the charging status LED definitions.

Table 23 – Charging Status LED Definitions

Color	Indication	Operating State
None	Off (with heartbeat—status LED heartbeat indication flickers ON briefly every five seconds).	Night.
Green	On solid (with heartbeat—status LED heartbeat indication flickers OFF briefly every five seconds).	Charging.
Red	Flashing.	Error.
Red	On solid (with heartbeat—status LED heartbeat indication flickers OFF briefly every five seconds).	Critical error.

Battery Status LEDs

Three battery status LEDs indicate the level of charge on the battery—based only on battery voltage set points—providing an approximation of the actual SOC of the battery. Table 24 on the next page identifies the battery status LED definitions.

Table 24 – Battery Status LED Definitions

SOC LED	Indication	Battery Status	Load Status
Green	Fast flashing (2 flash / sec).	Full battery: equalize charge.	Load on.
	Med. flashing (1 flash / sec).	Full battery: absorption charge.	Load on.
	Slow flashing (1 flash / 2 sec).	Full battery: float charge.	Load on.
	On solid.	Battery nearly full.	Load on.
Yellow	On solid.	Battery half full.	Load on.
Red	Flashing (1 flash / sec).	Battery low.	LVD warning (load on).
	On solid.	Battery empty.	LVD (load off).
None	No LEDs on.	Battery missing.	Load off.



An error condition exists if multiple battery SOC LEDs are flashing. See "Battery Status LED Error Indications" on the facing page for more information.

LED Error Indications

The following tables describe how to interpret the LED error indications.

Table 25 – Charging Status LED Error Indications

Error Condition	LED Status
Solar Overload	Flashing red.
High Voltage Disconnect	Flashing red.
High Temperature Disconnect	Flashing red.
Damaged Local Temperature Sensor	Solid red ¹ .
Damaged Heat-sink Temperature Sensor	Solid red ¹ .
Damaged Input MOSFETs	Solid red ¹ .
Firmware Error	Solid red ¹ .

¹ A heartbeat indication flickers the Status LED off briefly every five seconds. A solid red Status LED indicates that a critical fault has been detected. Critical faults typically indicate that the controller is damaged and requires service.

Table 26 – Battery Status LED Error Indications

Error Condition	LED Status
High Voltage Disconnect	R-G sequencing – the red LED is on, then the green LED is on, then red LED is on, and so forth.
High Temperature Disconnect	R-Y sequencing – the red LED is on, then the yellow LED is on, then red LED is on and so forth.
External Wiring Error	R&G-Y sequencing – both the red LED and green LED are on, then just the yellow LED is on, then red and green LED are on, and so forth.
Load Over Current	R&G-Y sequencing.
Load Short Circuit	R&G-Y sequencing.
Self-test error	R-Y-G sequencing – the red LED is on, then the green LED is on, then the yellow LED is on, then the red LED is on, then the green LED is on, and so forth.

ProStar® Controllers

There are four different ProStar® controller models that may be installed in the solar power systems.

- PS-15 (15A rating).
- PS-15M (15A rating, with digital meter option included).
- PS-30 (30A rating).
- PS-30M (30A rating, with digital meter option included).



Figure 102 – ProStar® Controllers

The ProStar controllers have three LEDs which indicate charging status, battery status, and various faults.

Charging Status

For charging status indications, see below.

Table 27 – Charging Status LED Indicator

LED Color	Charging Status
Green	- ON – battery charging during sunlight (always on during sunlight). - OFF – normal during night (off during sunlight indicates solar reverse polarity or overcurrent).

Battery Status

For battery status indications, see below.

Table 28 – Battery Status LED Indicators

LED Color	Battery Status
Green	- ON – indicates battery is near full charge. - BLINKING – indicates PWM charging (regulation).
Yellow	ON – indicates battery at middle capacity.
Red	- BLINKING – indicates a low charge state and a LVD warning. - SOLID – indicates that the load has been disconnected (LVD).

Fault Indications

For fault indications, see Table 29 .

Table 29 – Fault Indications

LED Color	Fault Indications (G = green, Y = Yellow, R = Red)
G/Y/R blinking together	Battery select fault.
R - Y sequencing	High temperature disconnect.
R - G sequencing	High voltage disconnect.
R/G - Y sequencing	Load short circuit or overload.

Digital Meter

The ProStar PS-15M and PS-30M controllers include an optional digital meter. This section describes the information that can be displayed with the meter, and the added capabilities that are enabled by the push button switch (for example, manual disconnect).

The precision three-digit digital meter continuously displays battery voltage, solar current, and the load current. The meter automatically scrolls through these three displays. The three red LEDs indicate which parameter is being displayed.

The digital meter operates from -30°C to $+85^{\circ}\text{C}$. The values displayed are calibrated electronically in production and are accurate to within a few percent.



- If the Battery Sense is not connected, the voltage displayed is in error by the voltage drops in the battery wires.
- If the battery is located more than 5 meters from the controller, the Battery Sense connection is recommended.

Manual Disconnect

The ProStar PS-15M and PS-30M controllers have a push button next to the digital display which can disconnect the load or both load and solar. A second push of the button returns the controller to normal operation.

- LOAD OFF – A brief push of the button (less than two seconds) disconnects the load. The solar remains on and charging.
- LOAD and SOLAR OFF – If the button is held for two seconds, the solar is disconnected.

When the button is pushed, the red LED inside the cap lights up. In addition, the load or both load and solar displays OFF in the digital meter to indicate the disconnected state.

Display Disconnects and Protections

The following protection functions and disconnect conditions are displayed in the digital meter when they occur.

- Lud – Low voltage disconnect (load only).
- Hud – High voltage disconnect (both solar and load).
- Hot – High temperature disconnect (both solar and load).
- OCP – Overcurrent and short circuit protection (load, solar, overcurrent).
- 0.0 – Short circuit protection (solar only).

Self-Diagnostics (Self-Test)

If you hold the push button for four seconds, the ProStar goes into automatic self-diagnostics. The button must be released to start the self-test. See Table 30



You can use the push button to toggle through the displays faster. The entire self-test takes 30 to 45 seconds. The load is turned on for 0.1 seconds and can flash during the test. A short or overload condition could cause a controller restart.

Table 30 – Self-Test Display Examples

Display	Battery Status
8.8.8	Self-test started, checking the digital meter segments.
12u	System voltage (12 / 24 / 48).
15A	ProStar current rating.
r1.5	Software version installed.
E04	Fault detected (see Table 31 on the facing page for fault error list).
---	Display if no fault is found.
25c	Temperature measured at the controller remote.
rP	Temperature probe is detected (if connected).
25c	Temperature at the remote probe (if connected).
SEn	Battery sense detected (if connected).
S-2	Battery selected position (1, 2, or 3). Example: Position "2" is the desired position for AGM batteries.
J-1	Telecom noise jumper cut (change to on-off regulation).
END	End of self-test.
END---END	Display; continues if no error was detected.
END END	Display; continues if an error has been detected.

Table 31 – Fault Error List

Display	Error Condition
E01	Rotary switch battery selection failure.
E03	Voltage reference test failed (circuit, malfunctions).
E04	Solar array current fault (circuit), Field-Effect Transistor (FET).
E07	Load FETs off test (load connection, FETs shorted).
E08	Load current fault (circuit, FETs).
E09	Load FETs on test (load circuit, FETs open).
E10	Internal temp sensor out of range high.
E11	Internal temp sensor out of range low.
E12	Remote temp probe out of range.
E13	Battery sense fault (battery V drop over 5V, no Sense negative connection).

Terminate the Self Test

To terminate the self test, push the button. The self test can be repeated to confirm the result.

Select Battery Type

The ProStar controllers contain a battery type rotary switch that allows the selection of one of three charging algorithms. Set the Battery Type switch to position 2 (Sealed: AGM). The switch positions are defined as the following battery types.

Table 32 – Battery Type Switch Positions

Switch Position	Battery Type
1	Gel – Some gel and other battery types recommend lower regulation voltages and no equalization. This setting regulates to 14.0V (for a 12V battery).
2	Sealed – AGM, "maintenance free" and some types of gel batteries. Regulates to 14.15V (12V battery) with 14.35V boost charging.
3	Flooded – Vented cells that require water to be added. Regulates to 14.4V with 14.9V and 15.1V actualization (12V battery).

Additional Troubleshooting Information

For additional troubleshooting information, refer to the *ProStar Solar Controller Operations Manual*. This should be included with the solar power system. The manual is also available online from Morningstar.

Troubleshooting the Solar Panel's Battery

You can measure both the batteries voltage open circuit (Voc) and voltage under charge (Vuc). The Vuc is a simple method to measure voltage without disabling the load or disabling the system from charging. Use Voc when the battery end-of-life is in question and a more accurate means of measurement is required.

Batteries should be tested for end-of-life whenever a particular system begins to fall in a SOC below 80% repeatedly, or the system begins to exhibit LVD on a recurring basis. Battery life varies depending on load use, depth of discharge, and temperature extremes, but can vary between three to ten years.

Complete the following steps to measure for battery end-of-life.

1. Disconnect the battery from the system.
2. Charge the battery with an appropriate three-stage battery charger.
3. After completion, allow the battery to settle for three hours with no charge or load attached.

Table 33 provides Voc and Vuc for SOC at 25°C.

Table 33 – Voltages for SOC at 25°C

SOC (%)	Voc	Vuc
100	12.8	14.20
80	12.6	12.91
60	12.3	12.60
40	12.0	12.25
20	11.8	11.81
0	<11.6	<11.81

- If an individual battery does not hold a voltage of a least 12.6 VDC open circuit after a full charge and a three-hour wait period under no load, you could have a damaged cell and require a battery replacement.
- If battery voltage climbs very rapidly under charge, then falls rapidly after removing the charge, you could have a damaged cell and require a battery replacement.



The same battery, Sun Xtender Part No. PVX-1040T, is used in the 160 W and 220 W solar power options.

The following table provides the 120-hour load voltages during the discharge cycle from full charge to 100% discharge to 10.5V at 25°C (77°F).

Table 34 – Battery Load Voltage by DOD

DOD (%)	Battery Voltage (volts)
10	12.69
20	12.58
30	12.45
40	12.32
50	12.18
60	12.05
70	11.88
80	11.65
90	11.40
100	10.50



These voltages are averages. They vary slightly from battery to battery even if they are of the same rating. However, they are a good indicator of state of charge for AGM batteries. This data is for newer batteries with relatively few cycles. An older battery measures a lower voltage for a given depth of discharge (DOD).

Solar Panel Troubleshooting

This section provides information that can assist with troubleshooting problems with a solar panel.

Decreased Solar Panel Output

The solar panel is designed for long life and requires very little maintenance. Under most weather conditions, normal rainfall is sufficient to keep its glass surface clean and free of debris. Inspect for this annually. When solar panels are dirty, it can decrease the power output by 10-15%.

If dirt build up becomes excessive, clean the solar panel's glass surface only with a soft cloth using Windex or a mild dish washing soap (such as Dawn) and water.



Do not use harsh or abrasive chemicals to clean solar panels, because they could damage the seal between the frame and the laminate. Panels should never be pressure washed, because pressure washing forces moisture through the front glazing seal causing corrosion.

When choosing a site, avoid trees, buildings or obstructions which could cast shadows on the solar panel. Especially during the winter season, when the arc of the sun is lowest over the horizon. See "Facing True South" on page 79. Partial shading (3-13%) can cause a 25-54% reduction in output power from the solar panel.

Install solar panels in a location where they receive maximum sunlight throughout the year. In the northern hemisphere, the solar panel should face true south, and in the southern hemisphere, the solar panel should face true north. Panels facing 30° away from true South (or North, if Southern Hemisphere) lose approximately 10-15% of their power output. If the solar panel faces 60° away from true South (or North), the power loss is 20-30%.

Solar panels should be tilted for optimum winter performance. Incorrect tilt (off by 15°) can cause approximately a 7% reduction in solar power production. In general, if the system power production is adequate in the winter, it is satisfactory during the rest of the year. The tilt angle of the solar panel is measured between the solar panel and horizontal ground. See "Solar Power Zones" on page 82.

Verifying Solar Panel Output

If the solar panel is unobstructed, unshaded, at the correct tilt angle, and in full light between 10 A.M. and 3 P.M., you can verify the solar panel's performance per the nameplate ratings for Voc and short circuit current (ISC) as follows.

Complete the following steps to verify the solar panel output.

1. Set the **PV(+)** breaker to **OPEN (OFF)** position.
2. Using a volt meter, measure the Voc voltage between the **PV(+)** and **PV(-)** terminal blocks. It should measure within 5% of the nameplate rating in LOW to HIGH sunlight.
3. Set the **PV(+)** breaker to **CLOSED (ON)** position.
4. Using an ammeter rated for a maximum system ISC value, measure the charging current through the **PV(+)** terminal.

In LOW sunlight, it should measure approximately 30% or less of the rating shown on the nameplate: 60% or less of nameplate rating in MED sunlight; and 60% or greater in HIGH sunlight. The degree of sunlight is based on cloud cover and height on the horizon for that time of day in winter.

Table 35 provides the degree of sunlight at various times on a clear, sunny day in the winter.

Table 35 – Sunlight by Time of Day in Winter

Degree of Sunlight	Time	Sun Capacity
LOW	7:00 A.M. - 9:00 A.M.	10 - 30%.
MED	9:00 A.M. - 11:00 A.M.	30 - 60%.
HIGH	11:00 A.M. - 1:00 P.M.	60 - 100%.
MED	1:00 P.M. - 3:00 P.M.	30 - 60%.
LOW	3:00 P.M. - 5:00 P.M.	10 - 30%.

Table 36 provides the degrees of sunlight at various times on a clear, sunny day in the summer.

Table 36 – Sunlight by Time of Day in Summer

Degree of Sunlight	Time	Sun Capacity
LOW	7:00 A.M. - 9:00 A.M.	10 - 30%.
MED	9:00 A.M. - 11:00 A.M.	30 - 60%.
HIGH	11:00 A.M. - 2:00 P.M.	60 - 100%.
MED	2:00 P.M. - 5:00 P.M.	30 - 60%.
LOW	5:00 P.M. - 8:00 P.M.	10 - 30%.

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This appendix discusses the requirements for a proper ballast for the gateway stand (a non-penetrating roof mount).

Ballast Requirements

Prior to installation, verify that the supporting structure (for example, rooftop) has been investigated and found capable of withstanding all loads imposed by the proposed gateway system installation. If it has been determined that a particular supporting structure cannot withstand the load imposed by the proposed gateway system using the JRM stand (5 ft. by 5 ft.), then a larger footprint stand (such as ROHN BRM4 or BRM6) may be considered. The larger footprint stand requires less ballast for the same given EPA (Effective Projected Area). See Table 37

Table 37 – ROHN Stand Footprint Dimensions

ROHN Stand Model No.	Footprint Dimension	Protective Pad (¾" thick)
JRM	5 ft. x 5 ft.	JRMPAD.
BRM4	6.5 ft. x 6.5 ft.	BRM4PAD.
BRM6	10 ft. x 10 ft.	BRM6PAD.

The installation must meet all applicable local, state, and federal requirements. All antenna installations (including stand and mast) must be grounded to meet applicable electrical codes.



ROHN recommends a minimum 75 mph Effective Wind Velocity be used for determining ballast requirements. Local codes may require higher velocities or for sites located on hills, escarpments, coastal areas, or ridges (refer to ANSI/TIA-222-G). Do not rely on the information presented without competent professional examination and verification of its accuracy and suitability for a specific site or application.

Ballast material can be applied in the form of concrete blocks, 4" x 8" x 16" (10 cm x 20 cm x 40 cm) or 8" x 8" x 16" (20 cm x 20 cm x 40 cm) which weighs 20 lbs to 30 lbs each. Verify weight with the local supplier. Evenly distribute the ballast material.



Install a roof pad beneath the stand to protect the roof surface. For a 5 ft. x 5 ft. (1.5 m x 1.5 m) ROHN stand, use ROHN Part No. R-JRMPAD or JRMPAD.

ROHN Industries Stand

The ROHN-JRM stand ships disassembled on one skid and weighs approximately 50 lbs when assembled. It is 10 ft. (3 m) high and has a base that is 5 ft. x 5 ft. (1.5 m x 1.5 m). The stand is galvanized for corrosion protection. For ballast requirements for the ROHN Industries Stand (Part No. JRM23855), refer to the JRM Non-Penetrating Roof Mount section at ROHN'S website.

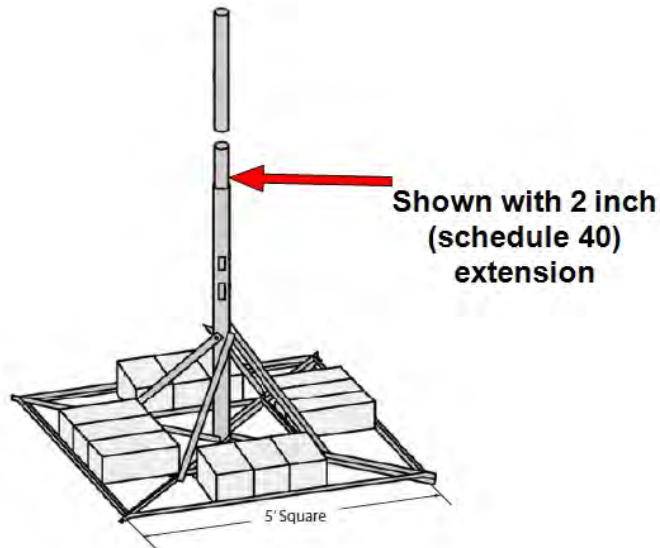


Figure 103 – ROHN JRM23855 Stand

Appendix C: RF Antenna and Coaxial Installation

This appendix provides information about how to install the RF antenna and coaxial cable.



Neptune recommends that you consult with a qualified installer on the design and installation of the antenna system. If the installer is already familiar with the site and the existing equipment, this can make the installation go more smoothly.

RF Antenna Overview

There are a number of critical items you must consider when placing and installing antennas. The following table contains actions that can influence the antenna placement and installation.

Mounting the Antennas

Consider the following when mounting the antennas.

Table 38 – Mounting Antenna Considerations

Action	Consideration
Mount antennas as high as possible with an unobstructed view of the coverage area.	• The supporting structure, if the antenna is not mounted above it, can cause specific areas of limited coverage. • Water towers can severely limit coverage where the signal must pass directly through the tank. When mounting antennas on a water tower, it is recommended that they be mounted on top as close to the center as possible. • When mounting the antenna on a traditional three-leg or four-leg tower, the standoff mount for the antenna must position the antenna at least 5 feet away from the tower to minimize coverage area problems.
Avoid making the antenna the tallest point in the surrounding area.	This may be unavoidable, but it increases the risk of the antenna being damaged by lightning.

Site Recommendations

The following is a list of recommendations for sites with multiple transmitters, receivers, and antennas. These sites require extra care.

- Avoid mounting the antenna so that it is at the same height as another on the site, regardless of the frequencies.
- Mount the antennas one above the other (if possible) for sites that have multiple antennas. Separate each antenna by at least 10 feet. This minimizes the interference between the systems.
- Exception to the previous rule is for cellular antennas. As long as the antenna is either above, below, or in the middle of the ring of cell antennas, the two systems can coexist without inference.
- Antenna sites that must share space with multiple transmitting systems could require additional equipment to protect the systems from interfering with each other. These sites could also require additional engineering to make them perform well.
- If there are radio systems at the site that are already operating on the frequency band, it can be advantageous to combine the signals into one antenna system using the appropriate equipment. This often works better than attempting to protect the individual systems from interfering with each other.
- Managed antenna sites can require additional equipment, and might dictate how an installation is to be performed. Follow the site's requirements as long as the installation meets Neptune's minimum requirements.

Antenna Requirements

Consider the following:

- The antenna—if mounted on the side of a tower or other supporting structure—must be mounted so that it is at least 5 feet away from the structure. The components to offset the antenna are specific to the installation which Neptune does not provide.
- The antenna must be carefully hoisted up a tower so that it is not damaged.
- The feed line should not be attached to the antenna while it is being hoisted up the tower or other supporting structure. The feed line should be attached after the antenna is in place.
- The antenna connector must not be damaged during installation. There have been reports of damage to the antenna's N connector where the center pin has become bent and shorts out the antenna system.

Feed Line Overview

The feed line is a significant contributor to both good and poor system performance. A properly installed feed line is critical to optimal system performance. Testing the antenna while it is on the ground can ensure the system works properly. It is best to install the connectors with the proper tools and a trained installer. With the proper tools and jigs, installing coaxial connectors takes only a few minutes each. Not using the proper tools as recommended by the manufacturer could potentially cause problems, either immediately or after several years of seemingly proper operation.

Coaxial Cable Lengths for the Gateway

Table 39 provides part numbers of acceptable coaxial cables.

Table 39 – Acceptable Coaxial Cables

Length	Part Number
40 ft. or <	Times Microwave Part Number: LMR-400-UF or LMR-400.
100 ft. or <	Andrew Part Number: LDF4-50A.
> 100 ft.	Andrew Part Number: AVA5-50 or AVA5-50FX.

You can order coaxial cable assemblies already terminated as accessories from Neptune or purchased from companies such as Tessco Technologies, Talley Communications, and Hutton Communications. Each end must be terminated with an N-male type connector. However, the larger 7⁄8-inch diameter coaxial cable, such as Andrew AVA5-50, uses a 7-16 DIN female connector on each end. Jumpers provide downsizing for the last 6 feet of the installation, allowing a more flexible and manageable connection. The jumpers are assembled with the appropriate connectors at each end: a 7-16 DIN male on one end and an N-male on the other. See Table 40 on the next page.

Table 40 – Coaxial Order Matrix

Coaxial Lengths	Description	Loss/100 ft. @ 900 MHz	Max Length	Min Bend Radius	Neptune Part No.	Manufacturer Part No.
≤ 60 ft. - Pre-terminated Coaxial Cable Assemblies	LMR-400-UF 10 ft. assembly	4.7 dB	40 ft.	1"	13090-001	Tessco LMR400UFNMNM-10.
	LMR-400-UF 20 ft. assembly	4.7 dB	40 ft.	1"	13090-002	Tessco LMR400UFNMNM-20.
	LMR-400-UF 30 ft. assembly	4.7 dB	40 ft.	1"	13090-003	Tessco LMR400UFNMNM-30.
	LMR-400-UF 40 ft. assembly	4.7 dB	40 ft.	1"	13090-004	Tessco LMR400UFNMNM-40.
	LDF4-50A 50 ft. assembly	2.09 dB	100 ft.	5"	13090-006	Tessco 377096 or Hutton HSF-L4A-PNMNM-50.
≤ 100 ft.	Cable, Coaxial, Helix ½-in. Diameter	2.09 dB	100 ft.	5"	10046-119	Andrew LDF4-50A.
≤ 100 ft.	Connector, Coaxial N-male (two connectors required per installation)	n / a	n / a	n / a	8138-200	Andrew L4TNM-PS.
≤ 200 ft.	Cable, Coaxial, Helix 7/8-in. Diameter ¹	1.08 dB	200 ft.	10"	10046-118	Andrew AVA5-50 or AVA5-50FX.
	Connector Coaxial, 7-16 DIN Female (two connectors required per installation)	n / a	n / a	n / a	8138-190	Andrew AL5DF-PS or Andrew 78EZDF.
	Cable, Coaxial 6 ft. Jumper N-Male to 7-16 DIN male (two jumpers required per installation)	n / a	n / a	n / a	10046-117	Andrew F4A-PNMDM-6-USA.

Feed Line Requirements

Consider the following:

- The antenna and feed line system installation must be certified by the installer after it is completed. The installer confirms that the installation is performing according to specifications.
- The cable must be secured at intervals per manufacturer specifications on vertical and horizontal runs. Horizontal runs may require a bridge to prevent damage.
- The feed line and connectors maximum loss must be less than 3dB.
- The feed line must be bonded at the top of the tower and at the base of the tower. Use Andrew bonding kits and procedures for all bonds.
- The feed line should be bonded at regular intervals down the tower for towers over 150 feet tall. The general recommendation is that the feed line should be bonded by a minimum of 200 feet. Site requirements and standard practices should dictate the configuration.
- A surge protector can be installed on the tower near the antenna to help protect the feed line, but it is optional.
- The cable should not exceed the bend radius. This helps prevent damage, which is not always visible on the exterior of the cable.
- The AVA5-cable (or larger) needs jumpers between the larger cable, and the collector and antenna connectors.
- The installation could use more than one type of coaxial cable. The ½-inch cable is flexible and may be used for the last section of a coaxial run to the collector, if the additional flexibility is required. See "Coaxial Cable Lengths for the Gateway" on page 103.
- The installation instructions for the Helix Coaxial Cable are provided by Andrew. See Bulletin 17800B Revision C. Neptune can supply a PDF copy by request through Customer Support.

Table 41 – Installation Materials Needed

Items	Description/Recommendation
Securing Coaxial Cable	- Cable clips / coaxial hangers - for ½" or ¾". - UV-Stable cable ties 8"- 12" (20.32 cm-30.48 cm).
Weatherizing Kit	Pick one of the following: - PolyPhasor P/N: WK-1. - Times Microwave P/N: WK-S-2. - Andrews P/N: 245171. - Scotch P/N: WK-101.
Additional Weatherizing Materials	- Scotch® Heavy Duty Vinyl 22. - Scotch® Super 88 Electrical Tape. - Scotch® Super 33+ Electrical Tape.
Coaxial Ground Kits	Manufacturer specified for specific cable.
Coaxial Hoisting Grips	Manufacturer specified for specific cable.

System Certification

The antenna supplied is specified as having a VSWR of 1.5:1 for operating frequency. When measuring VSWR, you need to take into account losses in the feed line. The 1.5:1 VSWR translates into a Return Loss of 14.0dB. It is recommended that the feed line be certified as a separate step. This is best performed by completing the following steps.

1. Put a known amount of power into one end of the cable.
2. Correct the cable losses.
3. Verify the correct amount of power is coming out the other end with the proper test equipment, such as Frequency Domain Reflectance (FDR) or Time Domain Reflectometry (TDR) cable and antenna testers.

Appendix D: Cellular and Ethernet Considerations

This appendix provides information on the cellular modem used with the R900[®] gateway and the Ethernet.

Cellular Modem Overview

The Sierra Wireless RV55 modem is an LTE-Advanced cellular router that supports LTE and HSPA+ radio bands.

Table 42 – Certifying Carriers by Nation

United States	Canada	Mexico
• AT&T • Verizon	• Rogers – certification pending • Bell – certification pending • Telus	• AT&T • Telcel • Movistar • Virgin Mobile Note: Operation in Mexico requires the R900 gateway variant (PN: 13458-200) that contains the global variant of the Sierra Wireless Modem.

Configuring the Cellular Modem

To manually configure the cellular modem for the gateway, refer to the *Quick Start Guide* for the modem in your unit.

- The *Sierra Wireless RV55 Quick Start Guide* is found on Sierra's website: <https://www.sierrawireless.com>.
- The *Vanguard 5530MC Quick Start Guide* is found on CalAmp's website: <http://www.calamp.com/help/devicehelp/desktop/homepage.htm>.

Equipment Required

To configure the cellular modem, you need the following equipment:

- Laptop or PC with Ethernet network port.
- *Vanguard 5530MC Quick Start Guide*.
- Ethernet cable.
- Cellular service provider, SIM card, if applicable, APN, and password (from the cellular service provider).



Certain cellular services, such as CDMA, don't require a SIM card to operate. However, some cellular services do require a SIM card, such as GSM (EDGE and GPRS). Verify with cellular service provider.

Configuring the Modem

Your gateway may include the Sierra Wireless RV55 modem or Cal Amp Vanguard 5530 MC modem. Complete the following steps according to the modem in your gateway.

Configure the Sierra Wireless RV55 Modem

Complete the following steps to configure the Sierra modem.

1. Check to see if a SIM card is present.

If a SIM card is not present, complete the following steps.

- Use a #1 Phillips screwdriver to remove the SIM card cover.
- Insert the SIM card into the upper slot. When the Sierra modem is powered on or reboots, it automatically connects to the network associated with the SIM card.
- Re-attach the SIM card cover.

2. Power on the modem.

When the modem is powered on, a green LED chase occurs. This indicates that the radio module is being configured for your SIM card. This process can take 6 - 7 minutes to complete.

After the radio module is configured for the SIM card, it begins the activation / provisioning process and attempts to connect to the mobile network. This process takes a few minutes. A successful connection is indicated by a solid green Network LED.

3. Verify the power, signal, and network lights are illuminated.

- Power: Solid Green.
- Signal: Flashing Amber, Solid Amber, or Solid Green.
- Network: Solid Green.

If the service is not operational, contact the service provider. For customization or more details on configuration, refer to the *ALEOS Software Configuration User Guide for AirLink RV55*.

Configure the CalAmp Vanguard 5530MC™ Modem



The customer maintains the username, password, and APN information provided by the cellular service provider.

Complete the following steps to configure the cellular modem.

1. Insert the SIM card, if applicable in the cellular modem's SIM card slot. For CalAmp Vanguard 5530MC™, be sure to insert the SIM card gold side facing upward.
2. Verify that the gateway is powered on if you are configuring the cellular modem in the field.



It takes about three minutes for the gateway to boot.

3. Verify the status LEDs on the cellular modem are:
 - RSSI - active.
 - SVC - active or flashing.



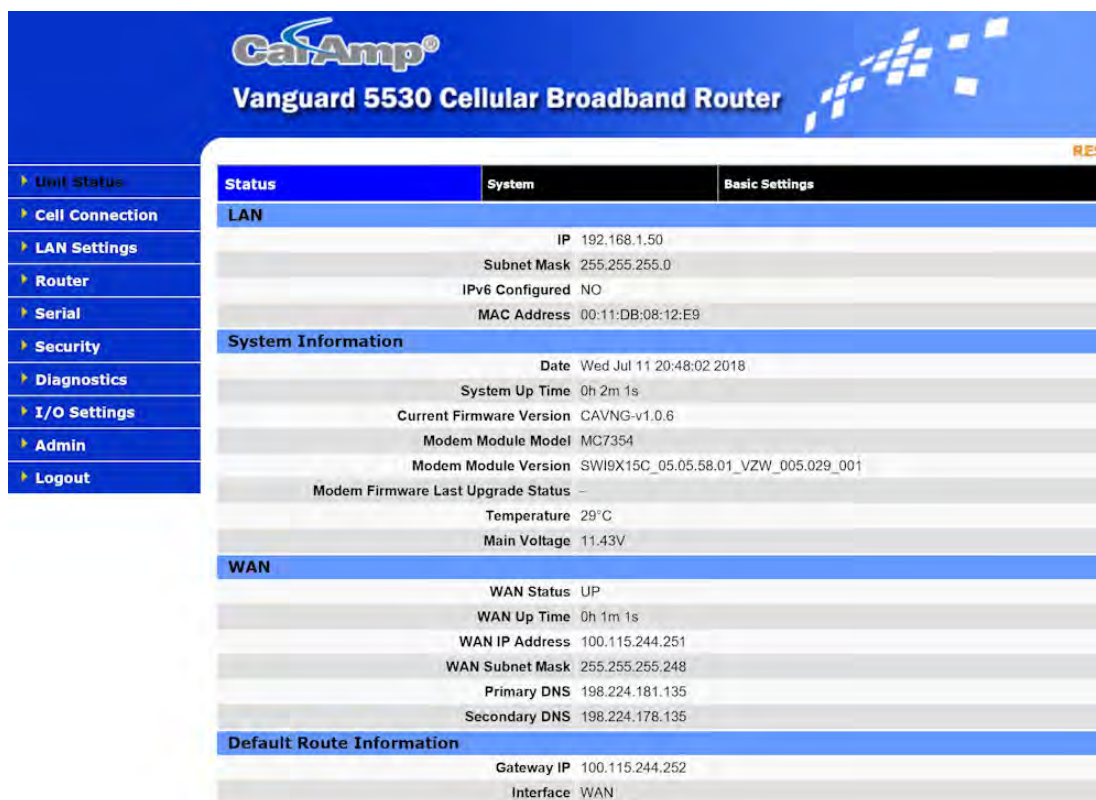
Figure 104 – Cellular Modem Front - Status LEDs



Figure 105 – Cellular Modem Back - Status LEDs

4. Run the online configuration application for the modem by following the steps outlined in the *Quick Start Guide* for the Vanguard 5530MC.

The Unit Status window appears.



Status	System	Basic Settings
LAN		
IP	192.168.1.50	
Subnet Mask	255.255.255.0	
IPv6 Configured	NO	
MAC Address	00:11:DB:08:12:E9	
System Information		
Date	Wed Jul 11 20:48:02 2018	
System Up Time	0h 2m 1s	
Current Firmware Version	CAVNG-v1.0.6	
Modem Module Model	MC7354	
Modem Module Version	SWI9X15C_05.05.58.01_VZW_005.029_001	
Modem Firmware Last Upgrade Status	-	
Temperature	29°C	
Main Voltage	11.43V	
WAN		
WAN Status	UP	
WAN Up Time	0h 1m 1s	
WAN IP Address	100.115.244.251	
WAN Subnet Mask	255.255.255.248	
Primary DNS	198.224.181.135	
Secondary DNS	198.224.178.135	
Default Route Information		
Gateway IP	100.115.244.252	
Interface	WAN	

Figure 106 – Unit Status Window

5. Verify the service is operational by opening an Internet browser page on the laptop.
If you are able to successfully connect to a Web page, then the service is operational.



If the service is not operational, contact the service provider.

If you are unable to connect to a web page, refer to the *Vanguard 5530MC User Manual*.

Provisioning the Vanguard 5530MC™ Modem



After initial log on, change the password to enhance modem's security. Contact Neptune Customer Support for how to change the password on the Vanguard 5530MC modem.

To provision the Vanguard 5530MC for service, complete the following steps.

1. Log on using **admin** as user name, and **password** as the password.
2. Confirm the settings, and then click **OTASP**.

The provisioning process could take up to 90 seconds.

3. Click **Reset**, and then click **Reboot**, after the modem is provisioned.
4. Click **Yes** to confirm reboot, when prompted.

Provisioning is completed after rebooting, when the confirmation message displays and the PPP status is UP.

Modem Setup Troubleshooting

If you finish provisioning the modem and the main screen still displays empty fields, select the **Cell Connection** tab, then **Carrier**, and make sure that you have a primary carrier selected. Carrier APN must be populated with a number that you obtain from the carrier.

4G LTE Signal Quality

To check the 4G LTE signal strength values of your cellular router (or modem), log in your cellular router's Web User Interface (UI), using a direct Ethernet connection. Referencing the cellular router's *"Quick Start Guide."*, note that a SIM card—with activated account—must be installed and the cellular router must already be provisioned.

For 4G LTE service mode, there are four relevant measurements:

- **RSSI** - Received Signal Strength Indicator. The **RSSI** is a negative value, and the closer to 0, the stronger the signal.
- **RSRP** - Reference Signal Received Power. The **RSRP** is the power of the LTE Reference Signals spread over the full bandwidth and narrowband.
- **RSRQ** - Reference Signal Received Quality. The **RSRQ** is a C / I type of measurement and it indicates the quality of the received reference signal (similar to EC / IO).
- **SINR** - Signal to Interference plus Noise Ratio. A minimum of -20 dB is needed to detect the **RSRP / RSRQ**. Indicates the throughput capacity of the channel. The **SINR** is the strength of the signal divided by the strength of any interference.

Table 43 – 4G LTE Cellular Signal Quality Measurements*

4G LTE Signal Quality	RSSI (dBm)	RSRP (dBm)	RSRQ (dB)	SINR (dB)
Excellent	> -65	> -80	N / A	> 10
Good	-65 to -77	-80 to -94	> -9	6 to 10
Fair	-78 to -93	-95 to -115	-9 to -12	0 to 5
Poor	-94 to -102	-116 to -1000	-12 to -20	< 0
Inadequate	< -103	< -1000	< -20	N/A

* Data extracted from Sierra Wireless "Software Configuration User Guide for AirLink Rv55".



An excellent or good RSSI value alone is not necessarily a good indicator of cellular signal quality. The RSRP and RSRQ must be considered as well.

Cellular Modem Conversion Kit

The cellular modem conversion kit (Neptune Part No. 13939-000) is an optional kit that's required to convert an Ethernet version gateway to a cellular version gateway in the field.

Upgrading to the Sierra Wireless RV55 Modem

See Appendix E "R900® Gateway Modem Upgrade" on page 117.

External Cellular Antenna Option

Some installation sites can have a very weak signal (-90 dBm or weaker). An optional external cellular antenna kit (Neptune Part No. 13147-000) can increase the signal strength in these cases. Refer to "Gateway Kits" on page 5.

Installing the External Cellular Antenna

Complete the following steps to install the external cellular antenna.

1. Open the gateway cover.
2. Disconnect the internal coaxial cable from the stubby cellular antenna.
3. Loosen and remove the lock-down nut and lock washer on the stubby cellular antenna, and then remove the antenna.

4. Install the coaxial surge arrestor in the same hole.
5. Verify that the O-ring for the surge arrestor is in place and is located on the inside of the gateway enclosure.
6. Attach the internal coaxial cable to the surge arrestor.
7. Install the external cellular antenna, mounting the antenna higher than the gateway to obtain better service reception.



An optional wall mounting kit (Neptune Part No. 13145-000) is available for the external cellular antenna. The kit includes a 5-foot mast and wall mount brackets.

8. Connect the 6-foot coaxial cable (included) from the gateway to the external cellular antenna.



You can order longer coaxial cable assemblies (terminated), if needed, or refer to the coaxial cable matrix ("Coaxial Order Matrix" on page 104). The coaxial cables are available in lengths from 10 feet to 40 feet. The LMR-400-UF and LMR-400 by Times Microwave are acceptable coaxial cable types for use up to 40 feet. Use Andrew Part No LDF4-50A for coaxial cable lengths greater than 40 feet.

9. Weatherize the coaxial connections using the weatherization kit. See "Recommended Tools and Materials" on page 25.

Ethernet Termination

This section provides information on the termination of the Ethernet cable.

Straight-Through Ethernet Cable

For most installations of the gateway, the straight-through Ethernet cable is used. Use a shielded category 5e or better Ethernet cable that is rated for outdoor use and is sunlight resistant, for example, Belden cable Part No. 7919A. Terminate the Ethernet cable according to Figure 107 on page 114 using the T-568B wiring standard for both ends. One end should already be terminated to the switch or hub.

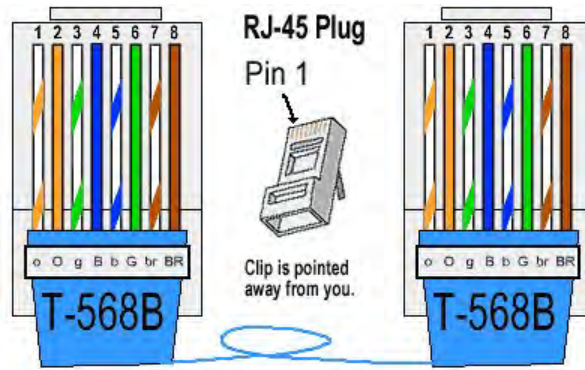


Figure 107 – Straight-Through Ethernet Cable

Crossover Ethernet Cable

In some cases, a crossover Ethernet cable is required. For example:

- You require a cable to connect two Ethernet devices together without a hub.
- You connect two hubs together.

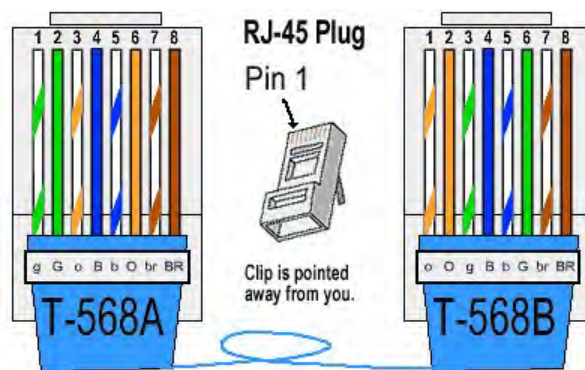


Figure 108 – Crossover Ethernet Cable

Determining if You Need a Crossover Cable

One method of determining if you need a crossover cable is to plug the Ethernet cable from the hub or modem into your laptop computer's Ethernet port. If the laptop computer can communicate through the Ethernet port, then the site requires a crossover Ethernet cable to be compatible with the gateway. See Table 44 on the facing page.

Table 44 – Cable Color Code

Symbol	Wire Color
o	White with orange stripe.
O	Solid orange.
g	White with green stripe.
B	Solid blue.
b	White with blue stripe.
G	Solid green.
br	White with brown stripe.
BR	Solid brown.

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Appendix E: R900[®] Gateway Modem Upgrade

This appendix provides the steps to upgrade the R900[®] gateway collector from the obsolete 3G CSM / CDMA cellular backhaul modem to the Sierra Wireless AirLink RV55 LTE-A pro modem.

Required Tools

This section provides a list of the required tools needed to upgrade the R900 gateway modem.

- Torque wrench preset to 8 inch-pounds.
- Phillips head screwdriver.
- T27 Torx head screwdriver.
- Adjustable pliers.

Instructions

This section provides the steps to upgrade the R900 gateway modem.

Opening the Gateway Box

Complete the following steps to open the gateway box.

1. Gather the required tools.



Figure 109 – Required Tools

2. Open the enclosure using the Torx screwdriver.



Figure 110 – Torx Screwdriver

3. Disconnect power to the collector.



Figure 111 – Disconnect Power to Collector

Removing the Old Modem

Complete the following steps to remove the old modem.

1. On the modem, disconnect the power (PWR) cable, the Ethernet cable (LAN1), and the antenna (ANT) cable.

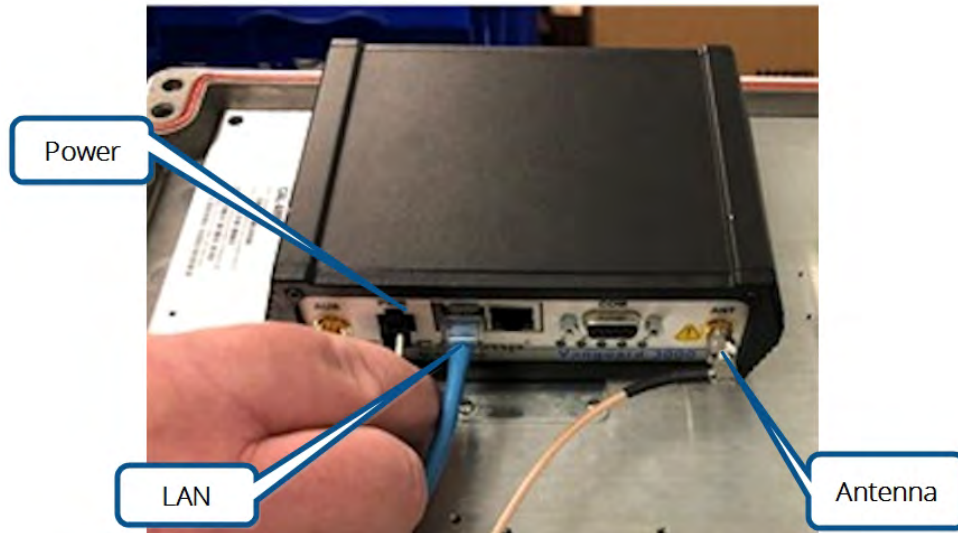


Figure 112 – Disconnect Power, Ethernet, and Antenna Cable

2. Remove the four screws from the mounting plate using a Phillips head screwdriver.
3. Remove the 3G modem from the gateway door panel.

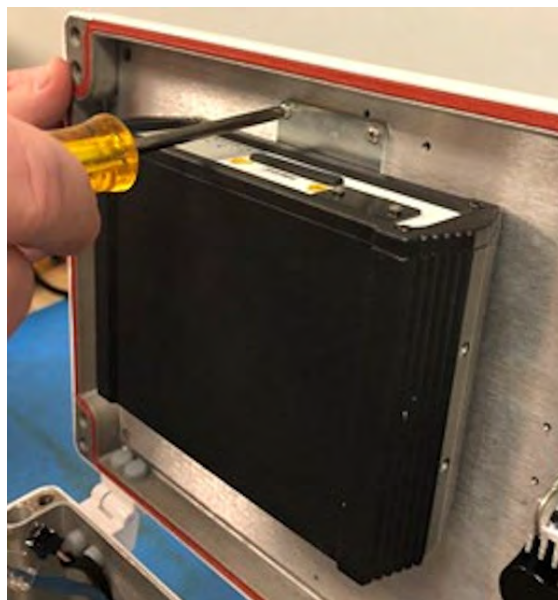


Figure 113 – Removing the Modem

Installing the New Wireless Modem

Complete the following steps to install the new wireless modem.

1. On the Sierra RV55 Wireless modem, remove the SIM card cover using a Phillips head screwdriver.



Figure 114 – Remove SIM Card

2. Insert the SIM card into the upper card slot and re-attach the SIM card cover.



Figure 115 – Insert New SIM Card

3. To mount the Sierra modem on the gateway door, align the drill holes on the modem with the drill holes on the gateway door panel. Use a Phillips head screwdriver to tighten the screws.



Figure 116 – Mount Sierra Modem on Gateway Door Panel

4. Reconnect the Ethernet cable to the Sierra modem.
5. Reconnect the antenna cable to the Sierra modem ("Cellular" SMA connector). Using a torque wrench, tighten to 8 inch-pounds.
6. Reconnect the "PWR" cable to the Sierra modem (DC Power port).



Figure 117 – Reconnect Cables to Sierra Modem

Upgrading the Cellular Antenna

Complete the following steps to remove the existing cellular antenna and install a new antenna.

1. Remove the existing external cellular antenna on the gateway using adjustable pliers.



Figure 118 – Remove Existing External Cellular Antenna

2. Clear dirt or debris from the mounting hole. Use a clean cloth and wipe the top and bottom of the 4G antenna mounting area.



Figure 119 – Clean Antenna Mounting Area



Failure to perform this step can result in water intrusion which can damage the unit. Improper installation voids the warranty.

3. Before installing the new antenna, make sure the black O-ring is fully seated in the antenna to prevent water intrusion.



Figure 120 – Check O-ring



Failure to perform this step can result in water intrusion that can damage the unit. Improper installation voids the warranty.

4. Screw in the lock washer and the tightening bolt from the underside of the gateway. Tighten the bolt to 4 foot-pounds.



Figure 121 – Lock Washer and Tightening Bolt

5. Turn on the power to the gateway. When the gateway and modem are powered, the modem displays a green "chase" light to indicate that it is configured for your SIM card and takes six to eight minutes to complete. After the modem is configured, it connects to the mobile network automatically and displays a solid green network LED.
6. Verify the door gasket is properly seated before closing the gateway door to prevent water intrusion.

Applying the New Modem Label

Complete the following steps to apply the new modem label to the gateway door.

1. Apply the new modem label to the top of or underneath the modem on the inside of the gateway door.

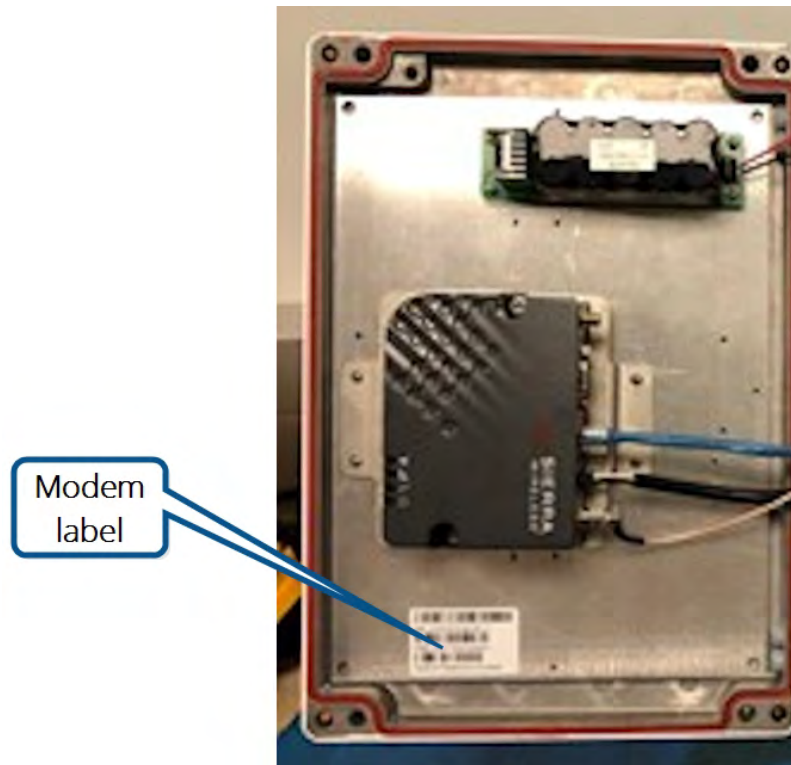


Figure 122 – Check Gateway Door Gasket



Failure to perform this step may result in water intrusion which can damage the unit. Improper installation voids the warranty.

2. Close the gateway door.
3. Verify the door seals properly.

4. Using the Torx screwdriver, finish securing the enclosure shut:
 - First, tighten the screws opposite the door hinge.
 - Then, tighten the remaining screws.
5. On the exterior of the gateway, place the new FCC label over the existing label. Make sure the gateway's serial number can be seen through the new label window.

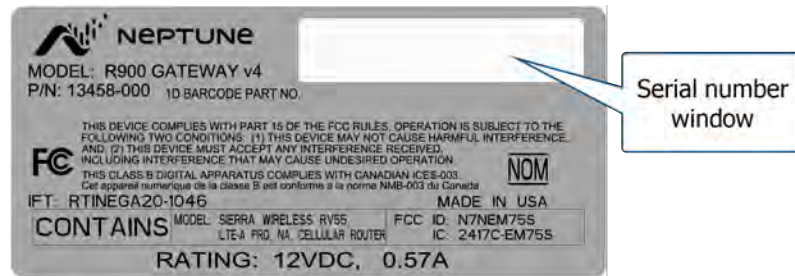


Figure 123 – New FCC Label

The gateway modem upgrade process is complete.

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A

AC

Abbreviation for alternating current, typically used in grid applications.

Agonic lines

Imaginary lines on the surface of the earth connecting all points at which the declination of magnetic field of the earth is zero.

AH

Abbreviation for Amp-hour. Refers to battery capacity.

Ammeter

Instrument used to measure current.

Amp

Common unit of measurement for electrical current.

AMR

Automatic Meter Reading. The automated process of reading meters.

APN

Access Point Name.

Array

PV modules and all the associated wiring and mounting hardware.

ASTM

American Society for Testing and Materials.

AWG

American Wire Gage.

B

Ballast

Heavy material used to secure the stability of the equipment stand. For the R900 Gateway system, concrete blocks are used for the ballast.

C

CDMA

Code Division Multiple Access. A channel-access method used by various radio communication technologies that allow multiple users to be connected over the same channel.

CIS

Customer Information System.

Converter

Instrument used to convert power from AC:DC or DC:DC in a regulated manner.

D

DC

Abbreviation for direct current, typically used in battery applications.

DOD

Abbreviation for depth of discharge. Refers to a battery's state of discharge.

E

Earth

Common term referring to the reference point for electrical equipment where it comes into contact with the soil, also referred to as Earth Ground.

EDGE

Enhanced Data for Global System for Mobile Communication (GSM) Evolution.

F

FDR

Frequency Domain Reflectometry.

FET

Field-effect transistor.

G

Gateway

Device that collects meter reading data from Neptune's absolute encoder register interfacing with Neptune's R900® endpoint and transmits the data for collection. This unit receives the data and stores data to be downloaded through the N_SIGHT® PLUS host software.

GPRS

General Packet Radio Service. It is a packet-based wireless communication service that promises data rates from 56 up to 114 Kbps and continuous connection to the Internet.

Ground

Common term referring to the electrical zero volt reference point.

GSM

Global System for Mobile Communication. It is an international standard for digital cellular communications.

H

Hud

High voltage disconnect (both solar and load).

Hz

Abbreviation for hertz, unit of measurement for AC frequency. 60Hz equals 60 cycles per second.

I

IMEI

International Mobile Equipment Identifier.

Inverter

Instrument used to convert power from DC:AC in a regulated manner.

Isogonic lines

Lines on the Earth's surface along with the declination have the same constant value.

J

Joule

Common unit of measurement for electrical energy. Joules equals watts per second.

L

LED

Light-Emitting Diode.

Lud

Low voltage disconnect (load only).

LVD

Abbreviation for Low Voltage Disconnect. A device in charge controllers that disconnects the load from the battery to protect from over discharge.

M

Magnetic Declination

The angle between the Magnetic North (MN, compass north) and True North (TN) at any given latitude / longitude.

MEID

Mobile Equipment Identifier.

MHz

Abbreviation for megahertz, where 1 MHz represents one million cycles per second.

MIU

Meter Interface Unit, also known as an endpoint.

MMK4

Heavy duty fiberglass base station mount.

MOSFET

Metal-oxide semiconductor field-effect transistor is a specialized FET (field-effect transistor), and like all transistors, is used for switching or amplifying signals.

N

N_SIGHT® PLUS Host Software

N_SIGHT® PLUS is a software tool for gathering data packets containing information on remote MIU readings. This software provides the ability to obtain frequent meter readings to perform detailed usage analysis, such as flow profiling. N_SIGHT® PLUS can increase the frequency of data collection and improve customer service.

NCP-2

Non Corrosion Product.

NGDC

National Geophysical Data Center.

No-OX ID

Electrical contact lubricant (electrical contact grease). It is an electrically conductive grease that keeps metals free from rust and corrosion.

NOAA

National Oceanic and Atmospheric Administration.

NTP

Network Time Protocol.

O

OCP

Overcurrent and short circuit protection (load, solar, overcurrent).

OD

Outer Diameter.

Ohm

Common unit of measurement for electrical resistance.

P

PF

Abbreviation for Power Factor. Used to describe the quality of AC current in percentage.

PV

Abbreviation for Photovoltaic. Refers to the solar module that generates power from sunlight.

PWM

Pulse Width Modulation. Is the most effective means to achieve constant voltage battery charging by switching the solar system controller's power devices.

R

RSSI

Strength of the radio signal when it is received.

S

SIM

System Information Manager.

Sine Wave

Refers to the wave-form of AC power, measured in hertz (Hz).

SOC

State of Charge.

SOV

Abbreviation for Silicon Oxide Varistor. Used to protect electrical equipment from surges.

SVC

Service.

T

TDR

Time Domain Reflectometry.

U

UV

Ultraviolet light.

V

VA

Common unit of measurement for AC power. VA equals Volts x Amps x Power Factor.

VDC

Volts Direct Current.

Voc

Voltage open circuit.

Voltmeter

Instrument used to measure voltage.

Volts

Common unit of measurement for electrical potential.

Vpc

Abbreviation for Volts Per Cell, used to describe the individual battery cell voltage. A 12V battery has 6, 2V cells.

VSWR

Voltage Standing Wave Ratio.

Vuc

Voltage under charge.

W

Watt

Common unit of measurement for DC power. Watts equals Volts x Amps.

Wattmeter

Instrument used to measure power.

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