NEPTUNE
TECHNOLOGY GROUP

R900® System Gateway
Installation and Maintenance Guide
Serial numbers beginning with GPV4EXXXX

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FCC Conformity

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.

Warning: Changes or modifications to this device not expressly approved by Neptune Technology Group Inc. could void the user's authority to operate the equipment.

Industry Canada

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

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

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 causerl'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peutcauser l'opération peu désirée.

R900® System Gateway GPV4EXXXX
Installation and Maintenance Guide
Serial numbers beginning with GPV4EXXXX
Literature No. IM R900 Gateway GPV4EXXXX 03.2025

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Chapter 1: Overview

The R900® System gateway is a fixed network data collector that collects meter reading data from endpoints and stores the data in the gateway until it synchronizes with 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.

Neptune's next generation gateway is a fixed-network AMI data collector that improves real-time data collection and remote management, and provides future-proof cybersecurity mechanisms and protocols based on the latest recommendations and other forward-looking cybersecurity research.

- The gateway enables real-time customer service and meter data analytics by immediately forwarding meter data updates to the Neptune 360 head end system as they are received from the endpoint every 15-minutes. This immediate forwarding of data also enables verification of AMI connectivity for the endpoint in just a few minutes during installation.
- The gateway supports secure remote firmware and configuration updates, which allow for flexibility in management, product enhancements, and bug fixes (if needed), without requiring costly truck-rolls and field visits.

About This Guide

This guide describes how to install, maintain, and troubleshoot the gateway and includes information for configuring the cellular modem for the gateway and installing the solar power unit. The guide also includes a complete list of cables and accessories and ordering information.

It is recommended that you familiarize yourself with the gateway's components, material specifications, optimal site selection, and step-by-step installation instructions. Refer to the *R900® Gateway Installation and Maintenance Guide* dated 11.23, if your gateway serial number begins with GPV4XXXX.

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

Gateway Kits

Caution! Neptune recommends using qualified professionals for installation and service.

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

Table 1 – Types of Gateway Installations

Installation	Solar-Powered	AC-Powered
Wall	N/A	✓
Stand	✓	✓
Pole (ranging from 2 inches to 16 inches in diameter)	✓	✓

Power Source

The following sections describe the power source of the gateway and the components for each of the gateway kits (cellular modem and Ethernet).

The gateway requires +12VDC power. A Solar Power System or AC Uninterrupted Power Supply (UPS) can provide the required 12VDC.

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 195 W solar panel for Zones A, B, C, D, and E1. See "Solar Power Information" on page 91 for more details and a map of the zones.
- You must use the 220 W solar panel for Zone E2, and Canada.
- If the utility is located near or along the boundary between Zones D and E1, then the 220 W option is recommended. 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.

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Chapter 2: Activating the Gateway in the Host Software

This chapter details the process of adding and configuring the gateway to Neptune® 360™, and includes a section on upgrading the gateway's firmware via an SD card.

Important! For the gateway (Ethernet variant), ports 443, 8443, and 8883 must be open in the utility's LAN firewall to ensure Neptune 360 connectivity. Refer to https://docs.aws.amazon.com/iot/latest/developerguide/protocols.html for additional information.

Important! For the gateway (Ethernet variant), UDP Port 123 must also be open in the utility's LAN firewall to ensure it can reach a time server for synchronization.

Adding a Gateway to Neptune® 360™

Before you can start receiving meter reading data from the Neptune R900® System gateway, you must add a gateway into Neptune 360. This is a required step that allows Neptune 360 to know that a particular gateway belongs to your Neptune 360 site. It also allows heard readings to appear on your site.

1. Log in to Neptune 360 and open the **Utility Management** page.
2. In the **Device Management** section, click **Create**, and then click **R900 Gateway** to display the slide out panel.

Figure 3 – Add R900® Gateway Window

3. In the **Serial Number** field, enter the serial number of the gateway.

   The serial number is an alphanumeric value in **GPV4EXXXX** format that is under the FCC label on your gateway.

4. In the **Name** field, enter a unique and descriptive name for the gateway.

5. **Optional**: in the **Latitude** and **Longitude** fields, enter the latitude and longitude of the gateway location. Enter the latitude and longitude in decimal degrees format, with a maximum of six decimal places.

6. Click **Add** to add the gateway.

   Neptune® 360™ displays a green confirmation message indicating the gateway is added. The system also adds a new record for the gateway in the Device Management Table. The gateway **Type** displays **R900 Gateway**.

7. In the **Device Management** section, click the device ID for the gateway to display the gateway details. The gateway reports its active configuration once it successfully communicates with Neptune 360.

Important! Powering on the gateway allows it to automatically attempt to communicate with Neptune 360 via DHCP (Dynamic Host Configuration Protocol). If your gateway cannot retrieve its network configuration over DHCP, you can configure the network locally instead. See the next section, Configuring the Gateway to Use Static Network Parameters, to locally configure your gateway's network parameters.

The Activity section of the details slide out shows a **Queued** command after a gateway is added in Neptune 360. This command is responsible for setting the site of your gateway. The status updates to **Completed** after the gateway successfully sets its site.

Important! If you encounter any issues while adding a gateway, please contact support@neptunetg.com for further assistance.

Configuring the Gateway to Use Static Network Parameters

By default, the gateway is set to acquire network settings automatically via **DHCP** from your server, which includes the IP address, a subnet mask, a default gateway IP address, and a **DNS** server. Some networks may not support DHCP and some organizations may prefer to assign static network parameters to their gateways. In this case, you can configure your gateway to use static network parameters by downloading an **.ini** file from Neptune 360. You can download a local configuration file that contains the static network parameters for your gateway, and apply the configuration file to your gateway using an SD card.

Important! Only Utility Administrator roles have permission to configure a gateway.

Prerequisites

- You have added a gateway to your site in Neptune 360. See "Adding a Gateway to Neptune® 360™" on page 5 for the steps to add a gateway.
- You have access to a computer with an SD card reader and an SD card.
- You have access to the physical gateway to update.

Steps to Configure

1. On the **Device Management** grid, click the device ID for the gateway you want to configure.
2. Click **Configure**.

3. Click **Configure via SD Card**.

   The system displays a Configure Via SD Card form.

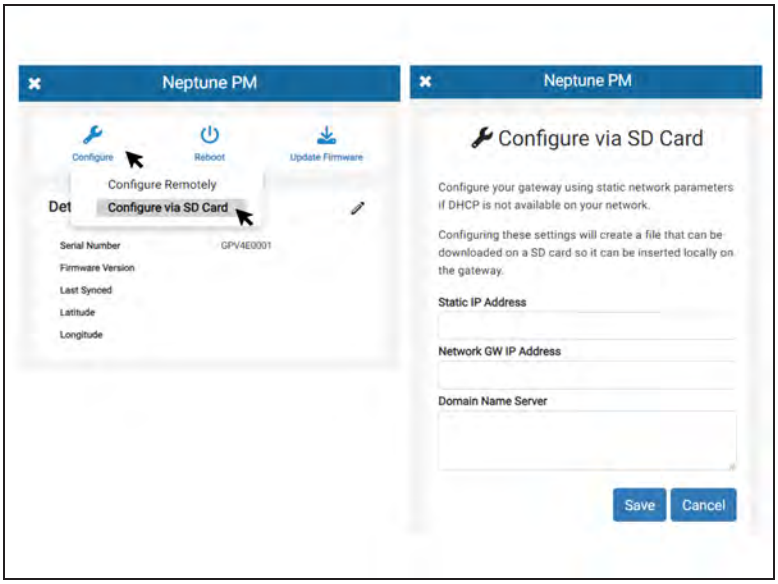

Figure 4 – SD Card Form

4. In the **Static IP Address** field on the form, enter the IP address assigned to the gateway's Ethernet interface.

   You can enter either an **IPv4** or an **IPv6** address, with a prefix length that specifies the subnet mask such as, **10.0.0.1/16** or **FE80:CD00:0000:0CDE:1257:0000:211E:729C/64**. For example, for 10.0.0.1/12, the prefix length 12 means that the first 12 bits of the address identify the subnet. The subnet mask is 255.240.0.0.

5. In the **Network GW IP Address** field, enter the Network gateway IP Address, which is the network gateway (default route) IP address assigned to the gateway's Ethernet interface.

   You can enter either an IPv4 or an IPv6 address like **10.0.0.1** or **FE80:CD00:0000:0CDE:1257:0000:211E:729C**.

6. In the **Domain Name Server** field, enter the address of the Domain Name System server assigned to the gateway's Ethernet interface.

   You can enter up to three IPv4 or IPv6 addresses in a space delimited list. For example, **10.0.0.1 10.0.0.2 FE80:CD00:0000:0CDE:1257:0000:211E:729C**.

7. Click **Save**.

8. The confirmation message shows the name and serial number of the gateway.

9. In the confirmation box, click **Yes, Assign as Owner** to confirm the configuration.

Figure 5 – Change Confirmation Box

The system generates and downloads the configuration file, which has a .ini extension. and contains the keywords and values of the static network parameters you entered.

10. Save the file to your computer.

Important! You can use the configuration file only on a single gateway, but you can create multiple configuration files for other gateways.

The system redisplays the Details and Activities, which shows a **Queued** command after a gateway is added in Neptune 360. You can page through the activities to determine the configuration status. This **Queued** command is responsible for setting the site of your gateway. Its status updates to **Completed** after the gateway successfully sets its site data.

11. Insert the SD card into the SD card slot of the gateway.

    You can insert the card at any time before or after the gateway boots. The gateway reads the configuration file from the SD card and applies the static network parameters. The gateway now displays the network parameters in the Configuration section on the Neptune 360 window.

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.

Important! 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 all major carrier cellular service.

2. Identify the modem identification number from the gateway, which is the International Mobile Equipment Identifier (IMEI).
3. After selecting the carrier, contact the carrier 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 "Setting Up the Cellular Modem" on page 119

Chapter 3: Gateway Specifications

This chapter provides essential information regarding the gateway. It is crucial to review this content carefully before proceeding with the installation.

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 2 – Electrical Specifications

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

Environmental Conditions

Table 3 – 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 (percentage)	10 to 95%.
Environmental Rating	NEMA 4X Enclosure.

Mechanical Specifications

Table 4 – Mechanical Specifications

Specification	Description
Maximum Weight	21 lbs. (9.53 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 5 – 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 6 – UPS Specification

Specification	Description
Manufacturer	TSi Power.
Part No.	OUTDOOR-DC-UPS-8009 w/option BH-5.
AC Input	120VAC 60 Hz (100 – 140 VAC range).
Output	12 VDC.
Dimensions	12.5" W x 12.0" H x 6.5" D (31.8 cm x 30.5 cm x 16.45 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.

- Solar Power System Specification - 195 W Option in the table on the following page.
- Solar Power System Specification - 220 W Option in the table on the following page.

To determine which option to use, see "Selecting the Correct Solar Power System" on page 94.

195 W Option Specifications

Table 7 – Solar Power System Specification - 195 W Option

Specification	Description
Rated Power	195 W.
Rated Voltage (Vmp)	20.54 V.
Rated Current (Imp)	9.48 A.
Open Circuit Voltage (Voc)	24.35 V.
Short Circuit Voltage (Isc)	10.06 A.
Dimensions (L x W x D)	59.6" x 26.8" x 1.9". or 1515 mm x 680 mm x 50 mm.
Weight (PV array only)	30.7 lbs. (14 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 8 – 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 (L x W x D)	48.15" x 52" x 1.97" (1223 mm x 1320 mm x 50 mm).
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

This section includes tables that define the battery and battery enclosure specifications.

Battery Enclosure

Table 9 – 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 10 – 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.
Nominal Capacity	104 Ah (C/24 rate).
Dimensions	12.0" L x 6.6" W x 8.7" H (30.5 cm x 16.8 cm x 22.2 cm).
Weight	63 lbs. (28.6 kg).

RF Antenna Specifications

Table 11 – RF Antenna Specifications

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

Table 11 – RF Antenna Specifications (continued)

Specification	Description
Gain	5 dB.
Normal Impedance	50 ohms.
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).

Chapter 4: Initial Installation Steps

This chapter contains sections detailing the initial installation steps for the R900® System gateway.

Storage

Important! 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 and UPS have internal lead-acid batteries. 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 12 shows the recommended tools and materials needed to successfully install the gateway.

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

Table 12 – Recommended Tools and Materials

Item	Description/Recommendation	Use

Took 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).
	  • Neptune P/N: 13084-001.
		Various installation procedures performed by the installer.

Ferrite	Round cable component, 380ohmz	Install onto DC power cable with loop through the ferrite.
Ultraviolet (UV)-stable cable ties	8" and 12" (20 cm and 30 cm).	Securing coaxial cable.
Coaxial ground kits	–	Grounding cable.
Coaxial hoisting grips	–	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 PolyPhaser 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-OX-ID A-Special Grease.	Apply to battery terminals for corrosion protection.
American Wire Gage (AWG)	10 AWG Copper wire with a minimum temperature rating of 75° C.	Equipment grounding.

Safety and Preliminary Checks

Warning! 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.

Parts List: Cellular Modem

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

Table 13 – Cellular Modem Parts List

Part Number	Description	Quantity
15155-000	Gateway cellular variant. Accessories are available. Contact your Neptune sales representative for details.	1
13194-002	*R900® System Gateway* *Installation and Maintenance Guide* *Serial numbers beginning with GPV4EXXXX.*	1
N/A	SIM card with cellular service account (customer provided).	1
13147-000	External Cellular Antenna Mounting Kit, optional. Some installation sites 1 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

Parts List: Ethernet

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

Table 14 – Ethernet Parts List

Part Number	Description	Quantity
15155-100	R900 System gateway Ethernet. Accessories are available. Contact your Neptune sales representative for details.	1
13194-002	*R900® System Gateway Installation and Maintenance Guide Serial numbers beginning with GPV4EXXXX.*	1

Selecting the Gateway Installation Site

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

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

Warning! Do not mount the gateway—antenna mast or antenna—to a pole or similar structure carrying an 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.

Important! 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 may require additional equipment to protect the systems from interfering with each other. For more information, see Appendix C: RF Antenna and Coaxial Installation.

Mounting Configurations

This section defines the mounting configurations for the gateway.

Wall Mount

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

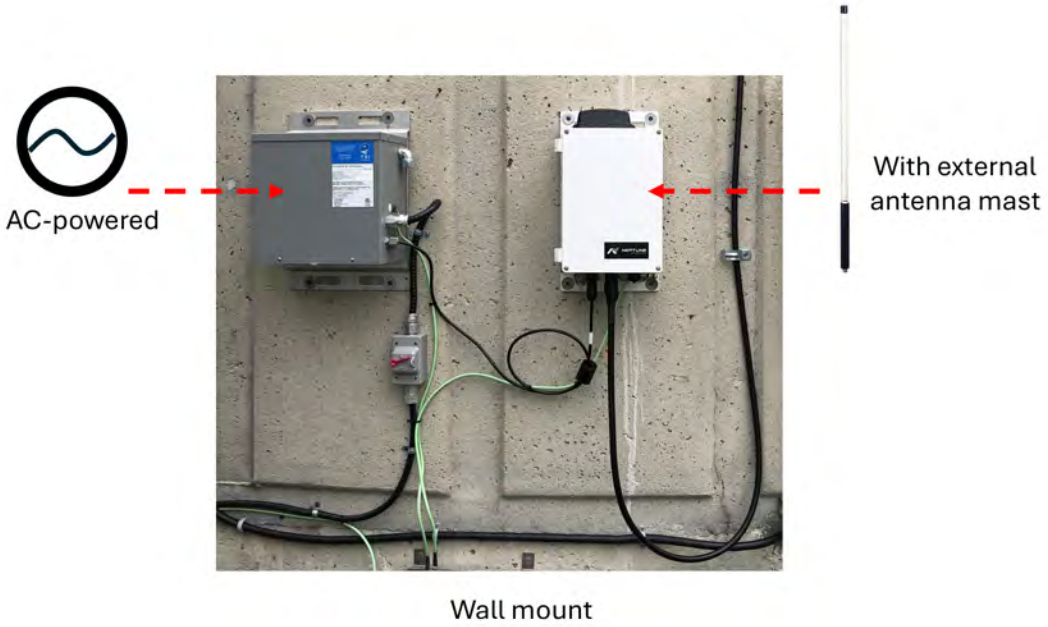

Figure 6 – Wall-Mounted Gateway

Important! The gateway uses either a cellular modem or Ethernet connection for backhaul communication.

Gateway Stand Mount

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

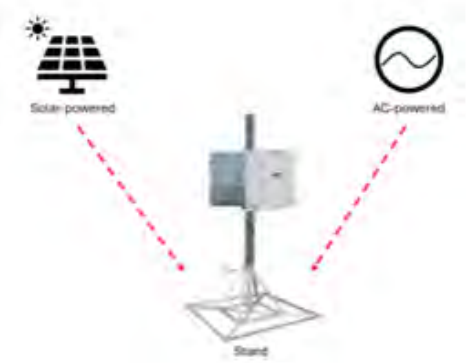

Figure 7 – Gateway Stand Installation

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 (See NEC, Article 810 for limitations).

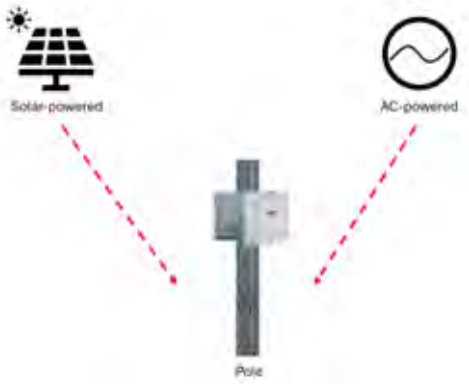

Figure 8 – Pole Mount Installation

Important! For backhaul communication, the gateway uses either a cellular modem or Ethernet connection.

Chapter 5: Mounting an RF Antenna to a Pole or Stand

This chapter contains sections detailing the installation options for the R900® System gateway's RF antenna.

Mounting an 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.

Steps to Mount the Antenna to a Pole

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

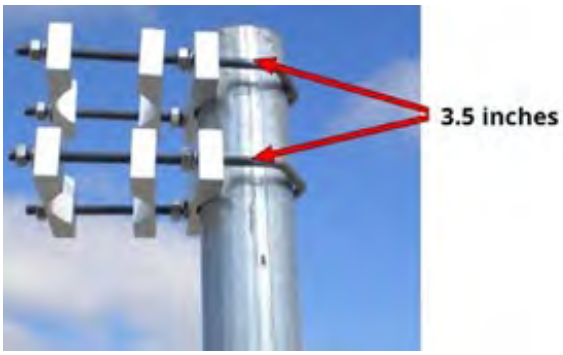

Figure 9 – Mounting Brackets

3. Attach the coaxial cable to the RF antenna.

Figure 10 – Attach Coaxial Cable

Important! Verify that the coaxial cable type is correct for the run length. See "Coaxial Cable Lengths for the Gateway" on page 115.

Warning! 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 "Tools and Materials"in Chapter 4.

Figure 11 – Weatherize the Antenna

5. Mount the RF antenna pole using antenna mounting brackets.

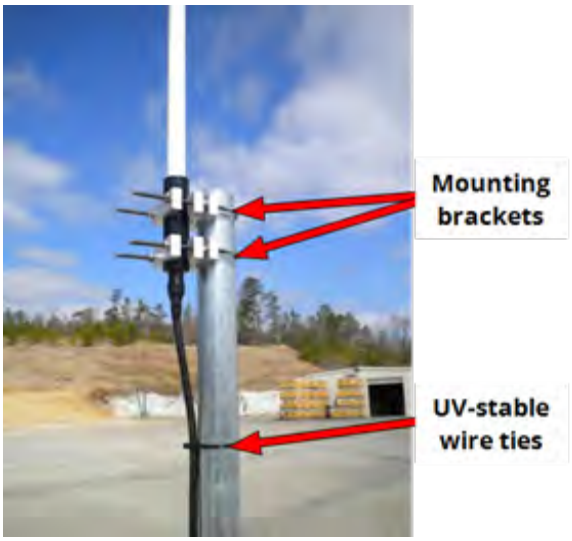

Figure 12 – Mounting Brackets and UV-Stable Wire Ties

For more information, see Appendix C: RF Antenna and Coaxial Installation.

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

Mounting the RF Antenna to a Large Pole

This section defines the procedure to mount the RF antenna to a 4-inch to 16-inch (10.1 cm to 40.7 cm) diameter pole.

Steps to Mount the Antenna to a Large Pole

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

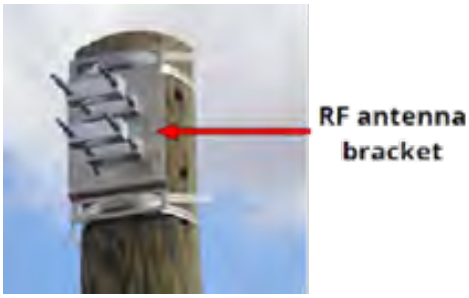

Figure 13 – Large Pole Bracket

2. Mount the RF antenna to the bracket.

Figure 14 – RF Antenna Bracket

Important! 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 15 – Coaxial Cable Attached

Important! Verify that the coaxial cable type is correct for the run length. See "Coaxial Cable Lengths for the Gateway" on page 115.

4. Weatherize the RF antenna connection using the weatherization kit. See "Tools and Materials" on page 17.

5. Secure the coaxial cable approximately every 3 feet.

Figure 16 – Weatherized Connection

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Chapter 6: Installing the Gateway (Solar Configuration)

This chapter provides instructions for mounting the R900® System gateway and all its components for a solar configuration.

Mounting the Battery Box (UPS)

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. See "Facing True South" on page 91.

Mounting the Battery Box to a Pole or Stand

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 17 – Installing Pole Brackets

Important! Apply anti-seize (e.g., Loctite® LB 8023) to the stainless-steel U-Bolt threads to prevent galling.

2. Hang the battery box without batteries on the upper mounting bracket. See above.
3. Attach the lower bracket to the battery box using the 5/16" carriage bolts.
4. Tighten bolts using a 1/2" wrench to 10-12 ft-lbs. torque.
5. Check alignment of all assembled parts and tighten all bolted connections.

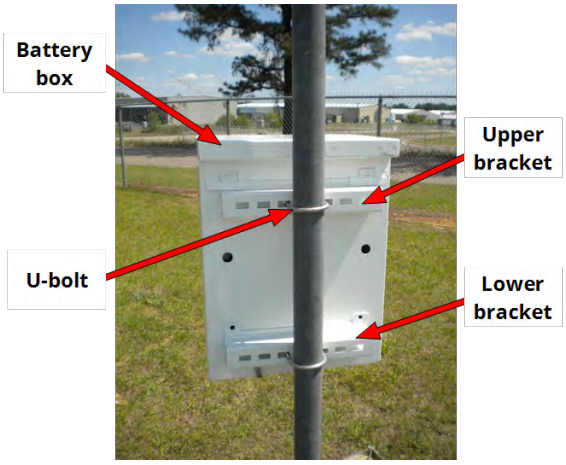

Figure 18 – Battery Box Installed

Important! 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.

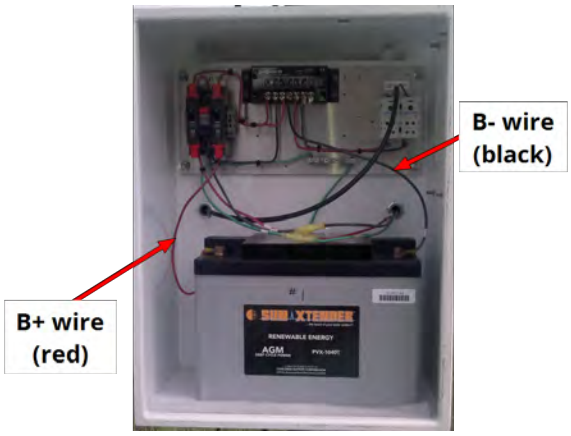

Figure 19 – Battery and Wiring

Important! Apply corrosion inhibitor to the battery terminals. For example, NOCO Company's NCP2® Battery Corrosion Preventative or Sanchem Inc.'s No-OX- ID® Grease A-Special.

Mounting the Battery Box to a Large Pole (4”-16" /10.1 – 40.7cm diameter)

1. Open the battery box and make sure the breakers are in the OFF position.
2. Mount the battery box to a large pole using the stainless-steel clamps (Neptune P/N: 13089-001).

Figure 20 – 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.

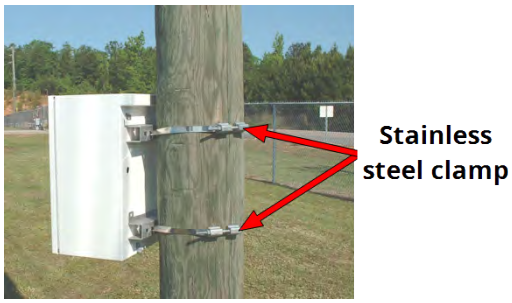

Figure 21 – Pole Hardware

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 22 – Mounted Battery Box

Mounting the Solar Panel

You can mount the solar panel to a stand or a pole, or to a large pole such as one the size of a telephone pole.

Mounting the Solar Panel to a Stand or Pole

You can mount the solar panel to a gateway stand or to a pole, which allows the panel to operate using energy generated by the sun. See the figure on the following page for an overview of the mount assembly and installation.

Figure 23 – Gateway Solar Panel

1. Place the solar panel on the pole immediately above the battery box.
2. Attach the solar panel to the pole using the U-bolts or bands provided.

3. Apply an anti-seize compound, such as Loctite LB 8023, to all stainless-steel fastener threads to prevent galling.

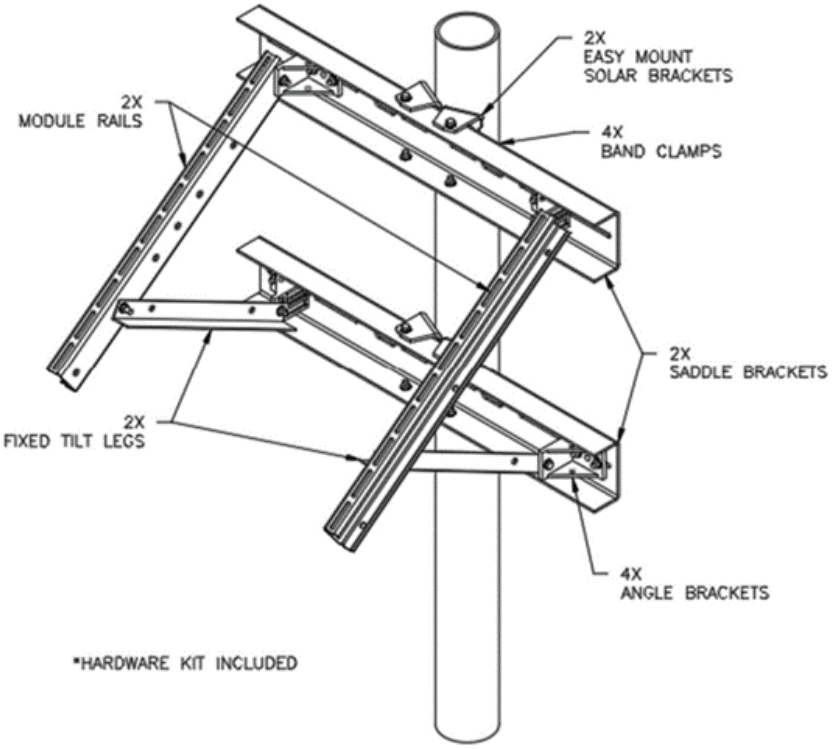

Figure 24 – Solar Panel Side-of-Pole Mount (SOP)

4. Position the solar panel so that it faces true south. See "Facing True South" on the first page of Appendix A: Solar Power Information.

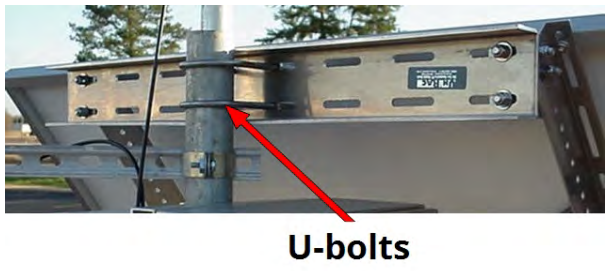

Figure 25 – Solar Panel Attached

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.

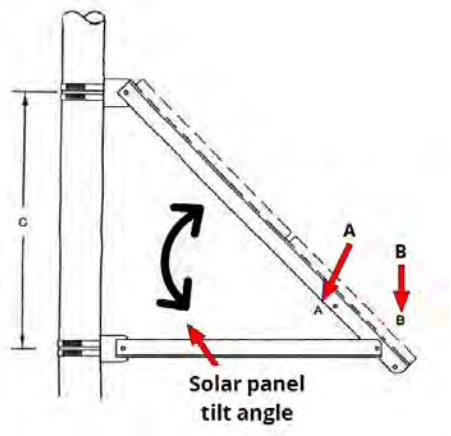

Figure 26 – Solar Panel Tilt Angle

See "Solar Power Information" on page 91 for more information.

Mounting the Solar Panel to a Large Pole (4"-16" / 10.1 – 40.7cm diameter)

Complete the following steps to mount the gateway to a 4-inch to 16-inch (10.1 cm to 40.7 cm) diameter pole.

See "Solar Power Information" on page 1 for information about solar power.

1. Attach the solar panel to the large pole using four stainless steel clamps (Neptune P/N: 13089-001), and then tighten band clamps to 4-5 ft-lbs.
2. Install the solar panel so that it faces true south.

1. Set the solar panel tilt angle based on latitude.

Figure 27 – Mounted Solar Panel

Important! 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" in Appendix A: Solar Power Information.

2. Apply an anti-seize compound, such as Loctite LB 8023, to all stainless-steel fastener threads to prevent galling.
3. Tighten all the nuts and bolts to the manufacturer's specification:
   - Tighten 1/4" stainless-steel bolts to 5.3-5.6 ft-lbs torque.
   - Tighten 5/16" stainless-steel bolts to 10-12 ft-lbs torque.
   - Tighten stainless-steel band clamps to 4-5 ft-lbs torque.

Important! 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

You can mount the gateway to a stand or a pole, or to a large pole such as one the size of a telephone pole.

Mounting the Gateway to a Pole or Stand

Complete the following steps to mount the gateway to a pole or stand.

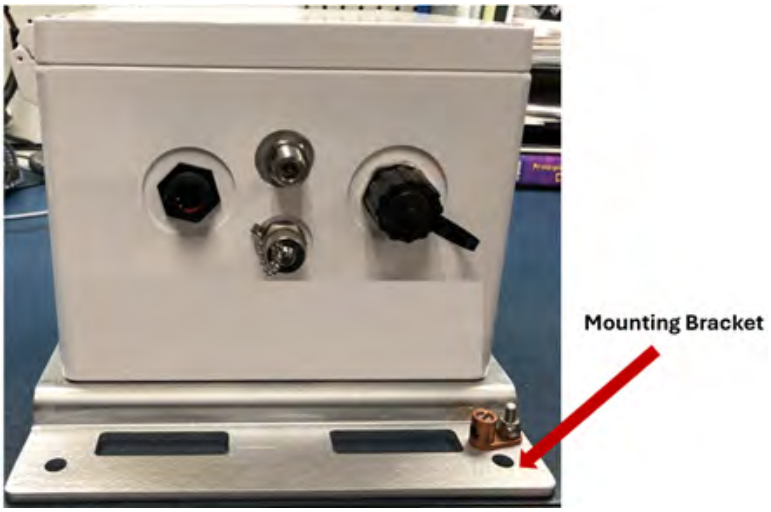

Figure 28 – Mounting Bracket

1. Position the gateway so the top of the box is approximately level with the battery box.
2. Attach the gateway to the pole using two stainless steel clamps (Neptune P/N: 13089-002), and then tighten the band clamps to 4-5 ft-lbs torque.

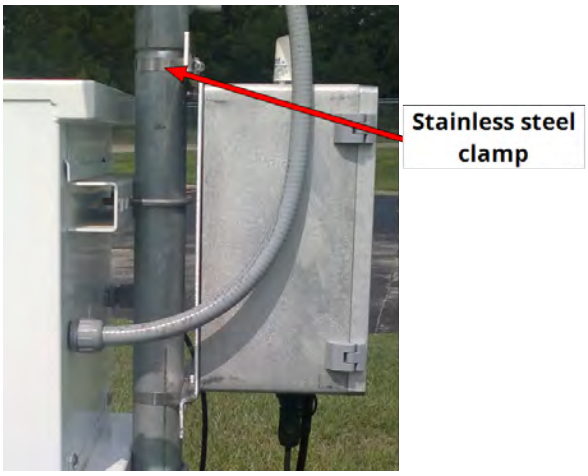

Figure 29 – Positioning the Gateway

Mounting the Gateway to a Large Pole (4”-16”/ 10.1-40.7cm diameter)

Complete the following steps to mount the gateway to a 4-inch to 16-inch (10.1 cm to 40.64 cm) diameter pole. See "Solar Power Information" on page 91.

1. Mount the gateway to pole using two stainless steel clamps (Neptune P/N: 13089-001).

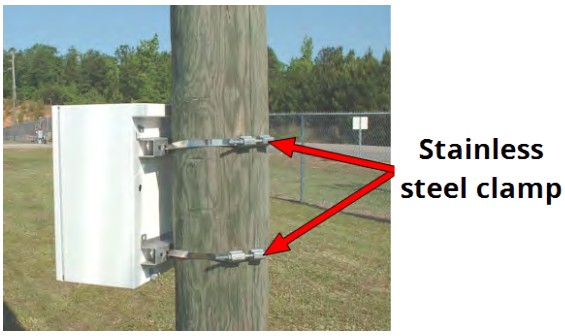

Figure 30 – Gateway Pole Hardware

Important! 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.

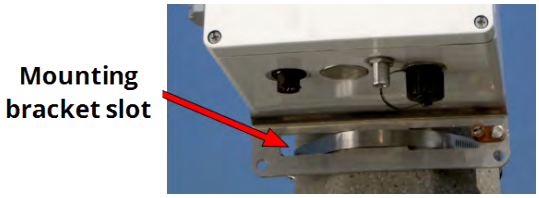

Figure 31 – Slot on Mounting Bracket

Wiring the Battery Box

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

Important! 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.

Figure 32 – 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.

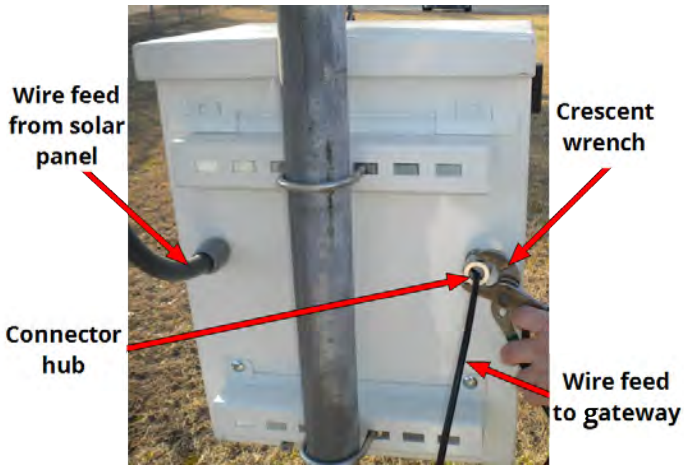

Figure 33 – Connector Hub

Important! Insert enough cable so that it can be terminated to the load terminals inside the battery box.

4. Strip 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.

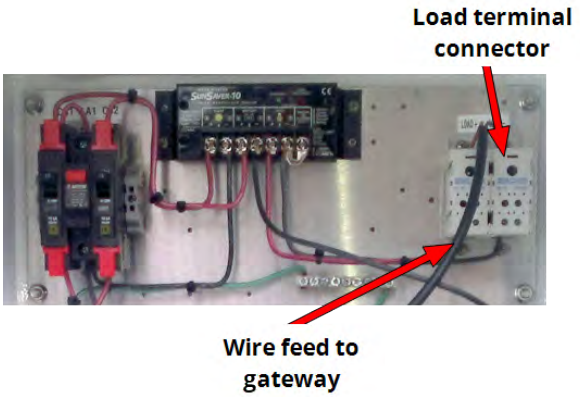

Figure 34 – Battery Box Wires

Wiring the Solar Panel

1. Feed the 10 AWG 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.

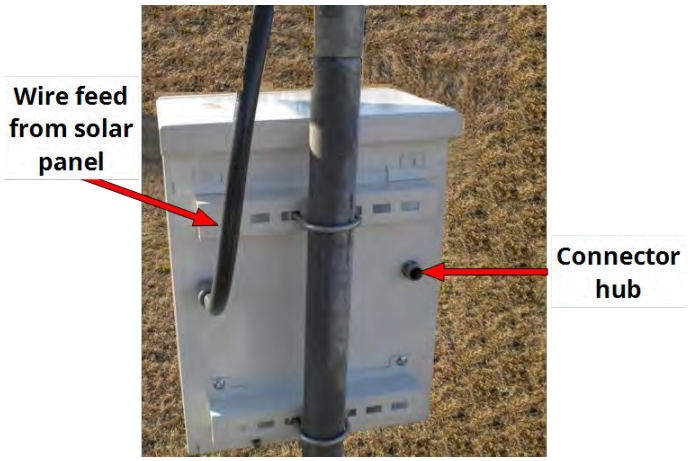

Figure 35 – Back of Battery Box

Wiring the Gateway

This section provides information on wiring the gateway.

Connecting the Ground Wire

Complete the following steps to connect the ground wire.

1. Locate the lightning protection system ground for the installation site.
2. Connect the external ground lug of the gateway to the lightning protection system ground for the site. Use 10 AWG (or larger) copper wire with a minimum temperature rating of 75°C.

Figure 36 – Ground Wire

Attaching the RF Antenna Cable

Complete the following steps to attach the 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).

Figure 37 – RF Antenna Cable

Weatherizing the RF Antenna Connection

Complete the following steps to weatherize the RF antenna connection.

1. Use the weatherizing kit, as described in "Tools and Materials" in Chapter 4: Initial Installation Steps.
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 ¼ inch (0.635 cm).
4. When complete, the weatherized port should resemble the following figure.

Figure 38 – Weatherized RF Port

Attaching the Power Cable

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

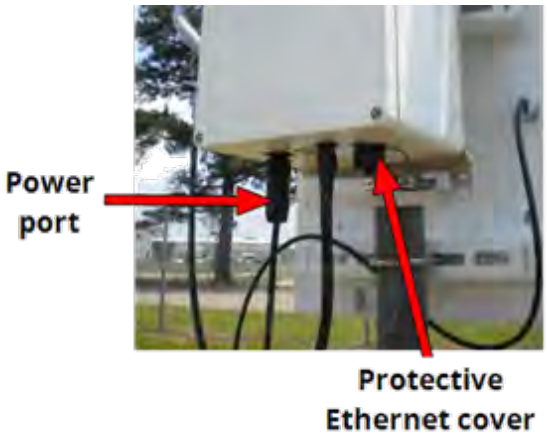

Figure 39 – Power Cable

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

Warning! The protective cover (CONEC P/N: 17-10002) should always cover the Ethernet port when the port is not in use. See the previous "Power Cable " figure as an example.

Securing the Gateway

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

Apply the Ballast to the Stand

After you wire the gateway, apply the ballast material (for example, concrete blocks). See "Ballast Requirements" on page 111to determine the adequate amount of ballast for your installation.

Warning! Install a roof pad (Neptune part number 12955-001) between the stand and rooftop to protect the roof.

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

Warning! 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.

1. Distribute the ballast material evenly.
2. Secure the stand and ballast material in accordance with local code requirements.

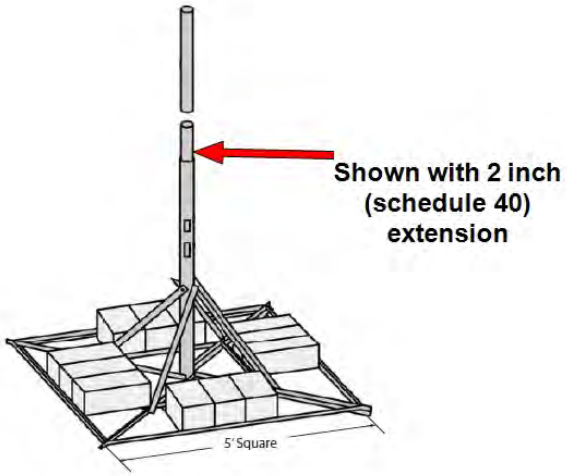

Figure 40 – Concrete Block Ballast

Activating the Gateway System

After you have attached and mounted all the kit items, you can 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 91.
4. Close the battery box with the locking key.

   The battery box and the gateway system are activated.

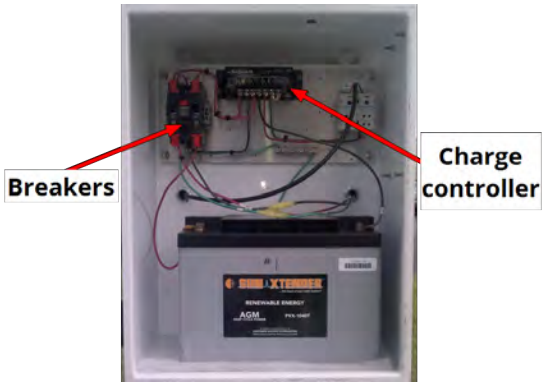

Figure 41 – Activating the Battery

5. Open the gateway.
6. Watch for LED activity. See "Installation Troubleshooting" on page 79 for definitions and status indications of LED lights.

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

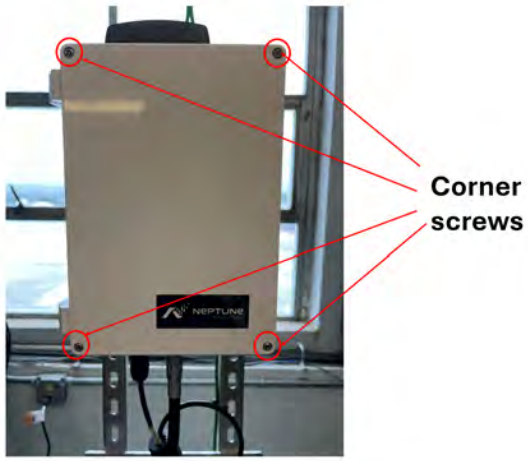

Figure 42 – Gateway Cover Screws

Important! 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.

Chapter 7: Installing the Gateway (AC Configuration)

This chapter provides instructions for mounting the R900® System gateway and all its components for an AC configuration.

Mounting the (UPS)

This section defines the procedures to mount and connect the Uninterruptible Power supply (UPS).

Mounting the UPS to a Pole

1. Attach the UPS to a pole using the two stainless steel clamps (Neptune P/N: 13089-001) as shown in the following images.

Figure 43 – UPS Attached to a Pole

Figure 44 – UPS Attached with Clamps

Important! 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.

Warning! 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.

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 "Mounting the Gateway to a Wall" on page 57. See also "Checking UPS Status LEDs" In Chapter 11: Troubleshooting the Gateway.

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

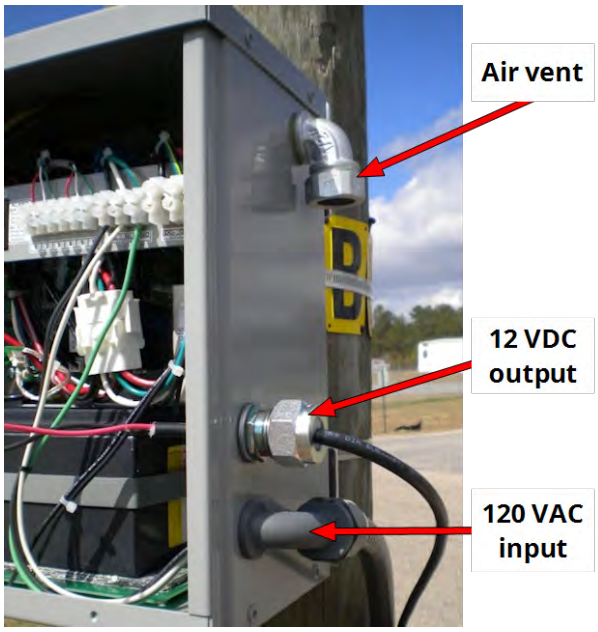

Figure 45 – Inside of the UPS

Important! 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

This section defines the procedures to mount the gateway to a pole or stand, or to a large pole, such as one the size of a telephone pole.

Mounting the Gateway to a Pole or Stand

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

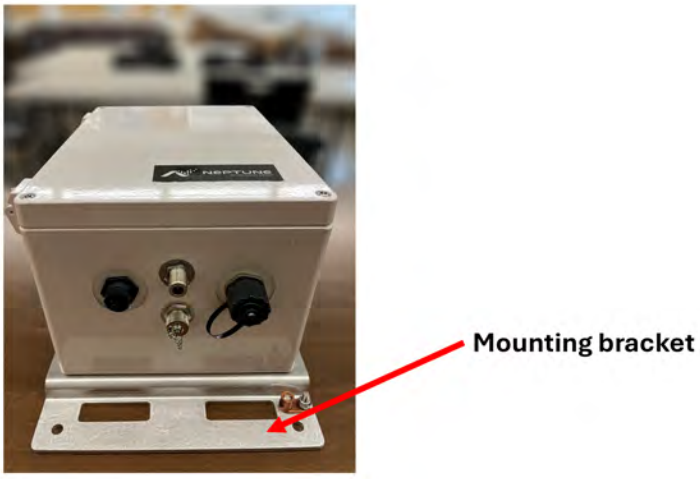

Figure 46 – Mounting Bracket

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 (Neptune P/N: 13089-002).

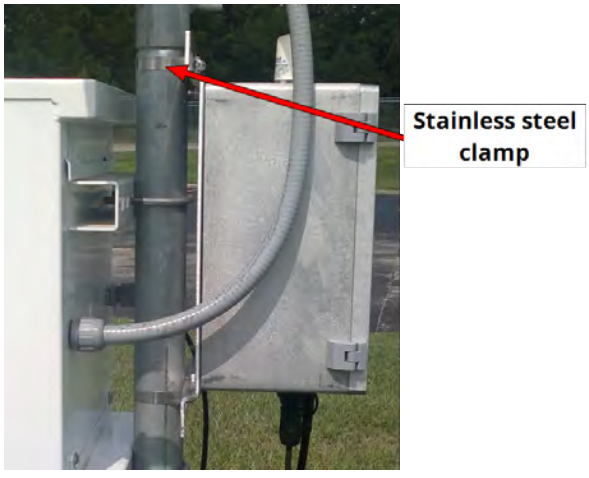

Figure 47 – Positioning the Gateway

Mounting the Gateway to a Large Pole

You can mount the gateway to a 4-inch to 16-inch diameter pole using two stainless steel clamps (Neptune P/N: 13089-001).

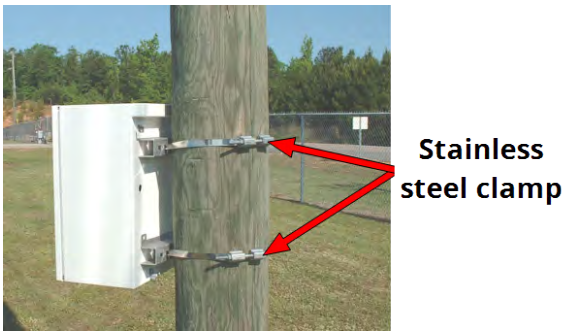

Figure 48 – Gateway Pole Hardware

Important! 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.

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

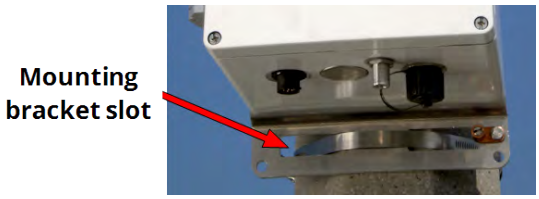

Figure 49 – Mounting Bracket Slot

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 for that site. Use 10 AWG copper wire with a minimum temperature rating of 75°C.
3. Tighten with a flathead screwdriver and torque to 35 inch-lb. (4.0 Nm).

Figure 50 – 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 and torque to 14 inch-lbs. (1.58 Nm).

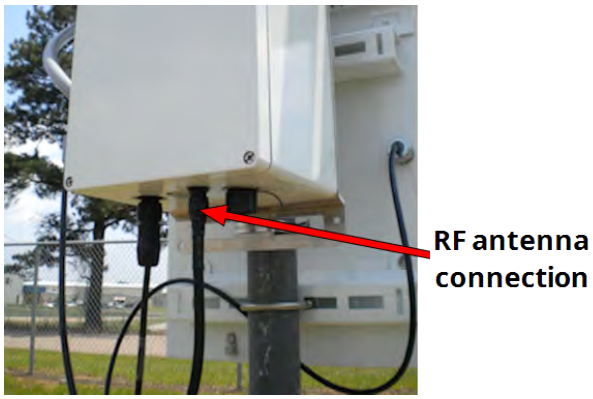

Figure 51 – RF Antenna Cable

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 - Continued" on page 26.
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 ¼ inch (0.635 cm).
4. When complete, the weatherized port should resemble the following figure.

Figure 52 – Weatherized RF Port

Attaching the Power Cable

1. Clamp the ferrite onto the power cable, ensuring that the cable loops through the ferrite once.
   - Position the ferrite within three to four inches of the UPS.
   - For external installations, apply weatherization wrap to the ferrite.

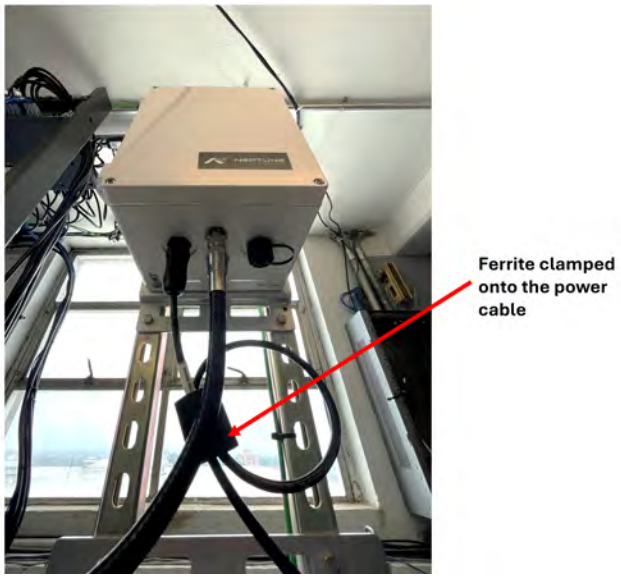

Figure 53 – Ferrite Clamped onto the Power Cable

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

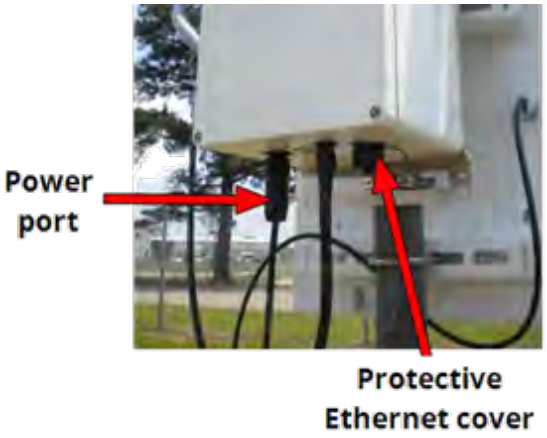

Figure 54 – Power Cable

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

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

Securing the Gateway

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

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Chapter 8: Installing a Wall Mount System

This chapter provides the instructions to install a wall mount system for the R900® System gateway. The following table shows the steps to complete to install a wall mount system.

Table 15 – 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 63	✓	✓
3	"Installing a Wall Mount System" above	✓	
	"Installing a Wall Mount System" above	–	✓
4	"Troubleshooting the Gateway" on page 79	–	✓

Mounting the Gateway to a Wall

Mount the gateway to a wall, as illustrated, 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.

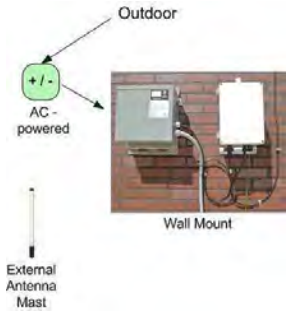

Figure 55 – Wall-Mounted Gateway

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 56 – UPS Mounted on a Wall

Important! 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.

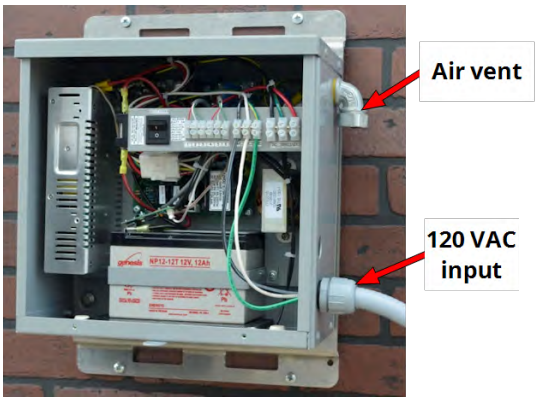

Figure 57 – UPS with VAC Input Wired

Warning! 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.

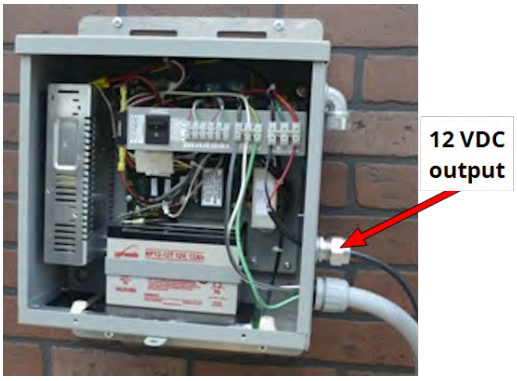

Figure 58 – 12 VDC Output Wired

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 10 AWG with a minimum temperature rating of 75° C.
3. Tighten with a flathead screwdriver and torque to 35 inch-lb (4.0 Nm).

Figure 59 – 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 "Weatherizing the RF Antenna Connection" on page 42.

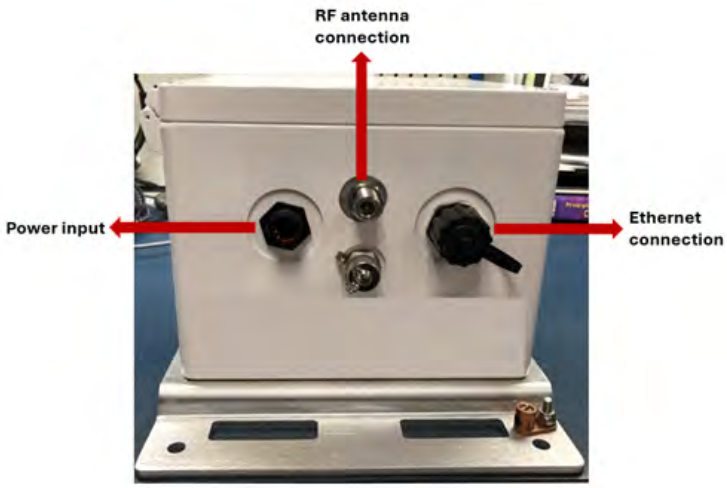

Figure 60 – Adding Gateway Cables

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

3. Clamp the ferrite onto the power cable, ensuring that the cable loops through the ferrite once.
   - Position the ferrite within three to four inches of the UPS.
   - For external installations, apply weatherization wrap to the ferrite.

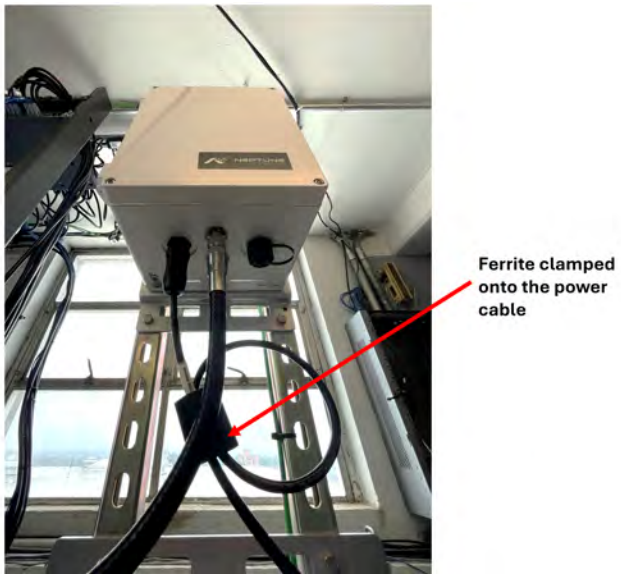

Figure 61 – Ferrite Clamped to the Power Cable

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

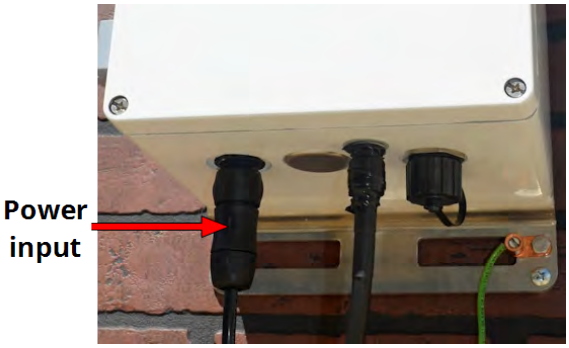

Figure 62 – Power Connector

5. Turn on the power switch inside the UPS to activate the system. For more information go to "Checking UPS Status LEDs" in Chapter 11: Troubleshooting the Gateway.

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

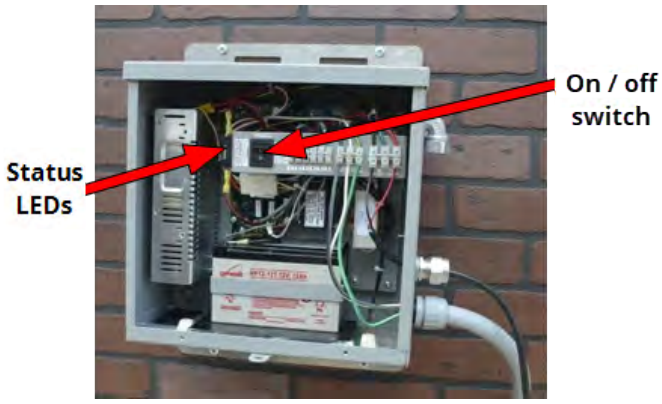

Figure 63 – UPS Power On / Off Switch

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

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

Figure 64 – Completed Wall Installation

Mounting the RF Antenna and Antenna Mast

Warning! 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).

Warning! 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.

Important! It is important to maximize the line-of-sight relationship between the RF antenna and 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 65 – Securing Pole Bracket

Important! 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 as you secured the first.
7. Line up the pole in the two brackets.
8. Secure the pole with the bolts provided.

Figure 66 – 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.

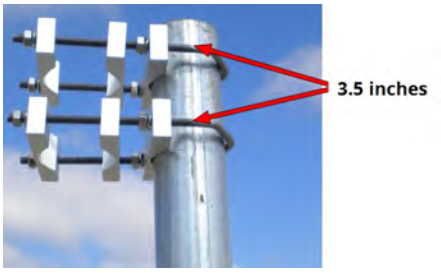

Figure 67 – Mounting Brackets

2. Attach the coaxial cable to the RF antenna.

Figure 68 – Coaxial Cable

3. Weatherize the RF antenna connection using the weatherizing kit, as described in "Tools and Materials" on page 17.

4. Follow instructions in the weatherizing kit and the coaxial ground kits for proper installation.

Figure 69 – Weatherizing RF Antenna

Warning! 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 70 – RF Antenna to Mast

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

Figure 71 – Securing the Coaxial Cable

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

Connecting the Ethernet Cable

Important! 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.

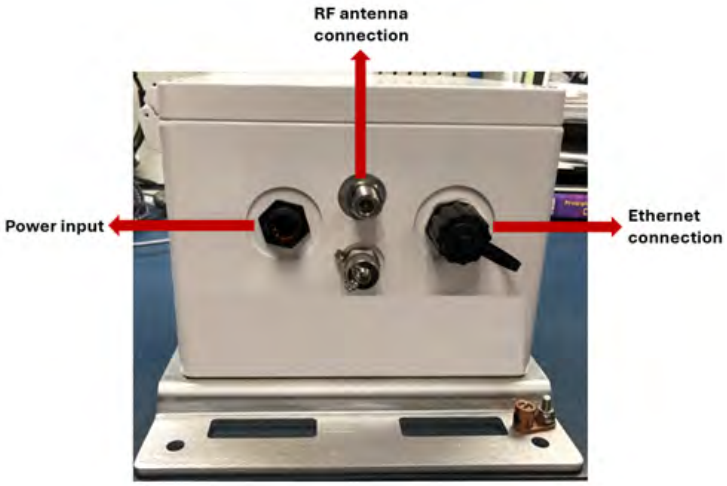

Figure 72 – Port Connection

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

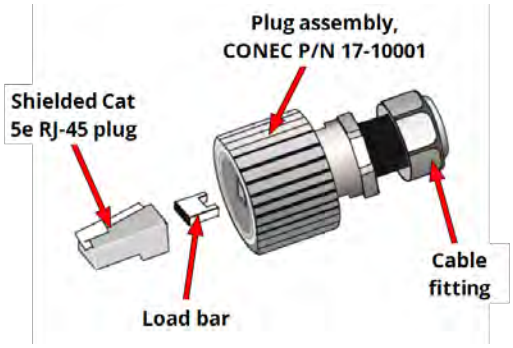

Figure 73 – Feed-Through Assembly

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

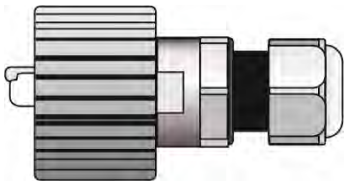

Figure 74 – RJ45 Ethernet Plug

4. Terminate the Ethernet jack to the Ethernet cable.

Figure 75 – 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 76 – Ethernet Plug Inserted

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

Chapter 9: Gateway Conversion (Ethernet to Cellular)

This section contains recommended steps to convert the R900® System gateway from Ethernet to cellular configurations.

Important! Discharge static electricity from your body by using an antistatic wrist strap that meets ANSI/ESD S1.1-2021. Connect cable side opposite the wrist to a metal grounded object (for example, the gateway's mounting bracket) before interacting with the gateway's internal electronic components. Antistatic wrist straps are designed to prevent build-up of static electricity and safely ground operators who are working with ESD sensitive components.

Connect the Gateway and the Cellular Modem

Complete the following steps to connect the gateway and the cellular modem.

1. Remove the two Ethernet cables from the Ethernet surge protector on the gateway.
2. Attach the RX55 cellular modem to the gateway's door plate using the four 4-40 screws provided.
3. Using a #1 Phillips screwdriver, remove the SIM card cover.
4. Insert the SIM card (Mini-2FF size) into the upper card slot of the cellular modem.
5. Reattach the SIM card cover.
6. Attach the power cable to the cellular modem's power port.
7. Attach the other end of the power cable to J9 (6-position connector) on the HVPS board.
8. Attach the three cellular antenna cables to the cellular modem and torque SMA antenna connections to 8 inch-pounds, using a SMA torque wrench.
9. Power on the gateway.
10. Attach a laptop computer to the cellular modem's Ethernet port, using an Ethernet patch cable.

Provision and Verify the Cellular Modem

Complete the following steps to provision and verify the cellular modem.

1. Provision the RX55 cellular modem per the *included Sierra Wireless RX55 Quick Start Guide*. The process can take 6–7 minutes.
2. Remove the Ethernet connection from the laptop computer that was used during the SIM card provisioning process.
3. Attach one end of the 18″ long Ethernet patch cable (Neptune P/N: 15190-002) to the board stack's Ethernet port and attach the other end to the cellular modem's Ethernet port.
4. Apply the appropriate new product label based on the gateway version you are updating.

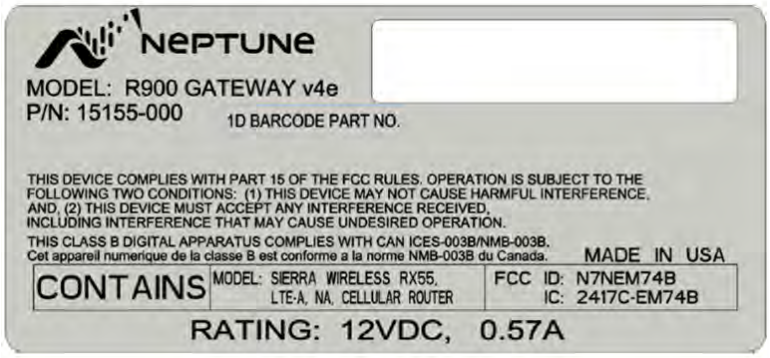

Figure 77 – R900® Gateway Label

5. Power on the cellular modem and verify that the modem has power based on the indicators in the following image.

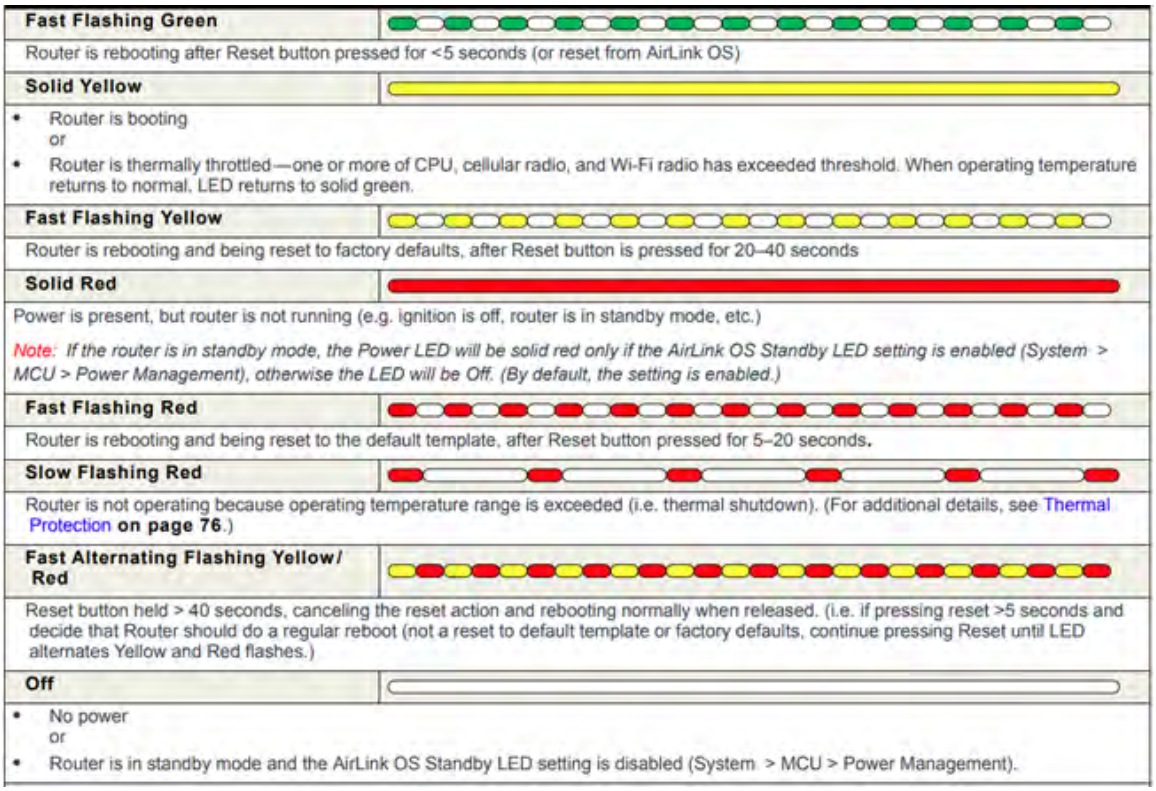

Figure 78 – Modem Power Indicators

6. Verify that the modem has ample cellular signal strength as shown in the following image.

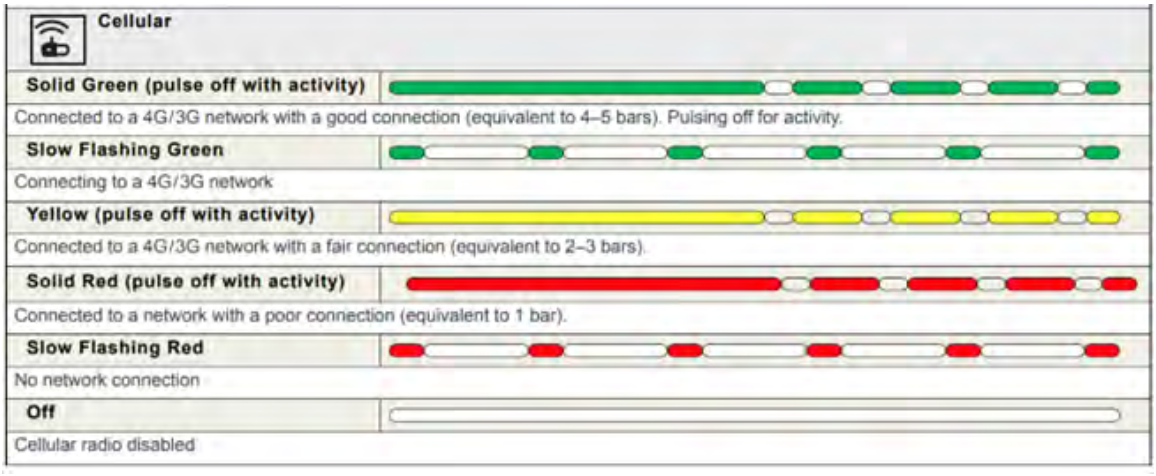

Figure 79 – Cellular Modem Strength

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Chapter 10: Updating Gateway Firmware

This chapter provides the steps to update and verify the R900® System gateway firmware.

Updating the Gateway Firmware Using an SD Card

Firmware is the software that runs on your gateway and controls its functionality. Upgrading the firmware can improve the performance and stability of your gateway. You can download a firmware update onto an SD card to update your gateway.

Important! Only Utility Administrator roles have permission to perform a gateway firmware update.

Prerequisites

- You have added an R900 System gateway to your site in Neptune 360. See "Adding a Gateway to Neptune 360" in Chapter 2: Activating the Gateway in the Host Software, for the steps to add a gateway.
- You have access to a computer with an SD card reader and an SD card.
- You have access to the physical gateway to update.

Steps to Configure

1. On the Device Management grid, click the device ID for the gateway for which you want to update the firmware.
2. Click **Update Firmware**.
3. In the **Firmware Version** field, select a firmware version greater than the firmware version running on the gateway.

   The firmware version displays in the Details section on the window. For example, if your gateway is running version 1.0.0, you can select version 1.0.1 or higher.
4. In the Firmware Delivery Method field, select **SD Card**.
5. Click **Update**.
6. In the confirmation box, click **Yes, Download.**

   The system displays the downloaded file, which is a .cms file, and displays a window with details and activities.

7. Insert the SD card into your computer SD card reader.
8. Copy the update file to the root directory of the SD card, and then eject the SD card from the computer.
9. Insert the SD card into the SD card slot for the gateway that you want to upgrade.

   The gateway reads the update file from the SD card and applies the update.
10. In the Device Management grid, select the gateway and verify the firmware version you selected displays in the **Firmware Version** field.

Updating the Gateway Firmware Over-the-Air

In addition to updating your gateway by downloading the firmware update onto an SD card, you can also choose the over-the-air remote firmware update option, which eliminates the need for an on-site visit.

Important! Only Utility Administrator roles have permission to perform gateway firmware updates.

Prerequisites

- You have added a gateway to your site in Neptune 360. See "Adding a Gateway to Neptune® 360™" on page 5 for the steps to add a gateway.
- You have access to a computer and the permission to see and update the gateway's firmware.

Steps to Configure

1. On the Device Management grid, click the device ID for the gateway for which you want to update the firmware.
2. Click **Update Firmware**.
3. In the **Firmware Version** field, select a firmware version greater than the firmware version running on the gateway.

   The firmware version displays in the Details section on the window. For example, if your gateway is running version 1.0.0, you can select version 1.0.1 or higher.
4. In the **Firmware Delivery Method** field, from the drop-down menu, select **OTA**.
5. Click **Update**.

6. In the confirmation box, click **Yes, Update**.

   The firmware update process takes a few minutes before the gateway begins the rebooting process.

7. Once reboot is complete, toggle back to Neptune 360's **Device Management** grid to ensure that the version number is updated.

Verifying the Gateway Firmware Update

This section defines the procedures to verify the firmware update to ensure the firmware is operating at maximum capacity without errors.

Installing a Firmware Update

When installing a firmware update, the gateway displays the wig-wag pattern in red on the RF Activity and WAN Connection LEDs.

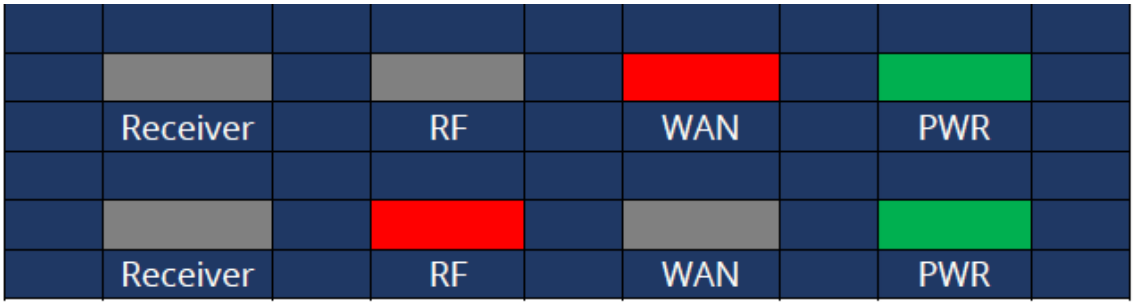

Figure 80 – Firmware Update LED Display

Verifying a Firmware Update

This section defines the LED indicators for a successful firmware update and an unsuccessful firmware update.

Successful Firmware Update

When the firmware update is complete, the gateway simultaneously flashes both the RF Activity and WAN Connection LEDs green three times, followed by a reboot.

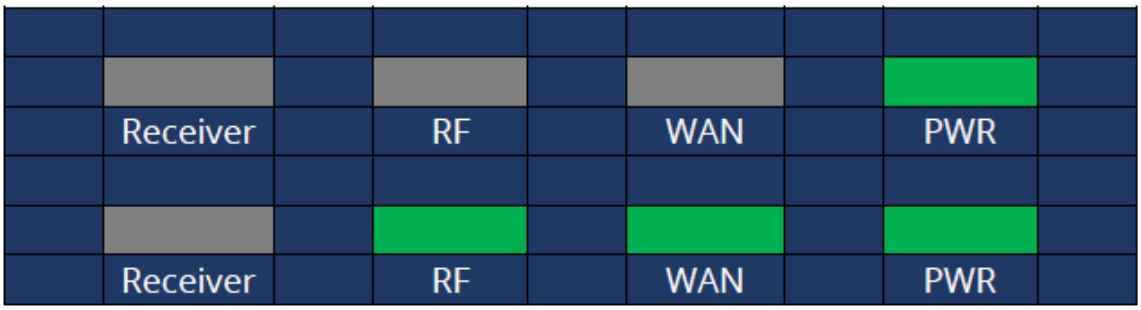

Figure 81 – Successful Firmware Update LED Display

Unsuccessful Firmware Update

When the firmware update process fails, the gateway simultaneously flashes both the RF Activity and WAN Connection LEDs red three times, and the gateway resumes normal functions.

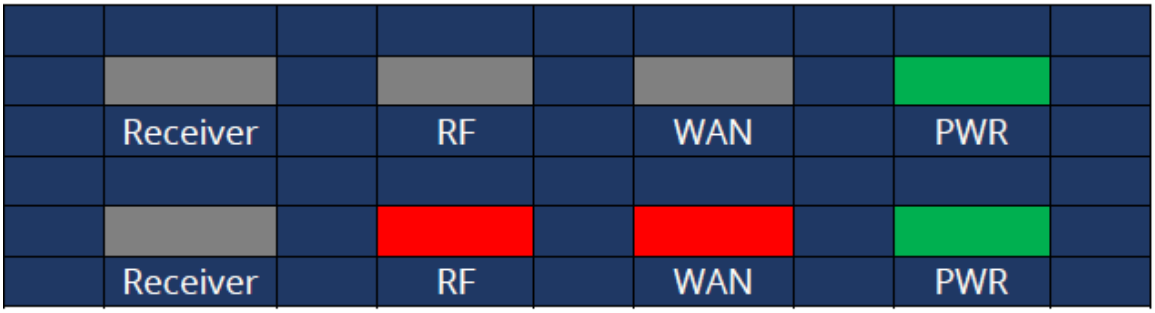

Figure 82 – Unsuccessful Firmware Update LED Display

Verifying Field Programmable Gate Array Bitstream Programming

This section defines the LED indicators for a successful FPGA bitstream update and an unsuccessful FPGA update.

Successful FPGA Bitstream Update

During a successful FPGA Bitstream update, the RF Activity LED is white.

Figure 83 – Successful Bitstream Update LED Display

Unsuccessful FPGA Bitstream Update

During an unsuccessful FPGA Bitstream update, the RF Activity LED is red.

Figure 84 – Unsuccessful Bitstream Update LED Display

FPGA or RF Hardware Error

If the FPGA or RF Hardware error occurs, the receiver LED is red. The RF activity LED may continue to flash green if the gateway is still receiving readings despite the error. The RF Activity LED turns red if the error results in a dead air condition.

Figure 85 – FPGA or RF Hardware Error LED Display

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Chapter 11: Troubleshooting the Gateway

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

Performance Troubleshooting

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

Table 16 – Performance Troubleshooting

Problem/Failure	Recommended Action
Cannot connect gateway to Neptune 360	Contact Customer Support at support@neptunetg.com.
All of the packets appear to be there but some packets are empty (0 bytes)	Refer to "RF LED Troubleshooting Actions" later in this chapter.
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 covers the troubleshooting process for a gateway installation. It also includes indicators to recognize if the gateway is experiencing overheating issues.

Checking UPS Status LEDs

Complete the following steps to check the Uninterruptible Power Supply (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 17 – 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.
   - If the AC input voltage is not present, then the voltage across DC+ and DC– should measure 10.5 VDC to 12.8 VDC.
6. Verify the DC voltage is not present across DC+ and DC–, and then:
   - Measure the AC input voltage across L1 and N1. This voltage should measure 120 VAC (± 20 V).
   - Verify that the internal switch for the UPS is on, for example, the battery should be charging.
   - Verify the UPS status LEDs. See the table in step 4.
7. Install the UPS cover again and secure it with the two screws.

Verifying the Main Power

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

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

Checking the Power Unit and the Receiver

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"in Appendix A.

Figure 86 – Gateway Power Plug

Verifying the Digital Board

The following image shows the inside of the gateway model. When you open the door of the gateway, you should see four LEDs in the top right corner of the device. These LEDs help you monitor the current performance of the gateway and assist you in fixing any issues.

This part of the user guide explains the LEDs on the gateway. It tells you what they mean and what to do if you see them.

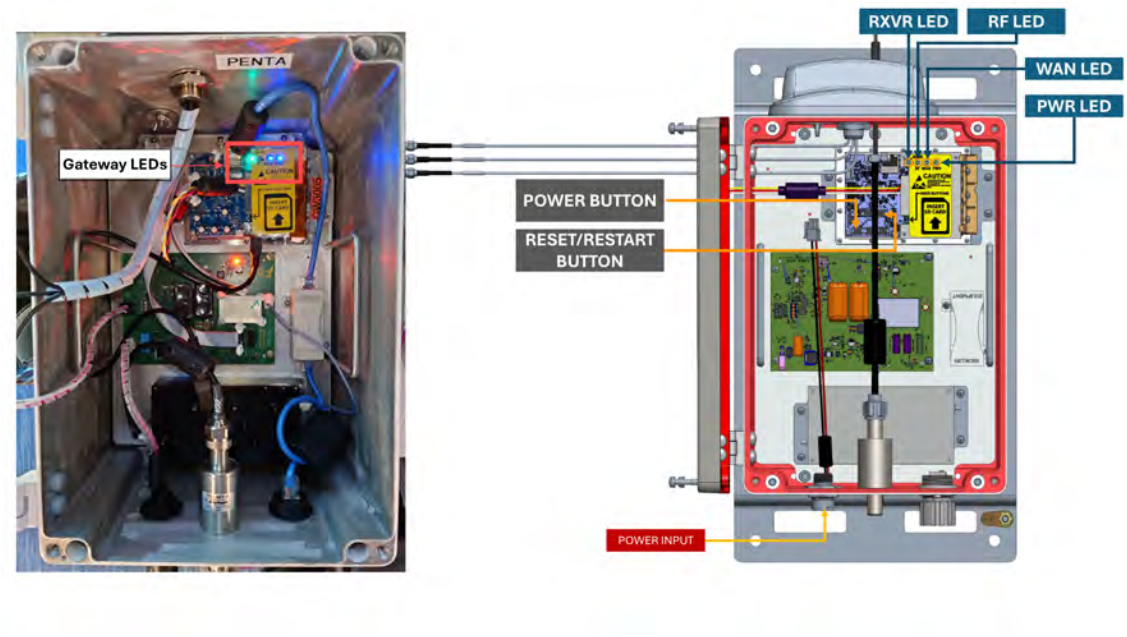

Figure 87 – Gateway System LEDs

Caution! Discharge static electricity from your body by using an antistatic wrist strap that meets ANSI/ESD S1.1-2021. Connect cable side opposite the wrist to a metal grounded object (for example, the gateway's mounting bracket) before interacting with the gateway's internal electronic components. Antistatic wrist straps are designed to prevent build-up of static electricity and safely ground operators who are working with ESD sensitive components.

RXVR LED Indicators

The RXVR LED indicates the condition of the receiver inside the gateway. The green light illuminates, indicating that it is powered on.

Table 18 – RXVR LED Indicators

Light Color	Indication
Green	Power on.
Red	Error.
Off	Receiver is off.

RXVR LED Troubleshooting Actions

If you see a red light or no light, there is an error detected. Perform the actions in the table to correct the error.

Table 19 – RXVR LED Troubleshooting

Light Color	Indication
Red	• Power cycle the gateway by turning it off completely, wait for a few seconds, and then turn it back on. • Ensure that the gateway is receiving stable power from its power supply. Fluctuations or insufficient power can lead to errors in the receiver operation. • Verify that all cables and connections, including power cables and antenna connections, are securely plugged in. Loose connections can cause errors in communication. • If the issue continues, contact Customer Support .
No light	• Power cycle the gateway by turning it off completely, wait for a few seconds, and then turn it back on. All LEDs turn yellow. Wait until the RXVR LED is green, showing that it is on. • If the issue continues, contact Customer Support .

RF LED Indicators

The RF LED represents RF activity. A flashing or solid green light illuminates when the gateway is receiving endpoint readings.

Table 20 – RF LED Indicators

Light Color	Indication
Flashing or solid green	Gateway is receiving endpoint readings.
Red	No readings received.
Off	Gateway has no packet reception.

RF LED Troubleshooting Actions

If you do not see a green light, there is an error detected. Perform the actions in the table to correct the error.

Table 21 – RF LED Troubleshooting

Light Color	Indication
No light	• Ensure that the gateway is properly powered and connected to a reliable power source. A loose power connection could prevent the LED from lighting up. • Ensure that the gateway is properly configured to receive and process RF signals from the endpoints. Check the gateway settings and make sure they match the requirements of your network. • Confirm that the gateway is in range of the endpoints it is supposed to communicate with. If it is too far away or obstructed by physical barriers, it may not receive RF signals effectively. • Ensure it is securely connected to the gateway. A loose or improperly connected antenna can weaken the RF signal reception. • Check for sources of interference that operate within the same frequency band (for example, 902 – 928 MHz) as they can interfere with RF signals. • If the issue continues, contact Customer Support.

WAN LED

The WAN LED indicates a connection to both the internet and the Neptune® 360™ platform. It serves as a diagnostic tool for identifying issues related to data transmission to Neptune 360. A green light illuminates when operating at its normal functionality, for example, there is connection to both the internet and the Neptune 360.

Table 22 – WAN LED Indicators

Light Color	Indication
Flashing green	Normal operation.
Yellow	WAN is connected, Neptune 360 is not connected.
Red	No WAN connection (no internet).
Off	Connection status is not available.

WAN LED Troubleshooting Actions

If you see a red light, there is no internet connection. Perform the actions in the table to correct the error.

Table 23 – WAN LED Troubleshooting

Light Color	Indication
Red	• Ensure the gateway is connected to a network with internet access. • If possible, verify the internet connection with a laptop. • Check that the cellular modem has a provisioned sim card. • For a cellular option gateway, verify the LEDs on the modem are illuminated and the modem is properly connected. • Power cycle the gateway by turning it off completely, wait for a few seconds, and then turn it back on. • Check the gateway's configuration settings to ensure they are correct for connecting to Neptune 360. • Ensure the gateway's firmware is up to date, as updates may resolve connectivity issues. • Check the gateway's system logs for error messages or alerts related to connectivity. • If the issue continues, contact Customer Support.
Yellow	• Confirm that the gateway's configuration settings are correct for connecting to Neptune 360. This includes checking network settings, gateway mode, and any specific parameters required by Neptune 360. • Power cycle the gateway by turning it off completely, wait for a few seconds, and then turn it back on. • If the issue continues, contact Customer Support.

PWR LED Indicators

The PWR LED indicates power being sent to the gateway. A flashing green light illuminates when the gateway is operating at its normal functionality.

Table 24 – PWR LED Indicators

Light Color	Indication
Flashing or solid green	Normal power capacity.
Yellow	Gateway is experiencing undervoltage.
Red	Error.

PWR LED Troubleshooting Actions

If you see a red light, there is an error. Perform the actions in the table to correct the error.

Table 25 – PWR LED Troubleshooting

Light Color	Indication
Red	• Ensure the gateway is properly plugged into a working power outlet or power source. Make sure the UPS is properly connected and charged. • Verify that all cables are securely connected and there are no signs of damage or wear. • Power cycle the gateway by turning it off completely, wait for a few seconds, and then turn it back on. • With a voltmeter, check UPS input voltage meets AC power requirements for example, 120V 60Hz) and output voltage meets DC requirements (12 VDC). • Check if there are any firmware or software updates available for the gateway that might resolve the issue. • If the issue continues, contact Customer Support.
Yellow	• Ensure that the gateway is receiving an adequate power supply. Verify that the power adapter is securely plugged into both the gateway and the power source. Make sure the UPS is properly connected and charged. • Look for any loose connections or damaged wires that could be causing a drop in voltage. • Look for any signs of hardware damage or malfunction on the gateway itself. Inspect components such as capacitors, voltage regulators, and circuitry for visible signs of damage or overheating. • Try plugging the gateway into a different power outlet or using a different power adapter to rule out issues with the power source. • Ensure that the gateway is not overloaded with too many devices or peripherals drawing power from it. Disconnect any unnecessary devices and peripherals to reduce the load on the gateway. • If the issue continues, contact Customer Support.

Verifying Gateway Overheating

When the unit is in an over-temperature or overheating condition, the Power LED turns solid red and briefly turns off every second. The gateway's firmware monitors the temperature and allows the system to resume full operation automatically once it has cooled down.

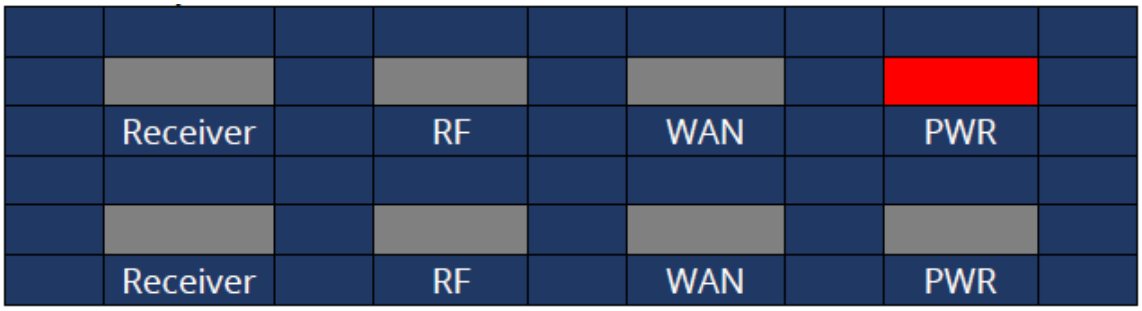

Figure 88 – Gateway Overheating LED Display

Verifying Cellular Modem Connectivity

This section provides instructions for checking the Sierra Wireless RX55 cellular modem connectivity.

Checking Connectivity

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

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 "Checking UPS Status LEDs" earlier in this chapter.
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.

Important! Refer to chapter 5 for information on the LED behaviors or refer to source.sierrawireless.com. You must create an account prior to accessing the Source.

Verifying Cellular Modem Power

Complete these steps to verify power to the cellular modem.

1. Remove the power plug from the cellular modem by pressing the latch to disengage it, and then remove the plug.
2. Measure between pins shown in the following figure. There should be 12 VDC between the pins shown.

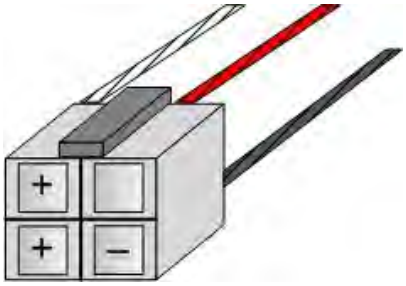

Figure 89 – Cellular Modem Power Plug

Contact Information

Neptune Customer Support is available in the United States Monday through Friday, 7:00 A.M. to 5:00 P.M. Central Time by telephone or email.

By Phone

To contact Neptune Customer Support by phone, call (800) 647-4832 and complete the following steps.

Press one of the following:

- 1 for Customer Service.
- 2 for System Support.
- 3 for Return Material Authorizations (RMAs)
- 4 for Subscriptions or Renewals
- 5 for Customer Success and Onboarding

For System Support or Customer Success and Onboarding, press one of the following:

- 1 if you know your site ID.
- 2 to input your PIN or if you do not have a PIN.

For RMAs, press one of the following:

- 1 for reading device support.
- 2 for meter, endpoint, and register support.

Neptune Customer Support Specialists are dedicated to you until the issue is resolved to your satisfaction. When you call, please be prepared to give the following information:

- Your name and a callback number
- Your utility name, company name, or site ID / PIN.
- 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.

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Appendix A: Solar Power Information

This appendix 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. For additional information about the size solar panel required and the proper tilt angle, refer to the PVWatts Calculator at www.pvwatts@nrel.gov/index.php.

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

This section defines the corrections to take to achieve optimal magnetic declination and solar panel tilt for your gateway setup.

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 "Magnetic Declination U.S. " on page 93.

1. Locate your site on the map shown in "Magnetic Declination U.S." later in this chapter.
2. Interpolate the value for magnetic declination in degrees based on the lines of constant declination (isogonic lines) shown in "Magnetic Declination for the United States" on page 93. For example, the declination of Washington, D.C. is approximately –11° W, for Chicago, IL, –4° W, and for Los Angeles, CA, +11 E°.
3. Determine magnetic south at your site using a magnetic compass.

Important! 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° + 11° = 191° 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° – 14° = 166° indicated.

4. Orient your solar panel in direction of true south (or north if applicable).
5. A declination chart for North America is provided in the figure titled "Magnetic Declination "Magnetic Declination U.S. " on the facing pageFigure 90 – 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.

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° + 15° = 47°. In this example, the solar panel tilt angle would be set for 47°.

   The following table shows the solar panel tilt angle based on winter performance.

Table 26 – Recommended Solar Panel Tilt Angle

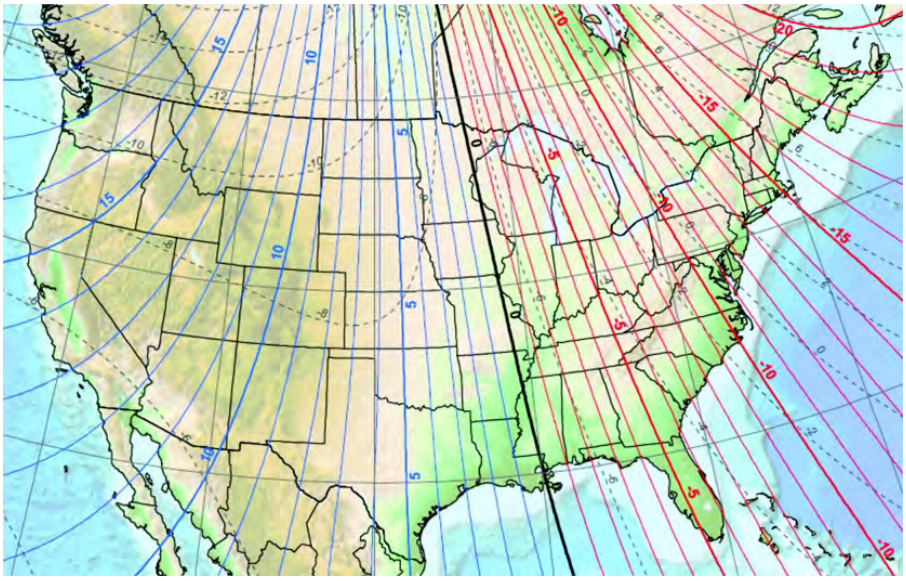
Site Latitude Range (Degrees)	Recommended Fixed Tilt Angle
46° – 90°	60°
26° – 45°	Latitude + 15°
15° – 25°	Latitude + 5°
0° – 15°	15°

Important! 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 90 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 90 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 90 – 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 the following figure, determine the zone where the site is located.

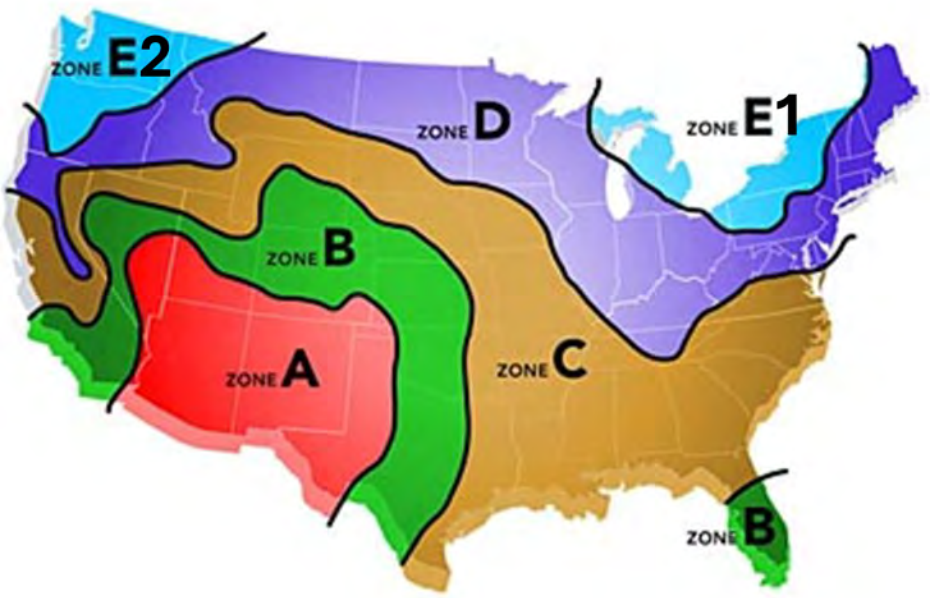


Figure 91 – Solar Power Zones

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

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

Table 27 – Solar Power System Selection

Zone	Solar Panel Wattage	Solar Power Dimensions	Solar Power System Selection Neptune Part No.
A, B, C, D, and E1	195 W	26 inch x 59 inch	13068-200 (pole / stand)
E2, and Canada	220 W	52 inch x 48 inch	13068-300 (pole / stand)

The pole / stand version is for a 2-inch to 16-inch diameter schedule 40 galvanized steel pole, or utility pole.

Important! 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 E2, choose the zone E2 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 28 – 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.

Important! 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.

SunSaver™ Gen 2

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

Figure 92 – 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 93 – 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" on the facing page lists the charging status LED definitions.

Table 29 – 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 30 below identifies the battery status LED definitions.

Table 30 – 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.

Important! An error condition exists if multiple battery SOC LEDs are flashing.

LED Error Indicators

The following tables describe how to interpret the LED error indicators. A heartbeat indicator 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 31 – Charging Status LED Error Indicators

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

Table 32 – Battery Status LED Error Indicators

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 94 – ProStar™ Controllers

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

Charging Status

For charging status indications, see the following table.

Table 33 – 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 the following table.

Table 34 – 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 35 .

Table 35 – 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°C. The values displayed are calibrated electronically in production and are accurate to within a few percent.

Important!

- 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 begins automatic self-diagnostics. You must release the button to start the self-test.

Important! 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 36 – 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 the table on the following 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 37 – 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.

Table 37 – Fault Error List (continued)

Display	Error Condition
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. You can repeat the self test 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 38 – 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 battery's 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, and 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 39 provides VOC and VUC for SOC at 25°C.

Table 39 – 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.

Important! 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 40 – 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

Important! 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 buildup becomes excessive, clean the solar panel's glass surface with only a soft cloth using glass cleaner, or a mild dish washing soap and water.

Warning! 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 91. Partial shading (3-13%) can cause a 25% to 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" earlier in this chapter.

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

Table 41 – 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 42 provides the degree of sunlight at various times on a clear, sunny day in the summer.

Table 42 – 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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Appendix B: Ballast Requirements

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).

Table 43 – ROHN Stand Footprint Dimensions

ROHN Stand Model No.	Footprint Dimension	Protective Pad (⅜" thick)
JRM	5 ft. x 5 ft.	JRMPAD.
BRM4	6.5 ft. x 6.5 ft.	BRM4PAD.
BRM6	10 ft. x 10 ft.	BRM6PAD.

Warning! 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.

Warning! 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.

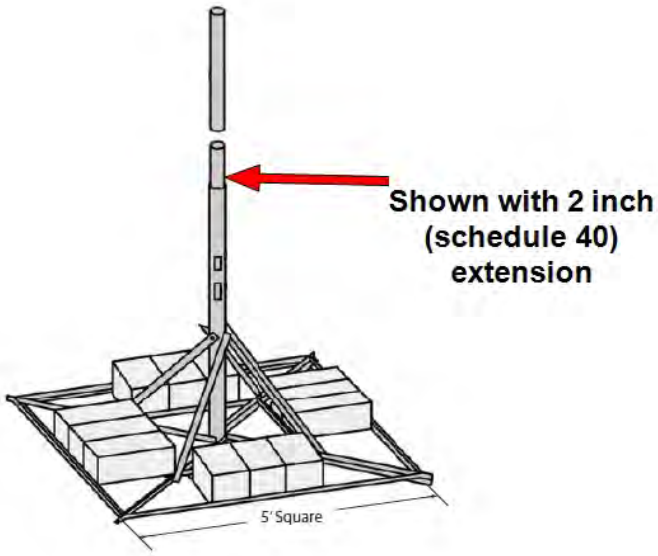

Figure 95 – ROHN JRM23855 Stand

Safety cable kits (if required by local building codes) consisting of a 3/16 EHS safety cable (3990 lbs. ultimate strength) with 6 clamps to secure mount and/or ballast are available as an option from Rohn. See the following table for details. Use three cable clamps at each end connection with the U-bolt on the dead end of the cable.

Table 44 – ROHN Safety Cable Options

Safety Cable Length	Rohn P/N
50 ft.	SCK50
100 ft.	SCK100
150 ft.	SCK150

Appendix C: RF Antenna and Coaxial Installation

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

Important! 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 45 – 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 interference.
- 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 46 provides part numbers of acceptable coaxial cables.

Table 46 – Acceptable Coaxial Cables

Length	Part Number
40 ft. or <	Times Microwave Part Number: 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, Custom Cable Assemblies (CCA), CDM Electronics, Wesco Anixter and Hutton Communications.

Each end must be terminated with an N-male type connector and sealed with adhesive lined heat shrink tubing. 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 the following table.

Table 47 – Coaxial Order Matrix

Coaxial Lengths	Description	Loss / 100 ft. @ 900 MHz	Max Length	Min Bend Radius	Neptune Part No.	Manufacturer Part No.
≤ 50 ft. - Pre-terminated coaxial cable assemblies	LMR-400 10 ft. assembly	3.9 dB	40 ft.	1"	13090-001	Tessco LMR400NMNM-10.
	LMR-400 20 ft. assembly	3.9 dB	40 ft.	1"	13090-002	Tessco LMR400NMNM-20.
	LMR-400 30 ft. assembly	3.9 dB	40 ft.	1"	13090-003	Tessco LMR400NMNM-30.
	LMR-400 40 ft. assembly	3.9 dB	40 ft.	1"	13090-004	Tessco LMR400NMNM-40.
	LDF4-50A 50 ft. assembly	2.09 dB	90 ft.	5"	13090-006	Tessco 377096 or Hutton HSF-L4A-PNMNM-50.
≤ 90 ft.	Cable, coaxial, Heliax® 1/2-in. diameter	2.09 dB	90 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, Heliax 7/8-in. Diameter	1.13 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 2dB. When feedline loss is above 2 dB, the RF receiver performance suffers.
- 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 (typically 4 to 6 feet long) between the larger cable, and the collector and antenna connector.
- The installation could use more than one type of coaxial cable. The 1/2-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. "Coaxial Cable Lengths for the Gateway" in the previous section.
- The installation instructions for the Heliax Coaxial Cable are provided by Andrew. See Bulletin 17800B Revision C. Neptune can supply a PDF copy by request through Customer Support.

Table 48 – Installation Materials Needed

Items	Description/Recommendation
Securing Coaxial Cable	• Cable clips / coaxial hangers - for 1/2" or 7/8". • 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 gateway and the Ethernet.

Cellular Modem Overview

The Sierra Wireless RX55 modem is an LTE-Advanced cellular router that supports 4G LTE-A, Cat-7 technology. The certifying carriers are:

- AT&T – U.S.
- Verizon – U.S.
- Rogers (certification pending) – Canada.
- Bell – Canada.

Setting Up the Cellular Modem

To set up the cellular modem for the gateway, refer to the quick start guide for the modem in your unit. The *Sierra Wireless Airlink RX55 Quick Start Guide* is on Sierra Wireless's website: https://source.sierrawireless.com/. You are prompted to create an account to get access to the guide.

Important! Before you begin, make sure you have an active cellular account with the carrier of your choice.

Equipment Required

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

- Laptop or PC with Ethernet network port.
- *Sierra Wireless® RX55 Quick Start Guide.*
- Ethernet cable.
- Cellular service provider, SIM card, if applicable, APN, and password (from the cellular service provider).

Important! Some cellular services, such as CDMA, operate without a SIM card. Other cellular services, such as GSM (EDGE and GPRS), require one. Check with your provider for specifics.

Steps to Set Up the Modem

This section provides information about configuring and setting up the modems. Complete the following steps to configure the Sierra modem.

1. Verify whether a SIM card (Mini-SIM 2FF size) 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 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 solid green Network LED indicates a successful connection.

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.

Cellular Modem Conversion Kit

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

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.

Installing the External Cellular Antenna

Complete the following steps to install the external cellular antenna.

1. Open the gateway cover.
2. Loosen wing nut on the hole seal, located on top of the gateway, and remove it.
3. Install the coaxial surge arrestor (13306-001) in the same hole, inserting from the outside. The surge arrestor is IP67 rated.
4. Verify that the O-ring for the surge arrestor is in place and is located on the outside of the gateway enclosure.

   The surge arrestor can be installed in either direction—it is a bidirectional device.
5. Secure with washer and hex nut from the inside. Mounting nut torque: 55-65 in-lbs.
6. Install the external cellular antenna, mounting the antenna higher than the gateway to obtain better service reception.
7. Attach the external coaxial cable to the surge arrestor.

Important! 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.

Important! You can order longer coaxial cable assemblies (terminated), if needed, or refer to the coaxial cable matrix . See"Coaxial Cable Lengths for the Gateway" on page 115). The coaxial cables are available in lengths from 10 feet to 40 feet. The LMR-400 by Times Microwave is an acceptable coaxial cable type 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 "Tools and Materials" on page 17.

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 the following figure, using the T-568B wiring standard for both ends. One end should already be terminated to the switch or hub.

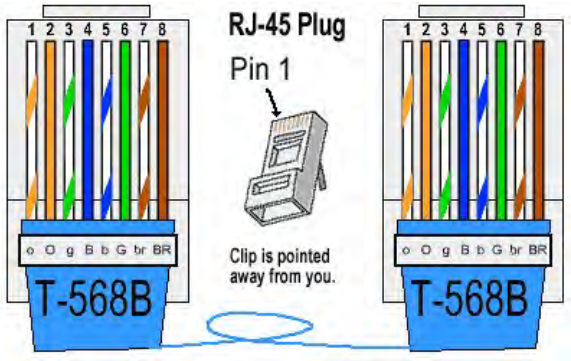

Figure 96 – Straight-Through Ethernet Cable

Crossover Ethernet Cable

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

- Require a cable to connect two Ethernet devices together without a hub.
- Connect two hubs together.

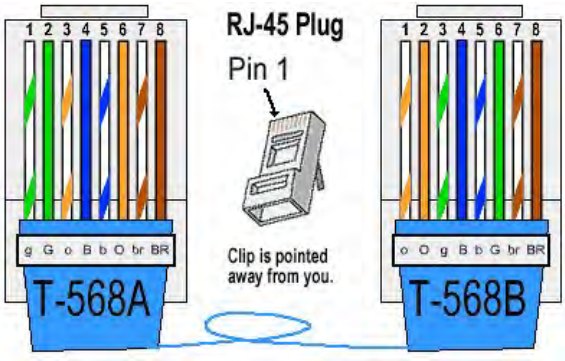

Figure 97 – Crossover Ethernet Cable

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.

Table 49 – 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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Glossary

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 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.

CMS

The CMS file system is the native file system of IBM's Conversational Monitor System (CMS), a component of VM.

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.

FPGA

Field Programmable Gate Array.

G

Gateway

Device that collects meter reading data from Neptune's absolute encoder register interfacing with Neptune's endpoint and transmits the data for collection. This unit receives the data and stores data to be downloaded through the Neptune® 360™ 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

NCP-2

Non Corrosion Product.

Neptune® 360™ Data Management Platform

Neptune 360 is a cloud-based software for capturing, processing, and housing all AMR and AMI meter reading data within AWS in the U.S. and Canada. It provides utilities a scalable, reliable, and secure data management solution without the burden of infrastructure and IT resources for all software management activities.

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.

PVM

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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W

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IM R900® System Gateway, serial numbers beginning with GPV4EXXXX, 03.2025