



R450™ Rack Mount Data Collector Installation and Maintenance Guide



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FCC Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to 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 that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.

RF Exposure Information

This equipment complies with the FCC RF radiation requirements for uncontrolled environments. To maintain compliance with these requirements, the antenna and any radiating elements should be installed to ensure that a minimum separation distance of 100 cm is maintained from the general population.



CAUTION: Changes or modifications not expressly approved by Neptune Technology Group 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, and (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 des règlements d'équipement. L'opération est sujette aux deux conditions suivantes: (1) ce dispositif peut ne pas causer l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peut causer l'opération peu désirée.

Professional Installation

In accordance with Section 15.203 of the FCC rules and regulations, the R450 Rack Mount Data Collector must be professionally installed. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Important Safety Precautions

Review the following precautionary measures prior to installation.



CAUTION: Refer installation and service to qualified service personnel only.

- Review the following precautionary measures prior to installation. Connections to the AC mains must be performed by a licensed electrician. No user-installable parts inside.
- Installation must be done in accordance with the instructions contained in this manual.
- Installation must be done in accordance with the National Electrical Code (NEC), NFPA 70 or Canadian Electrical Code (CEC), CSA C22.2, No. 1.
- In particular, installation must be done in accordance with NEC Article 810 or CEC Section 54.
- This unit is not intended to be powered directly from the Main Distribution System.



WARNING: Risk of explosion if UPS battery is replaced by an incorrect type. Dispose of used batteries according to the manufacturer's instructions.

Installations that Require Digging

If the installation requires digging, review the following warning.



WARNING: If the installation site requires digging, survey the area for concealed hazards. Call 811, the Call Before You Dig phone center, before proceeding. Be sure to locate any electric, natural gas, and water lines as well as cable and phone lines. In some states and jurisdictions, it is the law. Most state laws require at least two to three full work day's notice.

Antenna Alert

If installing or removing an antenna, review the following warnings.



WARNING: Antenna contact with high voltage wires can result in death. Watch for overhead electric power lines when erecting the antenna and mast. For proper installation and grounding of the antenna, please refer to National Electrical Code (NEC) Article 810 and Canadian Electrical Code (CEC) Section 54.



WARNING: Do not mount antennas on utility poles, electric service masts, or other structures carrying electric light or power wires. Outdoor antennas and coaxial cables must maintain clearance of at least 2 feet (0.6 m) from power or light wires carrying 250V or less, or at least 10 feet (3.0 m) from power wires carrying more than 250V per NEC Article 810 and CEC Section 54.

R450™ Rack Mount Data Collector
Installation and Maintenance Guide
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Chapter 1: Product Description

This chapter introduces the installation process. It explains the focus of the guide, the pre-installation personnel responsibilities, and general information on technical support.

General Product Overview

This section provides a general description of the R450™ Rack Mount Data Collector (RMDC).

The RMDC receives, stores, and communicates meter reading data to the Neptune host software. The RMDC collects meter reading data from Neptune's R450™ Meter Interface Unit (MIU) interfacing with Neptune's absolute encoder register. This data can be uploaded to the Customer Information System (CIS) and sent to the utility billing system for processing.



Figure 1 – R450™ Rack Mount Data Collector



The RMDC operates in frequencies in the 450-470 MHz licensed band. A Federal Communications Commission (FCC) license is required prior to installation of the system.

Before you Begin

Before you install the RMDC, it is important to become familiar with the unit and its components. This guide is intended for installer and is designed to help in the installation process. It contains information on the components and specifications, the site selection, and the actual installation of the unit.



WARNING: If the installation site requires digging, survey the area for concealed hazards. Call 811, the Call Before You Dig phone center, before proceeding. Be sure to locate any electric, natural gas, and water lines as well as cable and phone lines. In some states and jurisdictions, it is the law. Most state laws require at least two to three full work day's notice. Install in accordance with the FCC site license.

Two Versions of RMDC Installation

There are two RMDC versions available depending on the utility's backhaul preference. Each type is powered by external 12V DC power. Power is supplied to the RMDC by an Uninterruptible Power Supply (UPS).

Neptune provides an installation kit for each type of installation. The standard configuration of the RMDC backhaul is a cellular modem. The other backhaul option available is an Ethernet connection.

Backhaul Type

- Cellular modem (P/N 12799-800)
- Ethernet (P/N 12799-810)

The RMDC can be mounted on a wall, a pole, or H-frame.

Determining How to Install the RMDC

Consider the following information.



WARNING: Do not mount the RMDC, antenna mast, antenna, or lead-in conductor to a pole or similar structure carrying open electric light, power wires, or trolley wires over 250 volts. See NEC, Article 810.



Depending upon the availability of communications, you can use a cellular modem or Ethernet backhaul. Use with the selection checklist before installing the RMDC.

Mounting Components

This section describes the various mounting components for the RMDC.

Wall Mount

A wall-mounted RMDC can be installed indoors; however, because the unit uses an external antenna, you need an antenna mast. Refer to Figure 2 for how to mount the RMDC to a wall.

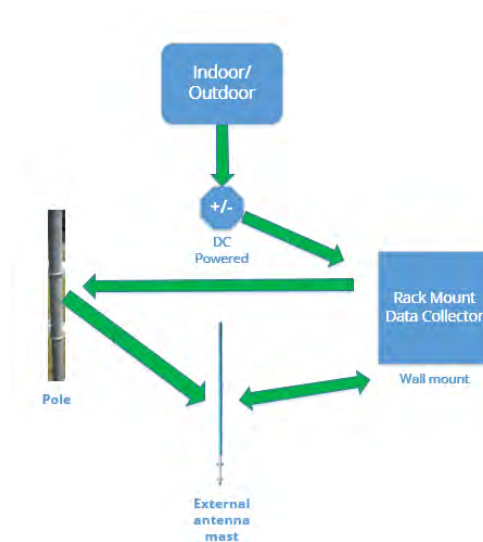


Figure 2 – Wall-Mount Installation



Depending upon the availability of communications, you can use a cellular modem or Ethernet backhaul.

Pole or H-Frame Installation

Use the pole or H-Frame installation to mount the R450 RMDC on an outdoor free-standing pole or H-frame. Refer to Figure 3 for how to install the RMDC on a pole.

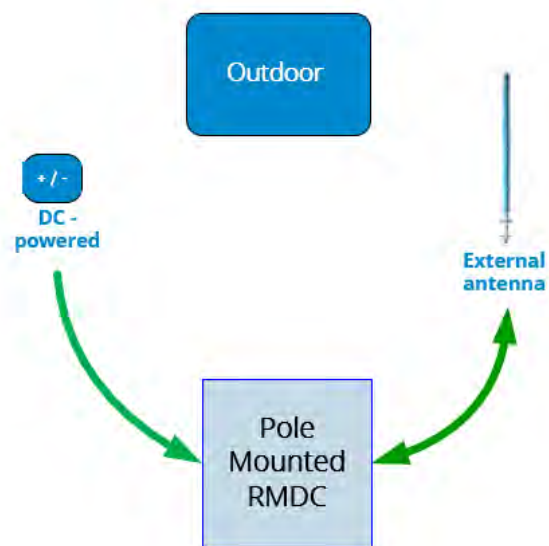


Figure 3 – Pole Installation



Depending upon the availability of communications, you can use a cellular modem or Ethernet backhaul.

Optimizing System Performance

This section addresses situations where the system is functioning, but the R450 RMDC or MIU communication is not performing as expected.

This discussion covers two situations:

- Newly-installed system does not perform per specification.
- Installed system performance degrades suddenly or over time.

Optimizing the Performance of a New System

Before you install the system, Neptune uses computer software and other resources to predict the performance of the system. Each site survey recommends a minimum number of RMDCs to provide the desired performance over a specified coverage area. The survey also recommends antenna placement and looks for potential radio interference. Neptune provides a propagation model which uses sophisticated software to predict the system performance. If you place an RMDC outside the recommended locations, it might not perform well.



CAUTION: If Neptune's propagation model is not followed, inadequate performance can occur.

Proper Operation

Review the following note.



Owners of both licensed and unlicensed equipment are responsible for the proper operation of their equipment. If it is not operating within specifications, the owner is required to bring the system into compliance or stop using it. The collaborative effort of all the affected parties is required to solve this problem.

It is possible for a piece of equipment to be functioning totally within its required specifications and still cause interference with the R450™ System.

During the initial installation, Neptune advises using a receiver or high-quality spectrum analyzer connected to the antenna to assure the transmit and receive frequencies are free from interference. Additionally, be sure that there are no potentially interfering signals around the frequencies the RMDC uses for transmitting and receiving. The overall noise level can potentially reduce the sensitivity of the RMDC or MIU receivers. A Rohde & Schwarz FSH3.03 or FSH3.23 or equivalent spectrum analyzer is acceptable.

Problems can occur from a number of sources. Some common problems include:

- Improper installation resulting in loose connectors. Refer to "RF Antenna Installation" on page 65 of Appendix A to confirm the correct installation procedures.



CAUTION: You must provide Appendix A to antenna contractors prior to installation. Failure to follow the procedures in the Appendix can result in poor system performance.

- Local cable systems operating with RF leakage from cables and amplifiers can degrade the performance of the R450 System.
- Local businesses and factories can have equipment that raises the ambient noise level, reducing the ability of the RMDC to hear MIUs.
- Local residences and businesses can have equipment that interferes with the R450 System.

Site surveys often find these problems but cannot detect intermittent, factory shift-related, or other time-specific sources of interference.

Being in close proximity to a high-power commercial broadcast antenna produces a unique set of problems. Loose or badly corroded hardware on or near the site can cause signals from the RMDC or other transmitters near the site to combine with the broadcast signal and produce interfering signals. Incorrectly installed antennas and feed lines can also cause similar problems. The RMDC and other local transmitters themselves can also be a source of re-radiated interference. Additional equipment that your installer recommends can help control these issues.

Terrain and the types of buildings in the area can affect the performance of the R450 System. Hilly or rolling terrain as well as tall buildings can make it difficult to receive even local MIU data. Placement of the MIUs (wall mount and pit style) can be critical in some areas. Additional RMDCs that supplement the problem areas is the best solution in these situations.

Maintaining the Performance of the R450 System

For consistent performance, be sure that you have properly installed all the R450 MIUs so that the R450 System can reliably receive their transmissions.

The Troubleshooting chapter of this guide includes recommendations on how to verify that the RMDC and antenna system are performing up to specification.

Storm activity can degrade the performance of the RMDC. If this happens, check the lightning arrestors and replace them, if defective.

Running the surveys again using the radio receiver can identify new sources of interference. For problems related to specific time periods, run the surveys during those time periods.

RMDC Components

The following section describes the components of the RMDC.

Cellular Modem

The RMDC is mounted on either a pole, wall, or H-Frame. Table 1 on the next page includes the components for the RMDC cellular modem version.

Table 1 – R450™ RMDC Cellular Modem Components List (P/N 12799-800)

Part Number	Description	Qty
12799-800	R450 Rack Mount, 4G Cellular Modem includes: • Uninterruptible power supply (UPS) • 4G/LTE cellular antenna • 6-foot cellular coax cable • Strut clamp • RJ45 connector, • Enclosure key • Manual	1
12896-001	Antenna, RF Omni (mounting hardware included)	1
	Coax cable (see Appendix A, "RF Antenna Installation" on page 65)	As required
13751-001	Antenna, 4G LTE cellular (included with the RMDC)	1
10046-112	Coax Cable, six-foot, cellular antenna (included with the RMDC)	1
13750-001	Strut clamp, 3/4-inch, stainless steel (included with RMDC)	1
13450-200	Uninterruptible Power Supply (UPS) kit (includes UPS, pole/wall mounting bracket, DC power cord, DC cord grip, and stainless steel clamps). Other vendors supply wall mounting hardware.	1
12835-002	<i>RMDC Installation and Maintenance Guide</i>	1



The cellular modem requires a System Information Manager (SIM) card which must be ordered separately. To obtain a SIM card, contact your preferred cellular service provider and give them the modem Mobile Equipment Identifier (MEID) and International Mobile Equipment Identifier (IMEI) numbers.

Ethernet

Table 2 shows the parts included in the RMDC Ethernet kit.

Table 2 – R450™ RMDC Ethernet Components List

Part Number	Description	Qty
12799-810	R450 Rack Mount, Ethernet version includes: • Uninterruptible power supply (UPS) • 4G/LTE cellular antenna • 6-foot cellular coax cable • Strut clamp • RJ45 connector • Enclosure key • Manual	1
12896-001	Antenna, RF Omni (mounting hardware included)	1
	Coaxial cable (see Appendix A, "RF Antenna Installation" on page 65)	As required
13450-200	UPS Kit (includes UPS, pole/wall mounting bracket, DC power cord, DC cord grip, and stainless steel clamps). Wall mounting hardware to be supplied by others	1
13138-001	External RJ45 Plug Kit (included with R450 RMDC - Ethernet version)	1
12835-002	<i>RMDC Installation and Maintenance Guide</i>	1

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Chapter 2: General Installation Guidelines

This chapter describes the specifications for the R450™ Rack Mount Data Collector (RMDC). It includes information on storage, unpacking, preliminary tests, tools, materials, site selection, and installation of the RMDC.

RMDC Specifications

This section provides the specifications of the RMDC.

Electrical Specifications

Table 3 – Electrical Specifications

Specification	Description
DC Power	12V DC, 7A
Power Consumption	84 Watts

Environmental Conditions

Table 4 – Environmental Conditions

Condition	Description
Operating Temperature	-22° to 140°F (-30° to 60°C)
Storage Temperature	-40° to 185°F (-40° to 85°C)
Operating Humidity	0 to 95% Non-condensing
Environmental Rating	NEMA 4X enclosure box
Operating Altitude	Less than 6561 feet (2000 meters)

Mechanical Specifications

The weight of the RMDC is 100 lbs.

RMDC Footprint

The RMDC measures 24"h x 27"w x 23"d.

Storage

Upon receipt, inspect shipping containers and their contents for damage prior to storage.

After inspection, store the cartons in a clean, dry environment where the temperature remains between -40° and 185°F (-40° and 85°C).

Unpacking

As with all precision electronic instruments, handle the RMDC with care; however, no special handling is required.

After unpacking the RMDC, inspect it for damage. If any parts of the RMDC appear to be damaged or prove to be defective upon installation, notify your Neptune sales representative. If the unit or item requires reshipment, use the original cardboard box and packing material.

RMDC Installation Kits

The RF 450 MHz antenna and accessories are now ordered separately from the RMDC. The RF 450 MHz antenna, coaxial cables, and coaxial connectors must be ordered as accessories. See "RF Antenna Installation" in Appendix A for a list of the antenna accessories and cables.



Figure 4 – R450 Rack Mount Data Collector

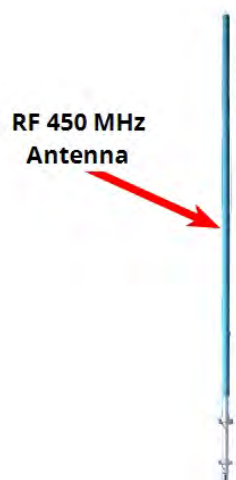


Figure 5 – RF 450 MHz Antenna

Tools and Materials

Table 5 below shows the recommended tools and materials you need to successfully install the RMDC.



Some items do not apply to your specific installation, and the list does not contain all tools or materials depending on which installation method you use.

Table 5 – Recommended Tools and Materials

Item	Description/Recommendation	Use
Tool Kit	Contains standard tools including: • Assorted screwdrivers (medium, Flat-Head (slotted), Phillips head) • Cordless electric drill/assorted bits • Adjustable wrench • Standard socket wrench set • Standard box-end wrench set • Hammer • Channel locks	Various installation procedures performed by the installer.
UV-Stable Ties	8" and 12" (20.32 cm and 30.48 cm)	Securing smaller short coaxial.
Cable Hangers	Various sizes	Securing coaxial cable. For larger coaxial (1/2" diameter and larger), secure to tower or structure per manufacturers recommendations.
RMDC Key	Key for lock on unit	Securing the unit.
Weatherizing Kit	3M Scotch® Wireless Kit P/N: WK-101 or Times Microwave P/N: WK-S-2	Weatherproofing coaxial cable connections.
Coaxial Grounding Kit	SG12-06B2A for 1/2" LDF4-50 Coaxial or SG78-06B2A for 7/8" AVA5-50 Coax	Grounding coaxial cable (see Andrew Bulletin 17800B-JC).
Coaxial Hoisting Grips	As recommended by coaxial cable manufacturer (see Andrew Bulletin 17800B-JC)	For tower and monopole installations - hoist and secure coaxial
Personal Protective Equipment (PPE)	Wear OSHA approved PPE as required. Safety glasses must meet ANSI Z87.1	

R450 MIU and Magnet

If you have R450 MIUs already installed, you can use these to test if the RMDC is receiving readings. However, it is recommended that you take an R450 MIU and Neptune magnet with you when you install the RMDC. These items are needed to test the unit. See "Swiping the MIU" on page 34.



When you install the R450 MIU, be sure that the N_SIGHT PLUS host software is running and that you have an R450 MIU and magnet with you. Use the R450 MIU and magnet to test the unit.

Chapter 3: Installing the R450™ RMDC

This chapter details the installation instructions for the R450™ Rack Mount Data Collector (RMDC). There are two installation options:

- "Mounting the RMDC to a Pole or H-Frame" below
- "Installing the R450™ RMDC " above

Mounting the RMDC to a Pole or H-Frame

This section provides information on mounting the RMDC to a pole or H-frame.

Locating the Site

Choose a location that does not interfere with any other wiring and is easily accessible. After selecting a site, complete the following procedures.

Mounting Recommendations



WARNING: Outdoor antennas and coaxial cables should maintain a clearance of at least 2 feet (0.6 m) from open electric light or power service conductors of 250 volts or less. If the power wires are more than 250V, maintain a clearance of at least 10 feet (3.0 m) per NEC Article 810 and CEC Section 54.

You can mount the RMDC to a pole (4 inch or larger) using two 3/4-inch wide stainless steel straps (Band-It #C20699 strap, #C25699 buckle, and #C00169 standard tool). Other vendors supply the straps, buckles, and standard tools. Hardware needs to be corrosion resistant and coastal areas can use stainless steel.



Figure 6 – R450 Rack Mount Data Collector

Mounting Hardware Recommendations

Table 6 lists installation types and the recommended mounting hardware to use.

Table 6 – R450 RMDC Pole Mounting Hardware Recommendations

Installation Type	Comments	Recommended Mounting Hardware (supplied by other vendors)
Small Pole	2-inch to 4-inch diameter galvanized steel, Schedule 40	• Slotted or half slot steel strut channel (1-5/8" x 1-5/8" x 22" L), two mounted to the back of the R450 RMDC enclosure • 3/8"-16 x 1" Grade 8 (A490) bolts, four minimum¹ • 3/8"-16 nuts • 3/8" fender washers • Two steel strut clamps (2" to 4" depending on pole size) • Optional: 1/4"-20 x 1" Grade 8 (A490) bolts; use a minimum of eight; also, 1/4"-20 nuts and 1/4" fender washers
Large Pole	4-inch diameter or larger	Use two 3/4" wide stainless-steel straps (Band-It #C20699 strap, #C25699 buckle, and #C00169 standard tool)
2-Pole "H-Frame" Strut Channel	Recommended minimum pole size is 2-inch diameter galvanized steel, Schedule 40	3/8"-16 x 1" bolts, 3/8"-16 spring nuts, and 3/8" washers; use a minimum of four 3/8" bolts Optional: 1/4"-20 x 1" Grade 8 (A490) bolts and 1/4" washers; use a minimum of eight

¹ Note: If mounting to the shallower 13/16" depth strut channel (1-5/8" x 13/16"), then 7/8" long bolts are recommended to keep from bottoming out.

² Note: Hardware listed is the minimum allowable recommended hardware. Additional provisions can be necessary for high wind areas.



For pipe mounting, use Schedule 40 or Schedule 80 galvanized steel pipe with at least a 2-inch or larger diameter. Seat the pipe per local codes.



For general recommendations on strut clamps and sizing information, see Appendix E: "Strut Clamp Recommendations" on page 99.

Attaching Cables for the RMDC

The corresponding sections detail how to attach the following components:

- RF 450 MHz antenna cable
- Ground wire
- Cellular antenna
- AC Power plug



Figure 7 – RF 450 MHz Antenna Connection

Attaching the RF 450 MHz Antenna Cable

To attach the RF 450 MHz antenna cable, complete the following steps.

1. Locate the RF 450 MHz antenna cable that extends from the RF 450 MHz antenna cable conduit.
2. Connect the RF 450 MHz antenna cable to the RF 450 MHz antenna connector located on the bottom of the RMDC. See Figure 8
3. Tighten the coaxial connector to 15 - 20 in-lb (1.7 - 2.2 Nm) for N-type connector.

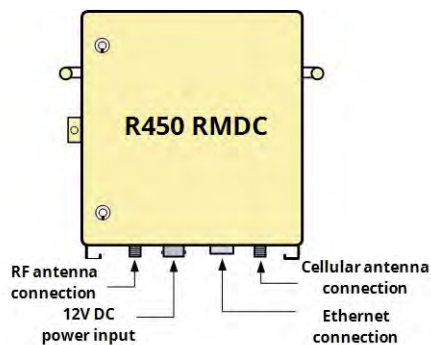


Figure 8 – Antenna Connections

WARNING: Give special consideration when the RMDC you installed is inside a building.



Connect the outer conductor (shield) of the coaxial cable to the earth (grounded) at the entrance to the building using the appropriate coax grounding kit. Be sure this is done in accordance with applicable national electrical installation codes (Section 820.93 of the National Electrical Code (NEC), ANSI/NFPA 70).

Connecting the Ground Wire

To attach the ground wire, complete the following steps.



Figure 9 – Ground Wire

1. Locate the lightning protection system ground for the site.
2. Connect the external ground lug of the RMDC to the lightning protection system ground for that site, as illustrated in Figure 9. Use #6 American Wire Gauge (AWG) copper wire with a minimum temperature rating of 75°C.
3. Tighten with a flathead screwdriver. Torque to 35 in-lb. (4.0 Nm).



If you are using an Ethernet backhaul, see "Connecting the Ethernet Cable" on page 26.

Mounting the Cellular Antenna



Neptune recommends mounting the cellular antenna to the tower or mast. Make sure the tower (or mast) does not obscure the line of sight path to the nearest cellular carrier's tower.

If the cellular modem RSSI signal level is marginal or weak, relocate the cellular antenna to the opposite side of the tower (or mast).

To mount the cellular antenna, complete the following steps.

1. Locate the cellular antenna, and strut clamp. See Figure 10.



Figure 10 – Items for Cellular Antenna



Some installations require a longer coax cable for the cellular antenna connection. See "Appendix D: Cellular Antenna Coax Cable" for recommendations.



Figure 11 – Attaching the Cellular Antenna



WARNING: Secure the clamp around the silver band of the cellular antenna only. Damage can occur if the clamp is secured around any other part of the antenna.



**Strut clamp
bolt**

3. Using a 3/8-inch socket wrench, tighten the bolt for the strut clamp around the cellular antenna, as illustrated in Figure 12.

Figure 12 – Tighten Bolt for Cellular Antenna



Cable

4. Connect the cable to the cellular antenna before connecting it to the base of the RMDc. See Figure 13.
5. Tighten the coaxial cable connection to 14 in-lb. (1.58 Nm).

Figure 13 – Cable to Cellular Antenna



**Cellular
Antenna
Connection**

6. Connect the cellular antenna cable to the base of the RMDc. See Figure 14.
7. Tighten to 14 in-lb. (1.58 Nm).

Figure 14 – Cellular Antenna Connection at Base



WARNING: Give special consideration when the RMDC is installed inside a building.

The screen (shield) of the coaxial cable must be connected to earth (grounded) at the entrance to the building. Do this in accordance with applicable national electrical installation codes (Section 820.93 of the NEC, ANSI/NFPA 70).

Attaching the Power Plug to the RMDC

Attach the circular power plug to the bottom of the RMDC. Push the connector plug upward while rotating the outer sleeve clockwise until you feel engagement.

Weatherizing the Cable Connections

Complete the following instructions to weatherproof the cables using the 3M Scotch® Wireless WK-101 or an equivalent weatherproofing kit.



Figure 15 – Weatherizing Connections

1. Using the weatherizing kit, start the tape at the bottom of the cellular antenna connection as illustrated in Figure 15.
2. Wrap the tape around the connection several times; slowly work your way up to weatherize your connection at the base.
3. Wrap the 3M Butyl Mastic Tape 2212 according to the detailed installation instructions in the 3M Scotch® Wireless Weatherproofing kit.
4. Wrap the entire section of cable with one or two layers of half-lapped 2-inch (51 mm) wide Scotch® Super 33+™ Vinyl Electrical Tape according to the detailed installation instructions in the 3M Scotch® Wireless Weatherproofing kit.



Figure 16 – Weatherizing the Base Connection



For detailed installation instructions on the 3M Scotch® Wireless Weatherproofing Kit (P/N: WK-101) refer to:

<http://multimedia.3m.com/mws/media/6590280/scotch-wireless-weatherproofing-kit-wk-101.pdf>.

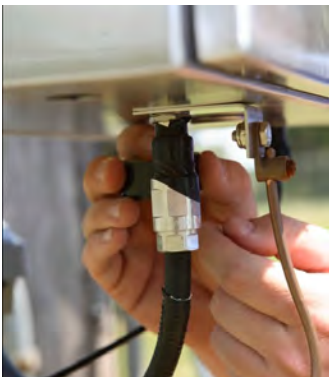


Figure 17 – Weatherizing the Antenna Connection



CAUTION: Wiring the AC-power for the UPS must be done by a licensed electrician. Install the wiring in accordance with the NEC, Canadian Electrical Code (CEC), and local electrical codes.

Installing a Wall Mount System

The following section contains the instructions needed to install a wall mount system.

Table 7 – Installing a Wall Mount System

Complete	Instructions	Cellular	Ethernet
1	"Installing the R450™ RMDC " on page 15	✓	✓
2	"Installing the R450™ RMDC " on page 15	✓	✓
3	"Mounting the Cellular Antenna" on page 19	✓	
4	"Connecting the Ethernet Cable" on page 26		✓
5	"Installing the R450™ RMDC " on page 15	✓	✓

Mounting the RMDC to a Wall



Choose a location that does not interfere with any other wiring and is easily accessible.

Mounting hardware (screws, bolts, slotted or half-slot steel strut channels, spring nuts, and strut clamps) for wall or strut channel installations, are provided by the party responsible for the installation. Hardware needs to be corrosion resistant and coastal areas can use stainless steel.

To mount the RMDC to a wall as illustrated in Figure 18 on page 24, use the following mounting hardware recommendations shown in Table 8 on the next page.



Figure 18 – RMDC Mounted on Wall



The mounting hardware listed in Table 8 is supplied by other vendors and should be corrosion resistant. Coastal areas can use stainless steel.

Table 8 – R450 RMDC Wall Mounting Hardware Recommendations

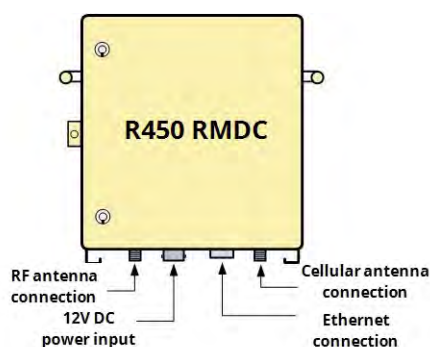
Installation Type	Comments	Recommended Mounting Hardware (supplied by installation vendors)
Wall - strut channel	Mounting the RMDC to the strut channel that is mounted to the wall	Use the following: • Two pieces of slotted or half-slot steel strut channel (1-5/8" x 1-5/8" x 22" L) • 3/8"-16 x 1" Grade 8 (A490) bolts • 3/8"-16 spring nuts • 3/8" washers • Use minimum of four 3/8" bolts. Optional: • 1/4"-20 x 1" Grade 8 (A490) bolts • 1/4" washers; use a minimum of eight

Table 8 – R450 RMDC Wall Mounting Hardware Recommendations (continued)

Installation Type	Comments	Recommended Mounting Hardware (supplied by installation vendors)
Wall - direct	Mounting RMDC directly to wall	Use the following: • 1/4" x 1-3/4" wood screws or • 1/4" x 1-3/4" masonry screws (for example Tapcon HW4-134) • Use a minimum of eight screws

Connecting Antenna Cables to the RMDC

The RF 450 MHz antenna and the communications antenna connect on the outside of the building to the RMDC inside the building.



1. Locate an area behind the wall where the cables can thread through to the outside of the building.
2. Secure the cables to the bottom of the RMDC as illustrated in Figure 19.
3. Thread the cables through to the RMDC antenna and mast.
4. Continue to work with the cables on the outside of the building.

Figure 19 – Adding Cables to the RMDC

Mounting the Cellular Antenna

See "Mounting the Cellular Antenna" on page 19



If you are using an Ethernet backhaul, refer to "Connecting the Ethernet Cable" on the next page.

Mounting Hardware

When mounting hardware, consider the following.



Mount the antenna using a unistrut for the collector or on separate mounting hardware. The bracket (P/N: 13750-001) is needed with the cellular kit variant of the R450 RMDC (P/N: 12799-800).

Connecting the Ethernet Cable



This procedure is only for kits using the Ethernet backhaul connection. If you are using a cellular modem and antenna, refer to "Mounting the Cellular Antenna" on page 19.

Prior to connecting to the Ethernet port (10/100/1000 Mbps) of the RMDC, you must run an Ethernet cable to the location of the RMDC. If you installed an Ethernet cable outside, be sure it is shielded and outdoor rated CAT5E or CAT5. For example, a Belden cable (P/N 7919A).

To connect to the Ethernet Port (10/100/1000 Mbps), complete the following steps.

1. Locate the Ethernet port (10/100/1000 Mbps) at the bottom of the RMDC. See Figure 20. Refer to Appendix C "Ethernet Termination" on page 95 for more information.

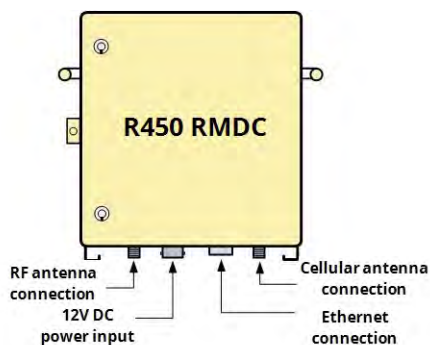
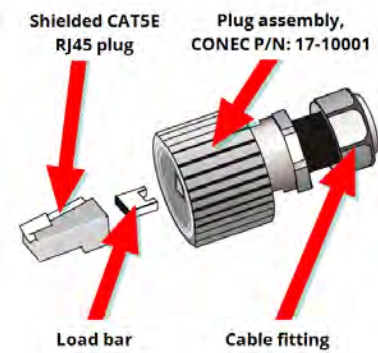


Figure 20 – Ethernet Port Connection



2. Locate the Ethernet plug that is included with the RMDC. See Figure 21.

Figure 21 – Feed-Through Assembly

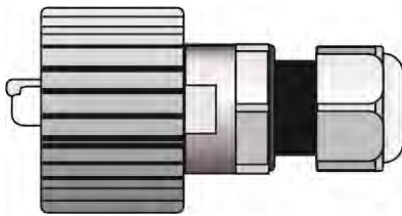
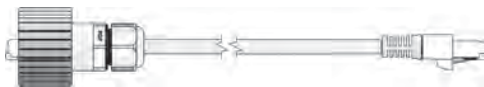


Figure 22 – RJ45 Ethernet Plug



3. Assemble the Ethernet plug according to the instructions included. See Figure 22.

4. Terminate the Ethernet jack to the Ethernet cable. See Figure 23. Refer to Appendix C "Ethernet Termination" on page 95

Figure 23 – Ethernet Plug Terminated



5. Insert the Ethernet plug into the Ethernet receptacle on the RMDC. See Figure 24.
6. Screw the entire Ethernet plug assembly into the RJ45 Ethernet housing, which is already mounted at the bottom of the RMDC.
7. Tighten the cable fitting until the gasket is tight around the RJ45 cable.

Figure 24 – Ethernet Plug Receptacle

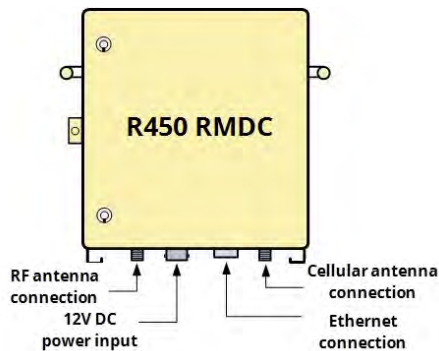


The Ethernet connector is weatherproof (IP67 rated) and does not require weatherproofing wrap.



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

Connecting the Cables to the RMDC



Connect the cables to the RMDC by completing the following steps.

1. Locate where the cables connect on the bottom of the RMDC.
2. Secure the cables to the bottom of the RMDC as illustrated in Figure 25.

Figure 25 – Connecting the RMDC

3. Thread the cables through to the RF 450 MHz Antenna.
4. Wire the DC-power as described in "Installing the R450™ RMDC" on page 15.
5. Weatherproof all coax cables using the weatherizing kit.
6. Verify all the connections as described in "Testing the Connections" on page 33.

Activating the RMDC

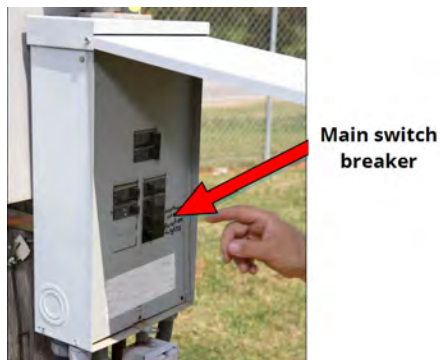


Figure 26 – Main Breaker Switch

To activate the RMDC, complete the following steps.

1. Open the door of the power box at the AC-power source.
2. Apply power from the main breaker switch as illustrated in Figure 26.
3. Close the door of the AC-power box.
4. Turn on the disconnect switch.
5. Turn on the UPS using the internal on-off switch.
6. Connect the DC power cable to the bottom of the RMDC.

Configuring the Cellular Modem

The following list of equipment is needed to configure the cellular modem.

- Laptop or PC with Ethernet network port
- CalAmp Vanguard modem and the modem's *Quick Start Guide*
- Ethernet patch cable

To configure the modem, complete the following steps.

1. Follow the instruction provided in the CalAmp Vanguard modem *Quick Start Guide*.



To use the modem, activate it for your specific carrier.

2. Turn off the power to the RMDC.
3. Remove the modem from the RMDC. See Figure 27.



Figure 27 – Modem in R450 RMDC



Figure 28 – Vanguard Modem Back Panel

4. Insert the SIM card with the gold side up into the SIM card slot on the back of the modem. Push the card completely into the slot until it clicks in place. See Figure 28.

5. Connect the modem to the laptop using the Ethernet cable.
6. Turn on the power for the RMDC.
7. Open a Web browser and in the address bar type the IP address 192.168.1.50.
The connection log on window appears.
8. Type **admin** in the User Name field.
9. Type your password.
10. Click **OK**.



On the Unit Status page, the WAN status reads DOWN until the cellular connection is enabled. Before activating the unit, select your carrier(s), activate the modem, and if applicable, activate your SIM card.

Selecting the Carrier

To select a carrier, with the model still connected to the laptop complete the following steps.

1. Select **Cell Connection** from the Main Navigation Panel and select the **Carrier** tab.
2. Select your carrier from the list provided.



You cannot select the same carrier for primary and secondary. Select Global System for Mobile communication (GSM) for any GSM carrier.

If you have more than one carrier, select whether the cell connection is on the primary or secondary carrier, or enable automatic switching, if possible.

3. Click **Save**.

This action refreshes the page. The information shown depends on the carrier you selected.

4. Configure the applicable settings on the **Settings** tab, for each carrier selected (primary or secondary).

Complete the following instructions that pertain to the carrier you selected.

CDMA Settings (Provisioning) Verizon subscribers:

To provision the cellular modem using Code Division Multiple Access (CDMA) setting, complete the following steps.

1. Make sure you have a **strong** or **medium** signal strength (dBm) and **not roaming**.
2. Click the **OTASP** button to start the provisioning process.
3. Verify the unit status.

The status has updated to show a Mobile Directory Number (MDN). If the number does not appear, your device did not provision properly. Refer to the cellular modem's *User Manual* for manual activation procedures.

GSM Settings (SIM Card Acceptance):

In the GSM settings, the SIM STATUS reads SIM ACCEPTED.

Configuration Complete

To verify the service is operational, open a browser on the laptop and navigate to an active Web page (for example: Google.com). If the service is not operational, contact the service provider.



Be sure to maintain the user name, password, and Access Point Name (APN) information the cellular service provides.

Configuring the Collector with the USB Flash Drive

To configure the RMDC with the USB flash drive, complete the following steps.



CAUTION: Operators need to wear a grounded wrist strap to mitigate the effects of Electro-Static Discharge (ESD).

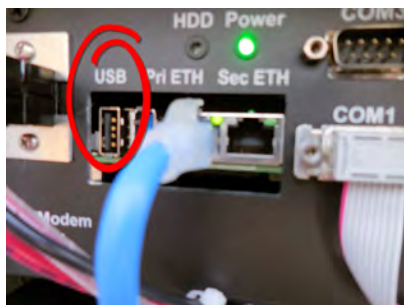


Figure 29 – USB Port on CPU Board

1. Configure the USB flash drive (included with the RMDC) as described in "USB Flash Drive Configuration for RMDC" on page 87.
2. Insert the configured USB flash drive into either one of the two available USB ports on the CPU board.

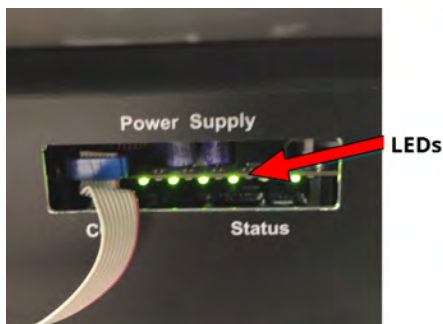


Figure 30 – Collector's Internal Power Supply LEDs

3. Make sure the collector's internal power supply is fully off before re-applying collector power. See Figure 30.
4. Cycle the power to the RMDC.



During configuration, the unit performs an automated self-reset. The entire process takes approximately five minutes without user intervention.

5. Remove the USB flash drive when configuration is completed.

Completing the Installation

After completing the wiring for the RMDC, you must verify that the unit has been activated.

- Test the connections - lights and audible sounds. See "Testing the Connections" below.
- Swipe a Meter Interface Unit (MIU) and receive the email the host software automatically sends to the installer. See "Swiping the MIU" on the next page.

Testing the Connections

Complete the following instructions to test the connections.

1. Wait approximately 60 seconds after you activate the RMDC and listen for the sequence of several tones and beeps that last approximately five seconds.

2. Check that the blue power light is on at the bottom of the Midland Radio.

3. Check that the power light is on for the modem.

If the modem finds a network, the power light is solid. For further details, refer to the modem's *Users Manual*.

4. If you use the Ethernet backhaul, check the status of the Pri ETH Ethernet connector.

These lights provide a visual indication of the link status, and network activity.

- The green Link Integrity light is lit when a valid connection is detected.
- The yellow Activity light blinks on and off when activity is detected on the wire.

Table 9 – Lights on the CPU Board

Designator	Light Color	Description
Pri ETH	Green	Link Integrity
Pri ETH	Yellow	Activity

5. After the RMDC has been powered up for five minutes, remove the USB flash drive from the CPU board.



Connect only the **Pri ETH** Ethernet connector. Do not connect any other component to the **Sec ETH** Ethernet connector.

Field Service Tool

Use the Field Service Tool (FST), Received Signal Strength Indicator (RSSI), MIU Simulator, Collector, and Collector Monitor to verify the RMDC is working properly. See the FST manual for instructions.

Swiping the MIU



Before you can proceed with these steps, the RMDC must be set up in the N_SIGHT PLUS host software. See "Creating a Collector" on page 87 and "Building a USB Drive for Collector Configuration" on page 93 for instructions on setting up the RMDC in the host software. In addition, confirm the Configuration Packet Alarms are set in the host software. To set the alarms, click the **Endpoints** tab, **System Commands**, and then **Alarm Notifications**.



To verify that the RMDC can receive readings from MIUs and can synchronize with the N_SIGHT PLUS host software, complete the following steps.

1. Wait about five minutes after you have powered on the RMDC.
2. Position the Neptune magnet against the left side of the R450 MIU directly in line with the Neptune logo, as shown in Figure 31.
3. Bring the magnet from the side and around the corner to the top of the MIU to swipe it. See Figure 31.

Figure 31 – Activating the MIU

4. When swiped, the RMDC sends an email to the address set up in the host software, similar to the following example.

```

MIU RSSI..... Pass[-68]
Collector RSSI..... Pass[-77]
Register..... Valid Read
Collector..... Morris Ave.
Signal/Noise..... 49
Noise..... 126
MIU id..... 110182462

```

Figure 32 – Email Sent from RMDC

- Make sure the email comes from the RMDC that you are installing.
- If you do not receive an email, follow the instructions outlined in the next section.

If You Do Not Receive an Email

If you do not receive an email, complete the following steps.

1. Check to see if the Midland Radio is getting power by verifying that the blue power light is on. See Figure 43 on page 55.
2. Check to see if the red **Tx** light of the Midland Radio is flashing every 10 seconds. See Figure 33

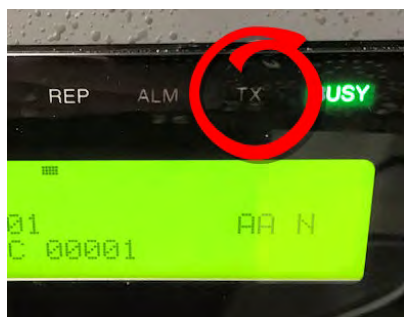


Figure 33 – Radio TX Light

Table 10 – Radio Tx Light - Identify Problem

If...	Then...
The red Tx light is not flashing every 10 seconds,	Call Neptune Customer Support. Refer to "Contacting Customer Support" on page 64.
The red Tx light is flashing every 10 seconds, but you do not receive emails,	• There could be a problem with the network connection. • There could be a problem with the N_SIGHT PLUS host software.
The problem is with the network concordance,	Refer to "Verifying Connectivity" on page 59.

Table 10 – Radio Tx Light - Identify Problem (continued)

If...	Then...
The problem is with the N_SIGHT PLUS host software.	• Verify the host software is configured to send emails to the correct email address. • Check the host software to ensure the RMDC is synchronizing. Refer to "Potential RMDC Problems" on page 52.

Securing the RMDC

After you finish the configuration, complete the following steps to lock the RMDC.



Figure 34 – Unit Door Locks

1. Close the door of the RMDC.
2. Using the key that is supplied with the unit, secure both door locks of the RMDC, as illustrated in Figure 34.

Chapter 4: Uninterruptible Power Supply

This chapter describes the specifications for the Uninterruptible Power Supply (UPS) or backup power solution. It also includes procedures for storing, unpacking and inspecting, installing and connecting the UPS, plus descriptions of tools and materials you use when working with the UPS.



Figure 35 – Outdoor UPS (Closed)



Figure 36 – Outdoor UPS (Cover Removed)

UPS Specifications

This section provides information on the specifications of the UPS.

Table 11 – UPS Specifications

Specification	Description
Neptune	P/N: 13450-200 (includes pole/wall mounting bracket, DC power cord, and stainless steel clamps)
UPS Topology	AC to DC rectifier, battery charger, and sealed, valve-regulated, lead acid batteries that are maintenance-free and rechargeable.

Input

Table 12 – Input Specifications

Input	Descriptions
Nominal Input Voltage	120 VAC
Operating Input Voltage Range	100 - 140 VAC
Input Current	6A
Operating Frequency	57 - 63 Hz
AC Input Surge Immunity	ANSI / IEEE C62.41: 6 kV, 1.2 x 50 μ s / 3kA, 8 x 20 μ s
AC Connections	Holes for 1/2" conduit connectors; wiring terminals

Output

Table 13 – Output Specifications

Specification	Description
Nominal Output Voltage	12 VDC
Output Voltage Range	10 - 14 VDC
Output Current	13.04 A
Efficiency: Line / Backup	84 / 95.5%
Power On / Off Switch	On / off rocker style power switch
Transfer Time to Backup	0 ms
DC Connections	Holes for 1/2" conduit connectors; wiring terminals

Battery

Table 14 – Battery Specifications

Specification	Description
Battery Type	AGM (12 VDC 7 Ah x 2), sealed, valve-regulated lead-acid (VRLA) battery that is maintenance-free and rechargeable. (EnerSys Genesis P/N: NP7-12TFR)
Recharge Time to 90%	4 hrs
Battery Backup Time	24 min @ full load (13.04A)

Physical

Table 15 – Physical Specifications

Specification	Description
Dimensions	12.5" (318 mm) wide x 12" (305 mm) high x 6.5" (165 mm) deep
Steel Cabinet	All weather NEMA 3R design, UL 50E rain tested, pad lockable enclosure
Weight	32 lbs (14.5 kg)
Mounting Option	Pole or wall mounting bracket included

Safety

Table 16 – Safety Specifications

Specification	Description
cETLus (Canada & US)	ANSI / UL 60950-1, CAN / CSA C22.2: No. 60950-1-07 Clause
	ANSI / UL 1778, CAN / CSA C22.2: No. 107.3-05 Clause
	ANSI / UL 50E, CAN / CSA C22.2: No. 94-2-07 Clause

Environmental

Table 17 – Environmental Specifications

Specification	Description
Operating temperature	-40° to + 122° F (-40° to +50° C)
	With BH5 optional battery heater

Checklists

This section provides safety checklists for:

- Handling the UPS and battery
- Unpacking and inspecting the UPS

UPS Safety Checklists



WARNING: The UPS should be installed by people trained in the safe use of high-energy power supplies and their batteries. The installer also should have knowledge of the local electrical code(s) and their safe application.

To prevent accidental shorts, shocks, or electrocutions, never let water enter the UPS. (Rain, a hose, tap, sprinkler output, or road splash.)

Table 18 – UPS Safety Checklist

	Safety Considerations
✓	Carefully unpack the components and report any shipping or other damage immediately.
✓	Always assume electrical connections or conductors are live. Turn off all circuit breakers and double-check using a voltmeter before performing installation or maintenance.
✓	Before installation, verify the input voltage and current requirements of the load meet the UPS's output (see specifications). Verify the line voltage and current meet the UPS's input requirements.
✓	Place a warning label on the utility panel to tell emergency personnel a UPS is installed.
✓	Use proper lifting techniques when lifting or moving the UPS or its components.
✓	Note that this UPS has more than one live circuit. DC power can be present at the output even if the UPS is disconnected from the DC line.

Battery Safety Checklist

WARNING: Battery Emergency Procedures



- If electrolyte splashes on your skin, immediately wash the affected area with water.
- If electrolyte gets into your eyes, wash them for at least 10 minutes with clean running water or a special neutralizing eye wash solution. Seek medical attention immediately.
- Neutralize spilled electrolyte with special neutralizing solutions in a "spill kit" or a solution of 1 lb. (0.45 kg) of baking soda (bicarbonate of soda) in 1 gallon (3.9 L.) of water.

Table 19 – Battery Safety Checklist

	Battery Safety Conditions
	Personnel knowledgeable about batteries and the required precautions needed to install and service them.
	Always replace batteries with the same type, numbers, and ratings. Never install old or untested batteries. One sealed lead-acid battery is rated to a maximum voltage of 12VDC.
	CAUTION: A battery can present a risk of electrical shock and high short-circuit current. Observe the following precautions when working on a battery. • Remove watches, rings, or other metal objects. • Use tools with insulated handles. • Wear rubber gloves and boots. • Do not lay tools or metal parts on top of the battery. • Disconnect charging source prior to connecting or disconnecting battery terminals. • Determine if the battery is inadvertently grounded. If so, remove source from ground. Contact with any part of a grounded battery can result in electrical shock. To reduce the likelihood of shock, remove grounds during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit). • Never dispose of batteries in a fire; they can explode. Follow the manufacturer's directions for safe battery disposal. • Never open or damage the batteries. Released electrolyte is harmful to the skin and eyes and it can be toxic and hazardous to the environment.

Table 19 – Battery Safety Checklist (continued)

	Battery Safety Conditions
	Never let live battery wires touch the UPS, the enclosure, or any other metal objects. This can cause a fire or explosion.
	Lead-acid batteries can release hydrogen gas. Never expose the UPS or enclosure to open flames or sparks to prevent a fire or explosion.
	Inspect the batteries once a year for signs of cracks, leaks, or swells. Replace as needed.
	If you have batteries in storage, charge them at least once every three months for optimum performance and to extend their lifetime.

Site Preparation Warnings

This section provides information on site preparation warnings.

Grounding

Consider the following warning concerning grounding the UPS.



WARNING: The UPS must be correctly grounded for proper operation. Older facilities can have inadequate electrical grounding. A qualified electrician must perform an inspection before installation to ensure that grounding meets the local electrical code.

Branch Circuit Breaker Protection

Consider the following warning about branch circuit protection.



WARNING: To provide branch circuit protection, the utility line attached to the UPS's input must be protected by a circuit breaker certified for this use and per the local electrical code. The breaker's minimum size is calculated by the following formula:

Minimum Breaker Size = UPS's maximum input current / 0.8

The UPS's maximum input current is read off the nameplate. For example, if the nameplate gives the maximum input current as 6A, be sure the circuit breaker is rated at least 7.5A; however, limit breaker size to a maximum of 15A.

Disconnects

Consider the following warning when installing the UPS.



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

Mounting the UPS

This section provides information on mounting the UPS.



A pole / wall mounting bracket is included with the UPS.

Wall Mounting



The UPS's maximum input current is on the nameplate. For example, if the nameplate gives the maximum input current as 6A, be sure the circuit breaker is rated at least 7.5A.

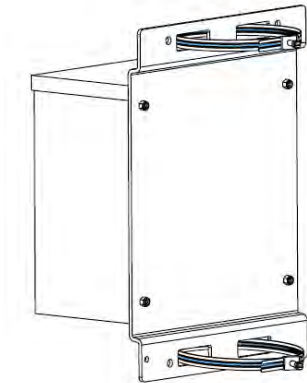
Secure the UPS to the strut channel or wall using the recommended hardware from Table 8 on page 24.

Figure 37 – Strut Channel or Wall Mounting



The UPS utilizes the same strut channel or wall mounting hardware as the RMDC.

Pole Mounting



To strap mount the UPS to the pole (4-inch to 16-inch diameter), use the two stainless-steel clamps (included).

1. Attach the straps to the UPS mounting bracket.
2. Attach the UPS to the pole.
3. Tighten the straps using a flat-head (slotted) screwdriver.

Figure 38 – Pole Mounting Straps



OPTIONAL: The UPS can be mounted to a large pole (4-inch or larger) using two 3/4-inch wide stainless-steel straps (Band-It #C20699 strap, #C25699 buckle, and #C00169 standard tool). The strap, buckle, and tool are supplied by other vendors.



To secure the UPS to a small pole (2-inch to 4-inch), use the recommended hardware from Table 6 on page 16. Also reference Appendix E: Strut Clamp Recommendations.

Connecting the UPS

This section provides information on the tools, materials, and procedures are needed to connect the UPS.

Tools and Materials Required

The following list describes the tools and materials needed to connect the UPS.

- Slotted-tip screwdrivers for tightening screws on terminal blocks
- AC/DC voltmeter
- #2 Phillips Head screwdriver for removing the cover
- Channel lock pliers for tightening cord grip and jam nut

Procedure

To wire the input and output connectors, complete the following steps.

Wiring the Input and Output Connectors



Figure 39 – Wire Input and Output Connectors



CAUTION: The UPS contains a vent on the upper right side of the case; do not remove this.

Installing and Wiring the UPS

1. Install Liquid-Tight Flexible Non-Metallic Conduit from the disconnect switch to the lower 1/2-inch conduit hole on the side of the UPS.
2. Install the black, white, and green wires through the conduit and terminate to the terminal block inside the UPS.
3. Install the DC cord grip in the upper 1/2-inch conduit hole on the side of the UPS; just above the conduit.
4. Route the open pigtail end of the DC power cable through the cord grip and terminate to the DC terminal block inside the UPS.
5. Tighten the DC cord grip using pliers or a wrench.
6. Attach the power cord to the bottom of the RMDC.

Powering On the UPS

To turn the UPS on, complete the following steps .

1. Turn the UPS power switch **ON**.
2. Re-install the UPS cover and secure it with the two screws.

Servicing the UPS

This section provides information on servicing the UPS.



CAUTION: Before attempting to service the UPS, verify that the disconnect device is turned OFF. Also verify that the UPS switch is turned OFF.

Checking UPS Status LEDs

This section provides information on checking and troubleshooting the UPS.

If the RMDC does not power up, complete the following steps to check the UPS status.

1. Remove the power plug from the bottom of the RMDC.
2. Measure between pin-1 (+) and pin-2 (-) on the plug.

The voltage measures 13.5-14.4 VDC. See Figure 40.



Figure 40 – RMDC Power Plug

Table 20 – RMDC Does not Power Up

If	Then
The voltage measurement is good	There is a problem with the RMDC. Refer to "Troubleshooting" on page 51.
The voltage is negative	There is a problem with the UPS wiring. Complete the following steps. • Remove the UPS cover. • Correct the wiring issue. • Recheck wiring.
There is no voltage present or the voltage is low (< 10.5V DC)	Complete the following steps. • Remove the UPS cover. • Verify the internal power switch is ON. • Check the status LEDs inside the UPS. See Table 21 .

Table 21 – UPS Status LEDs

LED Indicators	Description
Green	Solid on = AC is good
	Off = AC failure
Yellow	Solid on = battery fully charged
	Blinking slowly = battery charging
	Blinking rapidly = battery discharging (possible AC input voltage failure)
Red	Faulty DC output = fuse can be blown

5. Verify the UPS is producing the correct voltage at the output terminals by measuring across **DC+** (red) and **DC-** (black).
The voltage measures 13.5-14.4 VDC.



This step assumes the AC input voltage is present and the UPS internal switch is ON (battery is charging).

Table 22 – Verify UPS is Producing Correct Voltage

If the	Then
AC input voltage is not present	The voltage across DC+ (red) and DC- (black) measures 10.5-12.8 VDC.
Voltage is less than 10.5 VDC	The battery is fully discharged and must be recharged. Complete the following steps. 1. Measure the AC input voltage across L1 and N1. Verify that the voltage measures 100-140 VAC. 2. Verify the UPS's internal switch is ON. 3. Check the UPS status LEDs. See "UPS Status LEDs" on the previous page.

Checkup Complete

After completing the UPS diagnostics, perform the following steps.

1. Re-install the UPS cover.
2. Secure cover with two screws.



The batteries in the UPS have an expected life span of three to five years in float service applications. Length of service life is directly affected by the number of discharge cycles, depth of discharge, ambient temperature, and charging voltage.

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This section provides information for possible symptoms, areas of focus, and actions to resolve problems that can arise with your R450™ Rack Mount Data Collector (R450 RMDC).



WARNING: Neptune does not recommend servicing an RMDC during inclement weather.

Equipment Required

The following items are required to troubleshoot the RMDC.

- Keys to access the site and open the RMDC cabinet
- Digital Multimeter with long leads
- Voltage Standing Wave Ratio (VSWR) meter
- Sockets and open-end wrenches to install / remove the RMDC
- Small, medium, and large standard screw drivers
- #1 and #2 Phillips head screw drivers
- Electrical tape and wire ties
- A backup RMDC, if one fails
- RMDC configuration USB flash drive (included with the RMDC)



The USB flash drive must be configured for the specific RMDC.

- Anti-static wrist strap and ground lead with alligator clip for attaching the wrist strap to the RMDC cabinet
- MIU configured for site
- Magnet to swipe the MIU
- R450 System Field Service Tool (FST)

PC Notebook Configuration

To use a notebook computer, consider the following for the CalAmp Cellular Modem:

- Requires an Ethernet patch cable to connect to the network port of the computer.
- Uses a Web-based application, not software, for configuration. Refer to the cellular modem's *Quick Start Guide* for log on and setup instructions.

Potential RMDC Problems

The following sections describe problems that can arise and how to handle these potential problems.

Multiple RMDC Not Syncing with Host Database

The following issues can cause syncing problems:

- Host database server is down or not connected to the Internet.
- Remote Internet, phone, cable, or cell service provider is either down or experiencing degraded service.
- Multiple power outages affecting several sites.

Storm Damage Affecting Multiple Sites

One RMDC is not syncing with the host database. Troubleshooting this problem requires going to the RMDC site.

First Steps

Before leaving for the site, assess the health of the RMDC using the host system.



For instructions on how to assess the health of the RMDC, refer to "Using System Health" in the "System Health" topic of the *N_SIGHT® PLUS Online Help*.

- If the RMDC is offline, this indicates that external power, internal power, CPU, relays, or the backhaul modem is not functioning.
- Some sites are configured so operators can log on to the RMDC remotely. Look at the logs, and watch the system activity. If the RMDC is offline but it is still possible to log on the system, this indicates that the computer and backhaul modem are both functional.

Initial Site Activities

- Open the RMDC and inspect the equipment.
- Make sure that there is no obvious physical damage to the system, condensate or standing water. For example, burned components or wires can indicate a direct or nearby lightning strike. If there is any evidence of physical damage, replace the RMDC with the spare and contact Neptune to request a Return Material Authorization (RMA) to return the damaged collector.



CAUTION: The ground wrist strap must be clipped to the RMDC's ground system. Do not touch the computer circuit board or any of the components if you are not wearing the wrist strap. Failure to use the strap can cause damage to the computer due to static electricity discharge.

Checking the General Health of Each Module

This section provides information on the general health of the R450 RMDC's internal modules.

CPU Board Power and Activity Visual Check

There are two Light Emitting Diodes (LEDs) above the CPU board. See Figure 41 on page 54.

- Green Power LED
- Red HDD LED

The green LED is lit if power is applied to the CPU board. The red LED flashes intermittently to indicate hard drive and CPU activity.

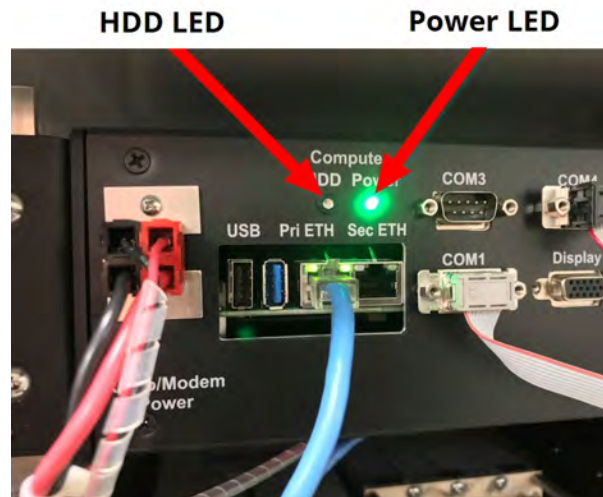


Figure 41 – LEDs Above CPU

There are two additional Ethernet status LEDs:

- One to the left of the primary Ethernet RJ45 connector that indicates an active link when lit.
- One to the right of the same connector that indicates communication activity.



Connect the Ethernet cable to the **Pri ETH** port. Connection to the **Sec ETH** port can cause unreliable operation.

When functioning properly, the link LED is steadily lit and the activity LED intermittently. Random flashes indicate live network activity. See Figure 42 on page 55.

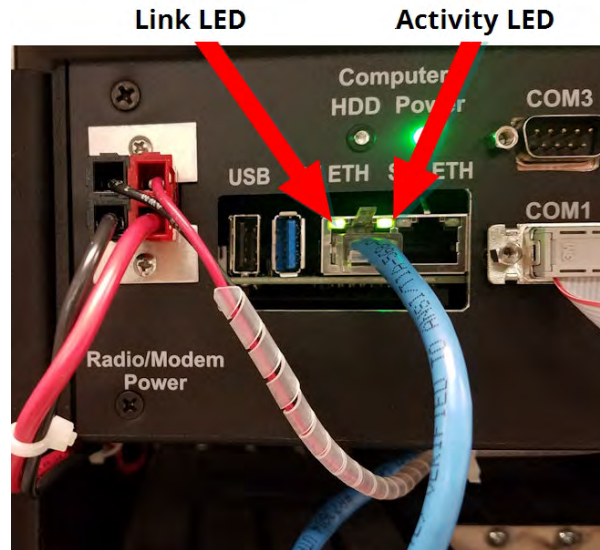


Figure 42 – Ethernet Status LEDs

Radio Power Visual Check

The radio has several indicator LEDs on the front panel. The power LED should be lit blue. See Figure 43. If the amber ALM LED is on or flashing:

- The radio may be malfunctioning.
- The R450 RMDC may be operating on UPS backup power in the event of a main power failure.

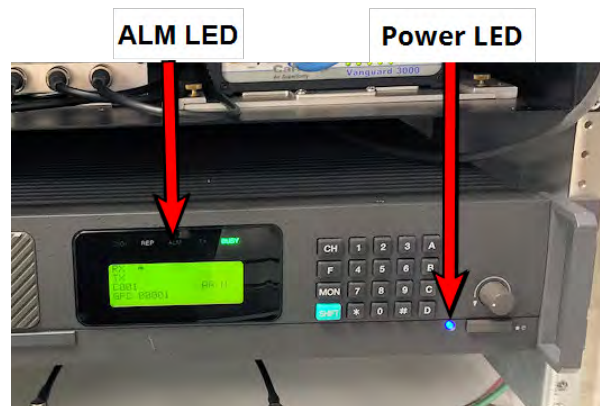


Figure 43 – Radio LEDs

Checking the Backhaul Modem Power and Connectivity

This section provides information on visually checking the backhaul modem.

CalAmp Vanguard Modem Visual Check

Look at the indicator LEDs on the modem to verify that the modem is working. See Figure 44 on page 56.

Table 23 – Visual Check Modem RSSI and SVC LEDs

If the	Then
RSSI and SVC LEDs are on	The modem is powered.
RSSI and SVC LEDs are not on	There is a power problem with the modem. Verify that the main power is on.
SVC LED is solid	The modem is connected to the cellular network. See Table 24 on the facing page.
SVC LED is flashing	The modem is trying to connect to the network. See Table 24 on the facing page

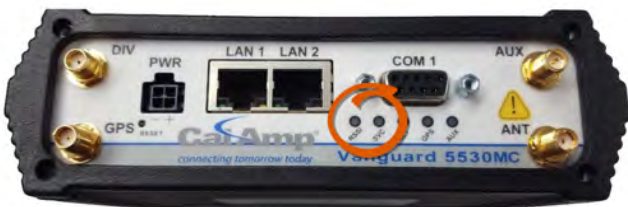


Figure 44 – Modem Indicator LEDs

The LED behavior is different thanTable 24 on the facing page at boot (initial power-up). The proper sequence is:



- All red LEDs
- All amber LEDs
- Off for a moment
- All green LEDs
- All green LEDs flash three times

This indicates a successful Built-In-Self-Test (BIST) and a healthy modem.

Table 24 – Modem Status LEDs

Function	Off	Green	Flash Green	Red	Flash Red	Amber	Flash Amber
RSSI		Strong		Weak/None		Medium	
SVC (cellular network connection)		4G	NC		NC	3G/2G	NC
NET	No connectivity		Rx data		Tx data		Rx/Tx
GPS	Disabled	Fix	Search	no fix			
AUX	Disabled	Good		Failed			

The CalAmp Vanguard 5530MC includes a multi-carrier feature which provides more choice in carrier networks and delivers 4G LTE performance with automatic fallback to 3G and 2G legacy GSM and CDMA networks.

Additional Detail Checks

If any of the previous checks failed, perform the following detail checks. Perform power supply voltage checks one at a time so that a load remains on the power supply. This is especially important for the CPU and modem voltage checks. With no load on the power supply, erroneous values can be measured.

Verify Main Power

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



1. Verify there is power on the upper front panel of the RMDC. Measure the DC voltage at the black and red Anderson connector labeled "Power" on the right side of the front panel. This voltage should measure 13.5 to 14.4V DC when the UPS is switched on and main power into the UPS is present. See Figure 45.

Figure 45 – Radio Modem Power Front Panel Connector

2. Verify the main AC power disconnect device is turned ON.
3. Verify the UPS output voltage. Refer to the "Checking UPS Status LEDs" on page 47.



The RMDC is capable of functioning on voltages as low as 10VDC.

If voltage is not present at the R450 RMDC main power connector, switch OFF the UPS, disconnect the power harness from the R450 RMDC power connector, and ohm-out the harness to the UPS +12VDC terminals. An open or high resistance indicates damage to either the internal or external power harness.

Verifying Switched DC Power

To verify switched DC power, complete the following steps.

1. Turn on the UPS and wait approximately 60 seconds for the R450 RMDC to power up.
The two right-most green LEDs should flash during this initial 60-second power-on delay.
2. Verify the R450 RMDC internal power supply's four left-most green LEDs are lit. See Figure 46.

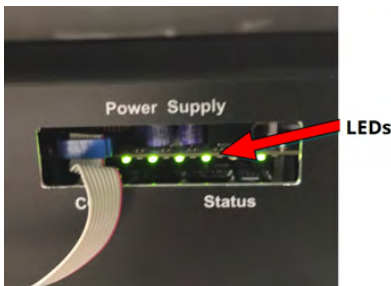


Figure 46 – RMDC Power Supply

If the LEDs are lit, complete the following steps.

3. Verify there is Switched DC power on the upper front panel of the RMDC at the Radio / Modem Power Anderson power connector.
4. Measure the voltage at the black and red Anderson connector labeled "Radio/Modem Power".

The voltage should measure between 13.5 VDC and 14.4 VDC. If the voltage is above or below these values, the internal power relays or UPS may be defective. Contact Neptune Customer Support for additional guidance.

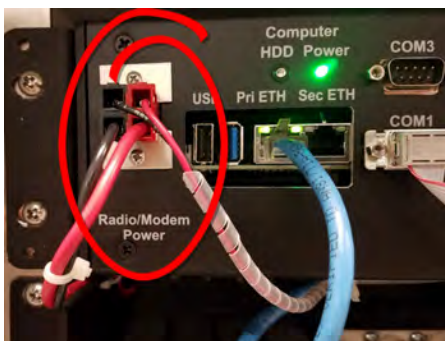


Figure 47 – Radio Modem Power Front Panel Connector

Verifying Cellular Modem Power

To verify cellular modem power, complete the following steps.

1. Disconnect the power harness from the cellular modem (black 4-pin Molex connector).
2. Verify the voltage is 13.5 VDC to 14.4 VDC between the red and black contacts.
3. Verify the voltage is 13.5 VDC to 14.4 VDC present between the white and black contacts.

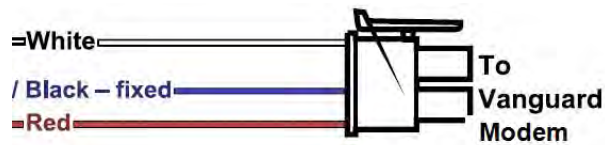


Figure 48 – Vanguard Modem Power Connector

Verifying Connectivity

CalAmp Vanguard Modem

To verify connectivity and signal levels, complete the following steps.

1. Locate and identify the RSSI LED light on the modem.
2. Identify the RSSI LED light:
 - Solid = indicates signal strength is strong
 - Blinking = indicates signal strength is medium
 - Off = indicates signal strength is poor, or no signal at all

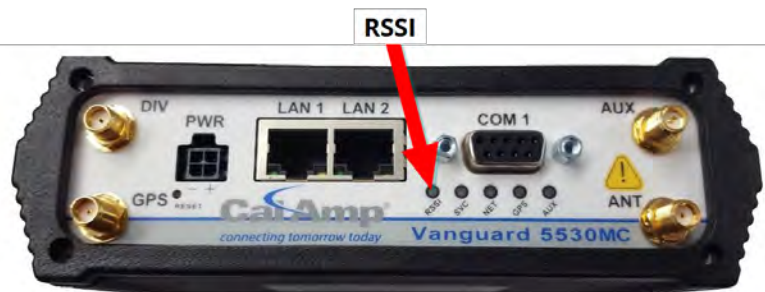


Figure 49 – CalAmp Vanguard Modem with RSSI LED

If the signal strength is poor or if there is no signal at all, there can be something wrong with the antenna. It is also possible that the local cellular service is not working.



For more detailed information on your wireless connection status, connect to the modem's configuration application. Refer to "Configuring the Cellular Modem" on page 29.

Ethernet

If you use an Ethernet backhaul, then check the status lights on the CPU board. Refer to "Testing the Connections" on page 33.

Verifying Radio and NTG Modem Functionality Using the MIU

To verify that the system is functioning properly, complete the following steps.



For this test to be valid, the R450 RMDC must send regular time beacon transmissions. This is indicated by the TX indicator flashing every ten seconds. See Figure 43 on page 55. If the RMDC does not send time beacons, it automatically fails the test.

1. Obtain a magnet and MIU.
2. Swipe the magnet across the MIU so that it sends out a configuration packet.
3. Watch for the NTG Modem **Rx/Tx** LED "couplet" in the Modem Status Window. This happens within a minute of swiping the MIU.
 - The **Rx** LED flashes followed immediately by a flash of the **Tx** LED. See Figure 50.
 - If the couplet is not observed or only the **Rx** LED flashes, there is an internal problem with the RMDC that can include its configuration, the radio, NTG modem, or the computer.

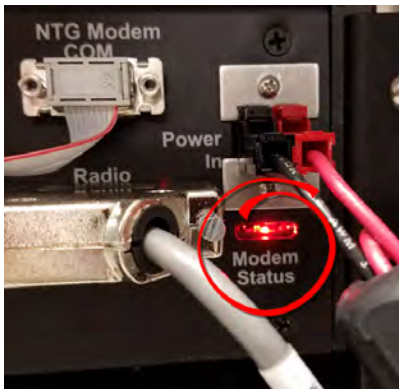


Figure 50 – NTG Modem Status LEDs



The radio's **BUSY** indicator can be constantly lit. This is normal.

RMDC is Syncing but Not Supplying MIU Data

If the RMDC is online, this indicates that the computer and the backhaul modem are both working. If the RMDC collects no readings, this indicates that there is a potential problem with the radio and modem.



Troubleshooting this problem requires going to the RMDC site.

Initial Observations

After opening the cabinet, assess the following.

- The RMDC sends out a time beacon every ten seconds. The transmit light on the radio and the NTG modem's **Tx** LED flashes every ten seconds. See "Radio LEDs" on page 55. Only the red transmit indicator should flash. If the amber **ALM** indicator flashes at the same time, this indicates that there is a problem between the radio's transmitter and the RF antenna.
- If the transmit indicator does not flash, this indicates that there is a potential problem with the NTG modem, the computer, or the I/O harness to the NTG modem.

Radio Transmits but ALM Indicator Flashes

This requires measuring the VSWR of the antenna system. If the VSWR is greater than 1.5:1, it indicates there is a problem with the RF surge arrestor, feed line or the antenna.

Measuring the VSWR

To measure the VSWR using the MFJ-269 SWR Analyzer, complete the following steps.

1. Make sure the red **Power** button is off. The red button is extended outward.
2. Press the **UHF** button to be sure it is extended outward.

3. Turn the **Frequency** knob fully counter-clockwise. This knob points to 114-170/UHF.
4. Connect the 2-inch attenuator pad to the **Antenna Connector**. Leave the other end open.
5. Press and lock the red **Power** button and the black **UHF** button.
6. Adjust the **Tune** knob to the desired frequency. Sweep the entire 450 - 470 MHz range.
7. Observe the indicated VSWR to ensure it reads 3.0 ± 0.2 . This indicates that the unit is calibrated correctly and the batteries are good.
8. Do one of the following:
 - If the reading is outside this range, then try replacing the batteries (eight AA batteries). If this does not improve the readings, the unit needs to be recalibrated.
 - If the reading is within the range, go to step 9.
9. Power off the unit.
10. Remove the attenuator pad and connect the antenna from the bottom of the collector.
11. Press and lock the red **Power** button and the black **UHF** button.
12. Adjust the **Tune** knob for desired frequencies. Look at both the collector receive and transmit frequencies.
13. Observe the indicated **VSWR**.

A value of 1.0 is ideal but not practical. Typical values are 1.1 to 1.2 for a healthy antenna system.
13. When finished, power off the unit.



If a flashing **SLP** indicator appears in the bottom-right corner of the display, this indicates **Sleep** mode. Simply turn the unit off and then on again.

The Radio Never Transmits

The simplest test is to cycle power on the RMDC to see if the radio starts transmitting.



It can take up to ten minutes for the RMDC to be fully functional.

- If the radio starts transmitting, this indicates that there was a soft failure in one of the serial ports possibly related to the effects of a storm.
- If cycling the power does not fix the problem, the RMDC has an internal problem, either with the computer, the NTG modem, or the modem's I/O harness. Return the RMDC for repair.

Reduction in Amount of Data Collected

If the RMDC is not collecting as much data as before (but it is still collecting some MIU data), this usually indicates that there is a problem with the antenna and feedline system. It could also indicate an internal problem. To determine the cause of the problem, complete the following steps.

1. Check all the system voltages as outlined above.
2. Measure the VSWR following the steps on the previous page.
If the VSWR is high, have qualified radio personnel check out and certify the feedline and antenna.
3. Check the power output.
If the power output is low, place the wattmeter between the duplexer and the surge protector to make a second VSWR.
If the VSWR measures much higher before the surge suppressor, the suppressor can be damaged.

If there is still a reduction in data collected, most likely there is a problem with the duplexer or radio. Contact Customer Support.

Contacting Customer Support

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

By Phone

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

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

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

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

By Fax

To contact Neptune Customer Support by fax, send a description of your problem to (334) 283-7497. Please include on the fax cover sheet the best time of day for a customer support specialist to contact you.

By Email

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

RF Antenna Overview

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

Mounting the Antenna

To mount the antenna, complete the follow these steps.

1. Mount the antenna 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.
 - A water tower in particular can severely limit coverage where the signal must pass directly through the tank. When mounting the antenna on a water tower, Neptune recommends mounting it on top as close to the center as possible.
 - When mounting the antenna on a traditional three-leg or four-leg tower, position the antenna using a standoff mount at least 5 feet away from the tower to minimize coverage area problems.
2. Avoid making the RMDC antenna the tallest point in the surrounding area to decrease the potential of the antenna being damaged by lightning.

WARNING: Do not mount antennas on utility poles, electric service masts, or other structures carrying electric light or power wires. Coaxial cables must maintain clearance of:



- At least 2 feet (0.6 m) from power or light wires carrying 250V or less.
- or
- At least 10 feet (3.0 m) from power wires carrying more than 250V, per NEC, Article 810, CEC Section 54.

Mounting the Antenna Mast

When mounting the antenna and antenna mast, it is important to maximize the line-of-sight relationship between the RF 450™ MHz antenna and R450 MIUs for optimum RF communications.



WARNING: The antenna mast and stand must be grounded to the same grounding electrode used for the building's electrical system. This ensures that all exposed, non-current-carrying metal parts are the same potential. Refer to NEC Article 810 and CEC Section 54.



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

Site Recommendations

The following are recommendations for sites with multiple transmitters, receivers, and antennas. These sites require extra care when determining a location to install the antenna.

- Avoid mounting the RMDC antenna so that it is at the same height as another antenna on the site, regardless of the frequencies.
- On sites that have multiple antennas, if possible, mount the antennas one above the other, separating each by at least 10 feet vertically. This minimizes the interference between the systems.
- For cellular antenna sites, mount the RMDC antenna either above, below, or in the middle of the ring of cellular antennas. The two systems can coexist without interference.
- Antenna sites that must share space with multiple transmitting systems can require additional equipment to protect the systems from interfering with each other. These sites can also require additional engineering to make them perform well.

- Sites with multiple radio systems that are already operating on the 450 - 470 MHz band can 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 dictate the installation. As long as the installation meets Neptune's minimum requirements, follow the site's requirements as recommended.

Feed Line and Antenna Recommendations



CAUTION: 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.

Feed Line

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 is working properly.

Installation of the connectors is best done 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 can potentially cause problems, either immediately or after several years of proper operation.

Feed Line Requirements

Consider the following feed line requirements.

- The installer must certify the antenna and feed line system installation (after it is completed) to ensure it performs according to specifications.
- The maximum loss for the feed line and connectors must be less than 3 dB.

- Bond the feed line at the top of the tower and at the base of the tower. Use Andrew / CommScope grounding kits and procedures for all bonds.
- For towers over 150 feet tall, bond the feed line at regular intervals down the tower. The general recommendation is that the feed line be bonded every 50 feet to 75 feet. Site requirements and standard practices always dictate the configuration.
- You can install an optional surge protector on the tower near the antenna to help protect the feed line.
- For the AVA5-50 cable or larger, use jumpers to go between the larger cable and the RMDC and antenna connectors. Jumpers provide coaxial cable downsizing for the last 6 feet of the installation, allowing a more flexible and manageable connection to the RMDC.
- Andrew provides installation instructions for the Heliac coaxial cable. See Bulletin 17800B Revision C. Neptune Customer Support can supply a PDF copy .

Cable Guidelines

Prepare the cable for installation, and check for damage. You need the following materials to install the cable.

Table 25 – Material Needed for Cable Installation

Action	Material Needed
Hoisting the Cable	• Hoist lines • Pulleys • Cable reel • Hoisting grips
Anchoring Cable	• Cable hangers • 3-feet to 4-feet intervals or as recommended by the coax cable manufacturer
Grounding	Coax ground kits (top, bottom, building entrance)
Horizontal Cable Runs	• Above ground - ice bridge • Buried cable - conduit or sand below the frost line or one meter

Table 25 – Material Needed for Cable Installation (continued)

Action	Material Needed
Cable Connections	• Connector installation instructions • Connector torque • Weatherizing kits
Measurements	• Return Loss (VSWR) • Distance to Fault (DTF)

Neptune Part Numbers

The following table provides Neptune part numbers for cable.

Table 26 – Neptune Part Numbers for Cable

Neptune Part Number	Coax Diameter	Loss per 100'	Minimum Bend Radius	Weight per Foot	Maximum Length	Notes
10046-119	1/2"	1.45 dB	5"	0.15	150'	Recommended antenna cable for 150' cable runs or less
10046-118	7/8"	0.74 dB	10"	0.30	400'	Recommended antenna cable for runs over 150'

The following table provides the Neptune part numbers for connectors and accessories.

Table 27 – Connectors and Accessories

Cable Type	Neptune Part Number	Coax Diameter	Notes
FSJ4-50B			
	10046-117	Pre-made Coax 6' Jumper DIN Male on one end, N Male on the other	Used as jumper from feed line to RMDC or antenna

Table 27 – Connectors and Accessories (continued)

Cable Type	Neptune Part Number	Coax Diameter	Notes
LDF4-50A			
	8138-200	Coax Connector, N Male	Mates with RMDC and antenna connectors
		SureGround Grounding Kit for 1/2 " coax	
AVA5-50			
	8138-190	Coax Connector, 7/16" DIN Female	Used to connect to FSJ4 jumper cable

For the long-term protection of all RF connections, use the appropriate Andrews weatherproofing kit (CommScope P/N 245171) on all coaxial connectors.

Antenna

General specifications for the supplied antenna are shown in the table below.

Table 28 – Antenna Specifications

Feature	Specification
Neptune P/N	12896-001
Frequency Range	450-482 MHz
Maximum Input Power (Watts)	500
Gain	8.1 dBi (6 dBd)
Bandwidth < 1.5 VSWR	32 MHz
Vertical Beamwidth (-3 db)	20 degrees
Lightning Protection	Direct ground
Termination	N female
Overall Length	9.3 feet
Element Housing Length	6.8 feet
Support Pipe Diameter	2.5 inches

Table 28 – Antenna Specifications (continued)

Feature	Specification
Support Pipe Length	26 inches
Wind Load Area	1.61 square feet
Rated Wind Velocity	225 MPH
Weight	30 lbs
Mounting Hardware Included	DB365 clamps

Requirements

- If mounting the antenna on the side of a tower or other supporting structure, mount it so that it is at least 5 feet away from the structure. The components to offset the antenna are specific to the installation and are not included with the RMDC package.
- The antenna is large so take care when hoisting it up a tower so that it is not damaged.
- Do not attach the feed line to the antenna while hoisting it up the tower or other supporting structure. Attach the feed line after the antenna is in place.
- There have been reports of damage to the antenna's N-type connector where the center pin is bent and shorts out the antenna system. Take care not to damage the connector.

System Certification

The Andrews antenna supplied with the RMDC is specified as having a VSWR of 1.5:1 or better over the 450 - 470 MHz range.

Measuring VSWR at the RMDC must take into account losses in the feed line. For instructions, see "Measuring the VSWR" on page 61. The easiest approach is to use return loss instead of VSWR. The 1.5:1 VSWR translates into a return loss of 13.98 dB. Refer to Table 30 on page 73 and Table 31 on page 75 to assist with the calculation.

It is recommended that the feed line be certified as a separate step. This is best performed by putting a known amount of power into one end of the cable and verifying that, after correcting for the cable losses, the correct amount of power is output at the other end.

Power Measurement

Table 29 – Power Measurement to Return Loss and VSWR
Conversion Table -Part I

Input Power			Return Loss	VSWR
1W	5W	10W		
Reflected Power Reading				
0.001	0.005	0.01	30.0	1.07
0.002	0.010	0.02	27.0	1.09
0.003	0.015	0.03	25.2	1.12
0.004	0.020	0.04	24.0	1.14
0.005	0.025	0.05	23.0	1.15
0.006	0.030	0.06	22.2	1.17
0.007	0.035	0.07	21.5	1.18
0.008	0.040	0.08	21.0	1.20
0.009	0.045	0.09	20.5	1.21
0.010	0.050	0.10	20.0	1.22
0.020	0.100	0.20	17.0	1.33
0.030	0.150	0.30	15.2	1.42
0.040	0.200	0.40	14.0	1.50
0.050	0.250	0.50	13.0	1.58
0.060	0.300	0.60	12.2	1.65
0.070	0.350	0.70	11.5	1.72
0.080	0.400	0.80	11.0	1.79
0.090	0.450	0.90	10.5	1.86
0.100	0.500	1.00	10.0	1.92
0.110	0.550	1.10	9.59	1.99
0.120	0.600	1.20	9.21	2.06

Table 29 – Power Measurement to Return Loss and VSWR Conversion Table -Part I (continued)

Input Power			Return Loss	VSWR
1W	5W	10W		
Reflected Power Reading				
0.130	0.650	1.30	8.86	2.13
0.140	0.700	1.40	8.54	2.20
0.150	0.750	1.50	8.24	2.26
0.160	0.800	1.60	7.96	2.33
0.170	0.850	1.70	7.70	2.40
0.180	0.900	1.80	7.45	2.47
0.190	0.950	1.90	7.21	2.55
0.200	1.000	2.00	6.99	2.62

Table 30 – Power Measurement to Return Loss and VSWR Conversion Table -Part II

Input Power			Return Loss	VSWR
1W	5W	10W		
Reflected Power Reading				
0.20	1.05	2.10	6.78	2.69
0.22	1.10	2.20	6.58	2.77
0.23	1.15	2.30	6.38	2.84
0.24	1.20	2.40	6.20	2.92
0.25	1.25	2.50	6.02	3.00
0.26	1.30	2.60	5.85	3.08
0.27	1.35	2.70	5.69	3.16
0.28	1.40	2.80	5.53	3.25

Table 30 – Power Measurement to Return Loss and VSWR Conversion Table -Part II (continued)

Input Power			Return Loss	VSWR
1W	5W	10W		
Reflected Power Reading				
0.29	1.45	2.90	5.38	3.33
0.30	1.50	3.00	5.23	3.42
0.31	1.55	3.10	5.09	3.51
0.32	1.60	3.20	4.95	3.60
0.33	1.65	3.30	4.81	3.70
0.34	1.70	3.40	4.69	3.80
0.35	1.75	3.50	4.56	3.90
0.36	1.80	3.60	4.44	4.00
0.37	1.85	3.70	4.32	4.11
0.38	1.90	3.80	4.20	4.21
0.39	1.95	3.90	4.09	4.33
0.40	2.00	4.00	3.98	4.44
0.41	2.05	4.10	3.87	4.56
0.42	2.10	4.20	3.77	4.68
0.43	2.15	4.30	3.67	4.81
0.44	2.20	4.40	3.57	4.94
0.45	2.25	4.50	3.47	5.08
0.46	2.30	4.60	3.37	5.22
0.47	2.35	4.70	3.28	5.36
0.48	2.40	4.80	3.19	5.51
0.49	2.45	4.90	3.10	5.67

Coax Cable Loss

Table 31 – Coax Cable Loss Table

Coax Type	FSJ4-50B	LDF4-50A	AVA5-50	
Loss 100 ft.	2.31 dB	1.45 dB	0.744 dB	
Length (ft.)				
10	0.231	0.145	0.074	
20	0.462	0.290	0.149	
30	0.693	0.435	1.223	
40	0.924	0.580	0.298	
50	1.155	0.725	0.372	
60*	1.386	0.870	0.446	
70*	1.617	1.015	0.521	
80*	1.848	1.160	0.595	
90*	2.079	1.305	0.670	
100*	2.310	1.450	0.744	
110	2.541	1.595	0.818	
120	2.772	1.740	0.893	
130	3.003	1.885	0.967	
140	3.234	2.030	1.042	
150	3.465	2.175	1.116	
160	3.696	2.320	1.190	
170	3.927	2.465	1.265	
180	4.158	2.610	1.339	
190	4.389	2.755	1.414	
200	4.620	2.900	1.488	
210	4.851	3.045	1.562	

* Acceptable range

Table 31 – Coax Cable Loss Table (continued)

Coax Type	FSJ4-50B	LDF4-50A	AVA5-50	
Loss 100 ft.	2.31 dB	1.45 dB	0.744 dB	
Length (ft.)				
220	5.082	3.190	1.637	
230	5.313	3.335	1.711	
240	5.544	3.480	1.786	
250	5.775	3.625	1.860	
260	6.006	3.770	1.934	
270	6.237	3.915	2.009	
280	6.468	4.060	2.083	
290	6.699	4.205	2.158	
300	6.930	4.350	2.232	
310	7.161	4.495	2.306	
320	7.392	4.640	2.381	
330	7.623	4.785	2.455	
340	7.854	4.930	2.530	
350	8.085	5.075	2.604	
360	8.316	5.220	2.678	
370	8.547	5.365	2.753	
380	8.778	5.510	2.827	
390	9.009	5.655	2.902	
400	9.240	5.800	2.976	

VSWR Calculation

Neptune recommends the following method of computing VSWR. Taking the reading at the RMDC end of the feed line without compensating for cabling losses can give a false impression of the antenna and feed line performance.

Using a Wattmeter and a Handheld 450MHz Radio

The recommended procedure is to:

- Use a handheld commercial grade transceiver that is tuned to the RMDC's transmitter frequency.
- Use an inline wattmeter, such as a Bird Model 43 Wattmeter with the appropriate element (slug) for the frequency range and power output of the transceiver.

The Bird Model 43 Wattmeter uses elements to set the frequency and power ranges that the meter reads. Be sure the wattmeter element is a 400 - 1000 MHz model sized so that the forward power reading is close to full scale. For a 5W output handheld, the Bird 5E element is recommended. If the radio puts out more than 5W, a Bird 10E or higher power element can be required.

Complete the following steps to use a wattmeter and handheld to calculate VSWR.

1. Connect the wattmeter and transceiver to the feed line in place of the RMDC.
2. Measure both the forward and reflected power.
3. Find the return loss value using Table 29 on page 72 and Table 30 on page 73.
4. Find the loss attributed to the coax using Table 31 on page 75 (based on the coax type and feed line length).

Use the following formula to calculate the adjusted return loss.

Return Loss (from Table) - (2 x Cable Loss) = Corrected Return Loss

5. Find the VSWR using Table 29 on page 72 and Table 30 on page 73 using the Corrected Return Loss value.
6. Change the frequency on the handheld transceiver to the RMDC's receive frequency.
7. Measure the power and calculate VSWR using the procedure just used for calculating transmitter VSWR.
8. Record the VSWR values for both the transmit and receive frequencies. For the antenna system to pass, both calculated VSWR values must be less than 1.5:1.

Using the AEA 140-525 Antenna Analyzer

To configure the analyzer, complete the following steps.



This procedure assumes that the analyzer has not been configured prior to use.

1. Turn the analyzer **ON**.
2. Type the frequency: **46000**.
3. Press **Enter**.
4. Use the width buttons to set the value next to **WID** to **20**.
5. Set the reading to return loss by pressing **F1** slowly three times. The unit beeps each time.

Taking the Reading and Calculating VSWR

To take the reading and calculate VSWR, complete the following steps.

1. Connect the analyzer to the feed line in place of the RMDC.
2. Configure the analyzer using the preceding procedure.



Be sure that there is not a vertical line running through the display in the plot area. If there is, press **EXAM PLOT** to clear it.

3. Allow 10 - 20 seconds for the analyzer reading to stabilize.
4. Press **EXAM PLOT** to freeze the display.
5. Using the **FREQ** arrows, move the cursor (the vertical line in the middle of the screen) to the RMDC's frequency. (It moves to within 100KHz of a frequency.)
6. Read the value next to **RETL** on the display. This is the return loss value.
7. Find the loss attributed to the coax (based on the coax type and feed line length) using Table 31 on page 75.
8. Calculate the adjusted return loss using the following formula.
Return Loss (from Table 5) - (2 x Cable Loss) = Corrected Return Loss.

9. Find the VSWR using the Corrected Return Loss value in Table 29 on page 72 or Table 30 on page 73
10. Move the cursor to within 100KHz of the RMDC's receive frequency.
11. Calculate the VSWR using the new return loss value.
12. Record both values. They must be less than 1.5:1 for the antenna and feed line to pass the test.

General Installation Guidelines

This section provides general installation guidelines.

Unpacking

As with all precision electronic instruments, handle the RF 450 MHz antenna with care; however, no additional special handling is required.

After unpacking the RF 450 MHz antenna, inspect it for damage. If any parts of the R450 MHz antenna appear to be damaged or prove to be defective upon installation, notify your Neptune sales representative. If the unit or item requires reshipment, use the original cardboard box and packing material.

In particular, check to be sure that the N-type connector at the base of the antenna is not damaged. This is much easier to check while the antenna is on the ground than after it is installed.

RF Antenna Installation Kit

The RF 450 MHz antenna (see Figure 52) and the basic accessories are included with the RMDC. The mounting brackets that are included are designed to mount on the top of a mast or similar structure.

If the installation requires offsetting the antenna from the supporting structure, an antenna standoff mounting bracket (see Figure 51) can be ordered separately from another vendor. Neptune does not sell it. Mounting the antenna with a standoff bracket moves the antenna out away from the structure and improves performance.

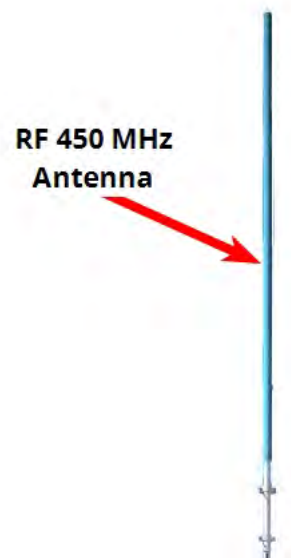
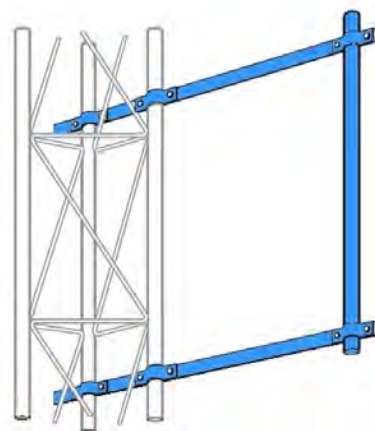


Figure 51 – Standoff Mounting Bracket Figure 52 – RF 450 MHz Antenna



Mounting the antenna using the standoff bracket will affect the antenna pattern.

Tools and Materials

Table 32 shows the recommended tools and materials you need to successfully install the RF antenna.

Table 32 – Recommended Tools and Materials

Item	Description/Recommendation	Use
Tool Kit	Contains standard tools including: • Assorted screwdrivers (medium, flat-head) • Cordless electric drill / assorted bits • Adjustable wrench • Standard socket wrench set	Various installation procedures performed by the installer

Table 32 – Recommended Tools and Materials (continued)

Item	Description/Recommendation	Use
	- Standard box-end wrench set - Hammer - Channel locks	
UV-Stable Cable Ties	8" and 12" (20.32 cm and 30.48 cm)	Secure coax cable
Cable Clips	Various sizes	Securing coax cable
Weatherizing Kit	3M - Scotch Weatherproofing Kit (P/N: WK-101) - or Times Microwave P/N: WK-S-2 - or CommScope P/N: 245171	Weatherproofing coax cable connections
Electrical Tape	Scotch® Heavy Duty Vinyl Electrical Tape 22 - or Scotch® Super 88	Weatherproofing coax cable connections and other connections as required

Installing the RF Antenna

This section contains the instructions for the RF antenna installation.

Mounting the RF 450 MHz Antenna

The RF 450 MHz antenna must be installed by professionals in accordance with the FCC site license before you begin the installation of the RMDC.

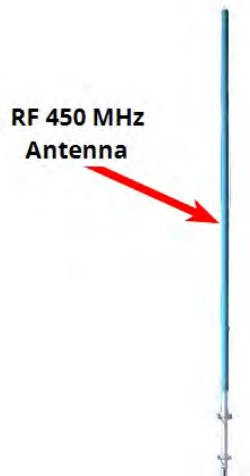


WARNING: Mounting and wiring the RF 450 MHz antenna must be done by a trained professional. Be sure to subcontract this work, so it is completed properly.



The subcontractor must check the cable, connectors, and the antenna installation using the VSWR meter.

To mount the RF 450 MHz antenna, complete these steps.



1. Assemble the RF 450 MHz antenna according to the instructions included with the antenna kit. See "Troubleshooting" on page 51.
2. Mount the antenna according to the instructions provided. Use the mounting hardware included with the antenna kit.
3. Install the antenna in accordance with the FCC site license (per the antenna mounting instructions contained in this appendix).
4. Weatherize the antenna coaxial connector using the weatherizing kit. See Table 32 on page 80.

Figure 53 – RF 450 MHz Antenna to be Mounted

Mounting the Antenna Mast to the Building

With a wall-mount installation, it is necessary to mount the RF 450 MHz antenna and cellular antenna on the exterior of the building. Complete the following steps to mount the antenna mast to the building. Use the manufacturer installation instructions provided with mounting hardware.

Pole bracket



1. Use antenna pole brackets to install the pole to the building. See Appendix A.
2. Pre-drill your holes for the first pole bracket.
3. Secure the pole bracket in one of the following ways. If mounting to:
 - A wood-constructed wall, use wood screws rated at minimum of 20 pounds loading.
 - Sheet metal or masonry, use appropriate sheet metal screws or masonry anchors rated at a minimum of 20 pounds loading.

Figure 54 – Securing the Pole Bracket



Figure 55 – Lining Up Second Bracket

4. Place the antenna mast pole within the bracket.
5. Using a level to make sure the pole is vertical, line up a second bracket a minimum of 2 feet from the bracket you just installed.
6. Secure the second bracket similarly to the first one, following steps 2 and 3.
7. Line up the pole in the two brackets. See Figure 55.
8. Secure the pole with the bolts provided.

Attaching the RF 450 MHz Antenna Cable

To attach the RF 450 MHz antenna cable to the RMDC, complete the following steps.



Figure 56 – RF 450 MHz Antenna Connection

1. Locate the RF 450 MHz antenna cable that extends from the RF 450 MHz antenna cable conduit. See Figure 56.
2. Connect the RF 450 MHz antenna cable to the RF 450 MHz antenna connector located on the bottom of the antenna. See Figure 56. Tighten the coaxial connector to:
 - **Type N:** 15 to 20 in-lb (1.7 - 2.30 N-m)
 - **Type 7 - 16 DIN:** 220 - 265 in-lb (25 - 30 N-m)

WARNING: Give special consideration when the RMDC is installed inside a building.



The screen (shield) of the coaxial cable must be connected to the earth (grounded) at the entrance to the building. Be sure to do this in accordance with applicable national electrical installation codes (Section 820.93 of the National Electrical Code, ANSI / NFPA 70).

Weatherizing the Cable Connections

To weatherproof the cables using the Scotch Wireless WK-101 Kit or equivalent, complete the following steps.



Figure 57 – Weatherizing the RF Antenna Connection

1. Using the weatherizing kit, start the tape at the top of the RF antenna connection as illustrated in Figure 57.
2. Wrap the tape around the connection several times; slowly work your way downward to weatherize your connection at the base.

Troubleshooting the RF Antenna

This section provides a list of equipment needed to resolve problems that can arise with your RF antenna.

Equipment Required

The following items are required to troubleshoot the RMDC.

- Keys to access the site and open the R450 RMDC cabinet
- Adjustable wrench or set of open end wrenches to remove the antenna N-type coaxial connector from inside of the R450 RMDC antenna surge arrestor.
- Handheld UHF (450 - 470 MHz) Radio
- Bird Model 43 Wattmeter with appropriate slug or AEA 140 - 525 Antenna Analyzer

Testing the RF Antenna

To test the RF antenna, complete the following steps.

1. Remove the power from the R450 RMDC.
2. Open the R450 RMDC cabinet.
3. Use an open-end wrench or adjustable wrench to carefully remove the coaxial cable assembly (with the N-type connector) from the main antenna surge arrestor (located inside the R450 RMDC cabinet at the bottom).
4. Go to "VSWR Calculation" on page 76



If using the power measurement method for the VSWR calculation, you cannot use the R450 RMDC's transmitter to certify the antenna system. The transmitter only transmits short packets approximately 50 ms in length, so taking an accurate reading of forward or reflected power cannot be done with standard equipment.

5. If the VSWR does not meet specifications, disconnect the RF antenna feed cable (with the N-type connector) that is located under the R450 RMDC cabinet.

Repeat the VSWR calculation procedure on the RF antenna and feed cable.

If the VSWR meets specifications, the problem may be a bad or damaged antenna surge arrestor. Contact Neptune Customer Support to return the R450 RMDC for repair.

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Appendix B: USB Flash Drive Configuration for RMDC

Overview

This appendix provides information and the steps for creating a R450™ Rack Mount Data Collector (R450 RMDC) and configuring the USB flash drive using the N_SIGHT® PLUS host software.

Creating a Collector

The **Collector** tab in the N_SIGHT PLUS host software provides valuable information about the R450 RMDC in your R450™ System. On this tab you can search for or create an R450 RMDC.

Searching for Collectors

To locate an RMDC, complete the following steps.

1. Click **Search Collectors** on the **Collector** tab.

The following page appears.

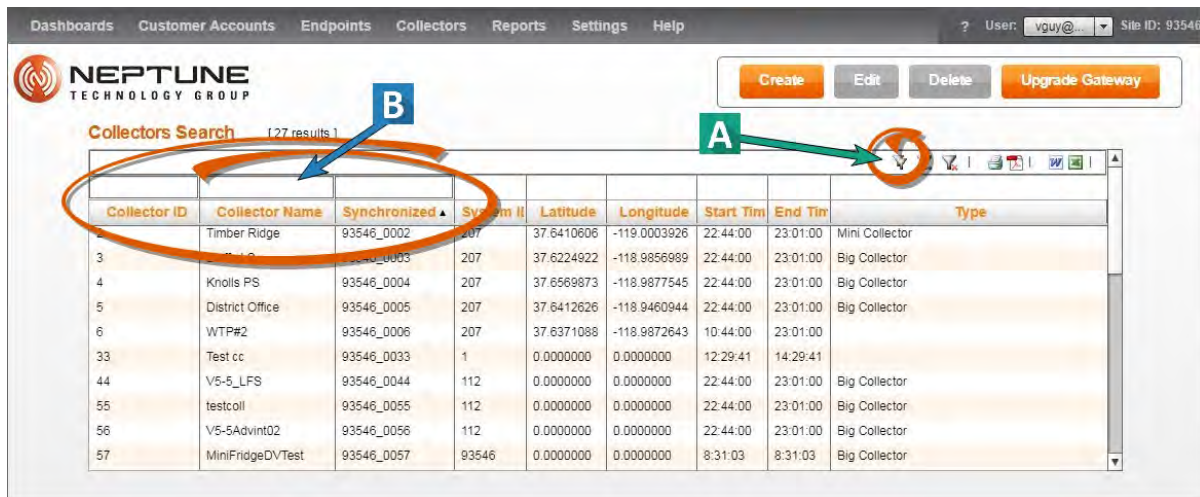


Figure 58 – Collector Search

2. Click the **Filter** button. See Figure 58.

Three search fields appear. See Figure 58:

- Collector ID
- Collector Name
- Synchronized User

3. Type all or part of the search criteria in the search field.
Everything matching your search criteria appears in the collector list on the **Collector** tab.
4. Select a collector and the detailed information for the collector appears in the lower-half of the page. See Figure 59.

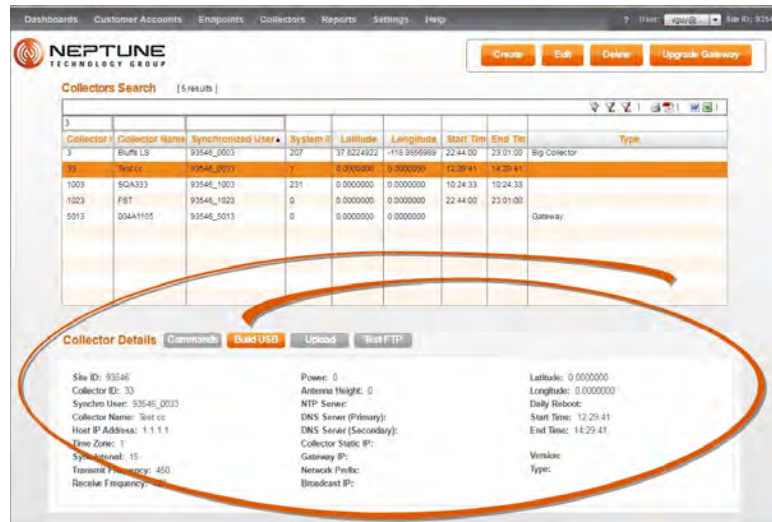


Figure 59 – Collector Search Results

5. Select one of the following options.
 - **Create**, to create another RMDC.
 - **Edit**, to edit information for the selected RMDC.
 - **Delete**, to delete the selected RMDC.
 - **Build a USB**, to build a drive for the RMDC.

Creating a New Collector



On this tab, remember the following:

- All fields with an * are required.
- All white fields are available fields.
- All fields with gray text are read-only fields.

To create a new RMDC, complete the following steps.

1. Open the N_SIGHT PLUS host software on the PC.
2. Select the **Collector** tab, and then click **Create Collector**.

The Create a New Collector window appears similar to Figure 60 on page 89. The **Collector Details** tab is the default tab displayed. All required fields display a red *.

Figure 60 – Create a New Collector Window

Table 33 – Collector Details

Field	Description
Collector ID	Indicates the unique identifier for the data collector which can be a street, location, or a neighborhood.
Collector Name	Indicates the name of the data collector, for example the street, neighborhood, tower name, and so forth.
Host IP Address	Indicates the static IP address for the host database.
System ID #	Indicates the system identification number.
Time Zone	Indicates the unique identifier for the time zone in which the RMDC is located; offset is from UTC: Atlantic Time is -4; Eastern Time is -5; and so forth.
Sync Interval (minutes)	Indicates, in number of minutes, the time between synchronizations between the collector and the database. Usually it is 60 minutes for a cellular system, and 30 minutes for an Ethernet system.
Transmit Frequency	Indicates the frequency used to transmit data.
Receive Frequency	Indicates the frequency used to receive data.
Latitude	Indicates the actual latitude of the RMDC.
Longitude	Indicates the actual longitude of the RMDC.
Power	Indicates the power used by the RMDC.
Antenna Height	Indicates the actual height of the RF antenna.
Daily Reboot	Indicates if the RMDC requires a daily reboot.
Start Time	Indicates the beginning time in hh:mm format for the quiet time period when the RMDC is not transmitting or receiving.
End Time	Indicates the ending time in hh:mm format for the quiet time period when the RMDC is not transmitting or receiving.

- Complete all the required and available information that applies, and then click **Save**.

The Collector Network Settings tab appears similar to Figure 61.

Figure 61 – Collector Network Setting Tab

Table 34 – Collector Network Settings

Field	Description
WAN Connection Type	Indicates the type of Wide Area Network (WAN) used by the RMDC. The options include the following: - Cellular - Cellular_Ethernet - Network_DHCP - Network_Static_IP - Mobile
NTP Server	Indicates a server that uses NTP (Network Time Protocol) to keep the clock accurate.
Primary DNS Server	Indicates the primary server, the first DNS (Domain Name System) server queried when resolving a server name. You can supply the name rather than the IP address, for example, Chicago rather than 10.10.10.10.
Secondary DNS Server	Indicates the second DNS server.

On this tab, remember the following:

- All fields with an ***** are required.
 - All white fields are available fields.
 - All fields with gray text are read-only fields.
4. Complete all the fields (on this tab, all fields are acquired), and then click **Save**.

The new RMDC appears in the list of R450 DCs on the **Collector** tab, and the detail appears in the lower half of the page.

Editing Collector Information

To edit information for an RMDC, complete the following steps.

1. On the **Collector** tab, select the RMDC for which you want to edit the information.
The **Edit Collector** window appears with the existing information for the collector.
2. Edit the appropriate information on both the **Collector Details** tab and the **Collector Network Settings** tab.
3. Click **Save** to display and save the new information for the collector.

Deleting a Collector

To delete a collector, complete the following steps.

1. On the **Collector** tab, select the collector you want to delete.
2. Click **Delete**.

A delete confirmation message appears similar to the following.

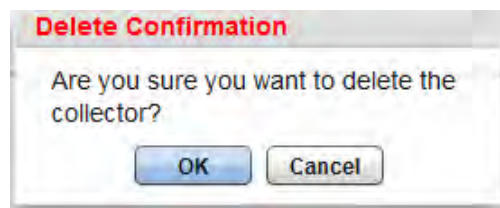


Figure 62 – Delete Confirmation Dialog Box

3. Click **OK**.
The RMDC is now deleted from the list of collectors on the **Collector** tab.

Building a USB Drive for Collector Configuration

This feature adds the ability to build a USB drive. It can be inserted into a replacement collector for automatic configuration in order to mimic an old collector.



R450 Collector configuration application must be installed on a local PC to extract files to the USB drive. Make sure only the desired USB drive is inserted into the computer.

To add a USB drive, complete the following steps.

1. Select the RMDC from the **Collector** tab to upload data to the USB drive.
2. Click **Build USB**.

A confirmation message appears similar to the following.

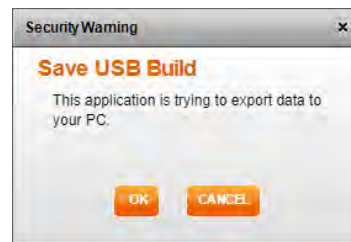


Figure 63 – Save USB Build

3. Click **OK** to build the drive.
4. Double-click the downloaded file (*.ntg).

The application formats and extracts files to the USB drive. A message similar to the following appears.

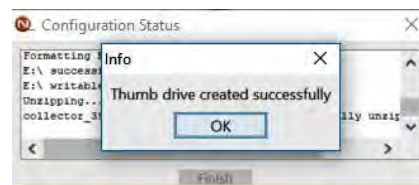


Figure 64 – Thumb Drive Created

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RJ-45 Straight-Through Ethernet Cable

For most installations, use the straight-through Ethernet cable. Terminate the Ethernet cable according to the diagram below using the T-568B wiring standard for both ends. Usually the end is already pre-terminated to the switch or hub.

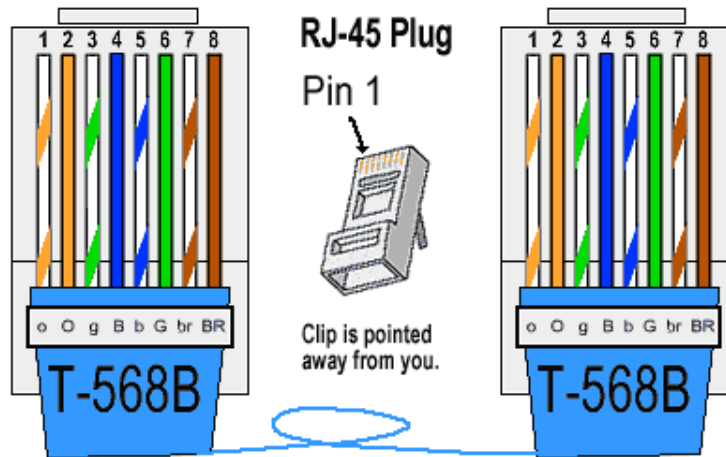


Figure 65 – Straight-Through Ethernet Cable

RJ-45 Crossover Ethernet Cable

For some installations, a crossover Ethernet cable is required. If you require a cable to connect two Ethernet devices directly together without a hub or when you connect two hubs together, you need to use a crossover cable instead.

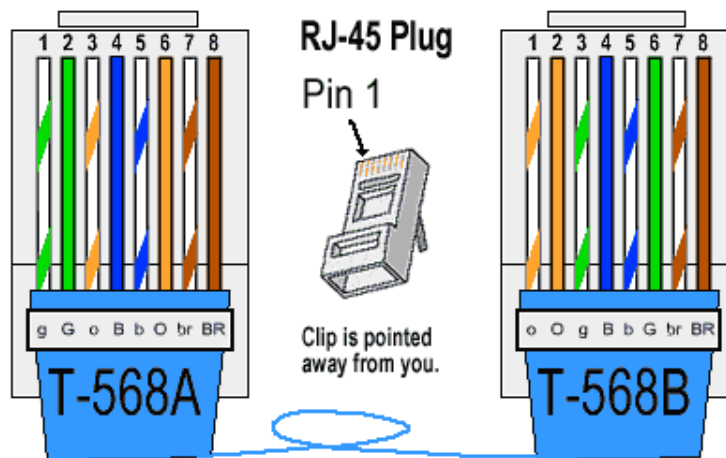


Figure 66 – RJ-45 Crossover Ethernet Cable

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 probably requires a crossover Ethernet cable to be compatible with the RMDC.

Table 35 – Cable Color Code Table

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

Appendix D: Cellular Antenna Coax Cable

This appendix provides information about the cellular antenna coax cable.

Cellular Antenna Coax Cable Recommendations

Some installations require a longer coax cable for the cellular antenna connection. In these instances, you can order longer pre-terminated coax cable assemblies from Neptune. Refer to the coax cable recommendations in Table 36.

The coax cables are available in various lengths with N-male (plug), 50 ohm, connectors terminated on each end. In addition, heat shrink tubing is applied to both ends for added weatherproofing. However, the weatherproofing wrap (for example 3M Weatherproofing Kit P/N: WK-101) is still required after you make the final connection.

Table 36 – Coax Cable Recommendations for Cellular Antenna

Coax Cable Length (ft.)	Coax Cable Type	Neptune P/N (if applicable)
6	Times Microwave LMR-195	10046-112
8	Times Microwave LMR-195	10046-113
10	Times Microwave LMR-400-UF	13090-001
20	Times Microwave LMR-400-UF	13090-002
30	Times Microwave LMR-400-UF	13090-003
40	Times Microwave LMR-400-UF	13090-004

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Appendix E: Strut Clamp Recommendations

Use the strut clamps to mount the R450™ Rack Mount Data Collector (R450 RMDC) and UPS to Schedule 40 or Schedule 80 galvanized steel pipe. You can purchase strut clamps from local electrical suppliers. A quantity of two per unit is required.

Table 37 shows some general recommendations for stainless steel (304) strut clamps.

Table 37 – Recommended Stainless Steel Strut Clamps

Inside Diameter (ID) Clamp (inch)	For SCH 40/SCH 80 steel pipe size (inch)	Manufacturer P/N (stainless steel)
2 3/8"	2"	McMaster-Carr 3115T47
2 7/8"	2.5"	McMaster-Carr 3115T48
3 1/2"	3"	McMaster-Carr 3115T49
4"	3.5"	McMaster-Carr 3115T51
4 1/2"	4"	McMaster-Carr 3115T52
5 9/16"	5"	McMaster-Carr 3115T53
6 5/8"	6"	McMaster-Carr 3115T54
8 5/8"	8"	McMaster-Carr 3115T66



WARNING: Do not mount the R450 RMDC or UPS to steel pipe that is smaller than 2 inches in diameter.

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A

ALM

Alarm indicator.

AMI

Advance Metering Infrastructure. System that captures, stores, and provides to the utility at frequent intervals detailed consumption and other information, such as, usage, leak, and flow status, in order to support advanced applications. These data can then be used to support a consumer portal. Furthermore, the mass of data generated by the system can feed an advanced Analects system to convert it into actionable information that supports the efficient management of the utility.

AMR

Automatic Meter Reading. The automated process of reading meters.

ANSI

American National Standards Institute.

APN

Access Point Name.

B

ballast

Heavy material used to secure the stability of the equipment stand. For the R450 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 allows multiple users to be connected over the same channel.

D

Data Collector

R450 Data Collector (R450 DC). The physical equipment that houses Neptune's N_SIGHT PLUS host software. The R450 DC is a device that collects meter reading data from Neptune's absolute encoder register interfacing with Neptune's R450 MIU and transmits the data for collection. This unit receives the data for collection. This unit receives the data and stores data to be downloaded through the host software.

dB

Decibels. The definition of the decibel is based on the measurement of power or the signal-to-noise ratio.

dBm

Power ratio in decibels (dB) of the measured power referenced to one milliwatt.

DC

Direct Current.

DHCP

Dynamic Host Configuration Protocol.

DNS

Domain Name System.

DTF

Distance to Fault.

F

FCC

Federal Communications Commission.

FST

Field Service Tool.

G

GSM

Global System for Mobile communication. The most widely-used digital wireless telephony technology.

I

IEEE

Institute of Electrical and Electronics Engineers.

IMEI

International Mobile Equipment Identifier.

in-lb

Inch-pound. A measurement of torque in the Imperial (American) system.

K

kA

Kiloampere. A measurement of electric current.

L

LED

Light Emitting Diode.

M

MDA

Mobile Directory Number.

MEID

Mobile Equipment Identifier.

MHz

Megahertz, a unit of frequency. One MHz is equal to one million hertz.

MIU

Meter Interface Unit.

MPH

Miles per Hour, as related to wind velocity.

ms

Milliseconds.

N

Nm

Newton meter or newton moment, a measurement of torque in the metric system.

NTP

Network Time Protocol.

O

ohm-out

Perform a continuity test with a digital multimeter or an ohm-meter.

P

P/N

Part Number.

PIN

Personal Identification Number.

R

R450 System

R450 System is a fixed network AMI system for targeted applications allowing a utility to conduct meter reading operations automatically ensuring maximum collection of the data.

RMA

Return Material Authorization.

RSSI

Received signal strength indicator.

S

serial number

A unique identification number given to each product at the factory.

SIM

Subscriber Identification Module.

U

UPS

Uninterruptible Power Supply.

V

VAC

Volts Alternating Current.

VSWR

Voltage Standing Wave Ratio. The ratio of the amplitude of a partial standing wave at an antinode (maximum) to the amplitude at an adjacent node (minimum) in an electrical transmission line.

W

WAN

Wide Area Network.

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