



# NetSure™ IPE Series -48 VDC Outdoor Rectifier

## Installation and User Manual

Specification Number: 1R482000C2-6

Model Number: R48-2000C2

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### **Technical Support Site**

If you encounter any installation or operational issues with your product, check the pertinent section of this manual to see if the issue can be resolved by following outlined procedures.

Visit <https://www.vertiv.com/en-us/support/> for additional assistance.

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## Admonishments Used in this Document



**DANGER!** Warns of a hazard the reader **will** be exposed to that will **likely** result in death or serious injury if not avoided. (ANSI, OSHA)



**WARNING!** Warns of a potential hazard the reader **may** be exposed to that **could** result in death or serious injury if not avoided. This admonition is not used for situations that pose a risk only to equipment, software, data, or service. (ANSI)



**CAUTION!** Warns of a potential hazard the reader **may** be exposed to that **could** result in minor or moderate injury if not avoided. (ANSI, OSHA) This admonition is not used for situations that pose a risk only to equipment, data, or service, even if such use appears to be permitted in some of the applicable standards. (OSHA)



**ALERT!** Alerts the reader to an action that **must be avoided** in order to protect equipment, software, data, or service. (ISO)



**ALERT!** Alerts the reader to an action that **must be performed** in order to prevent equipment damage, software corruption, data loss, or service interruption. (ISO)



**FIRE SAFETY!** Informs the reader of fire safety information, reminders, precautions, or policies, or of the locations of fire-fighting and fire-safety equipment. (ISO)



**SAFETY!** Informs the reader of general safety information, reminders, precautions, or policies not related to a particular source of hazard or to fire safety. (ISO, ANSI, OSHA)

# Important Safety Instructions

## Safety Admonishments Definitions

Definitions of the safety admonishments used in this document are listed under “Admonishments Used in this Document” on page vi.

## General Safety



**DANGER!** YOU MUST FOLLOW APPROVED SAFETY PROCEDURES.

Performing the following procedures may expose you to hazards. These procedures should be performed by qualified technicians familiar with the hazards associated with this type of equipment. These hazards may include shock, energy, and/or burns. To avoid these hazards:

- a) The tasks should be performed in the order indicated.
- b) Remove watches, rings, and other metal objects.
- c) Prior to contacting any uninsulated surface or termination, use a voltmeter to verify that no voltage or the expected voltage is present. Check for voltage with both AC and DC voltmeters prior to making contact.
- d) Wear eye protection.
- e) Use certified and well maintained insulated tools. Use double insulated tools appropriately rated for the work to be performed.



**CAUTION!** Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## Voltages

### AC Input Voltages



**DANGER!** This system operates from AC input voltage capable of producing fatal electrical shock. AC input power must be completely disconnected from the branch circuits wiring used to provide power to the system before any AC electrical connections are made. Follow local lockout/tagout procedures to ensure upstream branch circuit breakers remain de-energized during installation. DO NOT apply AC input power to the system until all electrical connections have been completed and checked.

### DC Output and Battery Voltages



**DANGER!** This system produces DC power and may have a battery source connected to it. Although the DC voltage is not hazardously high, the rectifiers and/or battery can deliver large amounts of current. Exercise extreme caution not to inadvertently contact or have any tool inadvertently contact an output terminal or battery terminal or exposed wire connected to an output terminal or battery terminal. NEVER allow a metal object, such as a tool, to contact more than one termination or battery terminal at a time, or to simultaneously contact a termination or battery terminal and a grounded object. Even a momentary short circuit can cause sparking and injury. Fuses may open during a short circuit event.

## Battery

Refer to the battery manufacturer documentation for specific battery safety instructions. The following are general guidelines.



**WARNING!** Correct polarity must be observed when connecting battery leads.



**WARNING!** Special safety precautions are required for procedures involving handling, installing, and servicing batteries. Observe all battery safety precautions in this manual and in the battery instruction manual. These precautions should be followed implicitly at all times.



**WARNING!** A battery can present a risk of electrical shock and high short circuit current. Servicing of batteries should be performed or supervised only by properly trained and qualified personnel knowledgeable about batteries and the required precautions.

The following precautions should be observed when working on batteries:

- Follow the recommended PPE requirements per the SDS for the battery to be used.
- Batteries are an energy source that can produce high amounts of electrical current.
- Remove watches, rings, and other metal objects.
- Use certified and well maintained insulated tools. Use double insulated tools appropriately rated for the work to be performed. Ensure that wrenches with more than one working end have only one end exposed.
- Verify that no current will flow when the battery is connected or disconnected by opening battery disconnects (if available) or adjusting the system to match battery voltage.
- Dispose of used batteries according to the instructions provided with the batteries. Do not dispose of batteries in a fire. They may explode.
- ALWAYS FOLLOW THE BATTERY MANUFACTURER'S RECOMMENDATIONS AND SAFETY INSTRUCTIONS.

### Additional Precautions for the Batteries Described in this Document

- The battery has an ON/OFF switch. Before making any electrical connection, disconnect power at battery by placing the ON/OFF switch to the OFF position.
- Do not immerse the battery in water.
- Do not approach a heat source.
- Do not short-circuit the positive and negative poles of the battery.
- Do not reverse charge.
- Do not use the battery in an extremely hot environment, such as a closed environment. Care must be taken to keep operational temp within -40 °C to +55 °C rating of battery. Outside of the range of operation (above +55 °C), the battery may overheat, and its performance will be severely degraded, including possibility of outgassing and cell damage.
- DO NOT OPEN THE BATTERY ENCLOSURE due to high hazard inside. Battery is only intended to be replaced, not repaired if faulty.
- If needing replacement, battery must be returned in HAZ MAT approved Class 9 packaging. Packaging shall be marked with UN 3480 and Haz Mat Cat 9 labels.



- Refer to the battery manufacturer battery manual for storage requirements. Refer also to “Battery Storage Environment” on page 15.
- Do not DROP the battery during installation.
- Battery maximum elevation – 3000 Meters.



**ALERT!** Performing maintenance and/or troubleshooting procedures may interrupt power to the loads, if battery reserve is not sufficient.

## Personal Protective Equipment (PPE)



**DANGER!** AC ARC FLASH AND SHOCK HAZARD.

Appropriate PPE and tools required when working on this equipment. An appropriate flash protection boundary analysis should be done to determine the “shock hazard and arc flash hazard” category, and to select proper PPE.



Only authorized and properly trained personnel should be allowed to install, inspect, operate, or maintain the equipment.

Do not work on LIVE parts. If required to work or operate live parts, obtain appropriate Energized Work Permits as required by the local authority, per NFPA 70E “Standard for Electrical Safety in the Workplace”.

## Hazardous Voltage



**DANGER!** HAZARD OF ELECTRICAL SHOCK.

More than one disconnect may be required to de-energize the system before servicing.

## Handling Equipment Containing Static Sensitive Components



**ALERT!** Installation or removal of equipment containing static sensitive components requires careful handling. Before handling any equipment containing static sensitive components, read and follow the instructions under “Static Warning” on page x.

The rectifier has a service port panel that can be removed for service or access to fuses and jumpers. A wrist strap must be worn when the rectifier is serviced.

## Maintenance and Replacement Procedures



**CAUTION!** When performing any step in the procedures that requires removal or installation of hardware, use caution to ensure no hardware is dropped and left inside the unit; otherwise, service interruption or equipment damage may occur.



**NOTE!** When performing any step in the procedures that requires removal of existing hardware, retain all hardware for use in subsequent steps, unless otherwise directed.

## Static Warning



This equipment contains static sensitive components. The warnings listed below must be observed to prevent damage to these components. Disregarding any of these warnings may result in personal injury or damage to the equipment.

1. Strictly adhere to the procedures provided in this document.
2. Before touching any equipment containing static sensitive components, discharge all static electricity from yourself by wearing a wrist strap grounded through a one megohm resistor. Some wrist straps have a built-in one megohm resistor; no external resistor is necessary. Read and follow wrist strap manufacturer's instructions outlining use of a specific wrist strap.
3. Do not touch traces or components on equipment containing static sensitive components. Handle equipment containing static sensitive components only by the edges that do not have connector pads.
4. After removing equipment containing static sensitive components, place the equipment only on static dissipative surfaces such as conductive foam or ESD bag. Do not use ordinary Styrofoam or ordinary plastic.
5. Store and ship equipment containing static sensitive components only in static shielding containers.

# 1 Introduction

## 1.1 General

The Vertiv™ NetSure™ IPE Series Outdoor Rectifier supplies power to critical infrastructure in harsh environments. Factory default output voltage is 54.2 VDC. The hardened rectifier is mounted inside an environmentally protective enclosure that can be wall or pole mounted.

These instructions apply to the following rectifier versions:

- Spec. No. 1R482000C2-6, Model R48-2000C2: Quick Connect Type, with controller.

## 1.2 What is in the Box

Refer to Table 1.1.

**Table 1.1 What is in the Box**

Part Number	Description	Qty.
1R482000C2-6	Outdoor Rectifier (with controller)	1
10024600	Rectifier Only Mounting Kit - see page 18 for additional details (use part number 10025106 if a spare or replacement rectifier bracket is needed)	1
10027555	Strain Relief Plate with Hardware	1
UM1R482000C2-6	Installation and User Manual	1



**NOTE!** The rectifier is equipped with plug-in cable receptacles (i.e., bulkhead quick-connect connectors). Pre-assembled cables with the appropriate mating half connector **MUST** be ordered separately. See “Pre-Assembled Cables” on page 2 for descriptions and part numbers.

## 1.3 Accessories

### 1.3.1 Mounting Kits

Refer to Table 1.2.

**Table 1.2 Mounting Kits**

Part Number	Description
10025106	Rectifier Only Mounting Kit (Order <u>ONLY</u> if a spare or replacement 10024600 rectifier mounting bracket is needed)
10025107	Battery Only Mounting Kit (See “Companion Lithium-Ion Battery Only Mounting Kit P/N ” on page 20.)
10025108	Rectifier Add-On Kit (for Narada battery) (See “Rectifier Add-On Kit P/N 10025108 (for Narada Battery)” on page 21.) Allows combined rectifier and battery mounting. Requires Rectifier Only Mounting Kit P/N 10024600 and Battery Only Mounting Kit P/N 10025107.

## 1.3.2 Pre-Assembled Cables

### For 1R482000C2-6 Rectifier

Refer to Table 1.3.

**Table 1.3 Pre-Assembled Cables for 1R482000C2-6 Rectifier**

Part Number	Rectifier Port Label	Description
10023420 (30 feet)	LOAD 1	Pre-Assembled Cable (6 AWG, Type W) (Cable with Mating Half to Rectifier 'DC Output Load1' Receptacle, other end unterminated) (2kW) (see note below)
10023471 (30 feet)	LOAD 2 LOAD 3	Pre-Assembled Cable (8 AWG, Type SOOW) (Cable with Mating Half to Rectifier 'DC Output Load2 / Load3' Receptacle, other end unterminated.) (1kW) (see note below)
10024814 (16.4 feet) 10023461 (32.8 feet)	PWR	Pre-Assembled Cable (14 AWG, Type SEOW) (Cable with Mating Half to Rectifier 'AC Input Power' Receptacle, other end unterminated.)
10039061 (32.8 feet)	COM	Pre-Assembled Cable (Cable with Mating Half to Rectifier DB15 'Alarm and COM' Receptacle, other end unterminated.)



**NOTE!** DC power ports are polarized: 2kW type (BAT, Load 1) have polarizing dimple at bottom, and 1kW type (Load 2, 3) have polarizing dimple at top.

### For Narada FEN4850 Battery

Refer to Table 1.4.

**Table 1.4 Pre-Assembled Cables for Narada FEN4850 Battery**

Part Number	Rectifier Port Label	Description
10023549 (31.5 inch), 10023604 (49.25 inch)	BATT / Output 4	Pre-Assembled Cable (10 AWG, Type SJ00W) (Cable with Mating Half to Rectifier 'Battery' Receptacle and Narada Battery 'Output' Receptacle) (2kW) (Cable to connect from rectifier to Narada battery.)
10023684 (31.5 inch), 10023685 (49.25 inch)	COM	Pre-Assembled Cable (Cable with Mating Half to Rectifier DB9 'Battery Alarm' Receptacle and Narada 'Battery Alarm' Receptacle) (Cable to connect from rectifier to Narada battery.)

## 1.3.3 Battery

Refer to Table 1.5.



**NOTE!** The Vertiv recommended "UL" type Li-ion battery has been investigated and is the only battery currently validated and approved for use with the Vertiv™ NetSure™ IPE Series Outdoor Rectifier, Spec. No. R48-2000C2-6. Vertiv cannot warranty any other battery for compatibility to the Vertiv™ NetSure™ IPE Series Outdoor Rectifier, Spec. No. R48-2000C2-6.

**Table 1.5 Battery**

Part Number	Description
48-BKB01030050-2UA	Narada FEN4850 (50 Ah)

## 1.4 Rectifier Overview

The rectifier provides load power during normal operating conditions. The rectifier is a constant power design. The rectifier is rated at its maximum output power. This means that, within the normal operating ambient temperature range and input voltage range, the maximum available output power is a constant 2000 W. Within these ranges, the rectifier operates in one of three modes, depending upon load demands. Transition between modes is completely automatic. If ambient temperature rises above or input voltage falls below acceptable values, the rectifier continues to operate but at derated output power levels.

- **Constant Voltage Mode:** For any initial output voltage setting from -42 VDC to -58 VDC (factory set at -54.2 VDC), output voltage remains constant regardless of load. This is the normal operating condition, in which loads are being supplied. The rectifier operates in the Constant Voltage Mode unless load increases to the point where the product of load current and output voltage is approximately 2000 W.
- **Constant Power Mode:** As load increases above approximately 2000 W (non-adjustable), output current continues to increase, but output voltage decreases as required to maintain constant output power. The rectifier operates in the Constant Power Mode unless load continues to increase to the point where the current limit setting is reached.
- **Constant Current Mode:** If load increases to the current limit setting, output voltage decreases linearly to maintain output current at the current limit setting.
- **Fold Back:** The fold back function is necessary to protect the rectifier against excessive load. The rectifier will deliver maximum current of 41.7 A down to 42 VDC output. If the load demand exceeds 41.7 A, the rectifier output will "fold back", reducing the voltage as shown in Figure 1.1 to limit the current and protect the rectifier. (The dotted line in Figure 1.1 represents the Fold Back.)

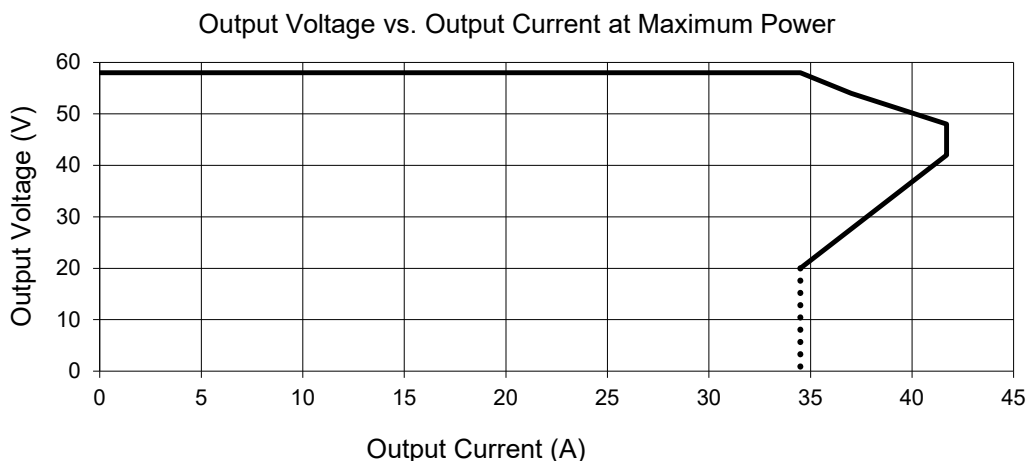
## 1.5 Rectifier Specifications

The specifications are for a single rectifier only, unless otherwise noted.

### 1.5.1 DC Output Ratings

1. **Voltage:** -42 VDC to -58 VDC, positive ground. Output voltage is factory set at -54.2 VDC.
2. **Output Power and Current:** 2000 W (41.7 A) @ 200 VAC to 250 VAC input and -48 VDC output.
3. **Output Characteristics:** Refer to Figure 1.1 for a graph of output voltage vs. output current.

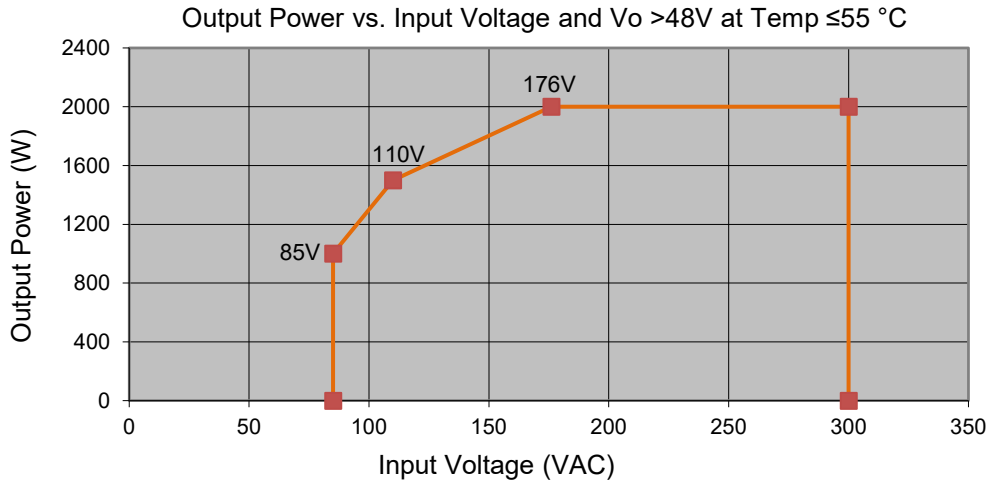
Figure 1.1 Output Voltage vs. Output Current



4. **Power Derating Based on Input Voltage:** The rectifier power varies with changes in input voltage. It uses an advanced power limitation method. The lower input threshold is 85 VAC. The rectifier can provide its maximum rated power (2000 W) as long as the input voltage is within the range of 176 VAC to 300 VAC. Below 176 VAC, and down to 85 VAC, the rectifier will continue to operate normally but will be in a power derating mode. The power output will derate linearly between 176 VAC to 110 VAC and then again linearly between 110 VAC to 85 VAC.

The relationship between the output power and input voltage is illustrated in Figure 1.2.

**Figure 1.2 Power Derating Based on Input Voltage**



At input voltage of 85 VAC with output >48 VDC, maximum output power is 1000 W.

At input voltage of 110 VAC with output >48 VDC, maximum output power is 1500 W.

At input voltage of 176 VAC with output >48 VDC, maximum output power is 2000 W.



**NOTE!** *For 120 VAC Operation:* Rectifier software version V1.00.16 and earlier will generate an Observational Alarm (OA) and the yellow LED will illuminate if 120 VAC nominal input voltage is utilized. This is an "AC-A Volt Low" alarm and is further explained in Table 8.1 on page 94. If the situation outlined above exists, this alarm should be ignored. For software versions V1.10.03 and later, an "AC voltage" setting is available. Selection options are 120V or 230V. Selecting 120V eliminates the above-mentioned alarm when operated at 120VAC input.

5. **Power Derating Based on Temperature:** The rectifier delivers full power when operating at an ambient temperature of +55 °C (+131 °F) or below. The rectifier continuously monitors the ambient temperature surrounding the power conversion circuit. If this temperature for any reason (such as a high ambient temperature) increases above approximately +55 °C (+131 °F), the rectifier will not shut down. Rather, the rectifier limits its maximum output power to maintain the temperature limit of the rectifier. Operation between +55 °C (+131 °F) and +75 °C (+167 °F) will result in output power being decreased. Full power capability is restored when the temperature decreases to below approximately +55 °C (+131 °F). Refer to Figure 1.3 to view the relationship between the output power and the ambient temperature.



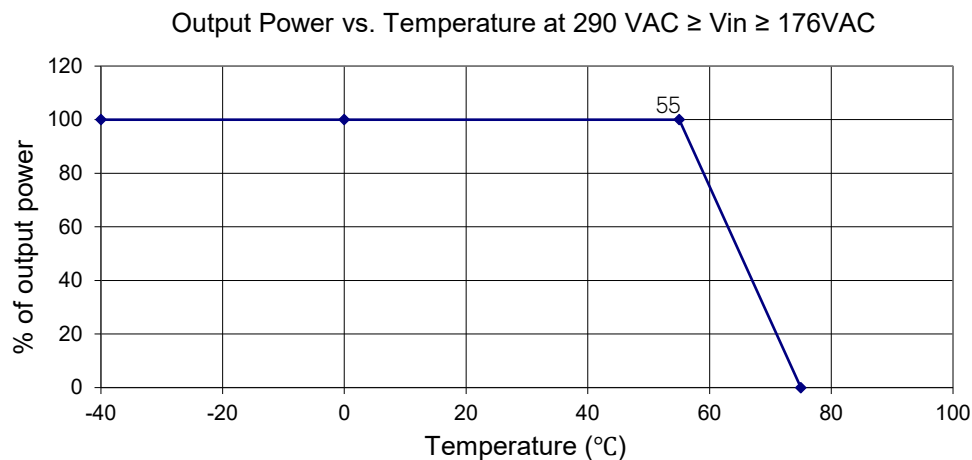
**WARNING!** The module is rated for continuous operation at full output power up to +55 °C (+131 °F). Operation between +55 °C (+131 °F) and +75 °C (+167 °F) will result in output power decrease. Operation above +75 °C (+167 °F) is considered abnormal and should be used on a temporary<sup>1</sup> basis only.

- <sup>1</sup> **Temporary Operation at Abnormal Temperature:** Temporary operation is defined as a period of not more than eight consecutive hours per day, and a total of not more than 15 days in a year, at a temperature above +75 °C (+167 °F). (This refers to a total of 120 hours in any given year, but no more than 15 occurrences in that one-year period.)

Other power rating values are as follows (refer to Figure 1.3):

- At an ambient temperature of +55 °C (+131 °F), the power delivered by the rectifier is 2000 W.
- At an ambient temperature between +55 °C (+131 °F) and +75 °C (+167 °F), the power is linear derated.
- At an ambient temperature of +75 °C (+167 °F), the power delivered by the rectifier is 0 W.

**Figure 1.3 Power Derating Based on Temperature**



6. **Regulation:**
- Static:** Steady state regulation is  $\pm 0.6\%$  as controlled within the rectifier for any and all combinations of load from 5% to 100% load, input voltage, and input frequency at a constant ambient temperature.
  - Dynamic:** Response time  $\leq 200$  microseconds and overshoot  $\leq 5\%$  for load changes at 50% - 25% - 50% and 50% - 75% - 50% at rated output current.

For any step load change within the range of 10% to 90% of full load within 50 microseconds, per Telcordia GR-947-CORE, the maximum voltage transient will not exceed 5% of the initial steady state voltage within  $50 \pm 10$  microseconds. Recovery to within 1% of the initial steady state voltage does not exceed 1 millisecond.

7. Filtering:

- a) Voice Band Noise: Peak-peak voltage is  $\leq 200$  mV at 0 MHz to 20 MHz and normal output voltage.
- b) Wide Band Noise: Wideband noise voltage is  $\leq 50$  mV at 3.4 kHz to 150 kHz and  $\leq 20$  mV at 0.15 MHz to 30 MHz.

**1.5.2 AC Input Ratings**

1. Voltage: Nominal 100 VAC to 250 VAC, 50 Hz / 60 Hz, with an operating range of 85 VAC to 300 VAC. The rated input voltage is 220 VAC. Acceptable input frequency range is 45 Hz to 65 Hz.

Permitted Variation: 85 VAC to 300 VAC.

2. Harmonic Content (THD): Meets EN61000-3-2.  $\leq 5\%$  from 50% to 100% of rated output current at 220 VAC to 240 VAC.
3. Inrush Current: Peak does not exceed 1.5 times of the peak value of the maximum steady-state input current at full load.
4. Typical Input Data: 50 Hz input.
  - a) Refer to Table 1.6.
  - b) Maximum Input Current: Refer to Table 1.7.
  - c) Efficiency Curve: Refer to Figure 1.4.
5. Typical Input Data: 60 Hz input.
  - a) Refer to Table 1.8.
  - b) Maximum Input Current: Refer to Table 1.9.
  - c) Efficiency Curve: Refer to Figure 1.5.

**Table 1.6 Typical Input Data with 50 Hz Input**

Nominal Input Voltage	Percent of Full Load	Input Current (Amperes)	Input VA	Input Watts	Power Factor	Efficiency %	Heat Dissipation BTU/Hr
120	0	0.387	46.65	16.93			57.765
	25	4.233	507.03	504.05	0.994	93.60	110.108
	50	8.364	999.04	996.08	0.997	94.99	170.283
	75	12.647	1505.74	1501.70	0.997	94.71	271.073
	100	--	--	--	--	--	--
220	0	0.622	137.00	17.33	0.231	--	59.130
	25	2.319	510.03	500.44	0.981	94.39	95.742
	50	4.509	991.15	984.13	0.993	96.18	128.121
	75	6.740	1480.05	1474.08	0.996	96.47	177.674
	100	9.793	2147.70	2143.99	0.998	96.10	285.552
240	0	0.673	16.16	17.14	0.106	--	58.482
	25	2.146	515.05	500.64	0.972	94.23	98.527
	50	4.143	993.62	983.46	0.990	96.27	125.191
	75	6.184	1481.90	1473.96	0.995	96.55	173.689
	100	8.971	2147.12	2141.83	0.998	96.23	275.432



**NOTE!** At 100% of full load with output at 54.2V as measured at the output terminals.



Table 1.7 Maximum Input Current with 50 Hz Input

Nominal Input Voltage	Input Voltage	Input Current (Amperes)
100 VAC to 250 VAC	176 VAC	12



**NOTE!** At 100% of full load with output at 54.2V as measured at the output terminals.

Table 1.8 Typical Input Data with 60 Hz Input

Nominal Input Voltage	Percent of Full Load	Input Current (Amperes)	Input VA	Input Watts	Power Factor	Efficiency %	Heat Dissipation BTU/Hr
120	0	0.448	53.80	16.90	0.314	--	--
	25	4.234	507.12	503.98	0.994	93.54	111.048
	50	8.365	999.10	996.14	0.997	94.99	170.446
	75	12.644	1505.31	1501.07	0.997	94.74	269.287
	100	--	--	--	--	--	--
220	0	0.757	166.83	29.66	0.170	--	101.207
	25	2.338	514.04	500.56	0.973	94.41	95.474
	50	4.519	993.32	984.16	0.991	96.19	128.056
	75	6.748	1481.92	1474.51	0.995	96.46	178.062
	100	9.806	2150.63	2146.230	0.998	96.17	280.356
240	0	0.804	193.16	17.36	0.089	--	59.232
	25	2.171	521.01	500.32	0.960	94.28	97.719
	50	4.157	996.94	983.31	0.986	96.26	125.566
	75	6.194	1484.25	1473.47	0.993	96.53	174.424
	100	8.980	2148.920	2142.43	0.997	96.27	272.512



**NOTE!** At 100% of full load with output at 54.2V as measured at the output terminals.

Table 1.9 Maximum Input Current with 60 Hz Input

Nominal Input Voltage	Input Voltage	Input Current (Amperes)
100 VAC to 250 VAC	176 VAC	12



**NOTE!** At 100% of full load with output at 54.2V as measured at the output terminals.

Figure 1.4 Efficiency Curve (@ 220 VAC, 50 Hz)

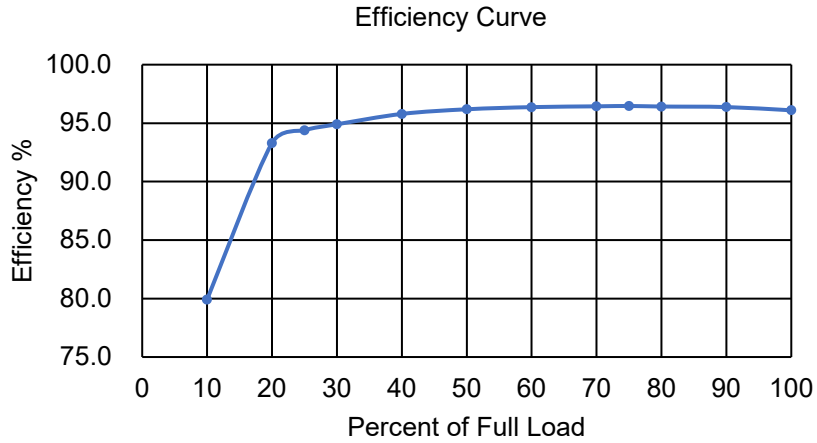
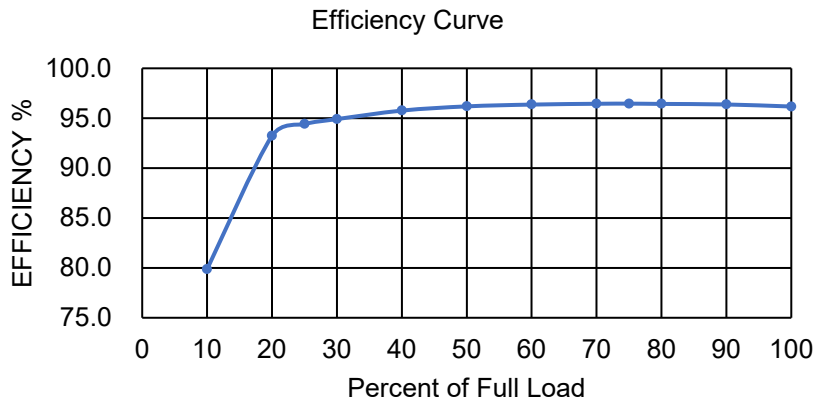


Figure 1.5 Efficiency Curve (@ 220 VAC, 60 Hz)



### 1.5.3 Environmental Ratings (Rectifier Only)

1. Operating Ambient Temperature Range:
  - a) Without Solar Load: -40 °C (-40 °F) to +55 °C (+131 °F) with full power performance.
  - b) With Solar Load: -40 °C (-40 °F) to +49 °C (+120 °F) with full power performance (GR-487 compliant).
  - c) +55 °C (+131 °F) to +75 °C (+167 °F) with derating output.
  - d) Output Regulation Temperature Coefficient: ±0.02% per degrees Celsius.
2. Storage Ambient Temperature Range: -25 °C (-13 °F) to +55 °C (+131 °F).
3. Relative Humidity: This rectifier is capable of operating in an ambient relative humidity range of 0% to 100%.
4. Altitude: 3000 m (9842 feet). Derating operating ambient temperature range by 3 °C per 300 m above 3000 m.

5. Surge Protection: EN61000-4-5 up to level 4, Telcordia GR-1089-Core issue 7:2017, IEEE C62.41-1999, B3.

AC Power Terminals:

Test Level		Source Impedance	Performance Criteria
Line to Line	Line to Ground		
± 4 kV	± 4 kV	2 ohms	B
NA	± 6 kV	12 ohms	B

AC Power Port, Diff Mode and Common Mode (2 ohms impedance):

Minimum Peak Voltage (volts)	Voltage Maximum Rise/Minimum Decay Time (μs)	Minimum Peak Current per Conductor (amperes)	Current Maximum Rise/Minimum Decay Time (μs)	Repetitions, each Polarity
± 6000	12/50	3000	8/20	5

Criteria:

The EUT (Equipment Under Test) shall not be damaged and shall continue to operate properly after the application of the first-level surge.

The rectifier will be designed to fulfill ANSI IEEE, C62.41-1999, B3.

The test wave is 12/50us and 8/20us mixed 6kV/3kA.

DC Power Terminals:

Test Level		Source Impedance	Performance Criteria
Line to Line	Line to Ground		
± 500 V	± 500 V	2 ohms	B
± 800 V	± 800 V	2 ohms	B

The test method is described in EN 61000-4-5. In this test the DC-cables shall be 5 m long.

DC Power Port, Common Mode (12 ohms impedance):

Minimum Peak Voltage (volts)	Voltage Maximum Rise/Minimum Decay Time (μs)	Minimum Peak Current per Conductor (amperes)	Current Maximum Rise/Minimum Decay Time (μs)	Repetitions, each Polarity
± 1000	12/50	\	8/20	5

The EUT (Equipment Under Test) shall not be damaged and shall continue to operate properly after the application of the first-level surge.

Requirements on RS485, CAN-bus Signals Are:

Minimum Peak Voltage (volts)	Voltage Maximum Rise/Minimum Decay Time (μs)	Minimum Peak Current per Conductor (amperes)	Current Maximum Rise/Minimum Decay Time (μs)	Repetitions, each Polarity
± 1000 (lines to ground)	10/700	\	5/320	5

Requirements on CAN-bus signals are 1kV diff. /2kV com. criteria B with 42ohms source impedance.

According Telcordia GR-1089-CORE issue 7:2017:

Requirements on CAN-bus signals are:

Surge	Minimum Peak Voltage (volts)	Minimum Peak Current per Conductor (amperes)	Maximum Rise/ Minimum Decay Time for Voltage and Current (us)	Repetitions, each Polarity	Performance criterion
1	800	100	2/10***	5	B
2	1500	100	2/10***	5	B

6. Single Rectifier Audible Noise: At 25 °C  $\leq 42$  dB(A). Measurement made at 0.6 m distance in front of rectifier and at the center of the rectifier.
7. Overvoltage Category (per IEC/UL62368-1): III
8. Power Distribution System: TN/TT/IT
9. EMI/RFI Suppression:
  - a) The rectifier conforms to the requirements of FCC rules Part 15, Class B for radiated and input conducted emissions limits.
  - b) The rectifier conforms to the requirements of European Norm, EN55022, Class B for radiated and input conducted emissions limits.
10. Pollution Degree: Degree 3, as per UL/ IEC/EN62368-1.

### 1.5.4 Compliance Information (Rectifier Only)

1. EMC: ETSI EN 300 386, FCC CFR 47 Part 15 Class B, Telcordia GR-1089-CORE issue 7:2017.
2. EMI Load Range: 10% to 100%.
3. Safety: IEC62368-1, UL62368-1.
4. Compliant to EN 61000-6-2, Radiated Immunity of 10V/meter, Criteria A.
5. Designed to meet all applicable sections of NEC 2020 (NFPA 70) code as installed.
6. 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.
7. 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.

## 1.5.5 Standard Features

1. Type of Power Conversion Circuit: High efficiency and high switching frequency.
2. Input Protection:
  - a) Input Over/Under Voltage Protection: The rectifier will shut down at low or high voltage input; based on the following voltage levels:
 

Low Voltage Disable Point: 80 VAC,  $\pm 5$  V; hysteresis is at least 15 VAC for restart.

High Voltage Disable Point: 305 VAC,  $\pm 5$  V; hysteresis is at least 10 VAC for restart.
3. Output Protection:
  - a) Overload / Reverse Current: The rectifier has three (3) fuses in the negative output DC bus and one (1) in the battery input. These fuses are customer replaceable.
  - b) Output Current Limiting: The rectifier has a current limit function. The current limit point is factory set at 41.7 A. The current limit accuracy is  $\pm 1.5$  A when the output voltage is in the range of 42 VDC to 58 VDC.
  - c) Advanced Current Limit Function: The rectifier has an enhanced non settable current limit function. When a short circuit occurs at the rectifier output terminals, the rectifier will limit the current to 34.5 A. This function effectively protects the rectifier and the equipment connected to the rectifier. When the short circuit is cleared, the rectifier will automatically restore back to normal operation.
  - d) High Voltage Shutdown:
    - Fixed Control: If rectifier output voltage exceeds 59.5 VDC, the rectifier shuts down.
 

The rectifier then restarts and a HVSD restart timer starts (factory set at 5 minutes). If output voltage again exceeds the high voltage shutdown value before the HVSD restart timer expires, the rectifier shuts down and locks out. Manual restart is then required (by turning power to the rectifier off, waiting 30 seconds or more, then turning power to the rectifier on). If the rectifier does not experience a high voltage condition before the HVSD restart timer expires, the restart circuit is reset.
4. Over-Temperature Protection: The rectifier provides over temperature protection by derating output power and recovers automatically.
5. Monitoring Function: The rectifier has a built-in advanced DSP that monitors and controls the operation of the rectifier.
6. Controller: A controller is built into the rectifier and contains two (2) possible modes of smart external communication. One smart mode is Ethernet HTTP/IP protocol with webpages viewing. This signal is wired out of the DB-15 connector in the bottom of the rectifier. The second is Bluetooth Low Energy ("BLE"). Bluetooth is default DISABLED and must be turned on via an internal jumper located under the customer access front panel. If the jumper is turned from OFF to ON, then Bluetooth can be accessed via a Vertiv™ NetSure™ app download (iOS and Android smartphones supported). The controller has a left-hand side mounted BT antenna internal to the rectifier shell that broadcasts through a plastic window. The Bluetooth allows ADMIN rights for setting changes. The Ethernet pair only allows VIEW ONLY user rights. The controller also controls the three LED lights on the left-hand side of the unit.

## 1.5.6 Mechanical Specifications

### Dimensions, Weight, Color

See Figure 1.6.

### Indicators

The following indicators are located behind a clear plastic window on the left-hand side of the rectifier.

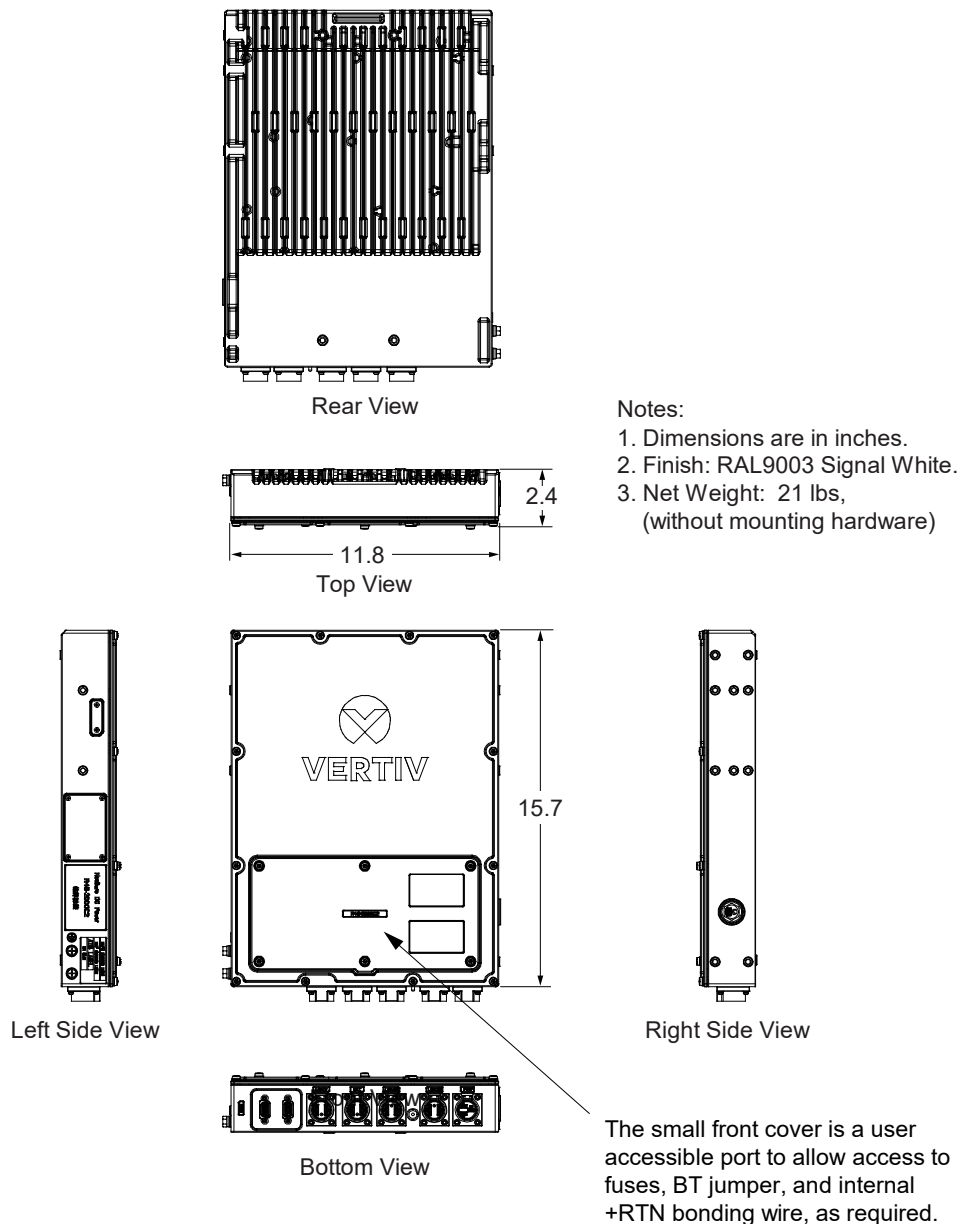
- Status (Green LED)
- Observation Alarm (Yellow LED)
- Critical or Major Alarm (Red LED)

### Bluetooth Low Energy (BLE) Signal Window

The Bluetooth Low Energy (BLE) signal window is located on left-hand side of rectifier.

**NOTE!** Do not block during installation. The BLE (if enabled) has limited broadcast range of approximately 10 meters (32.8 feet), maximum. Positioning the smartphone with line of sight to the BLE signal window is recommended, if possible.

Figure 1.6 Rectifier Overall Dimensions and Weight



## 1.6 Battery



**NOTE!** Refer to the battery manufacturer documentation (installation and operation manual) for specific battery instructions and latest battery information.

### 1.6.1 Narada FEN4850 (50 Ah) Battery



**NOTE!** There are four (4) DC power ports and two (2) communications RS-485 ports. Only first port of each type is used for connecting to Vertiv™ rectifier.



**ALERT!** Follow manufacturer's required float voltage setting as found in the battery manufacturer manual. Rectifier default is set to 54.2 VDC. For Narada FEN4850 battery, 54.2 VDC is the recommended setting.

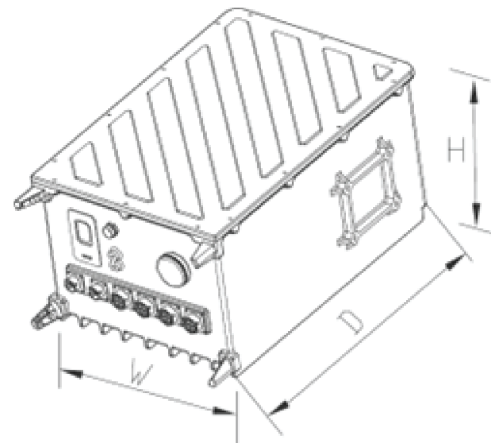
#### General

- Battery is equipped with a carrying handle. Handle shall not be used for hoisting, but only for hand carrying purposes.
- Battery is equipped with an on/off switch. Leave battery switch in default "OFF" position until mounting and cabling is complete. Only energize battery (turn switch to "ON") when performing commissioning of battery with rectifier. A key is supplied with the battery to operate the switch. Customer to secure key after installation per locally accepted practices. The AHJ may require emergency access to this key for shutdown purposes, so it should be readily accessible.
- Battery must be stored only on back side so that top cover points "UP".
- Battery cannot be installed UPSIDE down - cables must point downwards.

#### Narada FEN4850 Battery Appearance

See Figure 1.7.

Figure 1.7 Narada FEN4850 (50 Ah) Battery



Battery equipped with RED and GREEN LED's.  
 Battery equipped with ON/OFF switch with key.  
 Battery equipped with a 2-hole ground stud.

Battery Model	Typical Weight (kg)	Dimensions(mm)		
		Width (No ear)	Height	Depth
FEN4850	33	310	222	448

#### Narada FEN4850 Battery Specifications

Refer to Table 1.10 and Table 1.11.



**NOTE!** Batteries are not intended to be paralleled. Only one battery is designed to be connected to a rectifier.

**Table 1.10 Narada FEN4850 (50 Ah) Battery**

Specification	Narada FEN4850 (50Ah) Battery
Material Type	Lithium Iron Phosphate (LFP)
Open Cell Nominal Voltage	32V x 15 = 48.0V
Rated Capacity	50 Ah
Cell Combination	15S 1P
Max. Discharge Current	1900W / 42V = 45 amps
B LVD	42V nominal
Recommended Charge Current	0.1C (5 amps)
Float Charge Voltage	54.2V
Size	310 x 448 x 222 mm 12.2 x 17.6 x 8.7 inches (W x H x D)
Weight	33kg (73 lbs)
Temperature Rating Operational	-40°C to +55°C
Temperature Range Storage	+15°C to +35°C
Protection Level	IP65 Outdoor Rated
Work Humidity	100% Relative Humidity Maximum
BMS Protection Function	Integrated, with all safety functions and cell balancing.
Application	Outdoor
Communication	RS-485 Modbus (integrated to rectifier)
Compliance	See Battery Datasheet

**Table 1.11 Recommended Charging and Maximum Load Power (1 Rectifier + 1 Battery System) (Narada FEN4850 Battery)**

Battery Capacity	Maximum Battery Charge Current	Recommended Power for Customer Equipment
50 Ah	0.1C (= 5 amps)	1750 W Nominal Load 1900 W Maximum Load (*BCL dependent)

\* Vertiv default value is based upon setting BCL to 0.1C or 5 amps. This yields a customer load remaining of 1750 W. If customer changes BCL to a minimum value of 0.04C or 2 amps, the customer may harvest 1900 W of customer load capacity. The customer equipment power therefore is based upon the BCL value in Settings that reserves power for battery charging, and the remainder will be available for customer equipment.

Customer cannot go higher than 0.1C but may choose to go lower to increase power to equipment, lowering recharge current, but also lengthening recharge time. For example, at 2 amps, the expected recharge time will be  $50/2 = 25$  hours to full charge. At 5 amps, the battery will recharge in  $50/5 = 10$  hours, approximately.

Vertiv has validation data, and battery run time data up to 1900 W of customer load.



## 1.6.2 Battery Storage Environment

Refer to the battery manufacturer battery manual for storage requirements.

When the battery pack needs to be stored for a long time, please charge the battery pack to 50% to 80% state. Recharge the battery as required to maintain this level of charge. Please see battery operations manual for more detailed information and requirements.



**ALERT!** Due to Li-ion battery shipping regulations, battery will be typically only charged to <30% SOC. If battery is going to be stored prior to installation, a refreshing charge should be applied in a timely manner to avoid damage to the battery. Please see battery operations manual for additional information.

Operator may also want to consider fully charging battery prior to installation to limit recharge time when initially installed and connected to rectifier. Please refer to your company's practices and local regulations as it relates to transporting Li-ion batteries fully charged from warehouse to site.

Li-ion batteries are considered Hazardous Materials, and extra care may be required for storage, as required by local building codes (Haz Mat Category 9).

## 1.6.3 Battery Maintenance

After the battery pack is discharged, the battery must be charged within 48 hours. Otherwise, battery life will be affected. The battery pack may be damaged if it is not charged within this time period. If the battery is not used for a long time, remove the battery and place in a cool, dry environment. Otherwise, the battery may deteriorate.

When not in use, it is recommended to keep the caps on the battery connectors. Place the Narada FEN4850 battery ON/OFF switch to the OFF position (key required).

## 1.6.4 Precautions for Battery Use

Refer to the battery manufacturer documentation for specific battery safety instructions.



**DANGER!** Adhere also to the “Important Safety Instructions” starting on page vii.

## 2 Bluetooth Jumper Setup

### 2.1 Setting Bluetooth Jumper Position (if required)



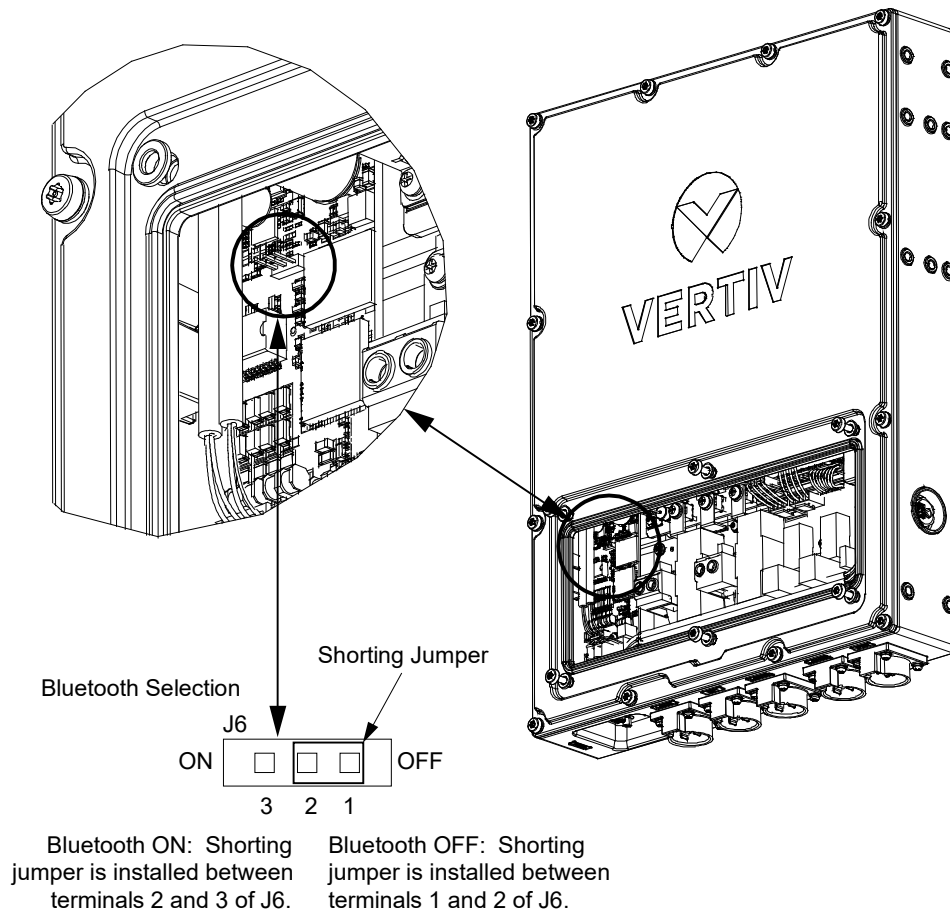
**DANGER!** Hazardous voltages are exposed when the cover is opened, and power is applied to the unit.

The rectifier can be connected to remotely via an App. This connection is done through a Bluetooth Low Energy (BLE) signal. Bluetooth in the rectifier is turned ON or OFF via a jumper selection inside the rectifier enclosure. Refer to the following procedure to turn Bluetooth in the rectifier ON or OFF.

#### Procedure

1. Refer to “Opening / Closing the Front Access Panel” on page 64, and open the rectifier enclosure front access panel.
2. Refer to Figure 2.1 and set the Bluetooth ON or OFF, as desired. **Bluetooth is OFF by default.**
  - Bluetooth ON: Jumper is placed between terminals 2 and 3 of J6.
  - Bluetooth OFF: Jumper is placed between terminals 1 and 2 of J6.
3. Refer to “Opening / Closing the Front Access Panel” on page 64, and close the rectifier enclosure front access panel.

Figure 2.1 Controller Bluetooth Jumper Setting



## 3 Installation

### 3.1 General



**WARNING!** Rectifier warranty will be VOID if any perimeter screw is tampered with. DO NOT loosen or remove any perimeter screw. Removal of outer perimeter screws is a safety hazard.



**CAUTION!** The rectifier must be installed to provide a separation distance of at least 8-inches from all persons.



**SAFETY!** Follow all safety rules as they pertain to applicable OSHA (CCOHS in Canada), state, local, customer, and installation company safety practices.



**NOTE!** If the rectifier's front access panel is opened during installation, ensure the access panel is securely closed and the screws are torqued to 22 in-lbs.

The rectifier can be pole mounted or secured to a suitable wall.

### 3.2 Tools, Test Equipment, and Materials Recommended for Installation

Refer to Table 3.1 for a list of tools, test equipment, and materials recommended for the installation of the system.

**Table 3.1 Tools, Test Equipment, and Materials Recommended for Installation**

Tool	Specification
Combination Wrench	Wrench Set (10#, 13#, 16#, 18#, 21#)
Hex Wrenches	7/16" and 3/8"
Hex Allen Key Wrench	M6 (for M8 screw head)
Metric Wrenches	10 mm and 13 mm
Electrician Diagonal Pliers	6-Inch
Electrician Sharp Nose Pliers	6-Inch
Tape Measure	16-Feet
Level	Normal Type
Ladder	As Required
Lifting Equipment	As Required
Lifting Sling	As Required
Torque Wrench	As Required
Insulated Screwdriver Set	#1, #2 Cross Blade Screwdriver, Small and Medium Slotted Blade Screwdriver
Non-Contact Voltage Tester	--
Wire Stripper	Maximum 6 AWG
Crimping Tools	Maximum 6 AWG
Digital Multimeter	Three-and-a-Half-Bit Digital Display
Impact Electric Drill	As Required
ESD Wrist Strap	--
Optional Bluetooth (if activated/required)	Requires Smartphone (iPhone or Android) and download of Vertiv™ NetSure™ app for communication.
Ground Lugs (6 AWG recommended)	2-Hole Ground Lug, Rectifier (5/16" clearance holes on 1" centers.) 2-Hole Ground Lug, Battery (1/4" clearance holes on 5/8" centers.)

## 3.3 Mounting Kits

### 3.3.1 Kit Requirements per Application

See Table 3.2.

**Table 3.2 Kit Requirements per Application**

Application	Pole or Wall Mount Flat	Pole or Wall Mount Flag
Rectifier Only	P/N 10024600	P/N 10024600
Narada Battery Only	P/N 10025107	--
Narada Battery and Rectifier	--	P/N 10024600 P/N 10025107 P/N 10025108

### 3.3.2 Rectifier Only Mounting Kit P/N 10024600

#### **General**

A rectifier only mounting kit P/N 10024600 is furnished with each rectifier. This kit allows the rectifier to be mounted to a pole or wall in either a “flag” or “flat” orientation.



**NOTE!** P/N 10024600 is provided with each rectifier. Use part number 10025106 if a spare or replacement rectifier bracket is needed.

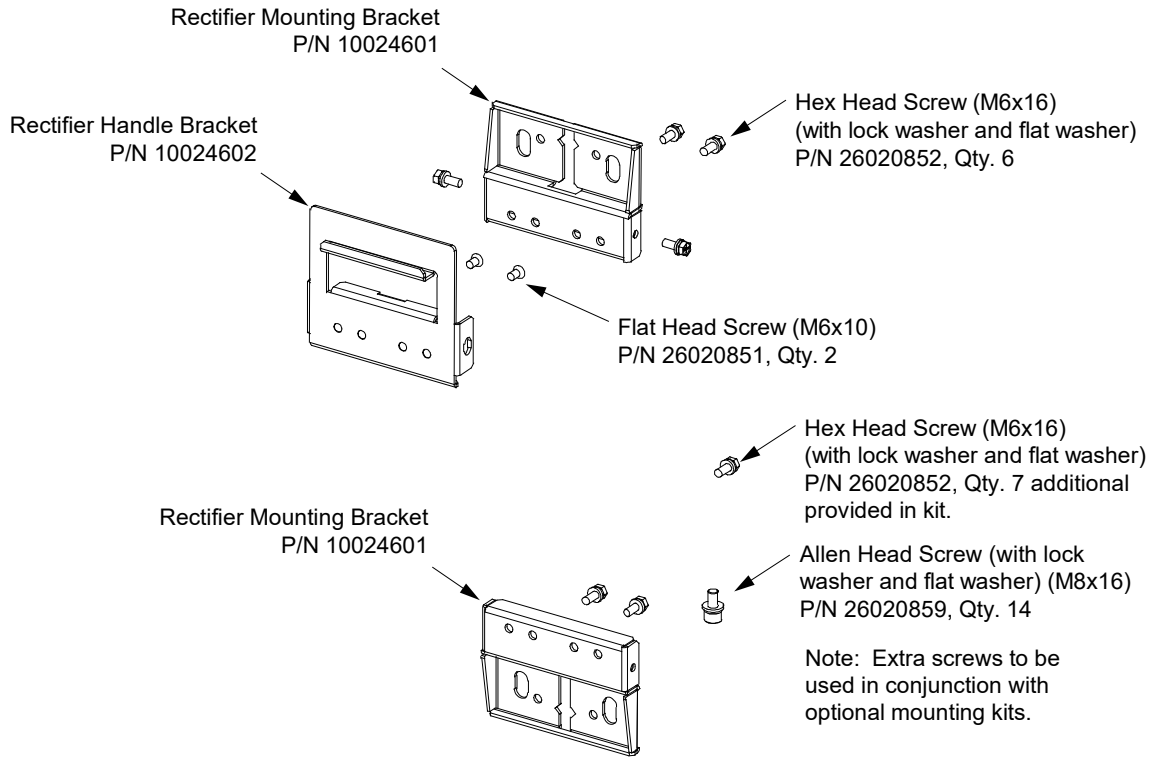
#### **Kit Contents**

Table 3.3 lists the items furnished as a part of this kit. See also Figure 3.1.

**Table 3.3 Rectifier Only Mounting Kit P/N 10024600 Contents**

P/N	Description	Qty.
10024601	Rectifier Mounting Bracket	2
10024602	Rectifier Handle Bracket	1
26020851	Flat Head Screw (M6x10)	2
26020852	Hex Head Screw (with lock washer and flat washer) (M6x16)	13
26020859	Allen Head Screw (with lock washer and flat washer) (M8x16)	14

Figure 3.1 Rectifier Only Mounting Kit P/N 10024600



### 3.3.3 Companion Lithium-Ion Battery Only Mounting Kit P/N 10025107

#### General

This kit allows a lithium-ion battery to be mounted to a pole or wall in a "flag" or "flat" orientation.

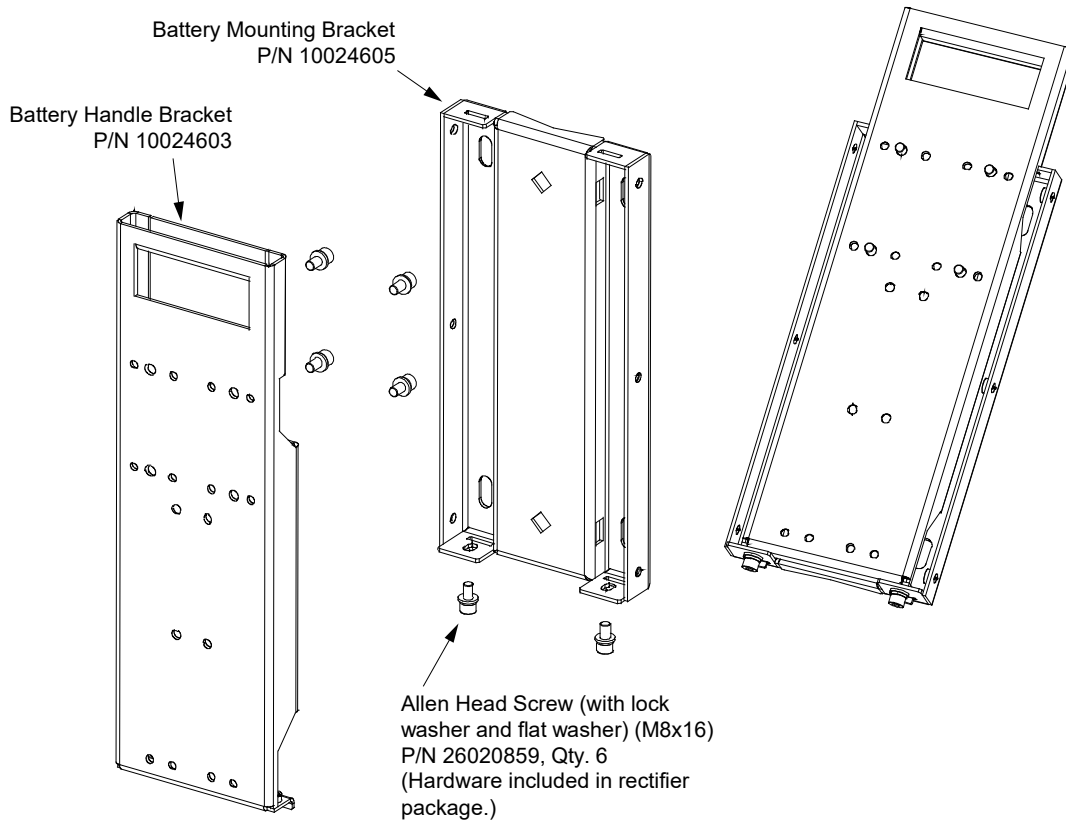
#### Kit Contents

Table 3.4 lists the items furnished as a part of this kit. See also Figure 3.2.

**Table 3.4 Companion Lithium-Ion Battery Only Mounting Kit P/N 10025107 Contents**

P/N	Description	Qty.
10024603	Battery Handle Bracket	1
10024605	Battery Mounting Bracket	1

**Figure 3.2 Companion Lithium-Ion Battery Only Mounting Kit P/N 10025107**



#### Acceptable Batteries

The following batteries are approved for use with this mounting kit.

- Narada FEN4850 (50 Ah), P/N 48-BKB01030050-2UA

### 3.3.4 Rectifier Add-On Kit P/N 10025108 (for Narada Battery)

#### General

This kit allows a rectifier and Narada lithium-ion battery to be mounted to a pole or wall in a “side-by-side flag” orientation. Requires both the rectifier only mounting kit P/N 10024600 furnished with each rectifier and the battery only mounting kit P/N 10025107.

#### Kit Contents

Table 3.5 lists the items furnished as a part of this kit. See also Figure 3.3.

Table 3.5 Rectifier Add-On Kit P/N 10025108 Contents (for Narada Battery)

P/N	Description	Qty.
10024608	Rectifier Add-On Mounting Panel	1
60033216	Narada Battery Link Plate	1

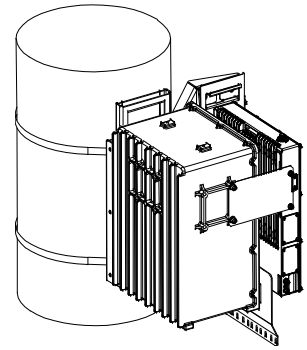
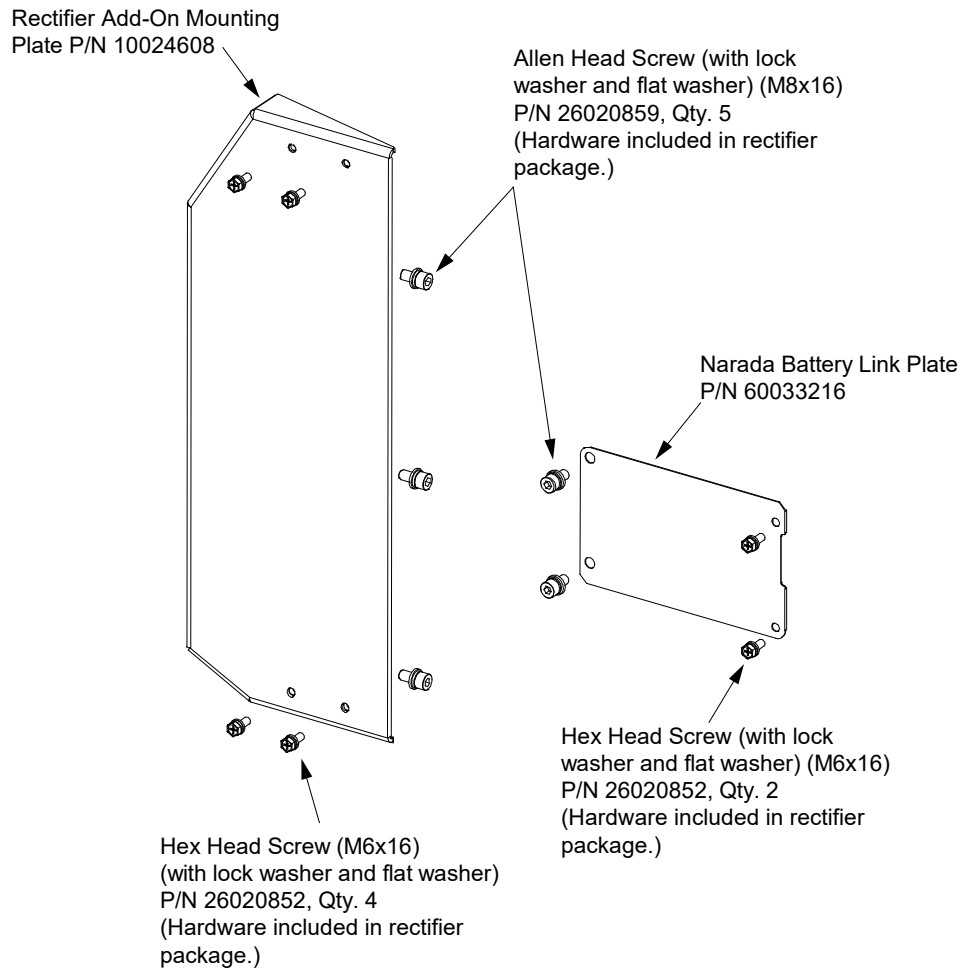


Figure 3.3 Rectifier Add-On Kit P/N 10025108 (for Narada Battery)



Note: Requires both the Rectifier Only Mounting Kit P/N 10024600 furnished with each rectifier and the Battery Only Mounting Kit P/N 10025107.

## 3.4 Mounting the Rectifier to a Pole or Wall Using Rectifier Only Mounting Kit P/N 10024600

### 3.4.1 General

A rectifier only mounting kit P/N 10024600 is furnished with each rectifier. This kit allows the rectifier to be mounted to a pole or wall in either a “flag” or “flat” orientation. See “Rectifier Only Mounting Kit P/N 10024600” on page 18.

- For pole mounting, the customer needs to supply either...
  - two (2) 1/2” diameter carriage bolts or threaded rods or,
  - two (2) pole mounting bands (3/4-inch wide, stainless steel, suitable for greater than 100 lbs of support, 0.030-inch thick).
- For wall mounting, the customer needs to supply four (4) 3/8” wall anchors capable of supporting the weight of the rectifier.



**NOTE!** If the rectifier's front access panel is opened during installation, ensure the access panel is securely closed and the screws are torqued to 22 in-lbs.

### 3.4.2 Pole / Wall Mounting Procedure



**NOTE!** Torque all hardware to the values shown in the illustrations.

1. Unpack the rectifier and mounting accessories.
2. Wall Mount: Drill appropriately sized holes into the wall for installation of customer provided 3/8” wall anchors. See Figure 3.4 for dimensions. Install the customer provided 3/8” wall anchors into the holes previously drilled.
3. Wall Mount: Install the top rectifier mounting bracket to the wall using the previously installed wall anchors. Refer to Figure 3.4. Torque per anchor manufacturer specifications.

Pole Mount: Install the top rectifier mounting bracket to the pole in the desired location. Install with either a customer supplied 1/2” carriage bolt or threaded rod, or a pole mount band (see “3.4.1 General” on page 22). Refer to Figure 3.5. If using a 1/2” carriage bolt or threaded rod, refer to Figure 3.5 and drill the two (2) appropriate holes in the pole.

4. Install the rectifier handle bracket and rectifier mounting bracket to the rear or side panel of the rectifier using supplied hardware as shown in Figure 3.6. Install the strain relief plate to the rectifier using supplied hardware as shown in Figure 3.6. Note that the rectifier can be mounted “flag” or “flat” on a pole or wall.
5. Lift the rectifier up using the rectifier handle bracket (previously installed on the rectifier) and slide the rectifier handle bracket down into the rectifier mounting bracket (previously installed on the pole or wall). Note that there are tabs on the rectifier handle bracket that slide down into slots on the rectifier mounting bracket. Secure the rectifier handle bracket to the rectifier mounting bracket with the supplied hardware as shown in Figure 3.7.
6. Wall Mount: Secure the bottom of the rectifier to the wall using the previously installed wall anchors. Refer to Figure 3.8. Torque per anchor manufacturer specifications.

Pole Mount: Secure the bottom of the rectifier to the pole with either a customer supplied 1/2” carriage bolt or threaded rod, or a pole mount band (see “3.4.1 General” on page 22) as shown in Figure 3.8.



Figure 3.4 Installing the Top Mounting Bracket to a Wall

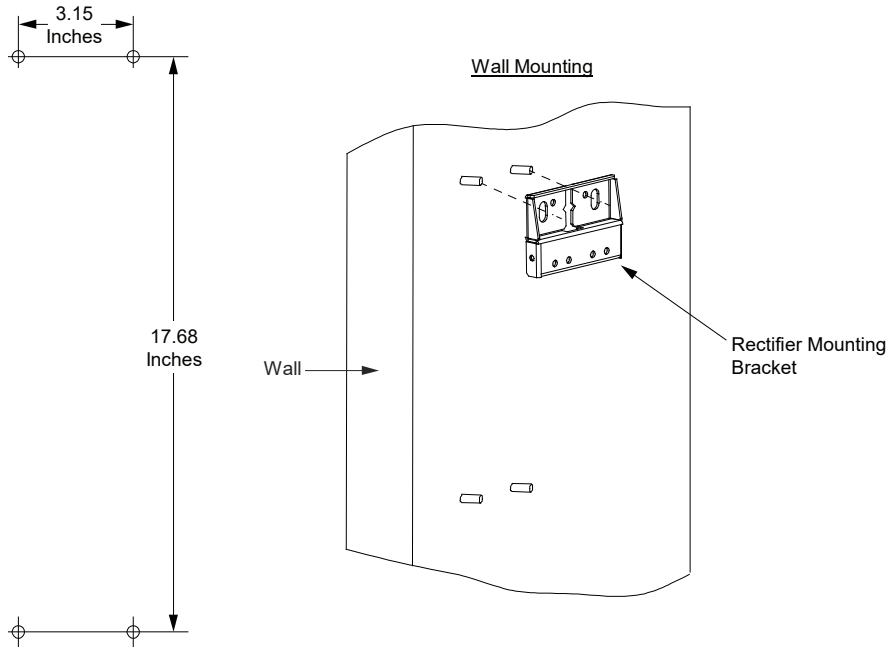


Figure 3.5 Installing the Top Mount Bracket to a Pole

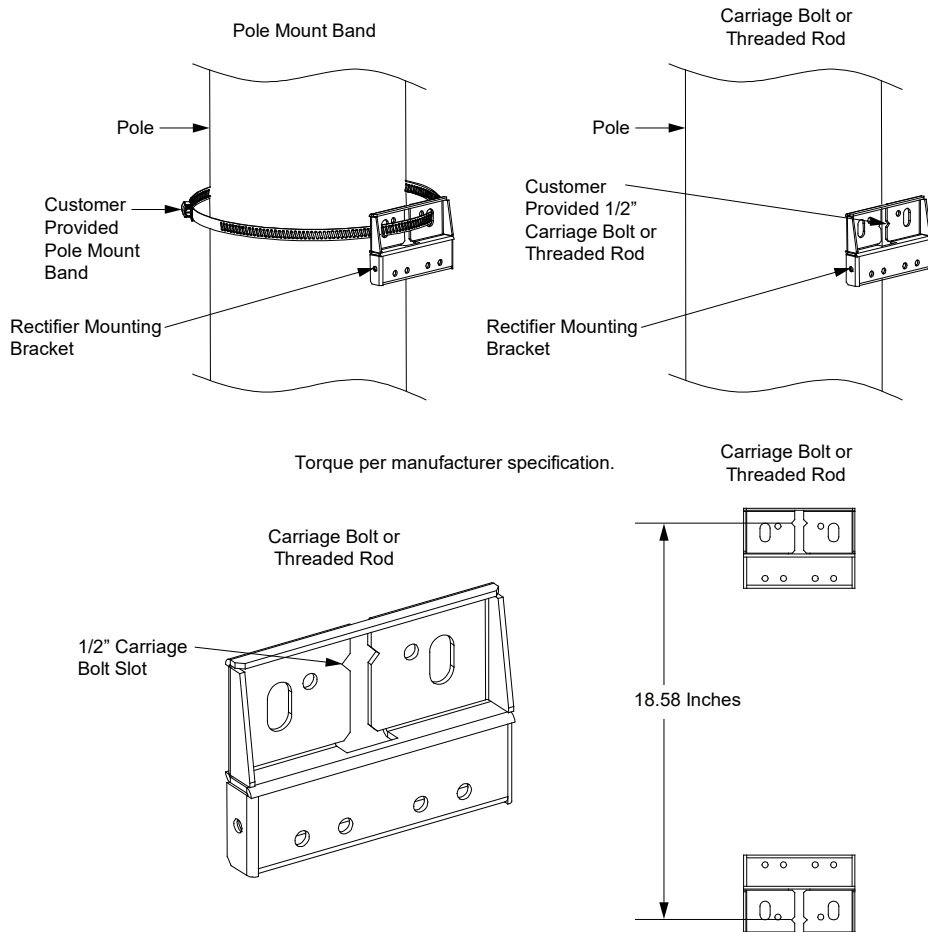


Figure 3.6 Installing the Top and Bottom Mounting Brackets and Strain Relief Plate to the Rectifier (cont'd on next page)

Flag Mounting

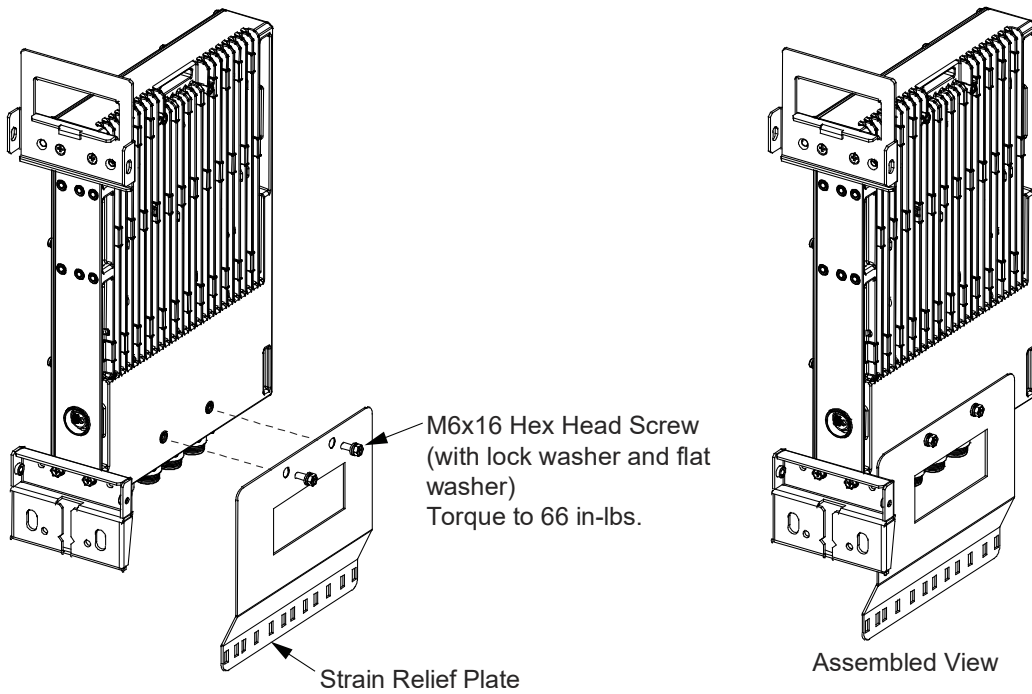
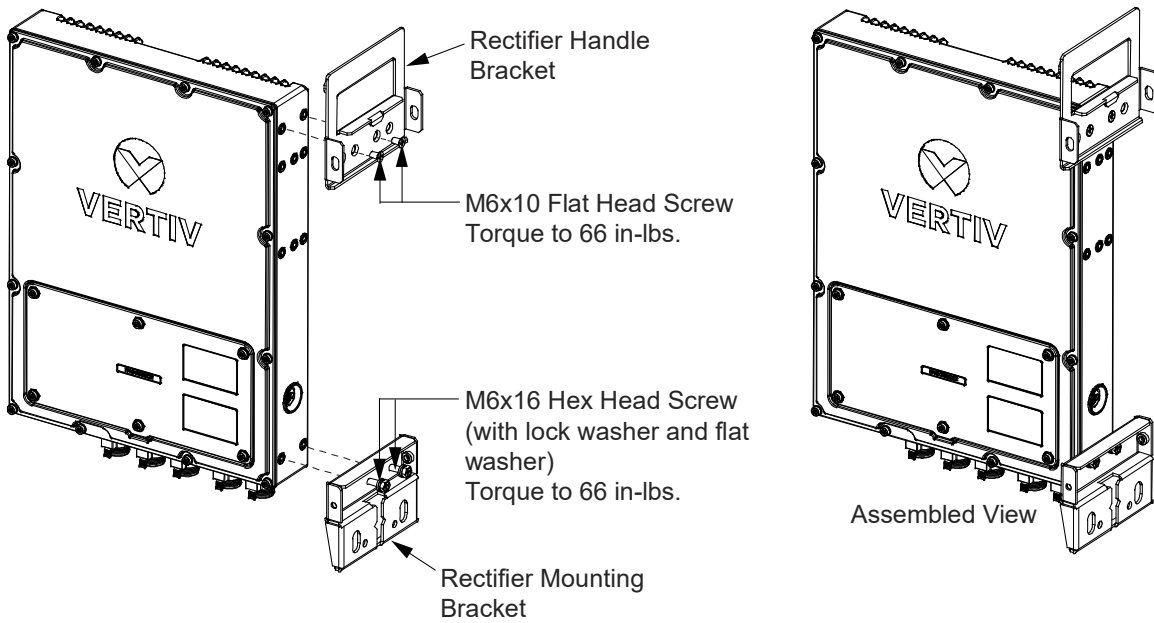
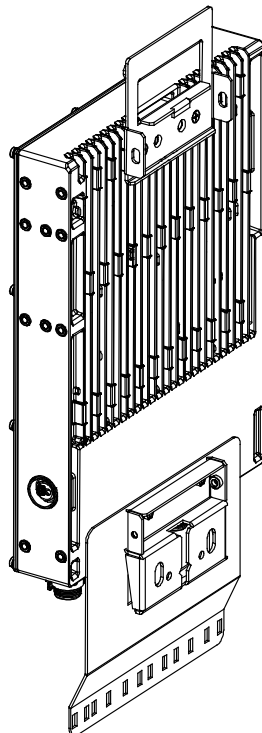
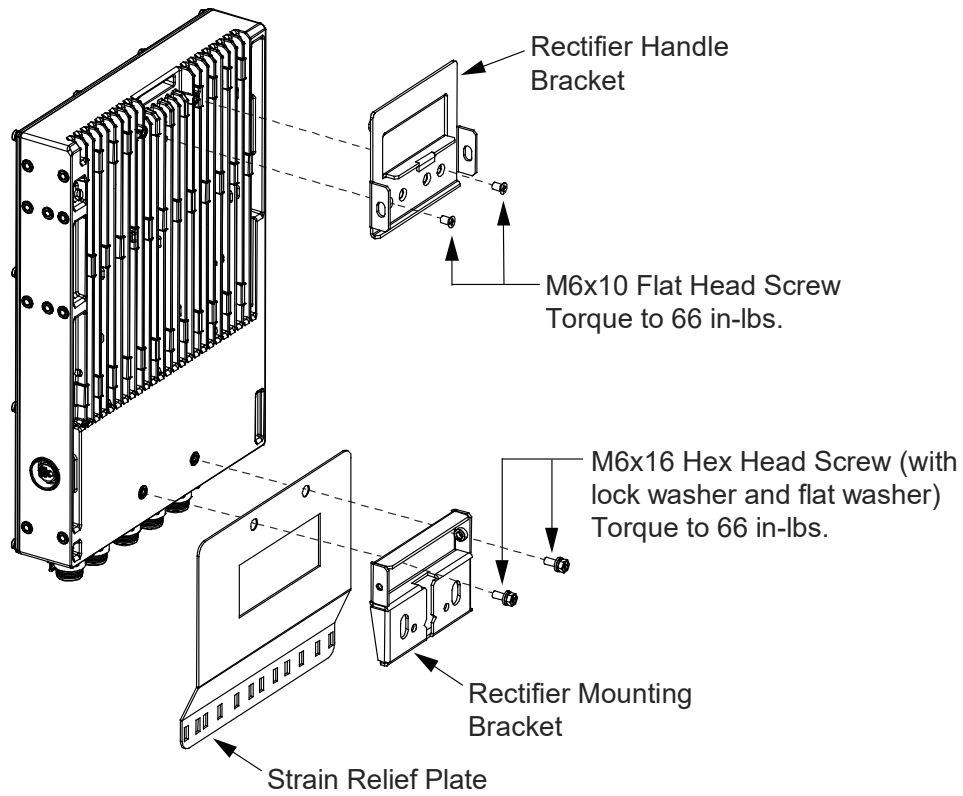


Figure 3.6 Installing the Top and Bottom Mounting Brackets and Strain Relief Plate to the Rectifier (cont'd from previous page)

Flat Mounting



Assembled View

Figure 3.7 Securing the Rectifier to the Pole at the Top (Pole Mounting Shown, Wall Mounting Similar)

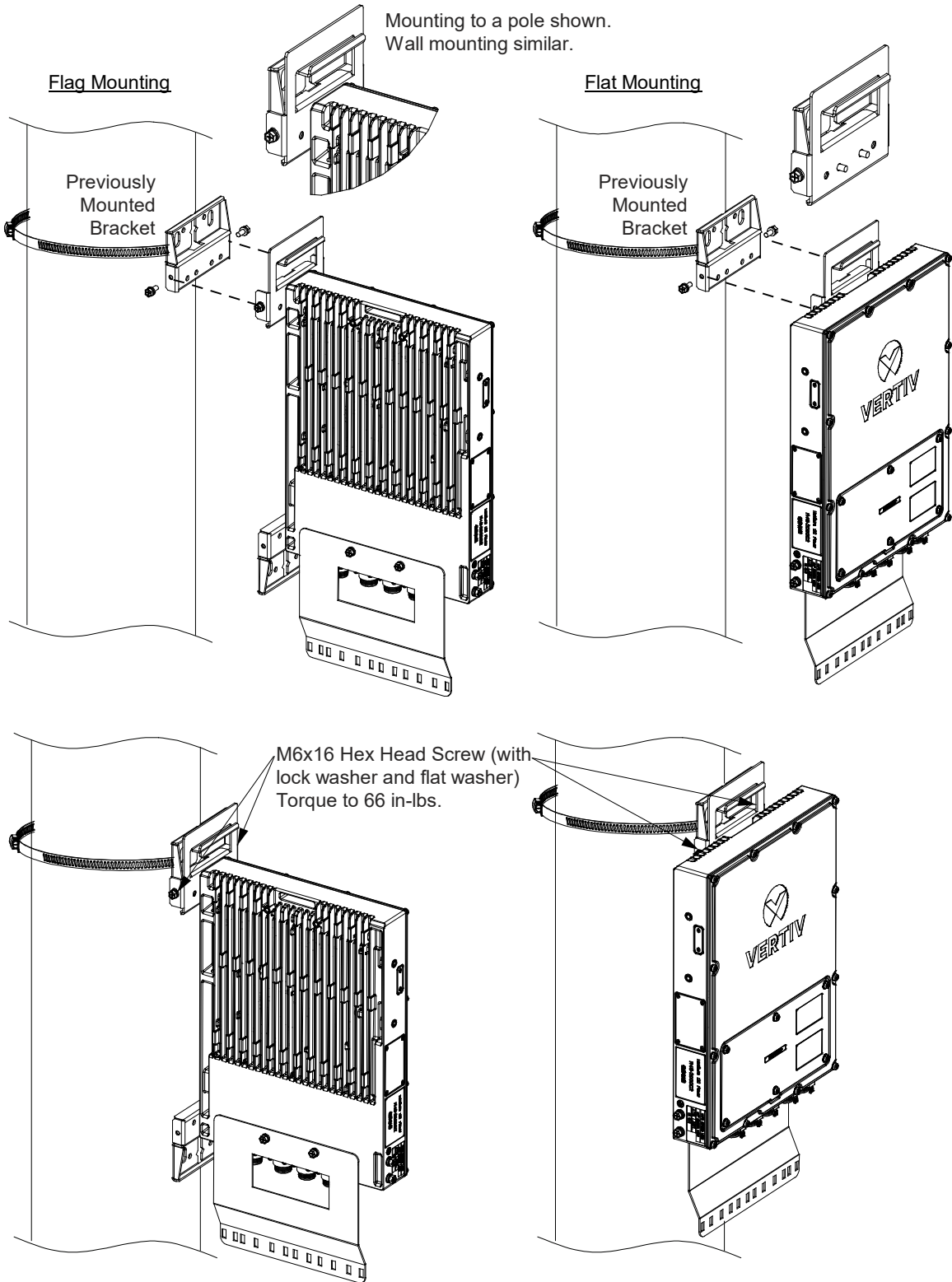
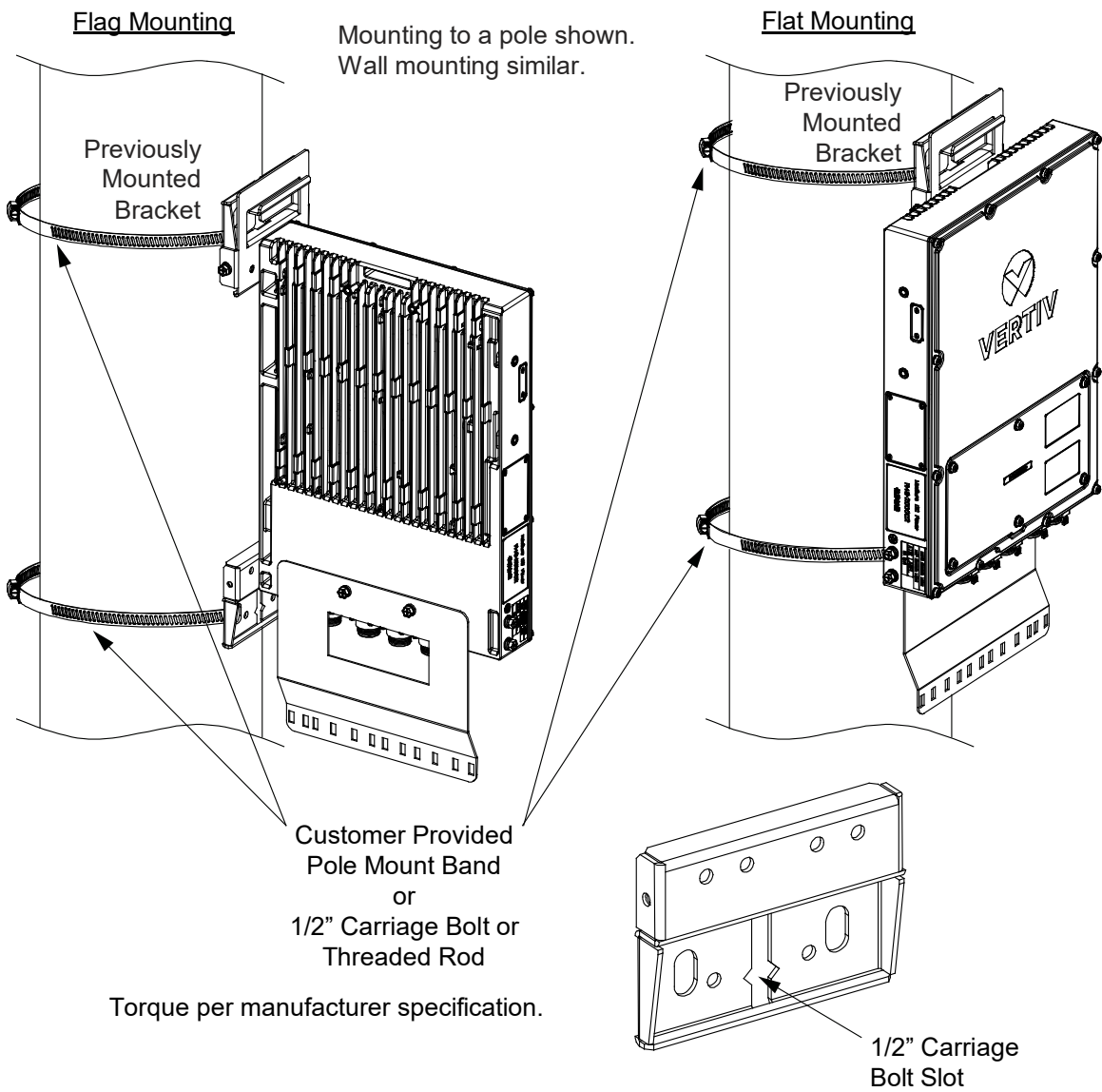


Figure 3.8 Securing the Rectifier to the Pole at the Bottom (Pole Mounting Shown, Wall Mounting Similar)



## 3.5 Mounting a Companion Lithium-Ion Battery to a Pole or Wall Using Battery Only Mounting Kit P/N 10025107

### 3.5.1 General

This kit allows a lithium-ion battery to be mounted to a pole or wall in a "flag" or "flat" orientation. See "Companion Lithium-Ion Battery Only Mounting Kit P/N 10025107" on page 20.

- For pole mounting, the customer needs to supply either...
  - two (2) 1/2" diameter carriage bolts or threaded rods or,
  - two (2) pole mounting bands (3/4-inch wide, stainless steel, suitable for greater than 100 lbs of support, 0.030-inch thick).
- For wall mounting, the customer needs to supply four (4) 3/8" wall anchors capable of supporting the weight of the battery.
- Rectifier to battery inter-connect cables are suited for an installation distance of approximately 12-inches apart maximum, using the longer cables (1.25 meter length variant).

### 3.5.2 Pole / Wall Mounting Procedure



**NOTE!** Torque all hardware to the values shown in the illustrations.

1. Unpack the battery and mounting accessories.
2. Wall Mount: Drill appropriately sized holes into the wall for installation of customer provided 3/8" wall anchors. See Figure 3.9 for dimensions. Install the customer provided 3/8" wall anchors into the holes previously drilled.
3. Wall Mount: Install the battery mounting bracket to the wall using the previously installed wall anchors. See Figure 3.9. Torque per anchor manufacturer specifications.

Pole Mount: Install the battery mounting bracket to the pole in the desired location. Install with either two (2) customer supplied 1/2" carriage bolts or threaded rods, or two (2) pole mount bands (see "3.5.1 General" on page 28). Refer to Figure 3.10. If using 1/2" carriage bolts or threaded rods, refer to Figure 3.10 and drill the two (2) appropriate holes in the pole.

4. Install the battery handle bracket to the rear panel of the battery using supplied hardware as shown in Figure 3.11. Note that the battery is to be mounted in a "flat" orientation.
5. Lift the battery up using the battery handle bracket (previously installed on the battery) and slide the battery handle bracket down into the battery mounting bracket (previously installed on the wall or pole). Note that there are tabs on the battery handle bracket that slide down into slots on the battery mounting bracket. Secure the battery handle bracket to the battery mounting bracket with the supplied hardware as shown in Figure 3.12.

Figure 3.9 Installing the Pole/Wall Battery Mounting Bracket to a Wall

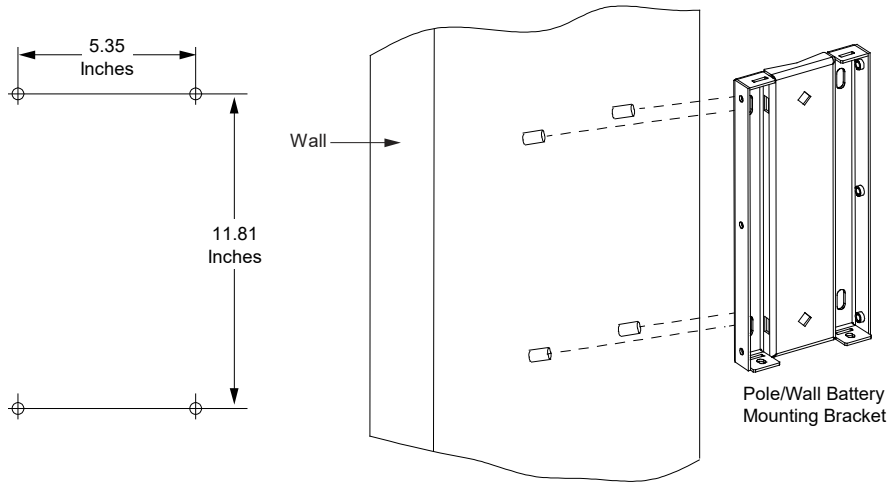
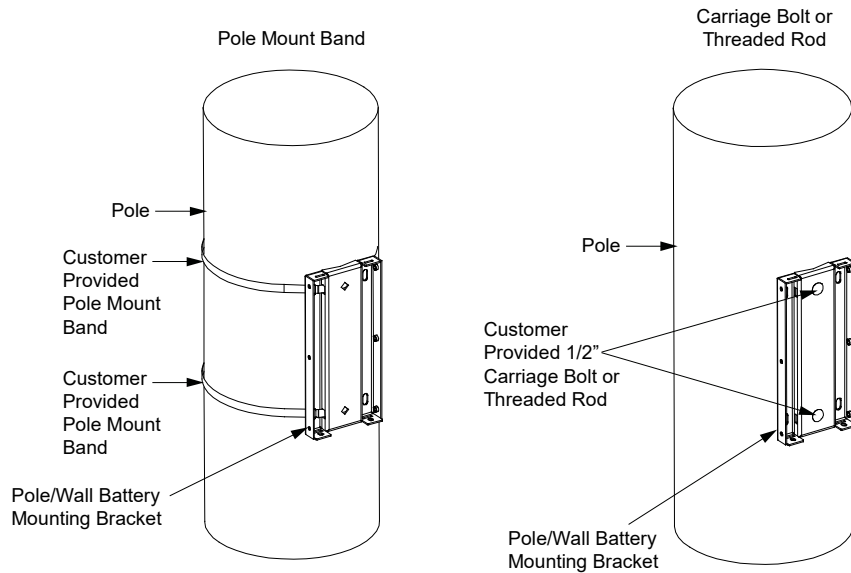


Figure 3.10 Installing the Pole/Wall Battery Mounting Bracket to a Pole



Torque per manufacturer specification.

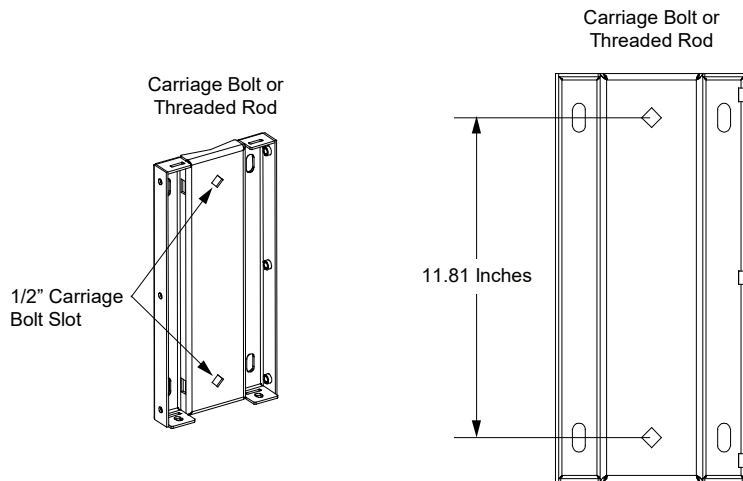


Figure 3.11 Installing the Battery Handle Bracket to the Battery

Narada FEN4850 Battery

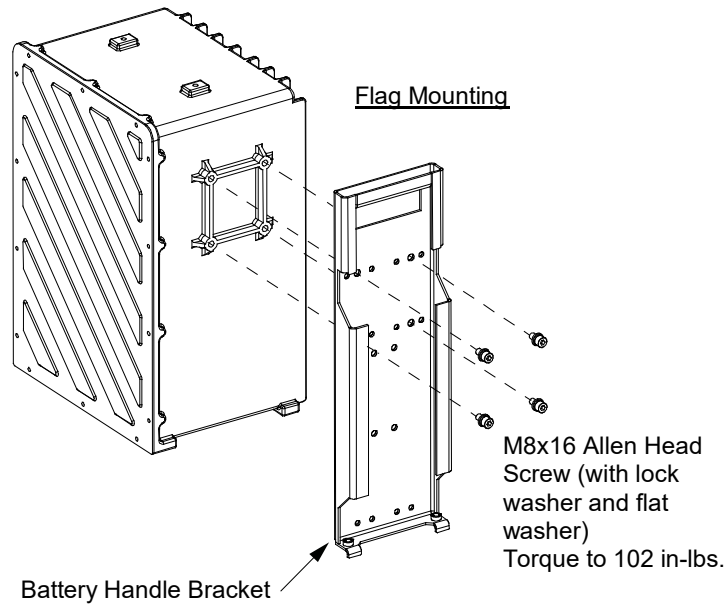
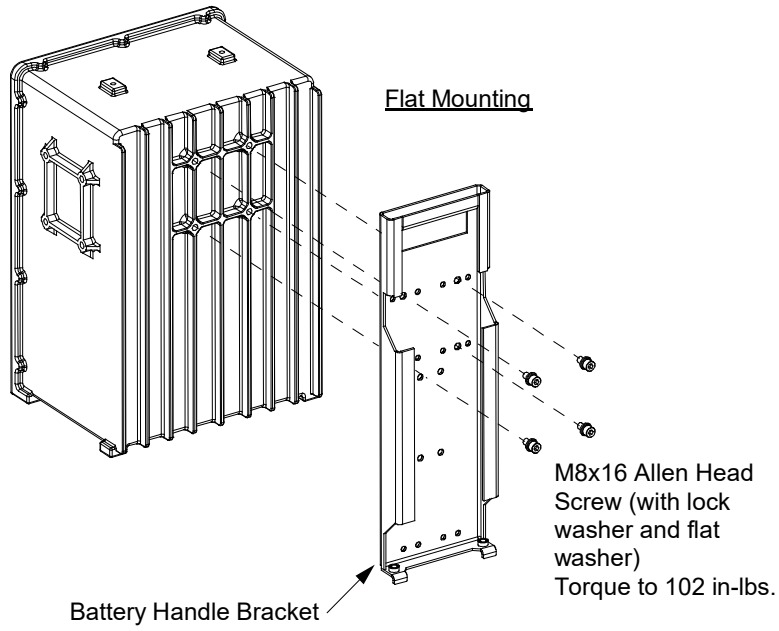
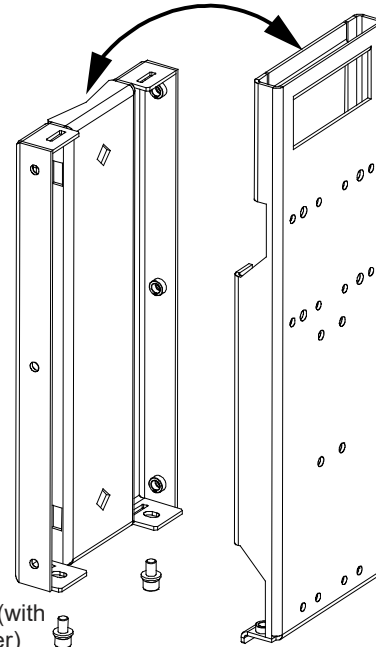




Figure 3.12 Securing the Battery Handle Bracket to the Pole/Wall Battery Mounting Bracket (cont'd on next page)

Lift battery with handle bracket up and slide down into pole/wall battery mounting bracket. Two tabs top and two tabs bottom slide down into slots in the pole/wall battery mounting bracket. Secure the handle bracket to pole/wall battery mounting bracket with the furnished two screws.



M8x16 Allen Head Screw (with lock washer and flat washer)  
Torque to 102 in-lbs.

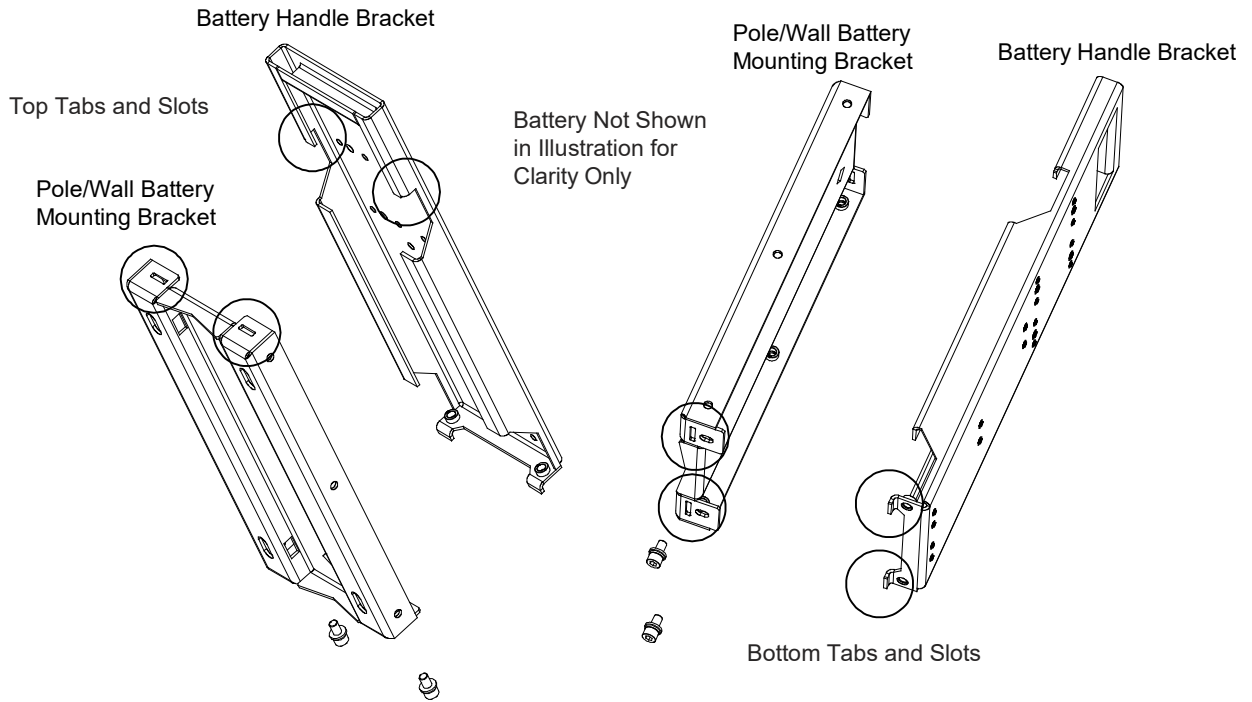
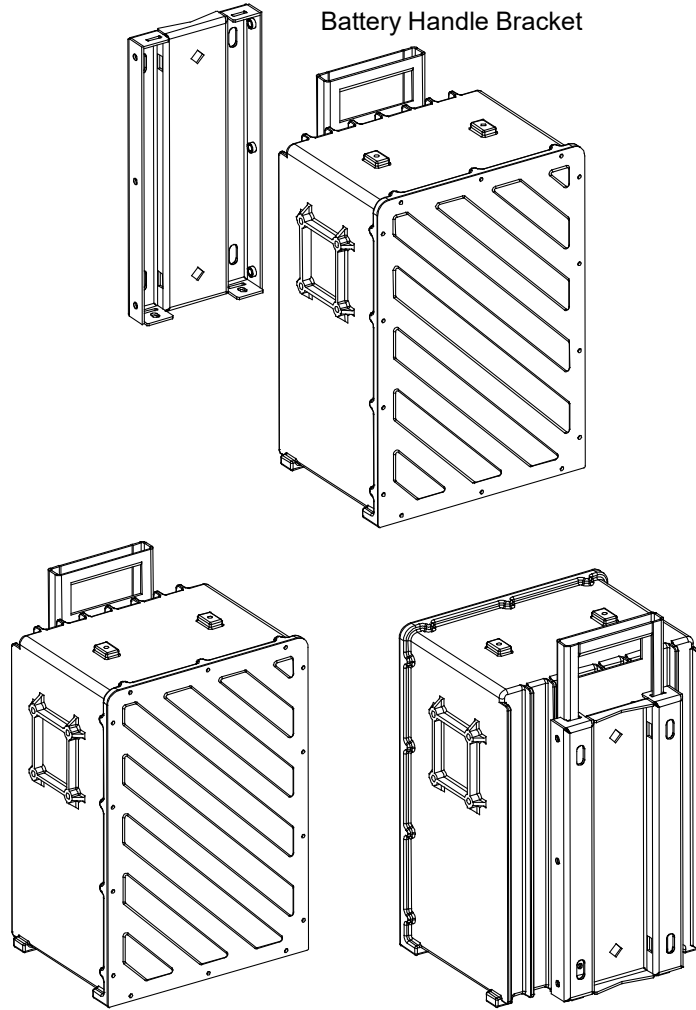


Figure 3.12 Securing the Battery Handle Bracket to the Pole/Wall Battery Mounting Bracket (cont'd from previous page)

Narada FEN4850 Battery

Pole/Wall Battery  
Mounting Bracket

Battery Handle Bracket



Assembled Views

## 3.6 Mounting the Rectifier with a Companion Lithium-Ion Battery to a Pole or Wall Using Rectifier Add-On Kit P/N 10025108 (for Narada Battery)

### 3.6.1 General

This kit allows for a rectifier and Narada lithium-ion battery to be mounted to a pole or wall in a “side-by-side flag” orientation. Requires both the rectifier only mounting kit P/N 10024600 furnished with each rectifier and the battery only mounting kit P/N 10025107. See “Rectifier Add-On Kit P/N 10025108 (for Narada Battery)” on page 21.



**NOTE!** For this adjacent (short distance) installation, Vertiv recommends use of the shorter cable set (31.5” / 0.8 meters long) of battery power cable (P/N 10023549) and RS-485 DB-9 communication cable (P/N 10023684).

### 3.6.2 Pole Mounting Procedure (Wall Mounting Procedure Similar)



**WARNING!** Do not attempt to assemble the battery with the rectifier, then lift both at the same time. Follow the instructions to mount the rectifier, then the battery separately.



**NOTE!** Torque all hardware to the values shown in the illustrations.

1. Unpack the battery, rectifier, and mounting accessories.
2. Install the top rectifier mounting bracket to the rectifier add-on panel using supplied hardware as shown in Figure 3.13.
3. Install the rectifier handle bracket and rectifier mounting bracket to the side panel of the rectifier using supplied hardware as shown in Figure 3.14. Install the strain relief plate to the rectifier using supplied hardware as shown in Figure 3.14. Note that the rectifier can only be mounted in the “Flag” orientation.
4. Install the battery handle bracket to the side panel of the battery using supplied hardware as shown in Figure 3.15. Note that the battery can only be mounted in the “Flag” orientation.
5. Fasten the battery mounting bracket to the pole in the desired location. Install with either two (2) customer supplied 1/2” carriage bolts or threaded rods, or two (2) pole mount bands (see “3.6.1 General” on page 33). Refer to Figure 3.16. If using 1/2” carriage bolts or threaded rods, refer to Figure 3.16 and drill the two (2) appropriate holes in the pole.
6. Install the rectifier add-on panel with the top rectifier mounting bracket to the battery mounting bracket as shown in Figure 3.17.
7. Lift the rectifier up using the rectifier handle bracket (previously installed on the rectifier) and slide the rectifier handle bracket down into the rectifier mounting bracket (previously installed on the rectifier add-on panel). Note that there is a tab on the rectifier handle bracket that slides down into a slot on the rectifier mounting bracket installed on the rectifier add-on panel. Secure the rectifier handle bracket to the rectifier mounting bracket with the supplied hardware as shown in Figure 3.18.
8. Secure the bottom rectifier mounting bracket previously installed on the rectifier to the rectifier add-on panel with supplied hardware as shown in Figure 3.18.
9. Lift the battery up using the battery handle bracket (previously installed on the battery) and slide the battery handle bracket down into the battery mounting bracket (previously installed on the pole). Note that there are tabs on the battery handle bracket that slide down into slots on the battery mounting bracket. Secure the battery handle bracket to the battery mounting bracket with the supplied hardware as shown in Figure 3.19.
10. Secure the battery link plate to the battery and rectifier with the supplied hardware as shown in Figure 3.20.

**Figure 3.13** Installing the Rectifier Mounting Bracket to the Rectifier Add-On Panel

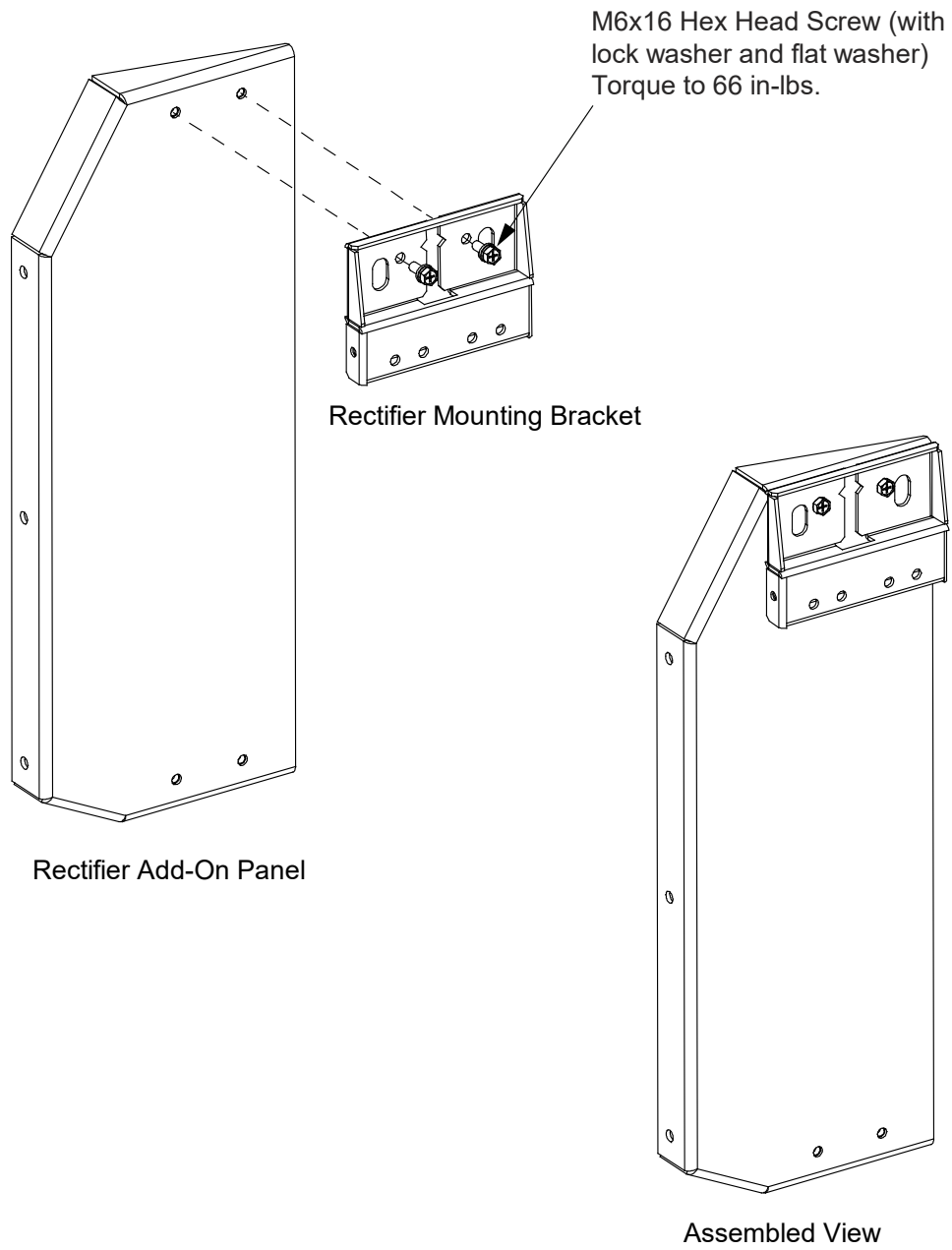


Figure 3.14 Installing the Top Rectifier Handle Bracket, Bottom Rectifier Mounting Bracket, and Strain Relief Plate to the Rectifier

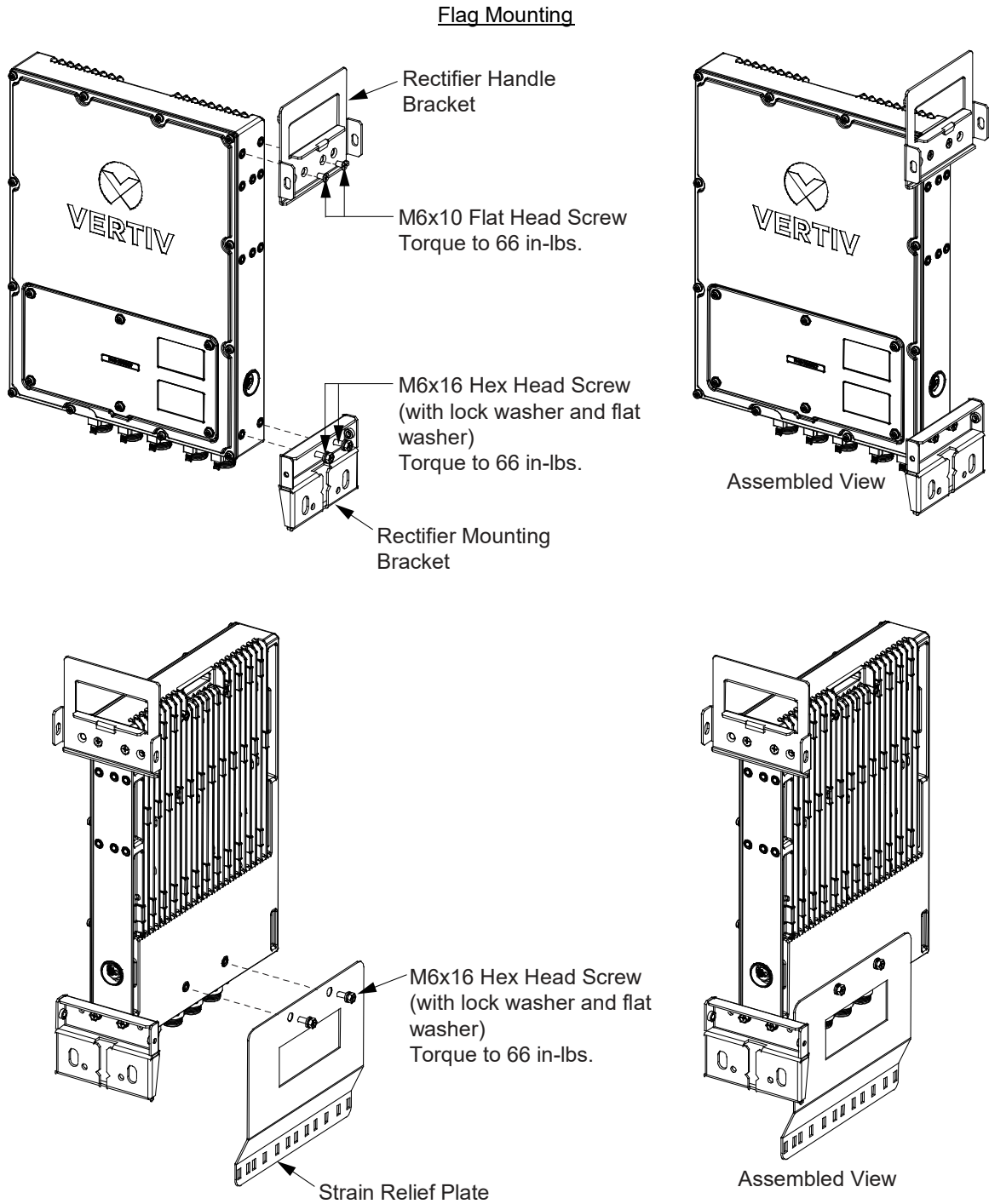


Figure 3.15 Installing the Battery Handle Bracket to the Battery

Narada FEN4850 Battery

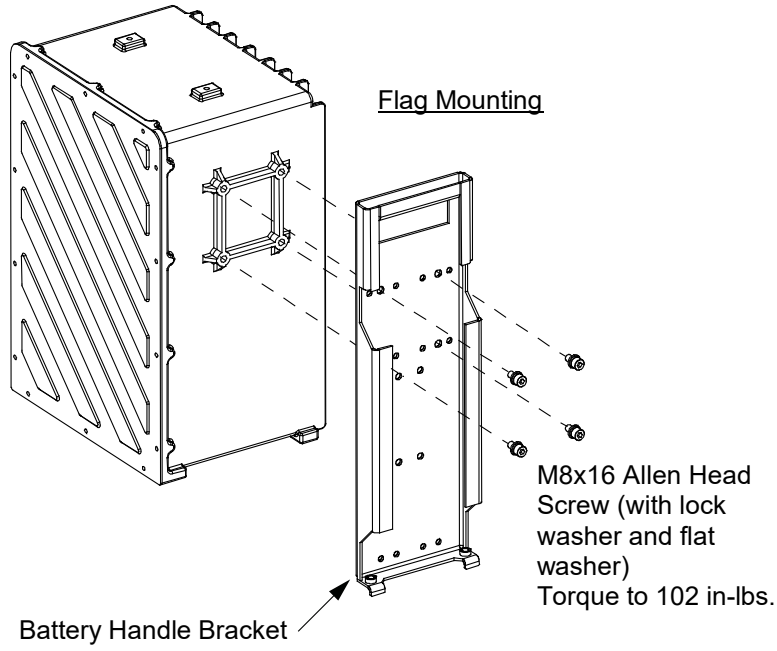
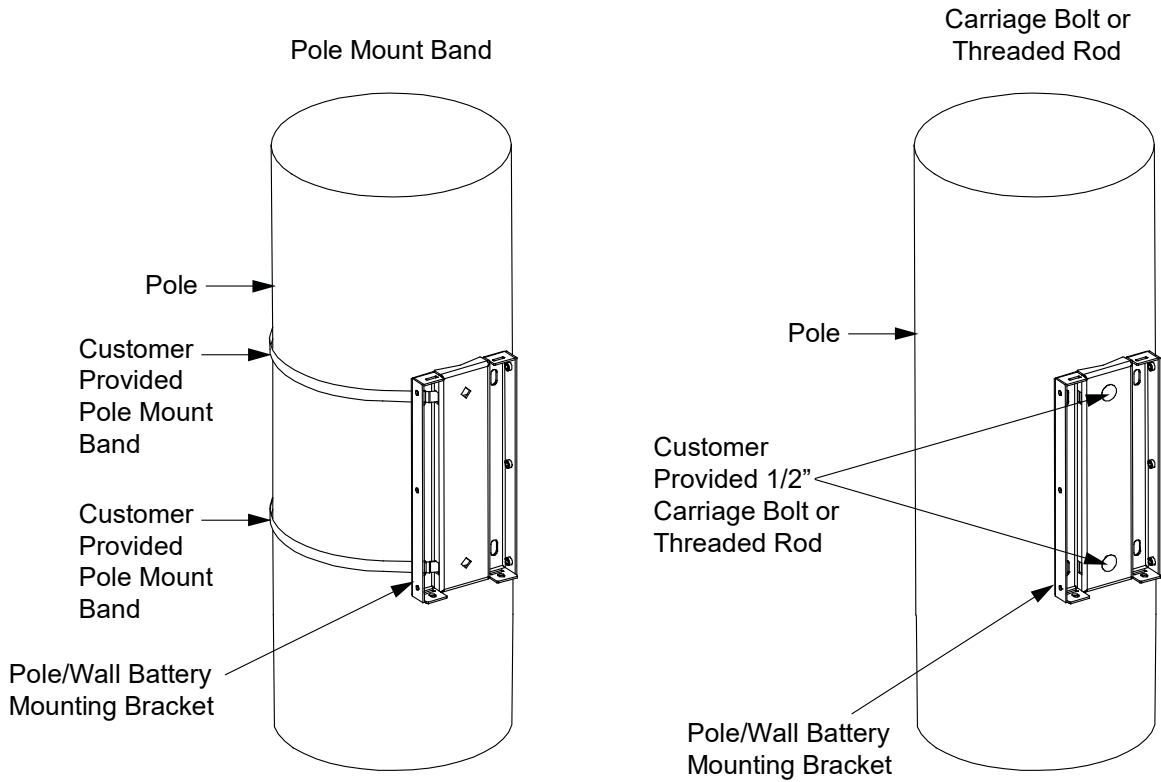
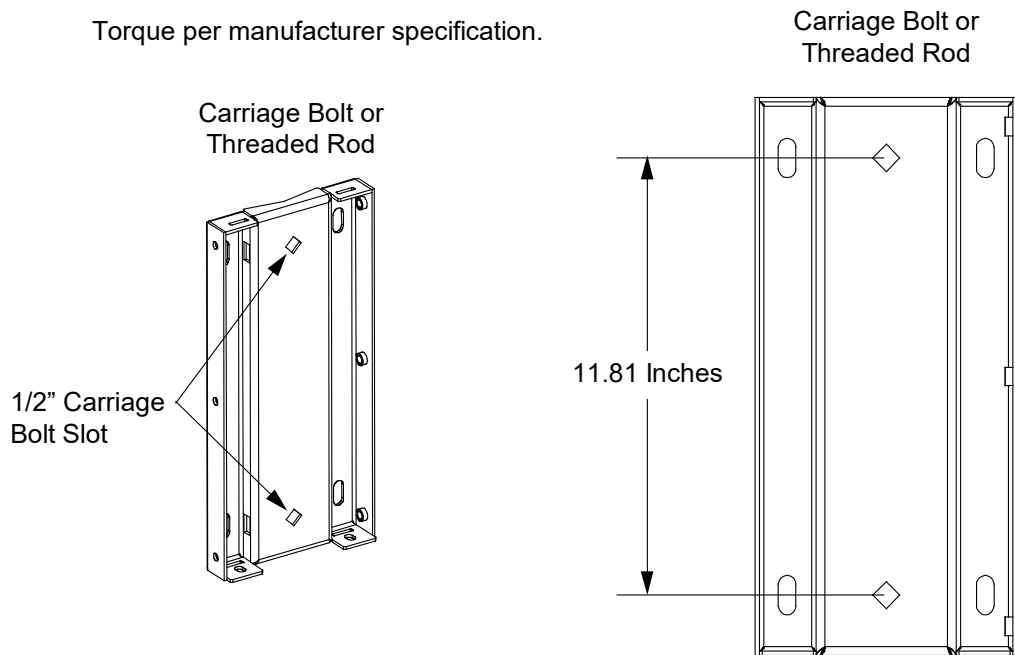


Figure 3.16 Fastening the Battery Mounting Bracket to the Pole (Pole Mounting Shown, Wall Mounting Similar)



Torque per manufacturer specification.



**Figure 3.17** Installing the Rectifier Add-On Panel with the Top Rectifier Mounting Bracket to the Battery Mounting Bracket (Pole Mounting Shown, Wall Mounting Similar)

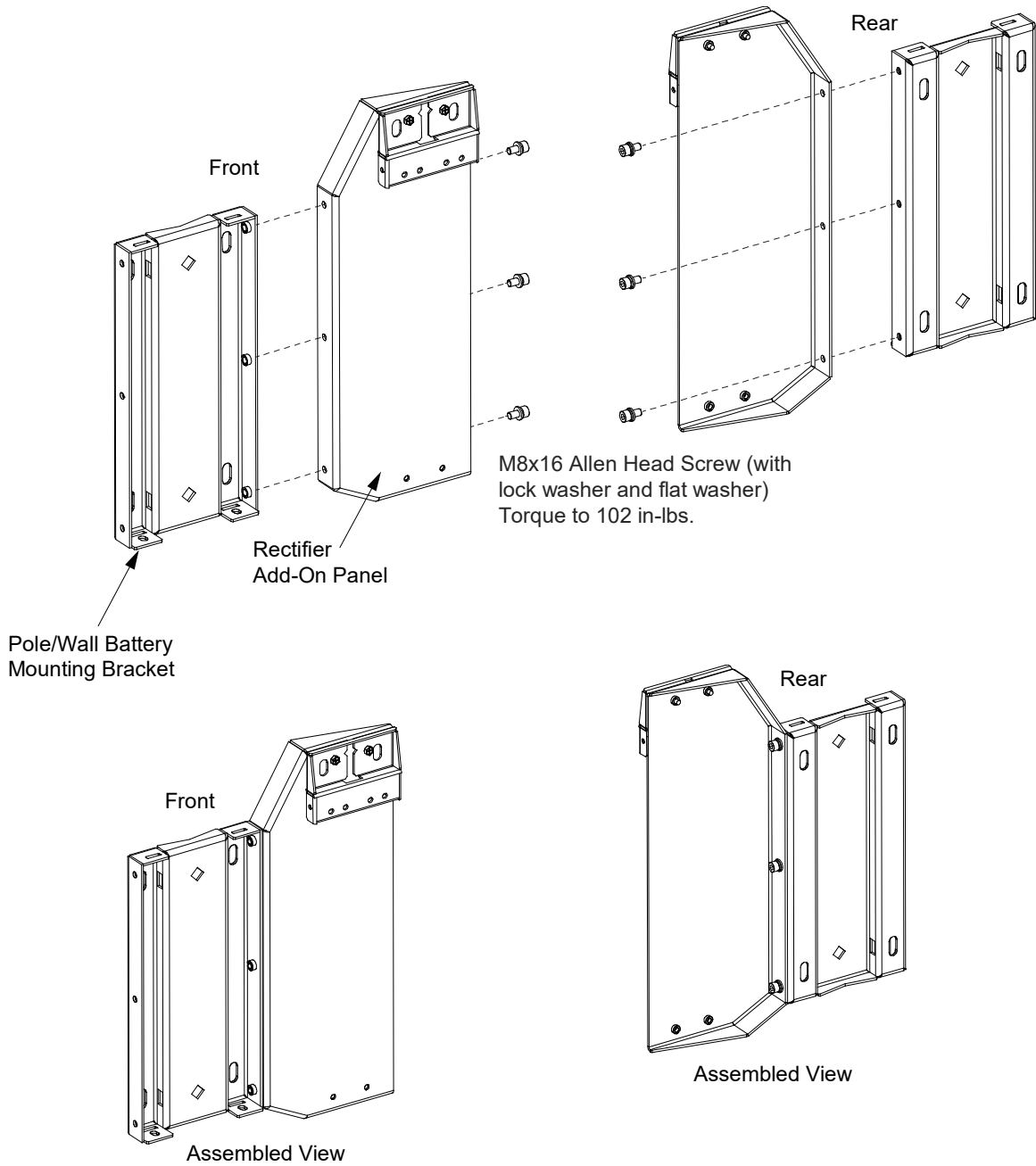




Figure 3.18 Securing the Rectifier to the Rectifier Add-On Panel (Pole Mounting Shown, Wall Mounting Similar)

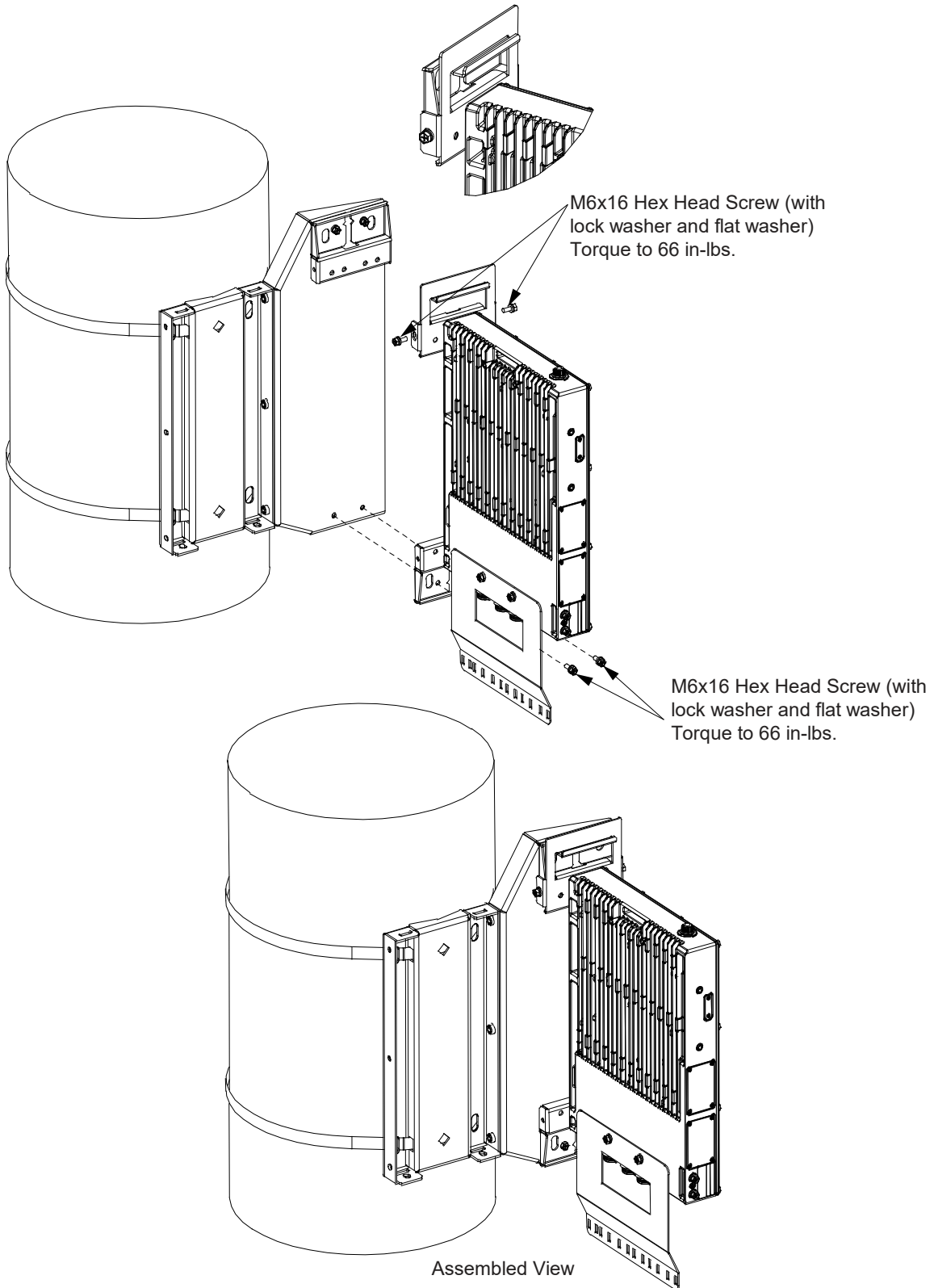
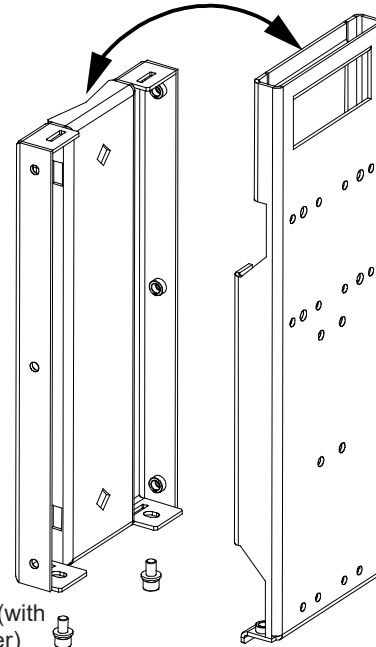


Figure 3.19 Securing the Battery Handle Bracket to the Battery Mounting Bracket (cont'd on next page)

Lift battery with handle bracket up and slide down into pole/wall battery mounting bracket. Two tabs top and two tabs bottom slide down into slots in the pole/wall battery mounting bracket. Secure the handle bracket to pole/wall battery mounting bracket with the furnished two screws.



M8x16 Allen Head Screw (with lock washer and flat washer)  
Torque to 102 in-lbs.

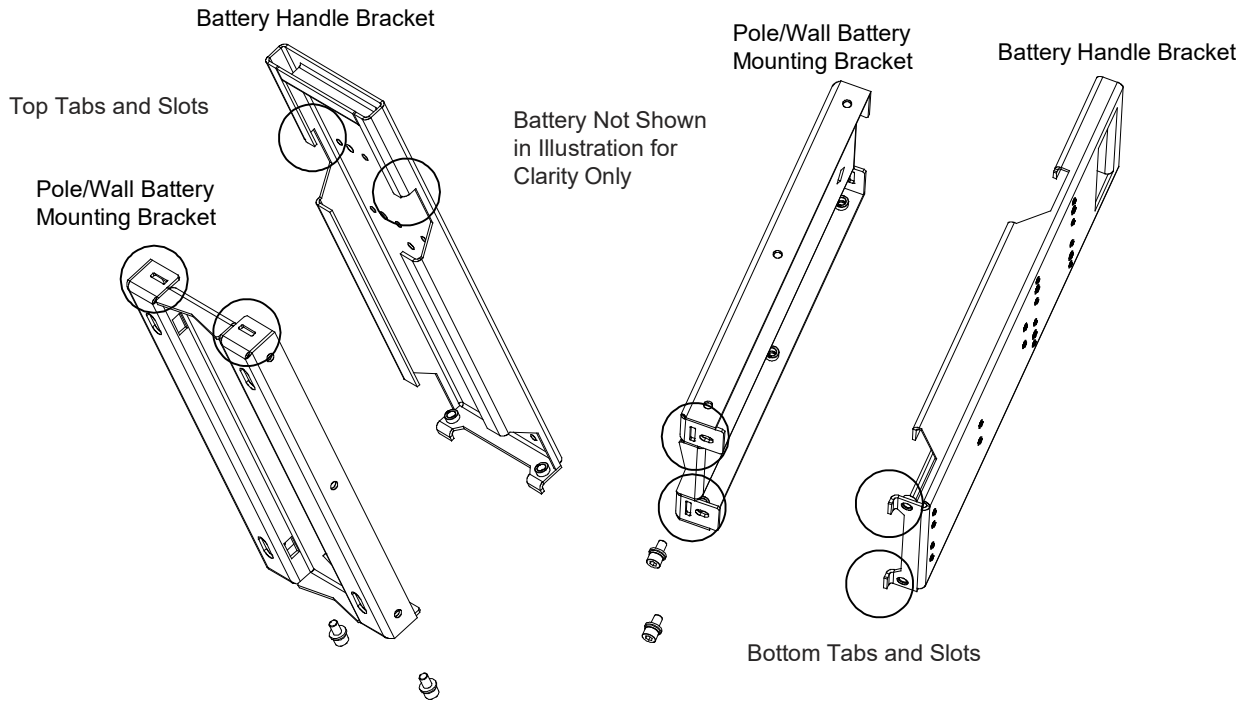


Figure 3.19 Securing the Battery Handle Bracket to the Battery Mounting Bracket (cont'd from previous page)

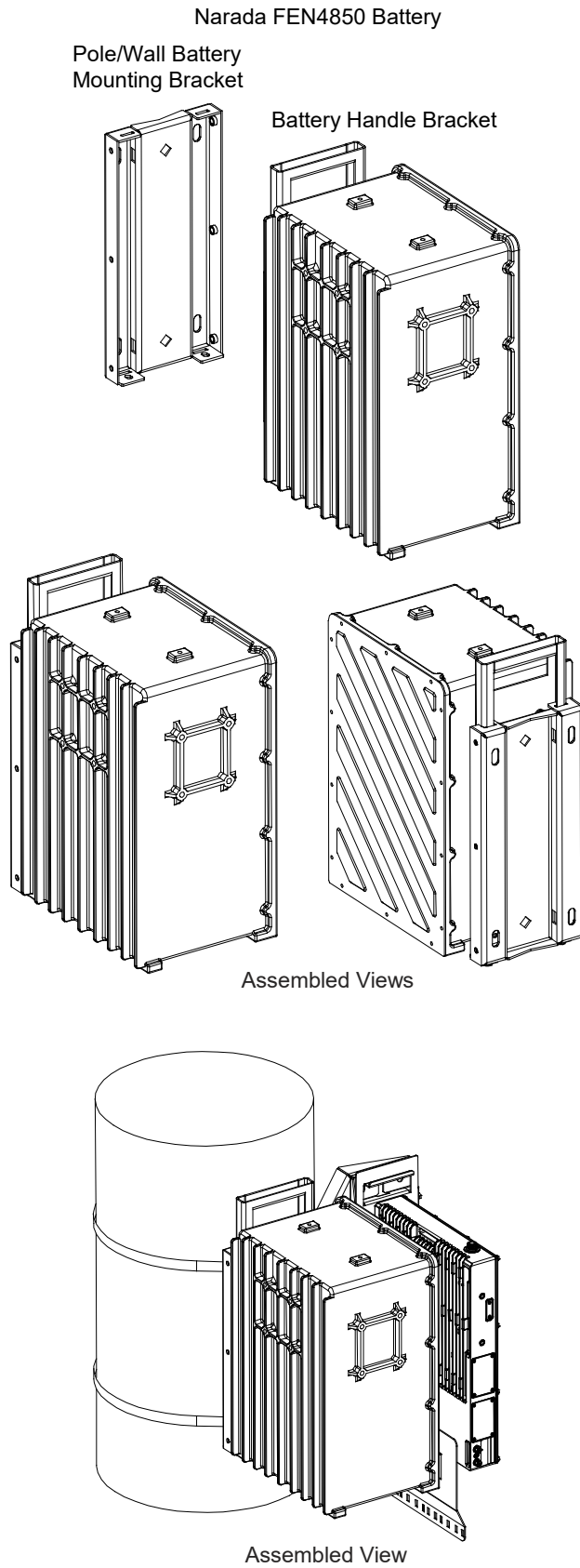
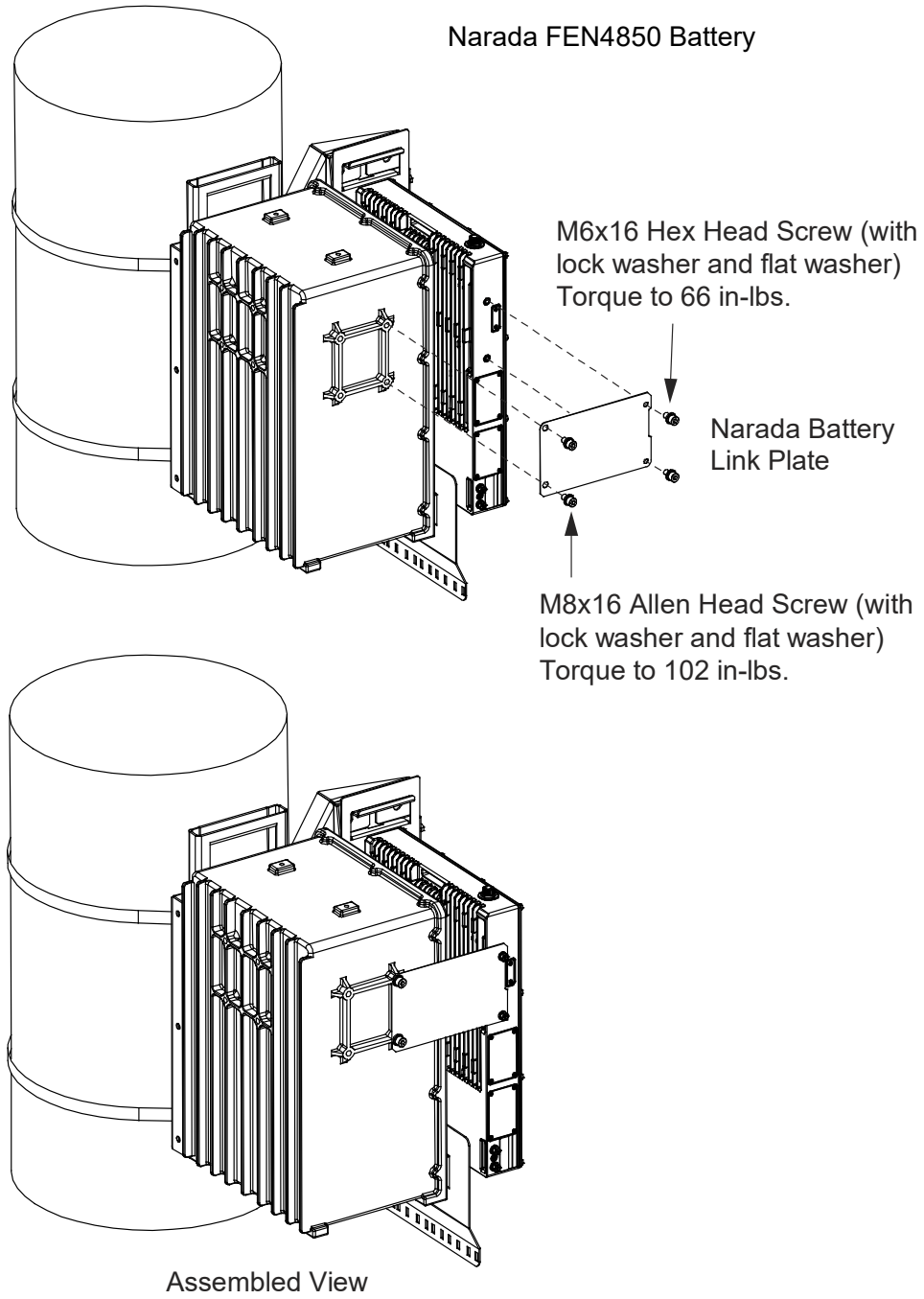


Figure 3.20 Securing the Battery Link Plate to the Battery and Rectifier (Pole Mounting Shown, Wall Mounting Similar)



## 4 Making Electrical Connections

### 4.1 Important Safety Instructions



**DANGER!** Adhere to the “Important Safety Instructions” starting on page vii.



**ALERT!** Wear an ESD wrist strap (see “Static Warning” on page x).



**WARNING!** Rectifier warranty will be VOID if any perimeter screw is tampered with. DO NOT loosen or remove any perimeter screw. Removal of outer perimeter screws is a safety hazard.



**NOTE!** If the rectifier's front access panel is opened during installation, ensure the access panel is securely closed and the screws are torqued to 22 in-lbs. See Figure 6.3 on page 65.

### 4.2 Wiring Considerations

All wiring and branch circuit protection should follow the current edition of the American National Standards Institute (ANSI) approved National Fire Protection Association's (NFPA 70) National Electrical Code (NEC), and applicable local codes. For operation in countries where the NEC is not recognized, follow applicable codes.

### 4.3 Electrical Connections Location Diagram

Electrical connections are made using separately ordered cable assemblies. One end of these cable assemblies contains a mating plug to the connector located on the bottom panel of the rectifier. Refer to Figure 4.1 for an electrical connection location diagram.

Figure 4.1 Electrical Connection Location Diagram (cont'd on next page)



**NOTE!** The rectifier battery port may be used as a Load 4 port. Refer to "Operation in a Batteryless Installation" on page 58.

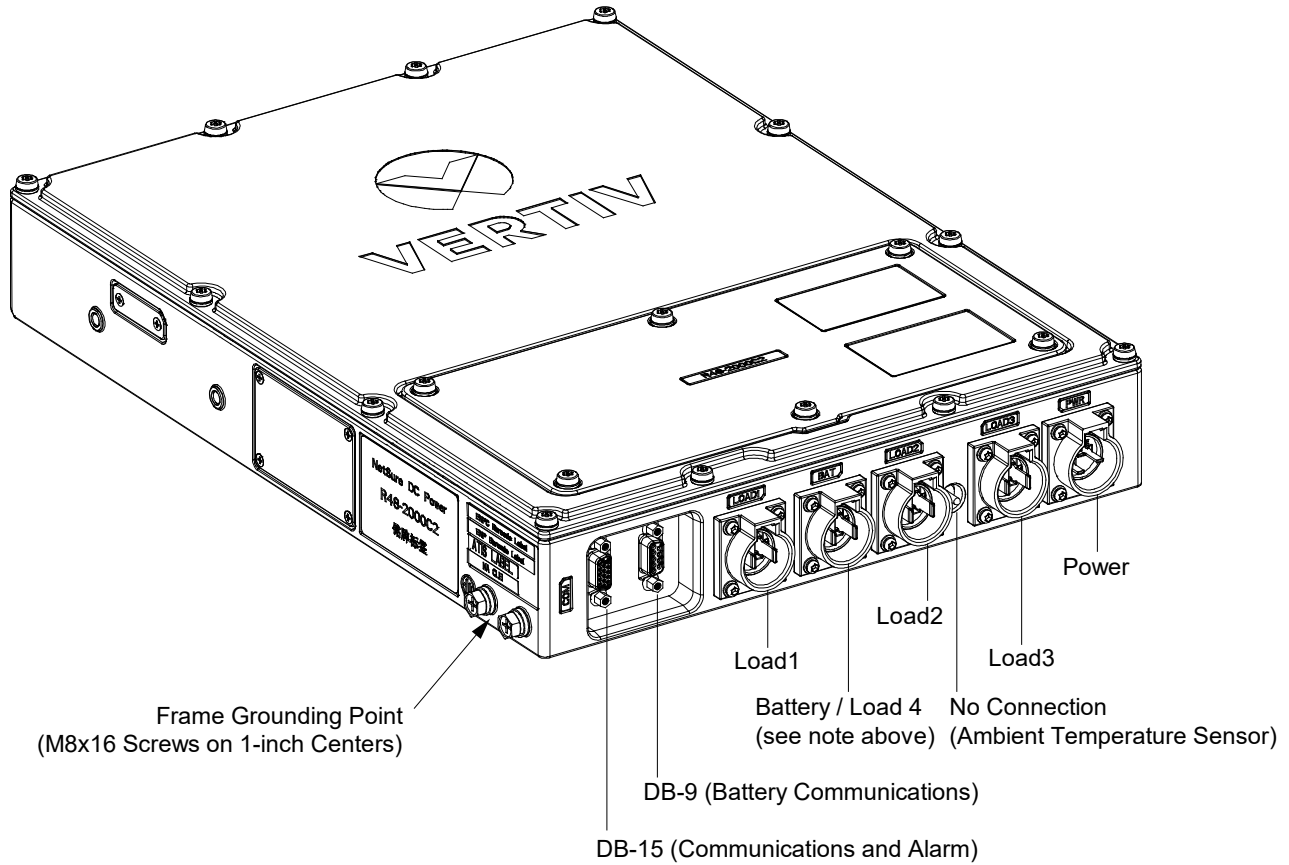
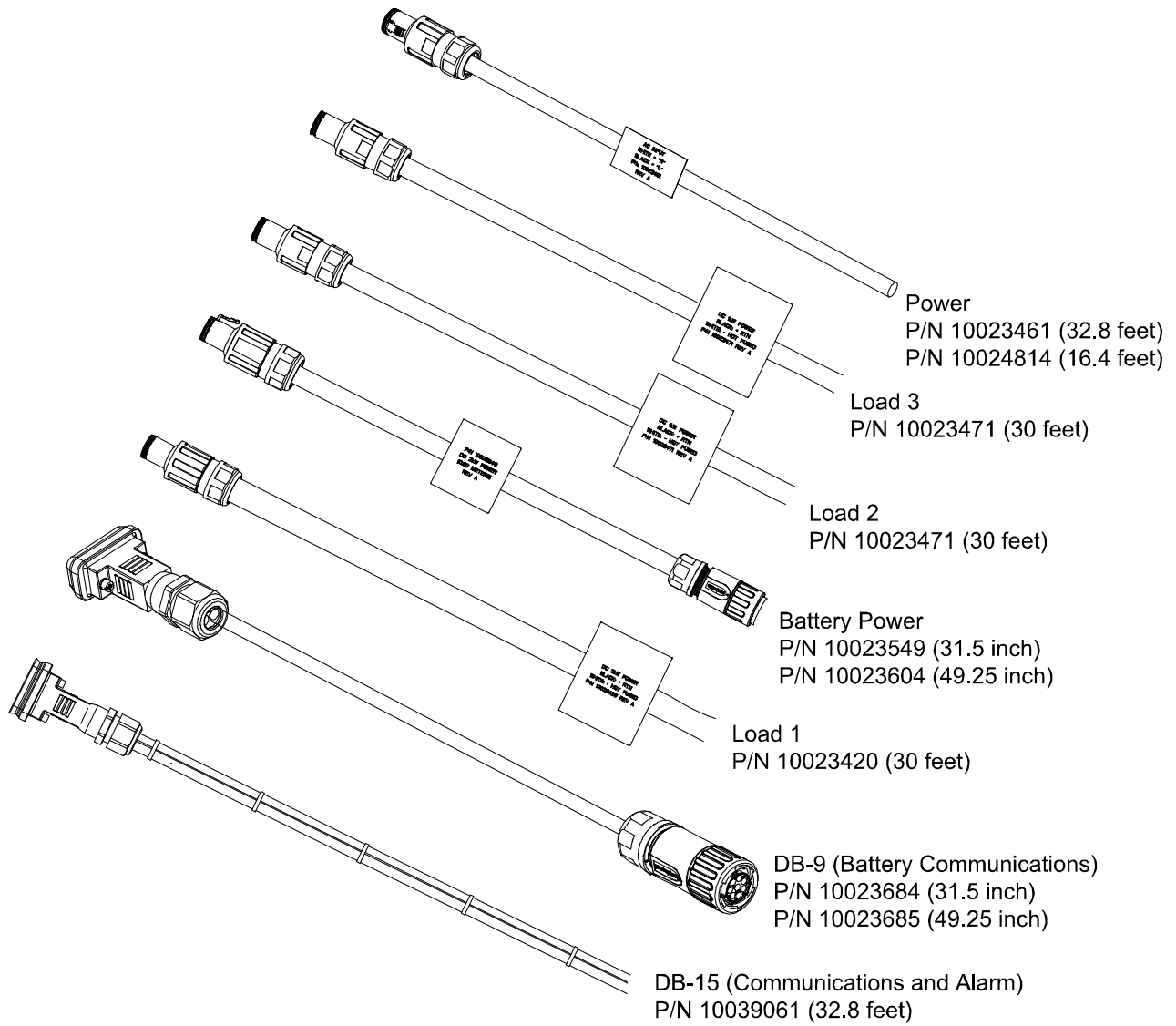


Figure 4.1 Electrical Connection Location Diagram (cont'd from previous page)

for Narada FEN4850 Battery



## 4.4 Rectifier Ground Connection

### 4.4.1 General

For grounding requirements, refer to the current edition of the American National Standards Institute (ANSI) approved National Fire Protection Association's (NFPA) National Electrical Code (NEC), applicable local codes, and your specific site requirements.

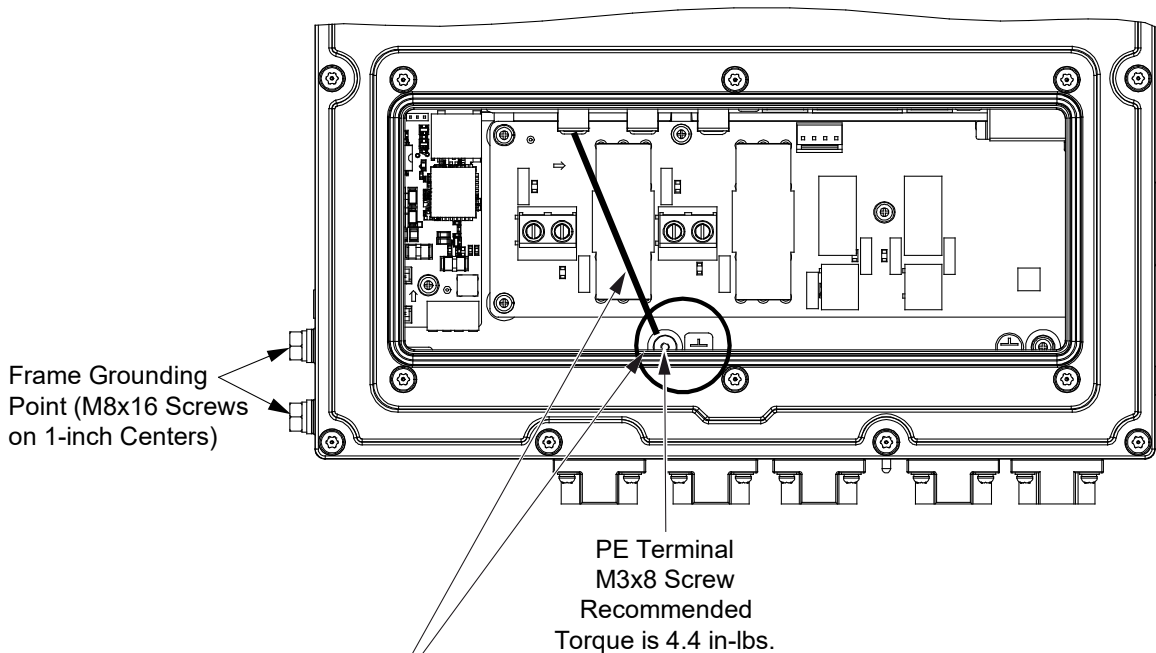
### 4.4.2 Positive Grounding

As default, the power system is positive grounded. The Return (+) Bar of the power system is factory default connected to the chassis PE terminal. If customer chooses to float the DC bus, perform the following procedure.

#### Procedure

1. Refer to "Opening / Closing the Front Access Panel" on page 64, and open the rectifier enclosure front access panel.
2. Locate the cable connected to the Return (+) Bar that is secured to the chassis PE terminal shown in Figure 4.2. Remove the cable from the chassis PE terminal and insulate and tie back the unconnected end.
3. Refer to "Opening / Closing the Front Access Panel" on page 64, and close the rectifier enclosure front access panel.

Figure 4.2 Configuring Rectifier Grounding



**IMPORTANT:** Rectifier is factory +RTN bonded to chassis. When chassis is bonded to earth ring ground, then +RTN will also be referenced to Earth. This means rectifier will be a DEFAULT -48 VDC power system. Internal +RTN wire is factory connected to the PE terminal M3 screw shown above, next to the earth symbol. If customer chooses to float DC bus, access panel must be opened, and this wire must be unterminated and insulated.



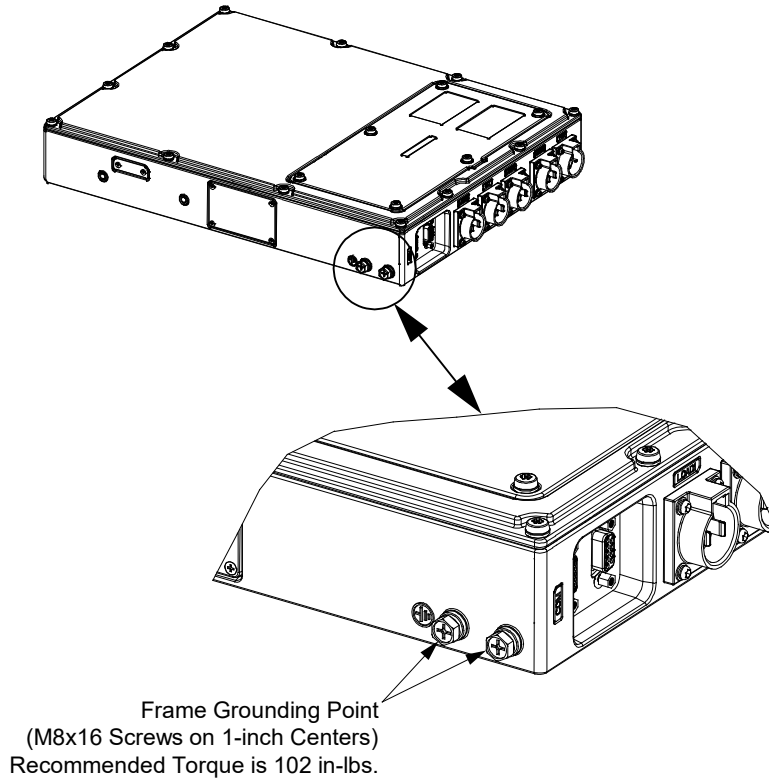
### 4.4.3 Rectifier Frame Grounding

Two (2) M8x16 screws are located on the rectifier left side panel for installation of a customer furnished frame ground lug. Screws are spaced on 1-inch centers.

#### **Procedure**

1. Connect the rectifier chassis to the site grounding point with a two-hole lug. Lug should be crimped per lug manufacturer's specifications. Refer to Figure 4.3 for location and recommended torque.

**Figure 4.3 Rectifier Frame Grounding Location**



## 4.5 Battery Frame Grounding Connection (Narada Battery)

### 4.5.1 General

For grounding requirements, refer to the current edition of the American National Standards Institute (ANSI) approved National Fire Protection Association's (NFPA) National Electrical Code (NEC), applicable local codes, and your specific site requirements.

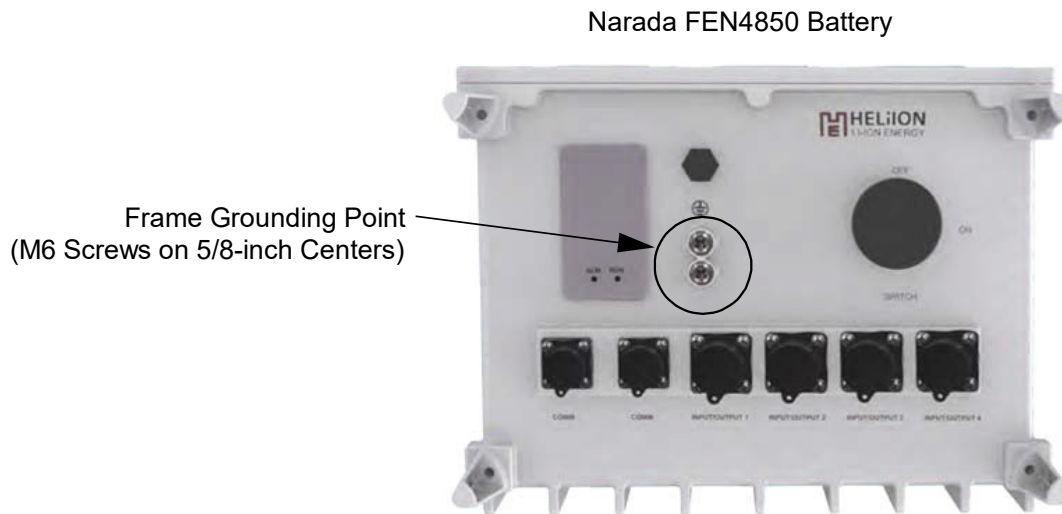
### 4.5.2 Battery Frame Grounding

Two (2) M6 screw inserts are provided on the battery for installation of a customer provided 2-hole frame ground lug. Screw inserts are spaced on 5/8-inch centers. Two (2) M6 screws are provided.

#### Procedure

1. Connect the battery chassis to the site grounding point with a two-hole lug. Lug should be crimped per lug manufacturer's specifications. Refer to Figure 4.4 for location

Figure 4.4 Battery Frame Grounding Location



## 4.6 Nominal 120 VAC / 208 VAC / 240 VAC Input Power and AC Input Equipment Grounding Connections



**ALERT!** AC input power must be turned off before connecting or disconnecting the AC input plug-in connector.

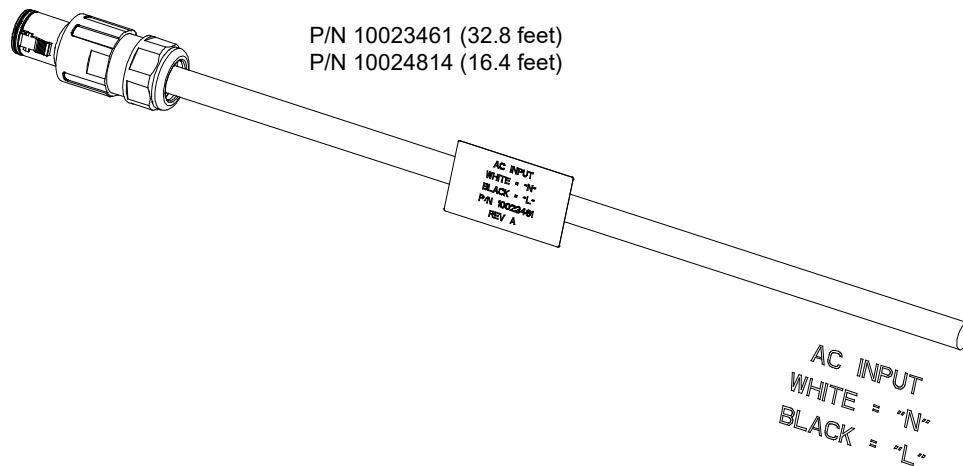
The rectifier is equipped with a plug-in AC input power connector located on the bottom of the enclosure. See Figure 4.1 for location. A separately ordered AC input power cable assembly with a mating plug is required (refer to Figure 4.5). See also “Pre-Assembled Cables” on page 2.

- This rectifier requires an external AC input branch circuit protective device rated for 15 A.
  - Assuming 208 VAC or 240 VAC Nominal Input: 15 A, 2-pole.
  - Assuming 120 VAC Nominal Input: 15 A, 1-pole (120 VAC results in reduced power output).

### Procedure

1. Connect the separately ordered AC input power cable assembly to the AC input power source as shown in Figure 4.5. Connect the green lead to Ground. Connect the white lead to Neutral (or Line 2 if bi-phase). Connect the black lead to Line (or Line 1 if bi-phase).

Figure 4.5 Mating AC Input Power Cable Assembly P/N 10023461 and P/N 10024814 (AC Input Power Connector)



## 4.7 -48 VDC Output Load Connections

### 4.7.1 General



**WARNING!** Check for correct polarity before making connections.



**ALERT!** AC power and battery power must be turned off before connecting or disconnecting any DC load plug-in connector.



**ALERT!** 1kW and 2kW load cable connections are polarized. Only use 1kW cable into 1kW load ports. Only use 2kW cable into 2kW load port. Connector has polarizing hole (rectifier connector has mating male dimple), but connector may be damaged if forced into non-matching incorrect port.

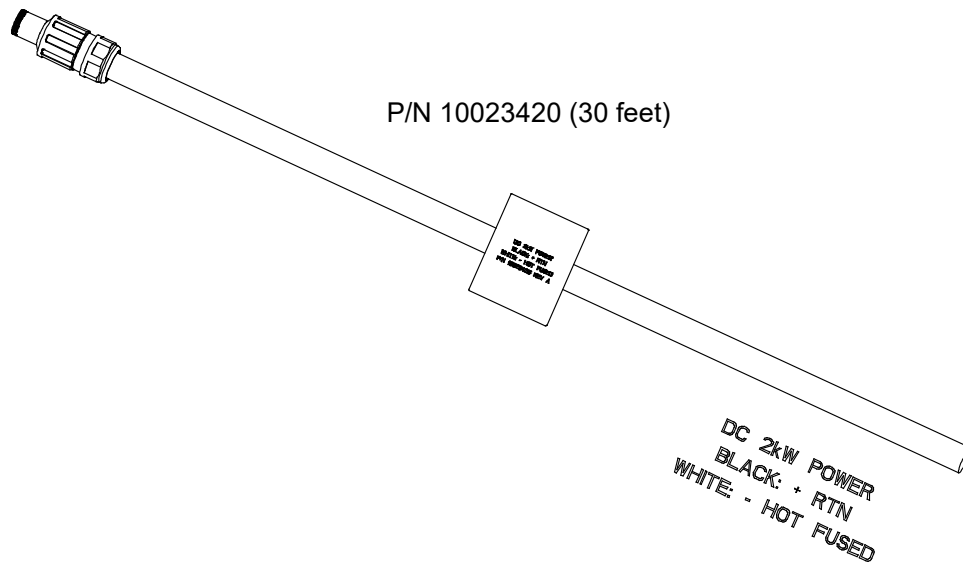
### 4.7.2 -48 VDC Output Load1 Connections (2kW)

The rectifier is equipped with a plug-in DC output Load1 “bulkhead” type connector located on the bottom of the enclosure. See Figure 4.1 for location. A separately ordered DC output cable assembly with a mating plug is required (refer to Figure 4.6). See also “Pre-Assembled Cables” on page 2.

#### Procedure

1. Connect the separately ordered DC output Load1 cable assembly to Load 1 (2kW) as shown in Figure 4.6. Connect the black lead to Load Return. Connect the white lead to -48 VDC Load.

Figure 4.6 Mating Load1 Cable Assembly P/N 10023420 (DC Output Load1 Connector)



**NOTE!** If Battery port is used as a Load 4 output, must use 2kW load cable only in Battery port.

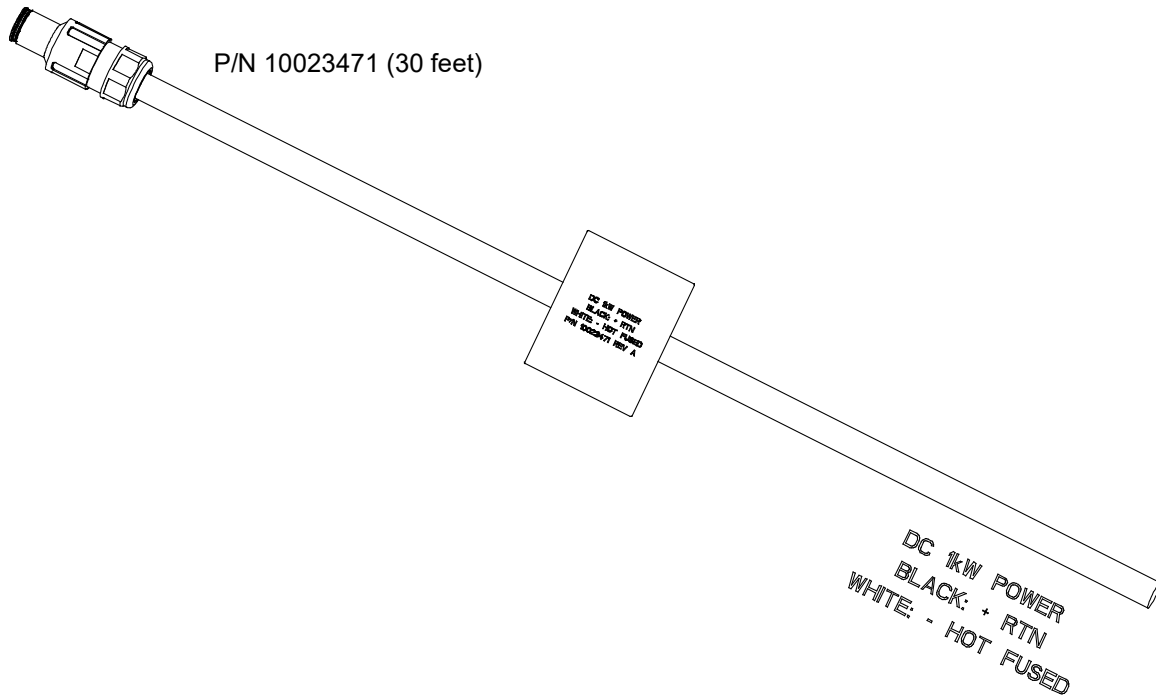
### 4.7.3 -48 VDC Output Load2 and Load3 Connections (1kW)

The rectifier is equipped with plug-in DC output Load2 and Load3 “bulkhead” type connectors located on the bottom of the enclosure. See Figure 4.1 for location. Separately ordered DC output cable assemblies with mating plugs are required (refer to Figure 4.7). See also “Pre-Assembled Cables” on page 2.

#### **Procedure**

1. Connect the separately ordered DC output Load2 / Load3 cable assemblies to Load 2 (1kW) and Load 3 (1kW) as shown in Figure 4.7. Connect the black lead to Load Return. Connect the white lead to -48 VDC Load.

**Figure 4.7 Mating Load2 / Load3 Cable Assembly P/N 10023471 (DC Output Load2 and Load3 Connector)**



## 4.8 External Alarm and Communications Connections (DB15)

### 4.8.1 General

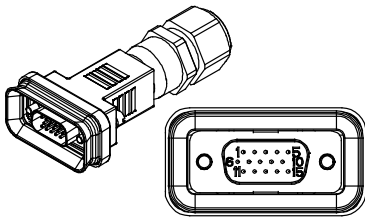
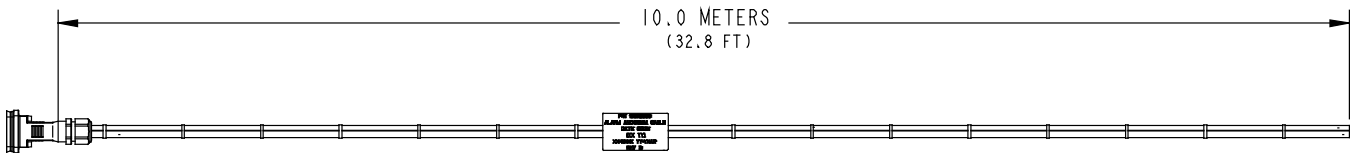
The rectifier is equipped with a plug-in external alarm and communication connector located on the bottom of the enclosure. See Figure 4.1 for location. A separately ordered external alarm and communications cable assembly with a mating plug is required (refer to Figure 4.8). See also “Pre-Assembled Cables” on page 2.

#### Procedure

1. Connect the separately ordered external alarm and communication cable assembly to external alarm and communications circuits as shown in Figure 4.8. See also Table 4.1 for connector pin-outs. Refer to the remainder of this section for further information.

Figure 4.8 Mating External Alarm and Communications Cable Assembly P/N 10039061 (DB15 Connector)

P/N 10039061 (32.8 feet)



CONNECTOR INFORMATION				
CONNECTOR			14190823	
DB-15 CABLE NO.	PIN	COLOR	CUSTOMER END PIN-OUTS	
CABLE #1, 4 PAIR, DO's, UNSHIELDED	1	PR 1, WHT/BLU	DO1 - COM	RECTIFIER ALARM OUTPUTS: 1: FUSE FAIL 2: SPD FAIL 3: AC FAIL 4: RECTIF FAIL
	2	BLU	DO1-SIGNAL	
	3	PR 2, WHT/ORG	DO2 - COM	
	4	ORG	DO2-SIGNAL	
	5	PR 3, WHT/GRN	DO3 - COM	
	10	GRN	DO3-SIGNAL	
	8	PR 4, WHT/BRN	DO4 - COM	
CABLE #2, 4 PAIR, SHIELDED, ETHERNET & RS-485	9	BRN	DO4-SIGNAL	
	6	-	RS-485-1A	NORTHBOUND RS-485
	7	-	RS-485-1B	
	11	PR 1, WHT/ORG	ETH_RX-	ETHERNET
	12	ORG	ETH_RX+	
	13	PR 2, WHT/GRN	ETH_TX-	
	14	GRN	ETH_TX+	
15	-	NOT CONNECTED - CUT OUT	None	
X	-	CUT OUT		

**Table 4.1 DB15 Pin Definition**

Pin	Signal Name	Description
1	Digital Output1+	Alarm Output
2	Digital Output 1-	
3	Digital Output 2+	
4	Digital Output 2-	
5	Digital Output 3+	For Future (No Connection)
6	RS485_1A	
7	RS485_1B	Alarm Output
8	Digital Output 4+	
9	Digital Output 4-	
10	Digital Output 3-	
11	ETH_RX-	Ethernet
12	ETH_RX+	
13	ETH_TX-	
14	ETH_TX+	
15	--	No Connection

## 4.8.2 Rectifier Digital Output (DO) Dry Relay Contacts

### Function and Operation State

Refer to Table 4.2 for rectifier digital output (DO) dry relay contacts function and operation state.



**NOTE!** The contact operation can be changed by moving the jumpers for each of the connectors to the alternate location, as described in “Changing the Alarm Relay Configuration for the Digital Output (DO) Relay Functions” on page 54.

**Table 4.2 Digital Output (DO) Dry Relay Contacts**

Dry Contact	Function	Jumper Connection	Dry Contact State when Alarm is Active
DO1	Fuse / Breaker Fail	JP4, short pin 1 and 2	Open
		JP4, short pin 2 and 3	Closed
DO2	SPD Alarm Fail	JP3, short pin 1 and 2	Open
		JP3, short pin 2 and 3	Closed
DO3	AC OV or AC UV	JP2, short pin 1 and 2	Open
		JP2, short pin 2 and 3	Closed
DO4	Rectifier Fail	JP1, short pin 1 and 2	Open
		JP1, short pin 2 and 3	Closed

### Digital Output (DO) Relay Ratings

- a) 30 VDC: 1 A resistive.
- b) 125 VAC: 0.5 A resistive.

## Changing the Alarm Relay Configuration for the Digital Output (DO) Relay Functions

The alarm relay contact configurations can be changed. Refer to the following procedure.

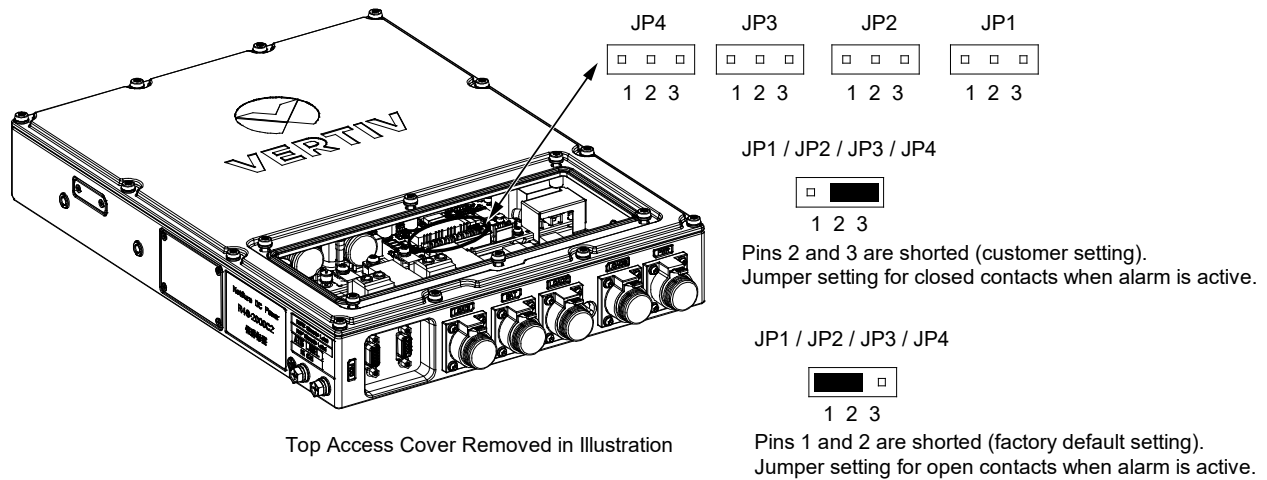
### Procedure



**DANGER!** Turn off AC input to unit before performing the following procedure.

1. Refer to “Opening / Closing the Front Access Panel” on page 64, and open the rectifier enclosure front access panel.
2. Locate jumpers JP1, JP2, JP3, and JP4. Set the jumpers per site requirements. See Table 4.2 and Figure 4.9.
3. Refer to “Opening / Closing the Front Access Panel” on page 64, and close the rectifier enclosure front access panel.

Figure 4.9: Changing Alarm Relay Configuration for Digital Output (DO) Relay Functions





## 4.9 Battery Connections



**WARNING!** Check for correct polarity before making connections.



**ALERT!** Battery power must be turned off before connecting or disconnecting the battery plug-in connector.



**NOTE!** The rectifier battery port may be used as a Load 4 port. Refer to “Operation in a Batteryless Installation” on page 58.

### 4.9.1 Narada Battery

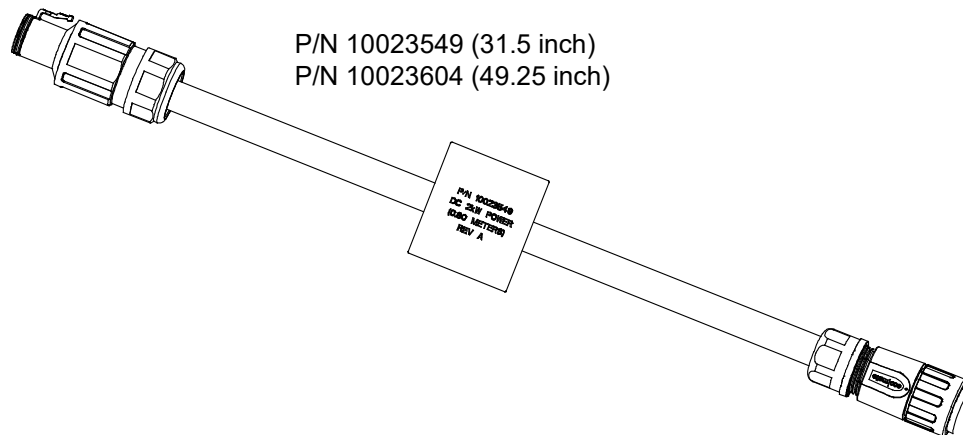
#### **-48 VDC Battery Connections**

The rectifier is equipped with a plug-in battery connector located on the bottom of the enclosure. See Figure 4.1 for location. A separately ordered battery cable assembly with a mating plug is required (refer to Figure 4.10). See also “Pre-Assembled Cables” on page 2.

#### **Procedure**

1. Connect the separately ordered battery cable assembly to a Narada battery. Refer to Figure 4.12 for a rectifier and Narada battery wiring diagram.

**Figure 4.10 Mating Narada Battery Cable Assembly P/N 10023549 and P/N 10023604 (Battery Connector)**



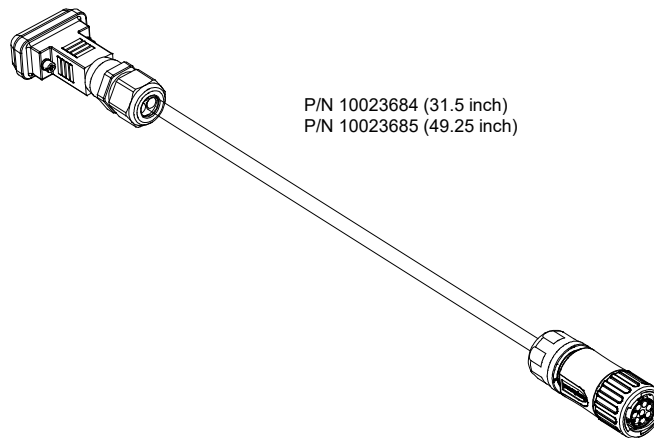
## Battery Alarm Interface Connections (DB9)

The rectifier is equipped with a plug-in battery alarm interface connector located on the bottom of the enclosure. See Figure 4.1 for location. A separately ordered battery alarm and communications cable assembly with a mating plug is required (refer to Figure 4.11). See also “Pre-Assembled Cables” on page 2.

### Procedure

1. Connect the separately ordered battery alarm and communications cable assembly to a Narada battery. Refer to Figure 4.12 for a rectifier and Narada battery wiring diagram. See also Table 4.3 for connector pin-outs.

**Figure 4.11 Mating Narada Battery Alarm Interface Cable Assembly P/N 10023684 and P/N 10023685 (DB9 Connector)**



**Table 4.3 DB9 Pin Definition**

Pin	Signal Name	Description
1	RS485_2A	The southbound RS485 interface to the battery.
2	RS485_2B	The southbound RS485 interface to the battery.
3	--	--
4	--	--
5	--	--
6	CAN+	Communicate with other rectifiers for parallel installation.
7	CAN-	Communicate with other rectifiers for parallel installation.
8	--	--
9	Digital Input	Sense the breaker state for parallel installation.

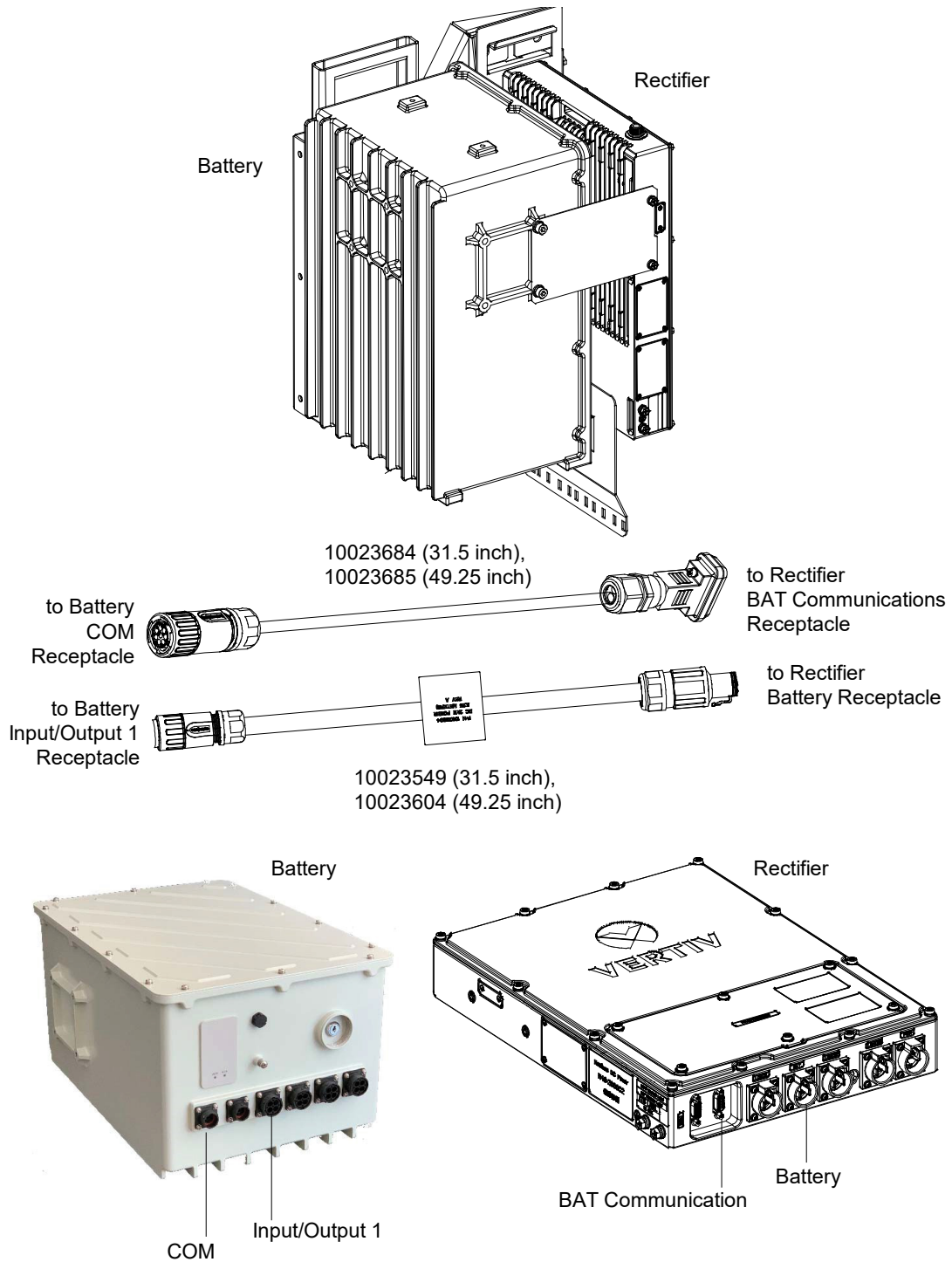
Note: Pins 6, 7, and 9 and not used in current application (FUTURE use).

## 4.10 Rectifier and Battery Wiring Diagram

### 4.10.1 Narada Battery

See Figure 4.12.

Figure 4.12 Rectifier and Narada Battery Wiring Diagram



## 4.11 Operation in a Batteryless Installation

The rectifier may be used in a batteryless installation. Refer to this section for batteryless installation notes and to set up the rectifier for batteryless operation.

### **Batteryless Installation Notes**

The rectifier battery port may be used as a Load 4 port. Refer to Figure 4.1 on page 44 for the battery port location. Use the same pre-assembled cable as used for the Load 1 port. See Table 1.4 on page 2 for Load 1 cable part number and description.

### **-48 VDC Output Load4 Connections (2kW) (to Battery Port when used in a Batteryless Application)**



**WARNING!** Check for correct polarity before making connections.



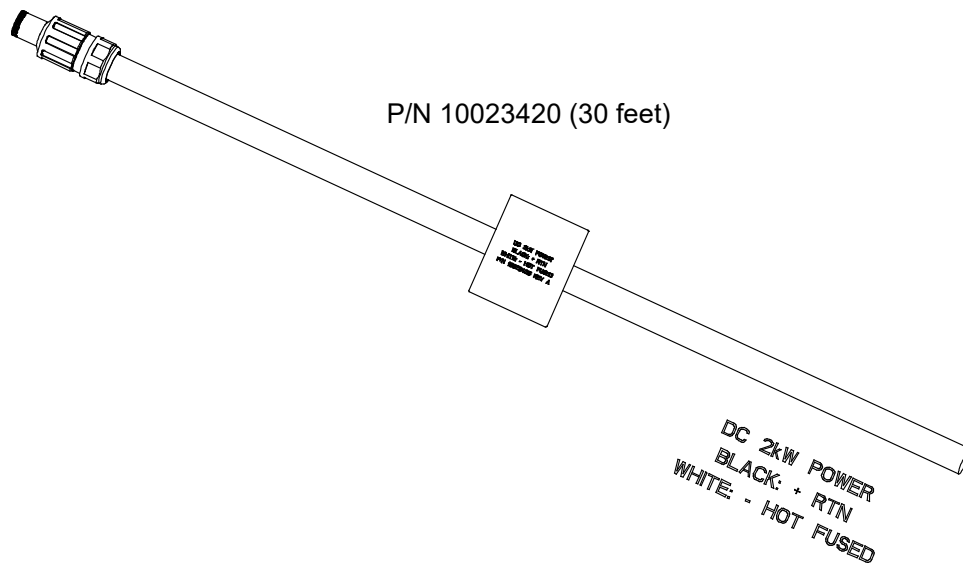
**ALERT!** AC power and battery power must be turned off before connecting or disconnecting any DC load plug-in connector.

The rectifier is equipped with a plug-in Battery connector located on the bottom of the enclosure. The rectifier Battery port may be used as a Load4 port in a batteryless application. A separately ordered 2kW DC output cable assembly with a mating plug is required (refer to Figure 4.13).

### **Procedure**

1. Connect the separately ordered DC output Load4 cable assembly to Load 4 (2kW) as shown in Figure 4.13. Connect the black lead to Load Return. Connect the white lead to -48 VDC Load.

**Figure 4.13 Mating Load4 Cable Assembly P/N 10023420 (to Battery Port when used in a Batteryless Application)**



## Batteryless Operation

For batteryless operation, recommended controller settings are provided in Table 4.4.



**IMPORTANT NOTE!** Controller is configured assuming connection to Narada battery. For batteryless operation, several changes are required to be made via Bluetooth APP settings page (shown in third column of table below). Furthermore, if "BATT/Output 4" port is desired to be used as a Load port, then the current limit setting should be changed to 1C from default 0.1C.

**Table 4.4 Batteryless Operation Rectifier Controller Settings**

Controller Setting	Recommended Settings with Narada Battery	Batteryless Operation Settings (Use Battery Port as Load 4 Port)	Notes
Float	54.2 V	54.2 V	No change required.
UV 1 alarm	47.5 V	49.0 V	Set to new value shown.
UV 2 alarm	46.5 V	46.5 V	No change required.
Walk-in	60 seconds	8 seconds	Set to new value shown.
Bat Rated Cap	50 Ah	50 Ah	No change required.
Curr Limit	0.1C	1C	Set to value shown to allow output to maximum port rating.
LVD	--	--	LVD function is not in software, since with battery the battery has internal BLVD, and since without battery if AC fails the system goes dead.
BCL	Enable	Disable	Must be set to "Disabled" or Load 4 port will be current limited.

## 4.12 Lashing of Cords and Cables



**NOTE!** A strain relief plate is furnished and attached to the rectifier as outlined in the previous procedures.

Follow all local laws and practices for installation requirements and clearances from power facilities. Installation must meet all applicable laws, ordinances, rules, and codes.

All flexible power and signal cords attached to rectifier, battery, and DC distribution boxes (if any), shall be lashed within 12-inches of the cord connection, so as not to transfer tension or pull on the physical connector termination or joint.

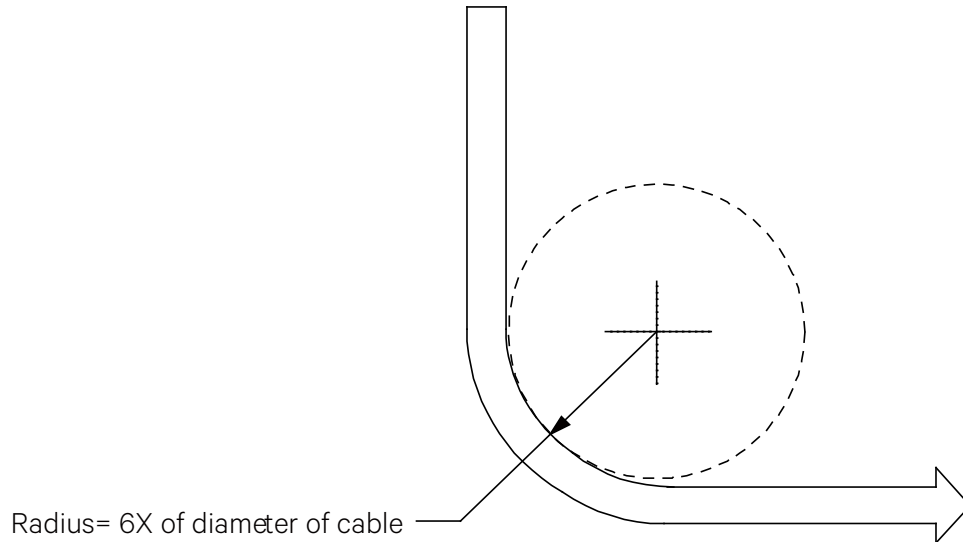
Connectors are IP65 rated when not accommodating installation cord or cable tension or pull.

At installation, use only approved outdoor rated devices and fittings, to protect all cords and cables from physical damage. Installer to use appropriate cable strain relief fittings/brackets as locally approved for pole and/or wall mounting.

Cords and cables shall be lashed and supported at intervals not exceeding 6-feet.

Vertiv recommends a minimum cable bend radius of 6X of the cable diameter. Example: 0.8-inches cable outer diameter, shall be installed using a 6 x 0.8-inches or 4.8-inches inside bend radius, minimum.

**Figure 4.14 Cable Bend Radius**



## 4.13 Final Step

If any of the connectors located on the bottom of the unit are left unused, attach the provided connector dust cover onto the unused connector.

## 5 Initially Starting, Configuring, and Checking Rectifier Operation

### 5.1 Initially Starting the Rectifier (assuming battery to be connected to rectifier)

#### Procedure

1. Make any internal rectifier jumper settings inside the rectifier as required before powering up the rectifier. This includes Bluetooth, DO alarms, and +RTN bonding.
  - Refer to “Bluetooth Jumper Setup” on page 16.
  - Refer to “Changing the Alarm Relay Configuration for the Digital Output (DO) Relay Functions” on page 54.
  - Refer to “Rectifier Ground Connection” on page 46.
2. Verify all customer side DC load output connections are properly terminated, carefully paying attention to +/- DC polarity at the output. Customer must verify DC polarity output to load before energizing rectifier.
3. With battery power disconnected by placing the Narada battery ON/OFF switch to the OFF position, apply AC input power to the rectifier by closing the external AC input power disconnect or protective device. The rectifier starts automatically.
4. The rectifier software settings must be reviewed, and set-up as required for the installation, including double checking battery float voltage (it is default set to 54.2 VDC), before performing the next step.
5. Apply battery power to the system by placing the Narada battery ON/OFF switch to the ON. Note that there is a key supplied with the battery necessary to operate the battery ON/OFF switch. The key should be stored per operator’s practices and procedures.

### 5.2 Configuring the Rectifier



**NOTE!** Rectifier controller auto senses battery connection via MODBUS and will configure the rectifier float voltage automatically when battery is turned "on". (Factory default is 54.2 V for Narada battery.)

Refer to Table 5.1 for required rectifier controller settings (with use of Narada battery).

**Table 5.1 Rectifier Controller Settings**

Controller Setting	Recommended Settings with Narada Battery	Notes
Float	54.2 V	No change required.
UV 1 alarm	47.5 V	No change required.
UV 2 alarm	46.5 V	No change required.
Walk-in	60 seconds	Change from default setting of 8 seconds.
Bat Rated Cap	50 Ah	No change required.
Curr Limit	0.1C	No change required.
BCL	Enable	No change required.

## 5.3 Setting Up via Bluetooth

Refer to “Accessing the Rectifier Controller via Bluetooth” on page 67 for rectifier Bluetooth access.

## 5.4 Checking Rectifier Status

### **Procedure**

1. Observe the status of the local indicators (visible from the outside through a window located on the left side of the rectifier). If operating normally, the status of these is as shown in Table 5.2. See Figure 6.1 for location.

**Table 5.2 Status and Alarm Indicators**

Indicator	Normal State
Status (Green)	On
Observation Alarm (Yellow)	Off
Critical or Major (Red)	Off

## 5.5 Checking Battery Status

The battery connection and charging status can be verified via the Bluetooth APP and through the ethernet webpage interface.



## 6 Operation

### 6.1 Rectifier Local Indicators

There are three (3) indicators located inside the rectifier enclosure (visible from the outside through a window located on the left side of the rectifier). See Figure 6.1 for location and Table 6.1 for indicator functions.



**NOTE!** AC voltage must be present at the rectifier input terminals for indicators to be functional.

Figure 6.1 Local Indicator Locations

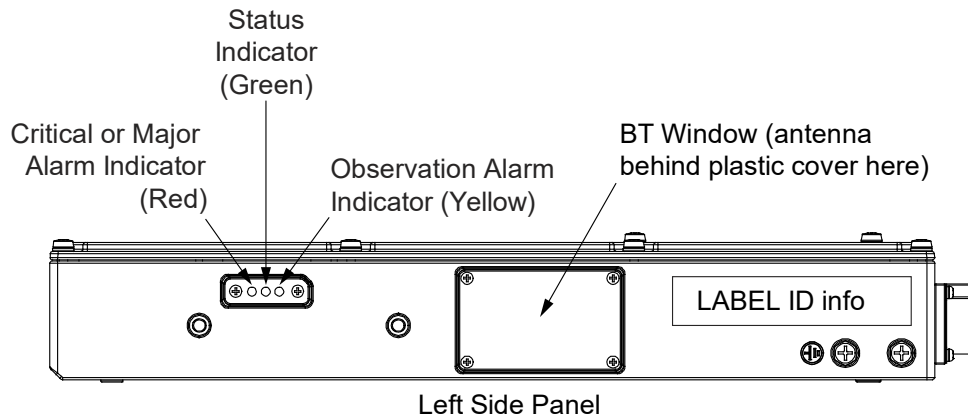


Table 6.1 Local Indicators

Indicator	Color	Normal State	Fault State	Fault Cause
Status	Green	On	Off	No operation power supply.
Observation Alarm	Yellow	Off	On	There is an observation alarm.
Critical or Major Alarm	Red	Off	On	There is a major or critical alarm.



**NOTE!** Load sharing is not in scope in the single rectifier system.



**NOTE!** Rectifier controller software version V1.00.16 and earlier may show an Observation Alarm (OA) (yellow LED alarm indicator illuminated, see above) if powered at 120 VAC input. This alarm can be masked in later software versions by setting the AC Voltage setting (in the Setting tab of the Bluetooth App) to the 120V selection.

### 6.2 Narada Battery Local Indicators

Two (2) LED indicators are located on the bottom side of the Narada battery. Refer to the Narada Operation Manual (Version 1.0 or later) for operating status of these.

### 6.3 Rectifier High Voltage Shutdown and Lockout Restart

#### Procedure

1. Remove AC input power to the rectifier. Wait 30 seconds or more (until the LEDs on the rectifier extinguish). Re-apply AC input power to the rectifier.

## 6.4 Opening / Closing the Front Access Panel



**DANGER!** Hazardous voltages are exposed when the cover is opened, and power is applied to the unit. Make sure AC power and DC battery inputs are de-powered before opening the small access cover. The small panel is for customer access, but the main front cover with perimeter tamper-proof screws is NEVER INTENDED TO BE OPENED.

Refer to the following procedure to open and close the rectifier enclosure front access panel.

### Procedure

1. To open, refer to the procedure in Figure 6.2. Tighten the hardware circled in the bottom view of Figure 6.2 to secure the access cover in the open position.
2. To close, refer to the procedure in Figure 6.3. Ensure the access panel is securely closed and the screws are torqued to 22 in-lbs.

Figure 6.2 Opening the Rectifier Enclosure Front Access Cover

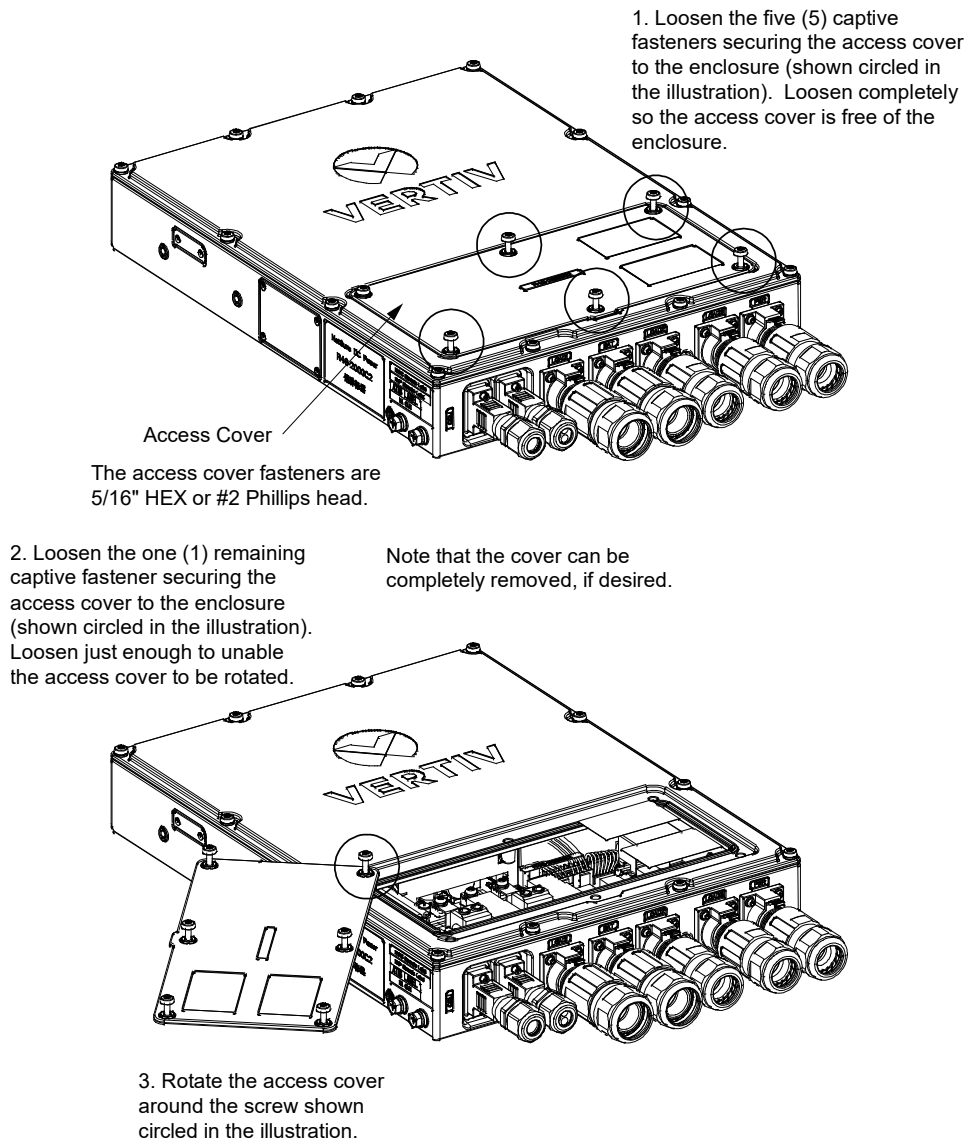
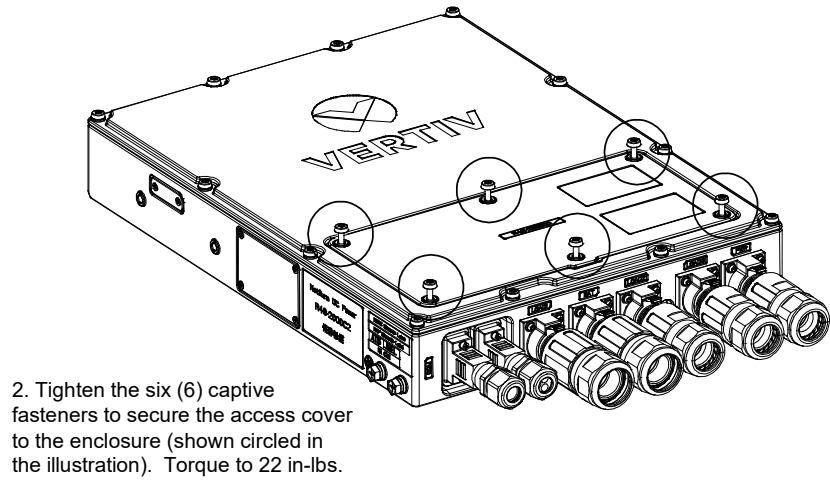
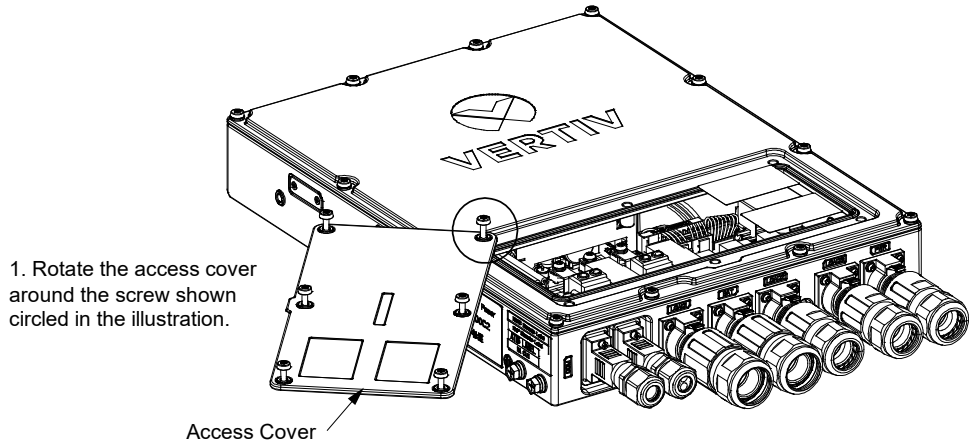


Figure 6.3 Closing the Rectifier Enclosure Front Access Cover



## 7 Controller and Controller Interface

### 7.1 General

Integrated inside the rectifier enclosure is a controller.

### 7.2 Controller Overview

#### 7.2.1 General

The controller performs the following functions:

- Rectifier Control and Monitoring (via internal CAN communication)
- Battery Monitoring (via Modbus communication)
- Alarms Generation (including history alarms log in Webpage)
- User Access via a Smartphone using a Bluetooth APP and/or a Computer Web Browser (Web Interface) Over an Ethernet Connection
- Access via an NMS (Network Management System) using SNMP (v2) over Ethernet Connection

#### 7.2.2 Rectifier Control and Monitoring

The controller controls the rectifier automatically via configured parameters. The controller monitors rectifier operation and performance. The controller board has one (1) CAN bus port, which is used to communicate with the rectifier board.

- The controller acquires, analyses, and processes rectifier information to monitor, manage, and report rectifier operation in real time.

#### 7.2.3 Battery Monitoring

The controller monitors battery operation and performance. Note that battery management is done via the battery itself. The battery has an internal Battery Management System (BMS). The controller board has two RS485 ports. The RS485-2 port is used to connect to "southbound" devices (i.e., battery's BMS). See Figure 4.1 for battery communications connections. The controller communicates with a battery using the Modbus protocol over an RS485-2 connection.

- The controller acquires, analyses, and processes battery information to monitor and report battery operation in real time.

#### 7.2.4 Alarms Generation

##### **General**

The controller monitors the rectifier and battery for alarm conditions. The controller generates alarms if a fault condition occurs. The controller also maintains an alarm history log. The log is viewed using the Web Interface.

- Alarm Management: The controller provides function of active alarm list and an alarm history log.
- Alarm History Log: The Web Interface displays the latest 5000 alarms that have occurred and been cleared.



**NOTE!** The alarm history log is only stored in the ethernet web pages, and not in the Bluetooth APP. Once the maximum number of log entries is reached, new entries overwrite the oldest entries.

##### **Alarms**

The possible alarms that can be reported by the controller are listed in Table 8.1 on page 94. The alarms are programmed with an alarm severity level as shown in Table 8.1 on page 94. Alarm severity levels and their attributes are as follows:

## Alarm Severity Levels

- CA Critical Alarm: The fault endangers the power systems continued function.
- MA Major Alarm: The fault reduces the power systems functionality.
- OA Observation Alarm: Special operating condition.
- NA No Alarm: The alarm is disabled, and no alarm is given.



**NOTE!** The Ethernet webpages keeps a log of alarms. The Bluetooth APP does not keep a log of alarms. Alarms are lost after logging out of system in the BT APP.

## Controller Relay Outputs (DO)

Specific alarms are mapped to the controller's relay outputs (DO). The controller's relay outputs (DO) can then be wired to external alarm circuits. See "Rectifier Digital Output (DO) Dry Relay Contacts" on page 53.

### 7.2.5 User Access via a Smartphone App using Bluetooth Connection and/or a Computer Web Browser (Web Interface) Over an Ethernet Connection

The controller supports on site access via a smartphone APP through Bluetooth. The communication distance is up to 32-feet (dependent on interference sources at the installation site). See "Accessing the Rectifier Controller via Bluetooth" on page 67. See also "Bluetooth Jumper Setup" on page 16.

The controller can be accessed from a computer browser (Web Interface) over an Ethernet connection. See "Accessing the Rectifier Controller via Ethernet" on page 84.

### 7.2.6 Access via an NMS (Network Management System) using SNMP (v2) over Ethernet Connection

The controller can be accessed via an NMS (Network Management System) using SNMP over ethernet connection. Refer to "System Settings Programmable Parameter Descriptions" on page 76 to set up SNMP. See "Accessing the Controller via a Network Management System (NMS)" on page 93 for operation information.



**NOTE!** SNMP information such as trap destination, public and private community settings may only be input via BT and not Ethernet, since Ethernet connection is a VIEW ONLY interface.

## 7.3 Accessing the Rectifier Controller via Bluetooth

### 7.3.1 Mobile Device and Mobile Device Operating System Version Requirements

The Bluetooth APP supports iOS and Android devices, when the following requirements are met:

- iOS Model
  - iOS Version: iOS 8.0 and above.
  - iOS Phone: Screen size of 4.7" or larger.
- Android Model
  - Android Version: Android 5.1 and above.
  - Android Phone: Screen size of 4.7" or larger.

### 7.3.2 Bluetooth APP

#### General

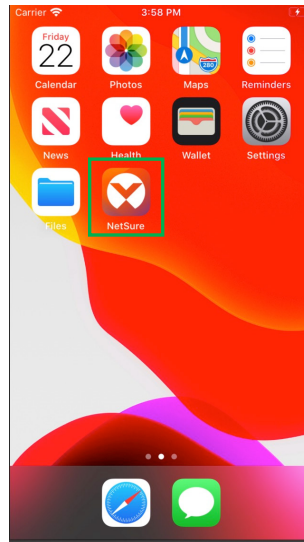
The controller provides a mobile wireless communication connection. Refer to the next sections to use the Bluetooth APP.

### 7.3.3 Setting Up the Bluetooth Connection

#### **Procedure**

1. Set the Bluetooth jumper. See “Bluetooth Jumper Setup” on page 16.
2. Acquire the Vertiv™ NetSure™ app and install the App on the mobile device.
  - iOS APP: Acquire the Vertiv™ NetSure™ app from Apple App Store.
  - Android APP: Acquire the Vertiv™ NetSure™ app from Vertiv product Website / Google Play Store.
3. Power up the rectifier before trying to connect to it with the mobile device.
4. Ensure mobile device, such as Cellphone, has Bluetooth Communications ON and ready to pair to other devices. In addition, for an Android cellphone, location must be ON.
  - The app supports one-to-one Bluetooth connection only.
5. With rectifier turned "on", the controller will broadcast a unique Bluetooth address. Connect to the appropriate unit ID.
6. Bluetooth Pairing – password is required in app for controls.
  - Read Only Account: Username: browser; Password: 123456
  - Admin Account: Username: admin; Password: 640275

**Figure 7.1 APP Running on an iOS Device**



### 7.3.4 Using the Bluetooth Application

The following sections introduce the mobile APP Screen, Homepage Screen, Alarm Icon, Setting Icon, Swap Controller Icon, and About Page Icon.



**NOTE!** The screens presented below are examples. The real content may be different according to the configuration, system mode, and system status.

#### **Bluetooth Login Screen**

Supported Application Language: English and Chinese

There are two account types: Read Only and Read-Write (Admin).

- Read Only Account: Username: browser; Password: 123456
- Read-Write Account (Admin): Username: admin; Password: 640275



**NOTE!** It is a best practice to change the password using a combination of upper-case letters, lower-case letters, and numbers.



**NOTE!** Each controller has a unique identifier when connected via Bluetooth. If a site has multiple rectifiers installed, each rectifier has a unique identifier, such as "Vertiv 2000C2 C2F609" for example.

Enter the following for Bluetooth read-write access to change controller settings:

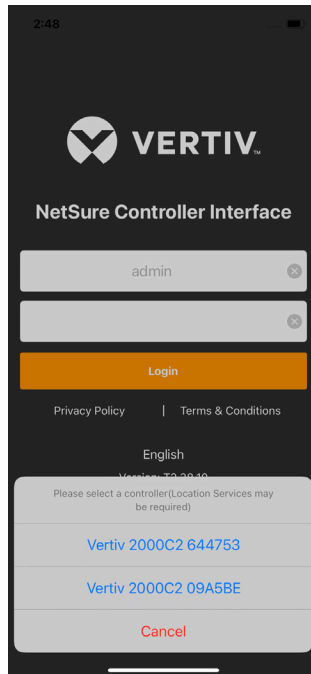
- Username: admin
- Password: 640275

## **Bluetooth Connection**

### **Procedure**

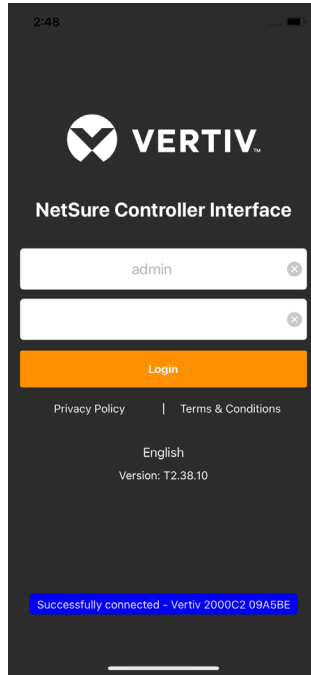
1. Open the Vertiv™ NetSure™ app on the mobile device. A list of supported controllers found in the Bluetooth connection appears. Select a controller from the list to connect (see Figure 7.2).

**Figure 7.2 Bluetooth Connection**



2. A connected successful screen appears (see Figure 7.3).

Figure 7.3 Connected Successfully

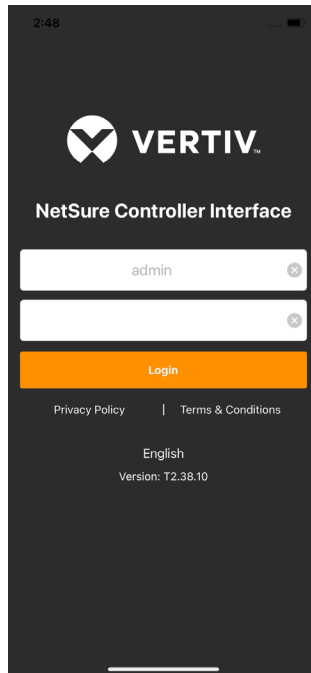


## **Login Screen**

### **Procedure**

1. After successfully connecting to a controller, the following login screen appears (see Figure 7.4).

Figure 7.4 Login Screen





2. Enter a valid Username and Password, then select “Login”.



**NOTE!** When you first login to the Vertiv™ NetSure™ app, you must read and agree to the Privacy Policy (Figure 7.5) and Terms & Conditions (Figure 7.6).

3. After logging into the App, the Homepage screen appears (see Figure 7.7).

Figure 7.5 Privacy Policy Page

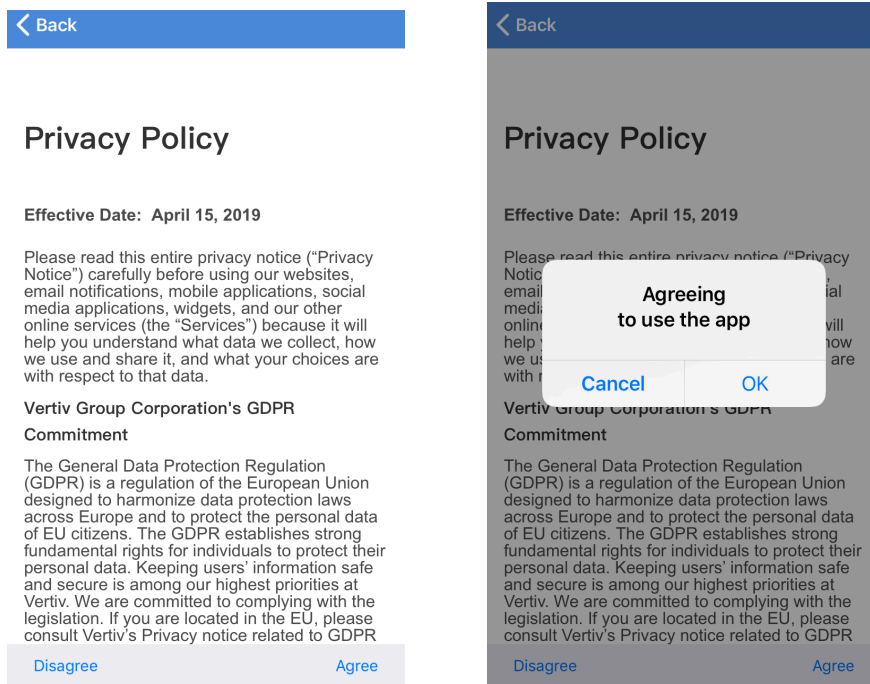
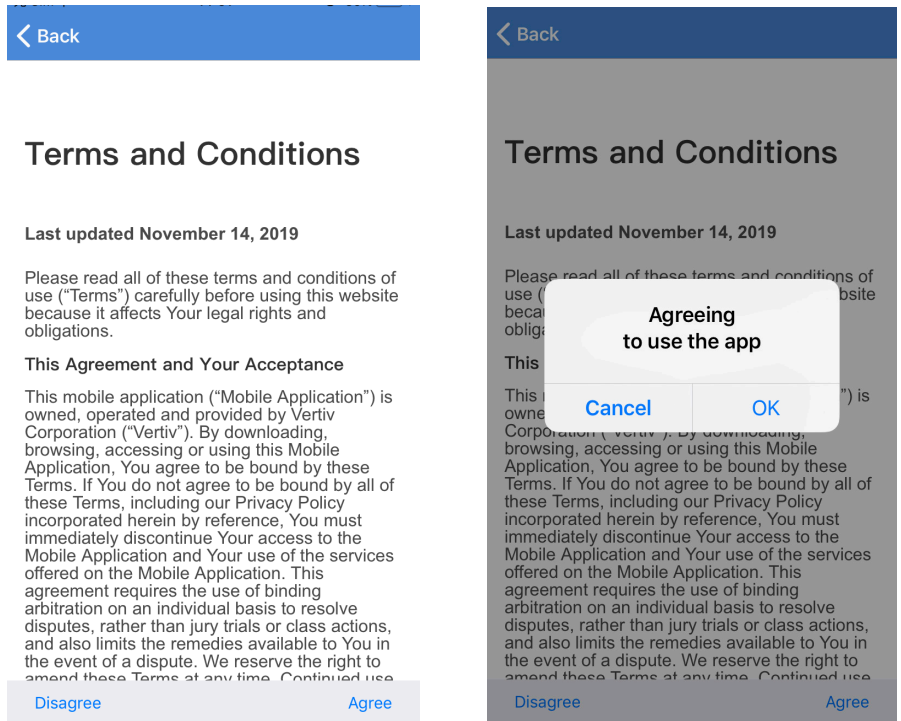


Figure 7.6 Terms & Conditions Page

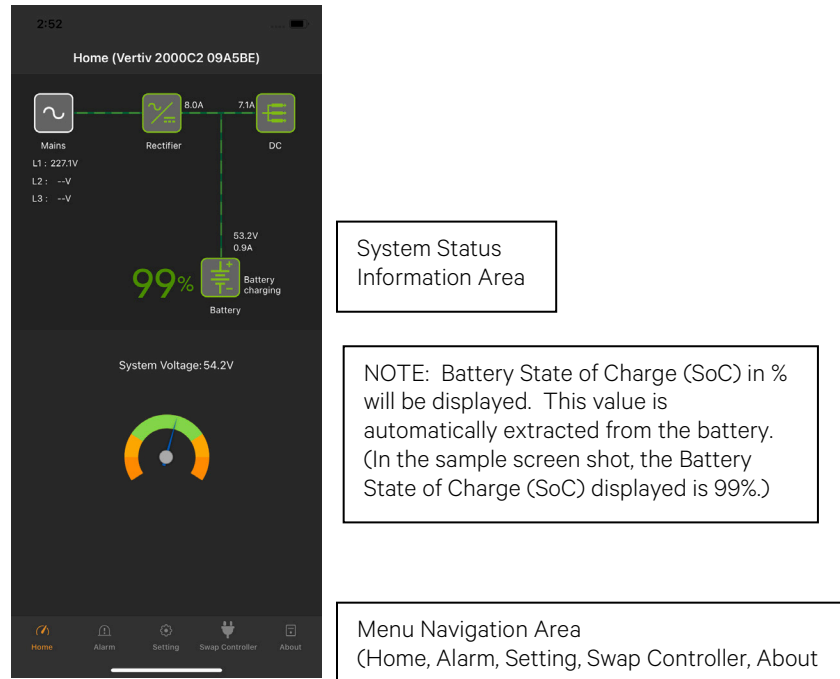


## Homepage Screen

The Homepage screen includes a system status information area and a menu navigation area (see Figure 7.7).

- From the system status information area, you can obtain information on the rectifier and battery by touching the “Rectifier” and “Battery” icons, as described in the following procedures.
- From the menu navigation area, you can navigate to the other screens, as described in the following procedures.

**Figure 7.7 Homepage Screen**



## Menu Navigation Area

The menu navigation area contains the following menu icons: Home, Alarm, Setting, Swap Controller, and About. The menu navigation area always appears in each screen.

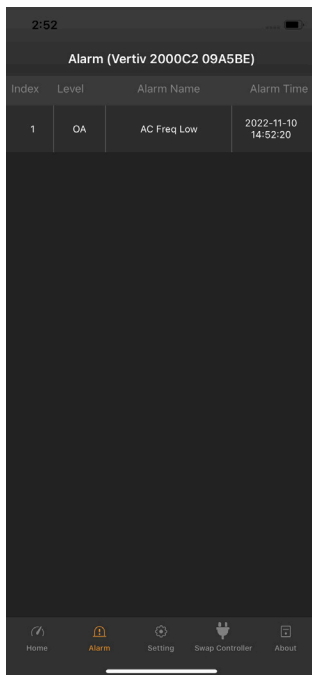
### Home Icon

When in other screens, click on the Home Icon to go to the Homepage screen.

## **Alarm Icon and Alarm Screen**

In the menu navigation area, click on the Alarm Icon to go to the Alarm screen. The Alarm screen displays active alarms. See Figure 7.8.

**Figure 7.8 Alarm Screen**

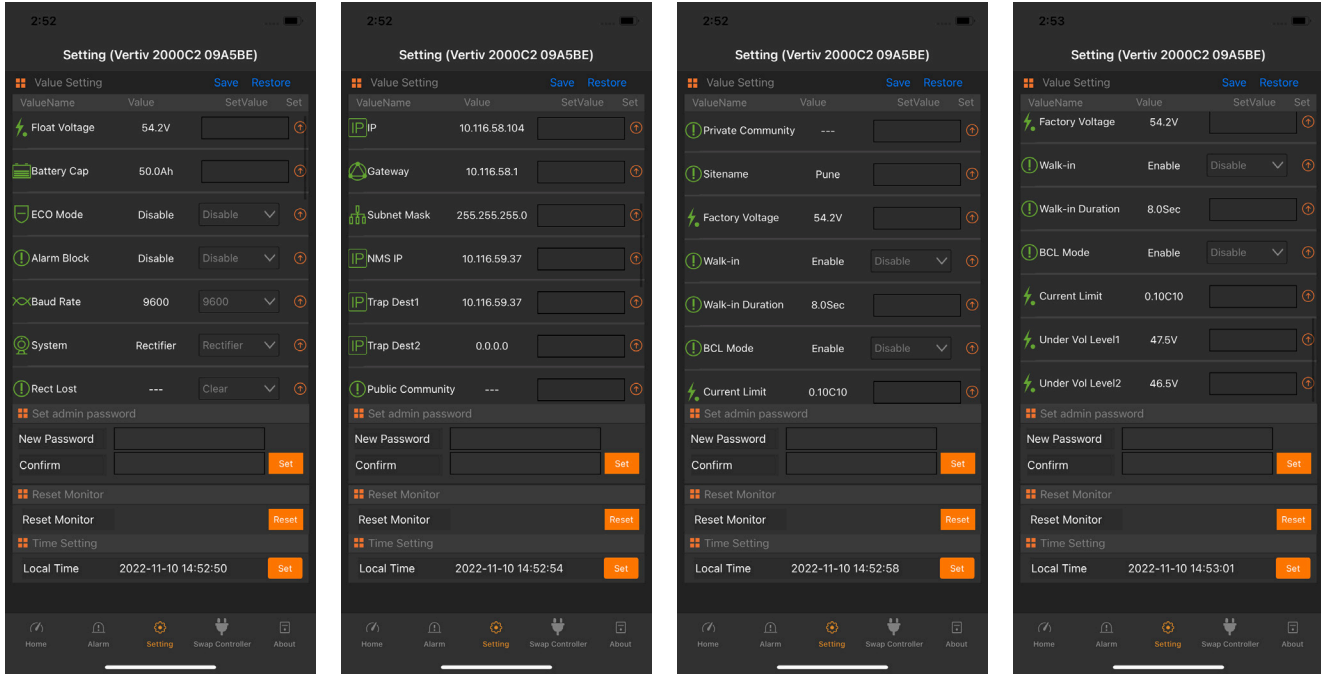


## Setting Icon and Setting Screen

In the menu navigation area, click on the Setting Icon to go to the Setting screen (see Figure 7.9).

The settings are divided into Value Setting, Set Admin Password, Reset Monitor, and Time Setting. The Value Setting supports save and restore function.

Figure 7.9 Setting Screen



V1.00.18 and Later Versions (such as V1.10.03) Showing 120V or 230V AC Input Voltage Selection, Default at 230V, Selectable to 120V

**Procedure**

- To change a setting, go to the “Set Value” column when in the Setting Tab, enter or select a value, and then click “Set” to save the value. If the value is none, ‘—’ displays.

**System Settings Programmable Parameter Default Values and Value Ranges**

Refer to Table 7.1 for the default values and value ranges of the system settings programmable parameters.

**Table 7.1 System Settings Programmable Parameter Default Values and Value Ranges**

Parameter Name	Default Value	Value Range
Float Voltage	54.2 VDC	42 VDC to 58 VDC
Battery Cap	50.0 Ah	8 Ah to 50000 Ah
ECO Mode	Disable	Disable, Enable
Alarm Block	Disable	Disable, Enable
Baud Rate	9600	9600, 19200
System	Rectifier	Rectifier
Rect Lost	--	Clear-App Side
IP	192.168.1.2	format nnn.nnn.nnn.nnn, where 0 ≤ nnn ≤ 255
Gateway	192.168.1.1	
Subnet Mask	255.255.255.0	
NMS IP	0.0.0.0	
Trap Destination1	0.0.0.0	
Trap Destination2	0.0.0.0	
Public Community	public	Up to Six (6) Characters (Alphanumeric)
Private Community	strpri	Up to Six (6) Characters (Alphanumeric)
Sitename	--	Two (2) to Sixteen (16) Characters (Alphanumeric)
Factory Voltage	54.2 VDC	40 VDC to 60 VDC
Walk-in	Enable	Disable, Enable
Walk-in Duration	8 Seconds	8 Seconds to 128 Seconds
BCL Mode	Enable	Disable, Enable
Current Limit	0.1C10	0.04C10 to 1.0C10
Under Vol Level1	47.5 VDC	40 VDC TO 60 VDC
Under Vol Level2	46.5 VDC	40 VDC to 60 VDC
<b>V1.00.18 and Later</b>		
AC Input Voltage	230V	230V or 120V

**System Settings Programmable Parameter Descriptions**

- Float Voltage:** Enter the float charge output voltage setting (per battery manufacturer recommendation). In batteryless applications, leave at battery float. Click Set.
- Battery Cap:** Enter the battery’s rated capacity (Ah rating). Click Set.
- ECO Mode:** Not used in this application.

- **Alarm Block:** When the outgoing alarms are blocked, the alarms shall not trigger relay outputs. The active alarms are continued to be displayed in the mobile app and in the Web pages. Select 'Yes' to block alarm from being transmitted or 'No' to allow notification. Click Set.
- **Baud Rate:** Enter the battery communication baud rate for the RS-485 port: 9600 (data bit, parity, and stop bit of 8, n, 1 are fixed). Click Set.
- **System:** The only system is rectifier.
- **Rect Lost:** Clears the Rectifier Lost Alarm (i.e., when rectifier is removed and replaced). Select Clear and click set.
- **IP:** Sets the controller's IPv4 address. Enter the address in the format nnn.nnn.nnn.nnn, where  $0 \leq nnn \leq 255$ . The address must be a valid address and must not be 255.255.255.255. Enter a value and click Set.



**NOTE!** After changing the IP Address, you will need to login again with the new IP address.

- **Gateway:** Sets the controller's IPv4 gateway address. Enter the address in the format nnn.nnn.nnn.nnn, where  $0 \leq nnn \leq 255$ . This is the address of the gateway of the network on which the controller resides. The address must be a valid address and must not be 255.255.255.255. Enter a value and click Set.
- **Subnet Mask:** Sets the controller's IPv4 network netmask. Enter the address in the format nnn.nnn.nnn.nnn, where  $0 \leq nnn \leq 255$ . Enter a value and click Set.
- **NMS IP:** Sets the permitted IP to access the NMSV2 agent. Enter the address in the format nnn.nnn.nnn.nnn, where  $0 \leq nnn \leq 255$ . The address must be a valid address and must not be 255.255.255.255. Enter a value and click Set.
- **Trap Destination1:** Sets the IP to which the trap is sent. Enter the address in the format nnn.nnn.nnn.nnn, where  $0 \leq nnn \leq 255$ . The address must be a valid address and must not be 255.255.255.255. Enter a value and click Set.
- **Trap Destination2:** Sets the IP to which the trap is sent. Enter the address in the format nnn.nnn.nnn.nnn, where  $0 \leq nnn \leq 255$ . The address must be a valid address and must not be 255.255.255.255. Enter a value and click Set.
- **Public Community:** Sets the public community string. Enter a value and click Set.
- **Private Community:** Sets the private community string. Enter a value and click Set.
- **Site Name:** Enter the site name. Click Set.
- **Factory Voltage:** Enter the factory default voltage. Click Set.
- **Walk-in:** Enables or disables the rectifier's start-up walk-in feature. Select Enabled or Disabled and Click Set.
- **Walk-in Duration:** Sets the rectifier start-up walk-in time (in seconds) when the "Walk-In" setting above is set to enabled. Enter a value and click Set.
- **BCL Mode:** Enables or disables the Battery Current Limit (BCL) mode. Select Enabled or Disabled and Click Set.



**NOTE!** Narada battery requires BCL to be ENABLED at max 0.1C rate for Warranty purposes and long-life operation of the battery. Recharge current limit is critical to long battery life (5 A for 50 Ahr Narada battery).

- **Current Limit:** Enter the maximum battery charging current setting. Click Set. For example, a value of 0.150C10 means that the charging current is limited to 15% of the battery's nominal capacity.
- **Under Vol Level1:** Enter the Under Voltage Level1 alarm point. Click Set.
- **Under Vol Level2:** Enter the Under Voltage Level2 alarm point. Click Set.

- Set admin Password: Enter a password in the "New Password" field. Sixteen (16) characters maximum; the valid characters are alphanumeric values (i.e., 0-9, a-z, A-Z). Special characters are not allowed. Passwords must be at least six (6) characters long. Re-enter the password in the "Confirm Password" field. Click Set.
- Reset Monitor: Resets the monitor.
- Time Setting: Sets the time and date.



**NOTE!** It is recommended to set the correct time and date immediately after turn-up (to track history of events).

V1.00.18 and Later

- AC Input Voltage Setting: Select the AC input voltage connected to the rectifier (120V or 230V).



**NOTE!** Rectifier software version V1.00.16 and earlier will generate an Observational Alarm (OA) and the yellow LED will illuminate if 120 VAC nominal input voltage is utilized. This is an "AC-A Volt Low" alarm. If the situation outlined above exists, this alarm should be ignored. For version V1.00.18 and later, the "AC Input Voltage Setting" corrects this situation when set to 120V. Default voltage setting is 230VAC input, and must be changed to 120V (if desired) via the AC voltage setting in the Settings Tab.

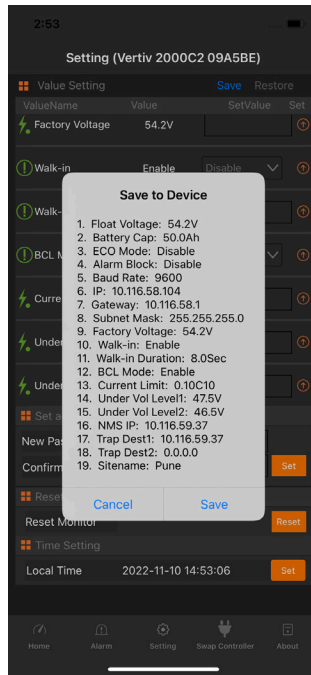
**Save Data Function**

The Save Data function saves the controller’s settings to your device (see Figure 7.10).

Procedure

1. To save the controller’s settings to your device, click “Save” in Value Setting. The Save to Device screen appears. Click “Save”.

**Figure 7.10 Save Data Screen**





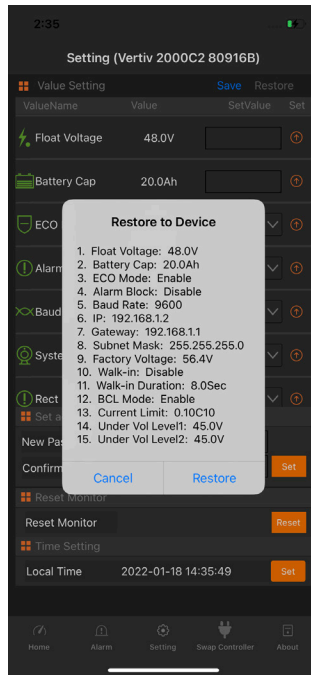
## Restore Data Function

The Restore Data function restores the controller's settings previously saved to your device into the controller (see Figure 7.11).

### Procedure

- To restore the controller's settings from your device to the controller, click "Restore" in Value Setting. The Restore to Device screen appears. Click "Restore".

Figure 7.11 Restore Data Screen



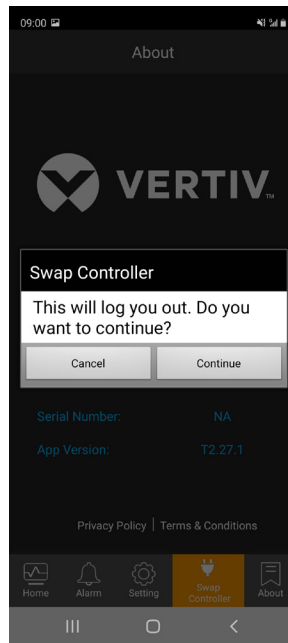
## **Swap Controller Icon and Swap Controller Screen**

In the menu navigation area, click on the Swap Controller Icon to go to the Swap Controller screen (see Figure 7.12). Click Continue. This will log you out of the connected controller and allow you do connect to a different controller.



**NOTE!** *Swap Controller is also the method used to LOGOUT of the controller.*

**Figure 7.12 Swap Controller Screen**



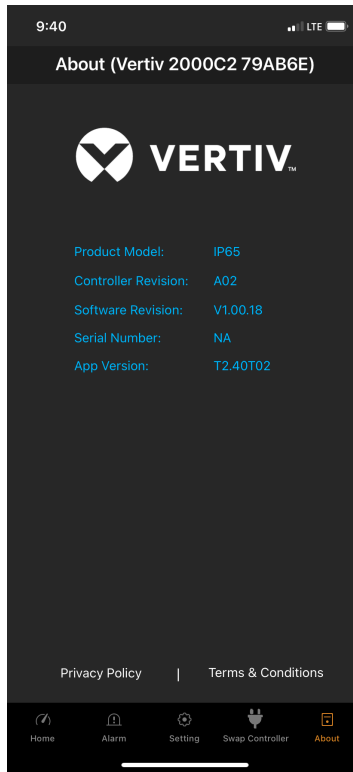
## **About Icon and About Screen**

In the menu navigation area, click on the About Icon to go to the About screen (see Figure 7.13).

The About screen displays the Product Model, Controller Revision, Software Revision, Serial Number, and App Version.

TIP: The Software Revision and APP Version are key details if troubleshooting.

**Figure 7.13 About Screen**

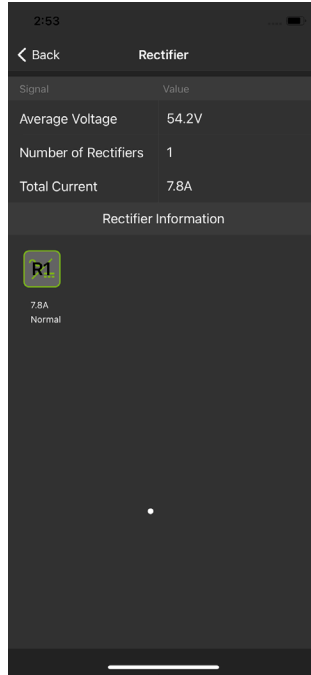


## System Status Information Area

### Rectifier Icon

In the Homepage screen (see Figure 7.7 on page 73), click on the Rectifier Icon (  ) to go to the Rectifier screen (see Figure 7.14).

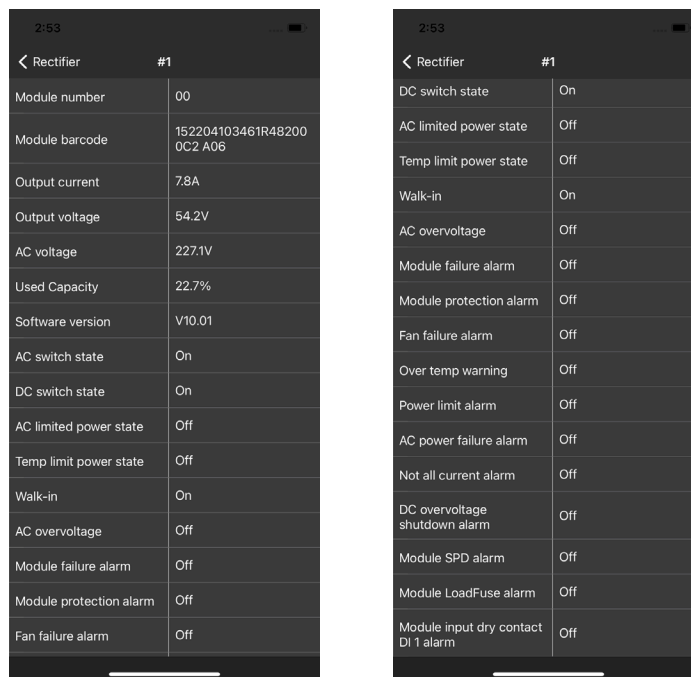
Figure 7.14 Rectifier Screen




### Rectifier Information Screen

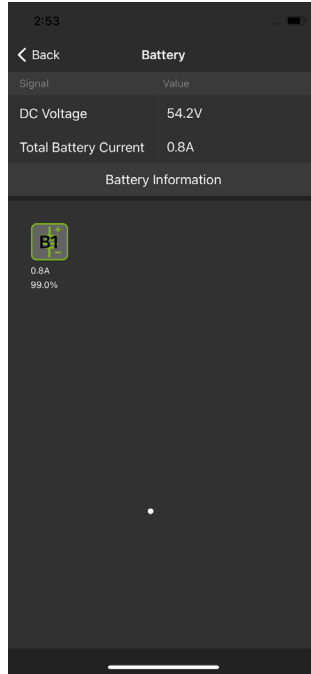
In the Rectifier screen, click on the particular Rectifier icon to go to the Rectifier Information screen (see Figure 7.15).

Figure 7.15 Rectifier Information Screen



**Battery Icon (Narada Battery)**

In the Homepage screen (see Figure 7.7 on page 73), click on the Battery Icon (  ) to go to the Battery screen (see Figure 7.16).

**Figure 7.16 Battery Screen (Narada Battery)****Battery Information Screen (Narada Battery)**

In the Battery screen, click on the Battery icon to go to the Battery Information screen (see Figure 7.17).

**Figure 7.17 Battery Information Screen (Narada Battery)**

The screenshot shows a mobile application interface for battery information. At the top, the time is 2:18. Below the status bar, there is a navigation bar with a back arrow and the word "Battery". Underneath, there is a table with two columns: "Signal" and "Value". The table contains ten rows of data. Below the table, there is a section titled "Battery Information". In this section, there is a green square icon with "B1" and a battery symbol. Below the icon, the text "0.8A" and "99.0%" is displayed.

Signal	Value
Pack Volt Value	53.2 V
Current	27.2 A
Remaining Capacity	49.8 Ah
Average Cell Temp	1.5 °C
Env Temp	11.0 °C
Model Number	FEN4850
SW Version	V11.0
HW Version	V0.0.8.1.1
Serial Number	148050A02021013100 06

## 7.4 Accessing the Rectifier Controller via Ethernet (Web Interface)



**NOTE!** The controller supports a 10/100M Ethernet connection.

### 7.4.1 Overview

Via the Web Interface, a User can:

- View real-time operating information (rectifier and battery).
- View active alarms and alarm history.

### 7.4.2 Supported Browsers

Multiple browsers are supported in the Web Interface. The User can use Edge, Chrome, Safari, or Firefox.



**NOTE!** Changes to the controller settings are primarily done via Bluetooth APP. Ethernet does not support changing controller settings at this time.

### 7.4.3 Connecting a Local Computer Directly to the Controller

Connect a local computer to the controller's Ethernet port. See "External Alarm and Communications Connections (DB15)" on page 52. This port is assigned an IPv4 address. The default settings for this port are as shown below.

- IP Address: 192.168.1.2
- Subnet Mask Address: 255.255.255.0
- Gateway Address: 192.168.1.1

#### **Procedure**

1. Before connecting your computer directly to the controller's Ethernet port, use the following procedure to record your computer's network settings (so they can be returned to these values when done) and then change these settings in your computer to match the communications settings programmed in the controller.

- a) Record your computer's network settings.
- b) Record whether the IP settings are set to automatic (DHCP) or are manually set. If manually set, also record the following:

IP Address: \_\_\_\_\_  
 Subnet Mask: \_\_\_\_\_  
 Default Gateway: \_\_\_\_\_

- c) Record the following controller's IP parameters. If these parameters were not changed, they should be at the default values as shown in the example section below.

#### IPv4

IP Address: \_\_\_\_\_  
 Subnet Mask: \_\_\_\_\_  
 Default Gateway: \_\_\_\_\_

#### Example:

IP Address: 192.168.1.2  
 Subnet Mask: 255.255.255.0  
 Default Gateway: 192.168.1.1

- d) Change your local computer's network settings using the information in the above step, except that the last part of the IP address needs to be replaced with any different number.

#### IPv4

IP Address: \_\_\_\_\_  
 Subnet Mask: \_\_\_\_\_  
 Default Gateway: \_\_\_\_\_

#### Example:

IP Address: 192.168.1.3  
 Subnet Mask: 255.255.255.0  
 Default Gateway: 192.168.1.1

- e) Note that you may have to reboot your local computer for the settings to take effect. Follow any instruction you see on the screen.
2. Connect your computer directly to the controller's Ethernet port (see "External Alarm and Communications Connections (DB15)" on page 52). The controller's Ethernet port is configured with an IP address. Default is 192.168.1.2. This is the address you will type into your Web browser to access the controller's Web Interface. You will also have to set the properties on your computer (refer to the previous procedure in step 1).
  3. When finished, disconnect your computer from the controller and, if necessary, reset your computer network settings as recorded in step 1.

## 7.4.4 Connecting the Controller to your Local Area Network (LAN)

### Procedure

1. Connect the Local Area Network (LAN) to the controller's Ethernet port. This port is assigned an IPv4 address.
  - An IP address and port parameters need to be set. This can be done through the Bluetooth APP. To assign an IP address and set port parameters, refer to "Accessing the Rectifier Controller via Bluetooth" on page 67.

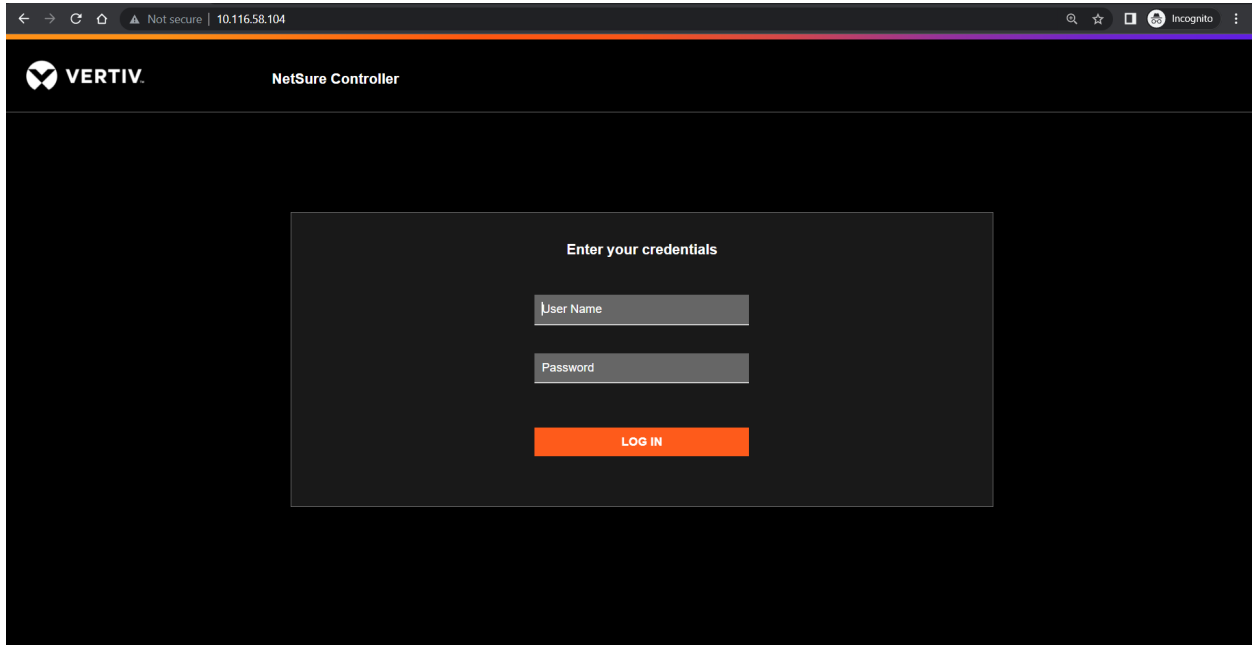
## 7.4.5 Logging into the Controller

Multiple browsers are supported. The User can use Edge, Chrome, Safari, or Firefox.

### Procedure

1. In your browser, enter http:// and the controller's IP address (default is 192.168.1.2) and press **ENTER**.
2. The following Web Interface Login window opens (Figure 7.18). Enter a valid **User Name** and **Password**, then click **LOG IN**. There is one account type: Read Only (ethernet access only supports READ ONLY; to make setting changes, log into Bluetooth APP).
  - Read Only Account:
    - User Name: browser
    - Password: 123456

Figure 7.18 Login Page



3. After entering a valid **User Name** and **Password** and clicking **LOG IN**, the Web Interface "HOMEPAGE" window opens (Figure 7.19). Refer to the next section.

## 7.4.6 Web Interface Pages

### General

This section provides descriptions of the Web Interface Pages.

### Homepage

In the Web Interface, after entering a valid **User Name** and **Password** and clicking **LOG IN**, the "Homepage" window opens (Figure 7.19). See previous procedure "Logging into the Controller".

The homepage window is divided into the following areas:

1. Alarms Area.  
Any alarms active in the system are shown in this area.
2. Main Menu Navigation Area.  
Available navigation icons are displayed in this area. When a navigation icon is clicked on, the sub-menus are updated accordingly, and the screen (Information Area) is replaced with the first tab of the sub-menu's screen. Note that, when HOME navigation icon is clicked, it will return to the Homepage.
3. Sub-Menu Navigation Area.  
Located to the right of each navigation icon (in main menu) are sub-menus. When a sub-menu is clicked on, the screen (Information Area) is replaced with the selected sub-menu's screen (Information Area).
4. Information Area.  
Displays the screen of the selected menu or sub-menu.



Figure 7.19 Homepage

1. Alarms Area

The screenshot shows the Vertiv NetSure Controller homepage. At the top right, there is an 'Alarms Area' with indicators for Observation(0), Major(1), and Critical(0). The main content area is titled 'General Readings' and is divided into two columns: 'Status' and 'Device Information'. The 'Status' column shows System Voltage (53.2 V), CA / MA / OA Number (0 / 1 / 0), and Auto/Manual State (Manual). The 'Device Information' column shows Firmware Version (V1.00.15), Hardware Version (A02), Output Current (0.0 A), and Site Name. On the left side, there is a navigation menu with a 'Main Menu Navigation Area' (indicated by an arrow) and a 'Sub-Menu Navigation Area' (indicated by an arrow pointing to the 'General Readings' sub-menu). A '1. Alarms Area' label is also present at the top right of the page.

2. Main Menu Navigation Area

3. Sub-Menu Navigation Area

4. Information Area

### Homepage - General Readings Screen

System operating status and device information is displayed in this screen (Figure 7.20).

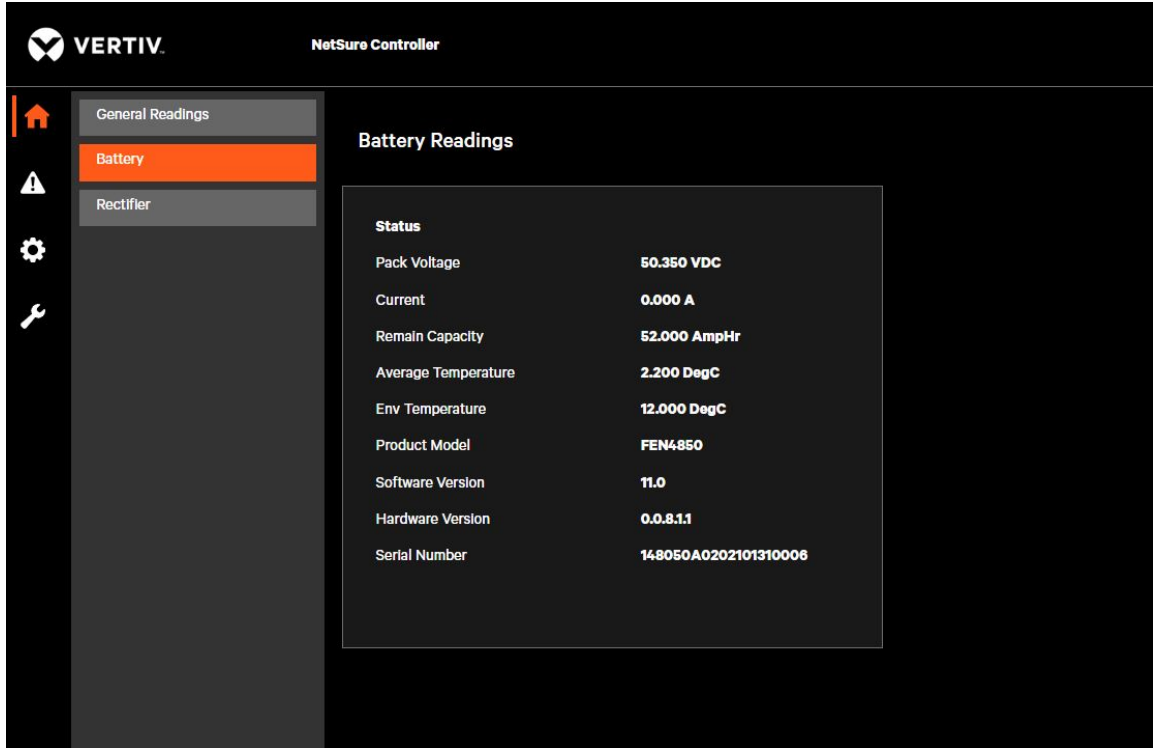
Figure 7.20 General Readings Screen

The screenshot shows the 'General Readings' screen of the Vertiv NetSure Controller. The page layout is consistent with Figure 7.19, showing the navigation menu on the left and the 'General Readings' content area. The 'Status' and 'Device Information' sections are clearly visible, displaying the same data as in Figure 7.19.

### Homepage - Battery Readings Screen (Narada Battery)

Battery status is displayed in this screen (Figure 7.21).

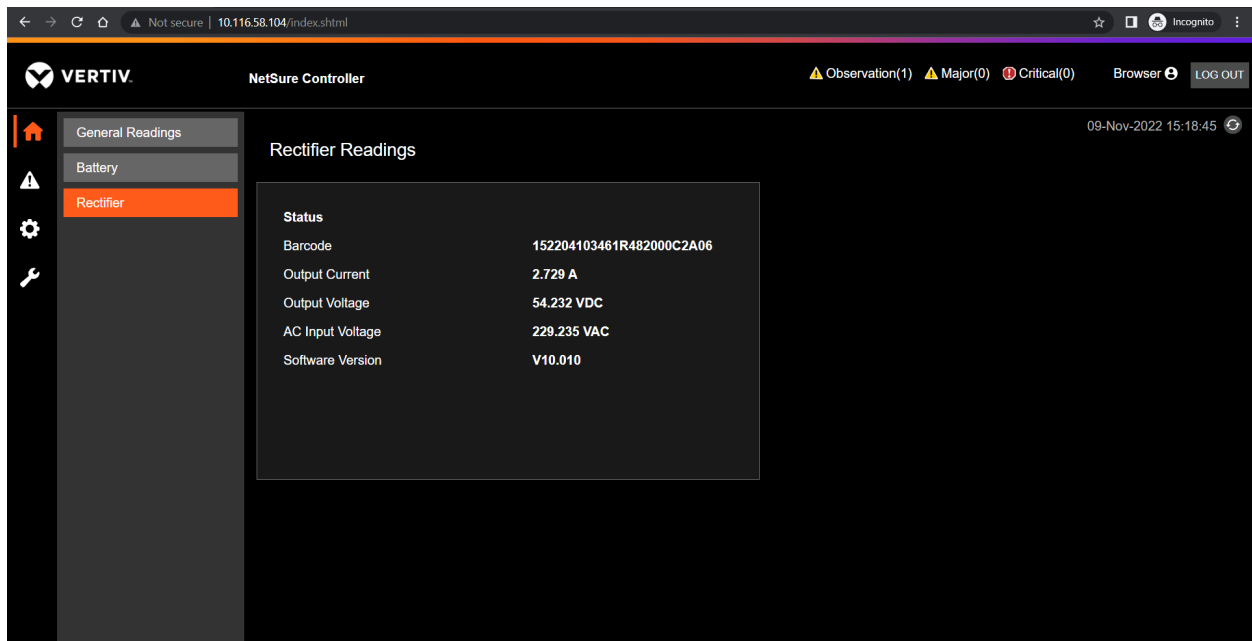
Figure 7.21 Battery Readings Screen (Narada Battery)



### Homepage - Rectifier Readings Screen

Rectifier status is displayed in this screen (Figure 7.22).

Figure 7.22 Rectifier Readings Screen



## Alarms Page - Active Alarms Screen

Any alarms active in the system are shown in this screen (up to 80) (Figure 7.23).



**NOTE!** For all logs, once maximum number of log entries is reached, new entries overwrite the oldest entries.

Figure 7.23 Active Alarms Screen

Index	Alarm Level	Alarm Name	Start Date	Start Time
1	MAJOR	Mains Failure	9-Nov-2022	11:35:25

## Alarms Page - Alarm History Screen

The latest alarms that have occurred and been cleared (up to 5000) are shown in this screen (Figure 7.24).



**NOTE!** For all logs, once maximum number of log entries is reached, new entries overwrite the oldest entries.

TIP: Alarm log history is only visible in Ethernet view, not available in BT APP views.

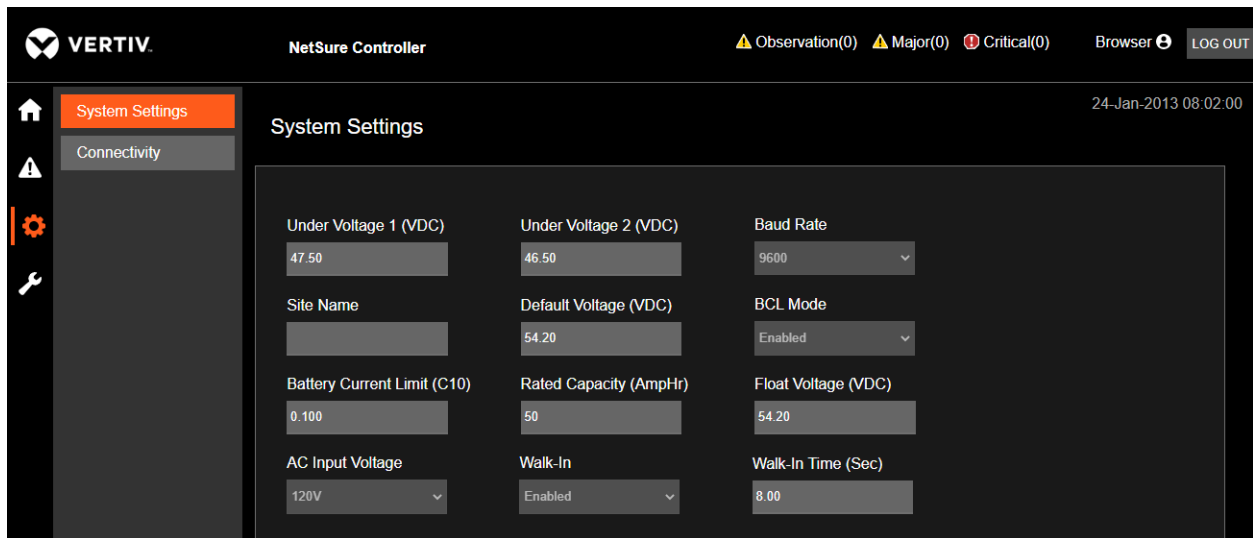
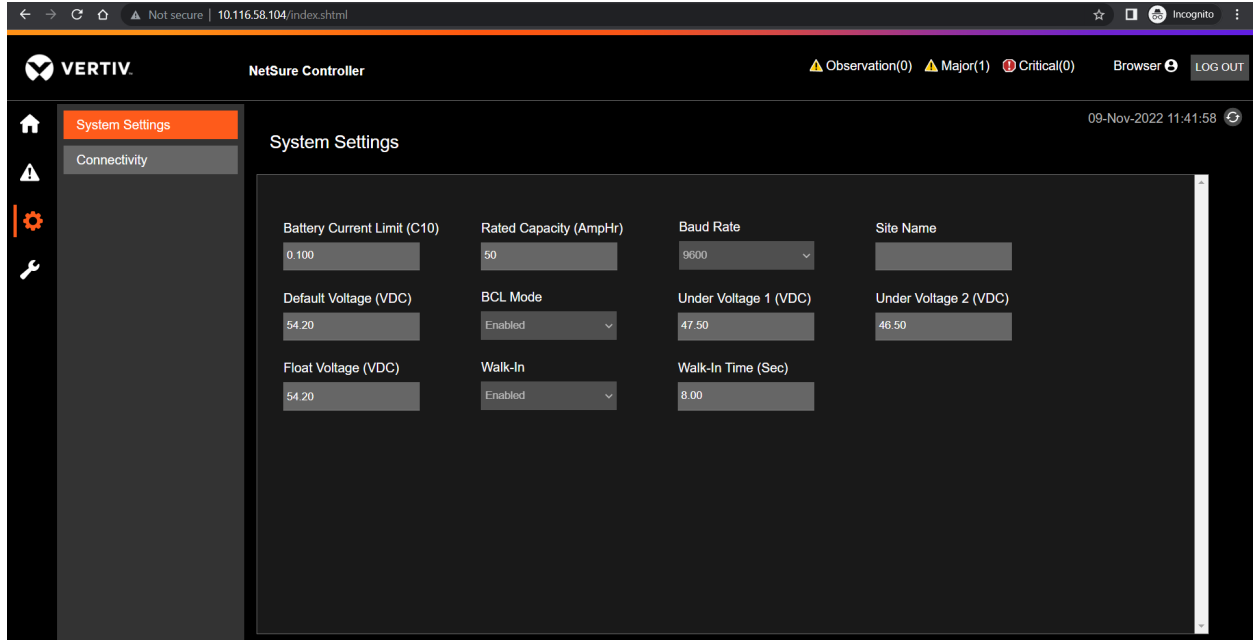
Figure 7.24 Alarm History Screen

Index	Alarm Name	Start Date	Start Time	End Date	End Time
1	Mains Failure	9-Nov-2022	11:11:02	9-Nov-2022	11:34:54
2	Mains Failure	8-Nov-2022	18:43:33	9-Nov-2022	11:10:31
3	Mains Failure	8-Nov-2022	18:43:33	8-Nov-2022	19:42:01
4	Mains Failure	8-Nov-2022	18:10:18	8-Nov-2022	18:43:02
5	Mains Failure	8-Nov-2022	18:10:18	8-Nov-2022	18:35:24
6	Mains Failure	8-Nov-2022	17:52:46	8-Nov-2022	18:09:47
7	Mains Failure	8-Nov-2022	16:58:04	8-Nov-2022	17:52:15
8	Mains Failure	8-Nov-2022	16:16:48	8-Nov-2022	16:57:33
9	Mains Failure	8-Nov-2022	15:39:08	8-Nov-2022	16:16:17
10	Mains Failure	8-Nov-2022	15:29:34	8-Nov-2022	15:38:37
11	AC Freq Low	8-Nov-2022	15:25:48	8-Nov-2022	15:29:03

## Settings Page - System Settings Screen

The system settings screen allows you to **view** the settings of the various system programmable parameters (Figure 7.25).

Figure 7.25 System Settings Screen



V1.00.18 and Later

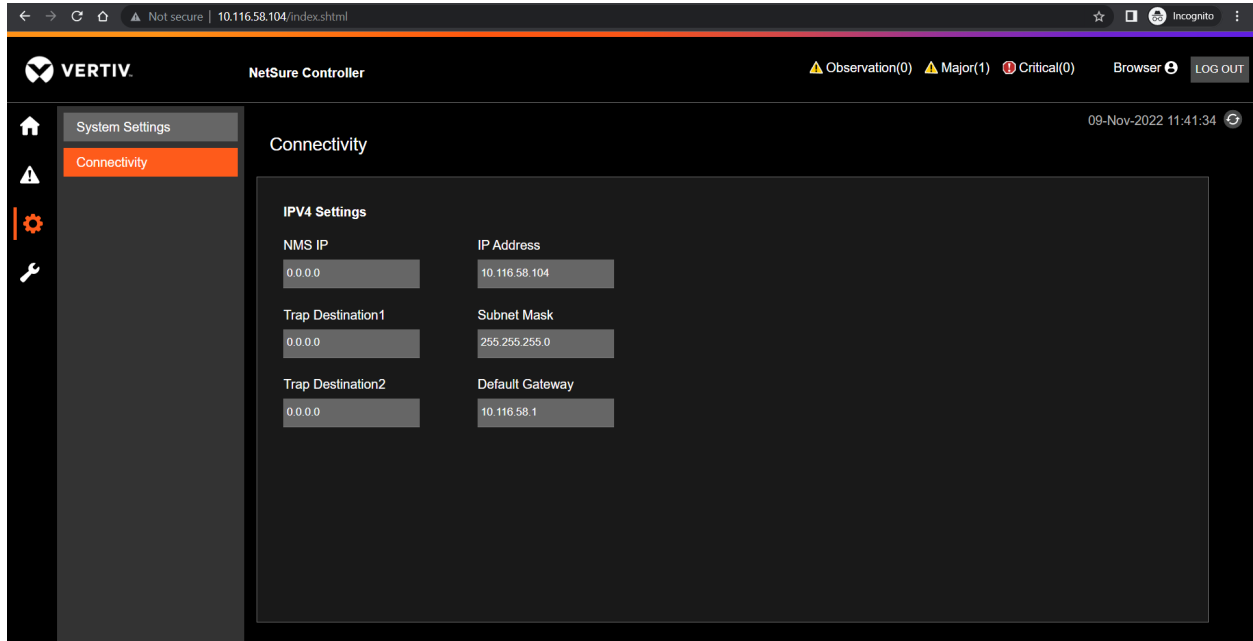
## Settings Page - Connectivity Screen

The connectivity settings screen allows you to **view** the settings of the various SNMP parameters and Ethernet port parameters (Figure 7.26).



**NOTE!** All SNMP settings must be done via BT APP, since ethernet is VIEW ONLY functions.

Figure 7.26 Connectivity Screen



### Connectivity Settings SNMP Programmable Parameter Descriptions

You can view the controller's SNMP V2 parameters.

- NMS IP: The permitted IP to access the NMSV2 agent.
- Trap Destination1: The IP to which the trap is sent.
- Trap Destination2: The IP to which the trap is sent.

### Connectivity Settings Ethernet Port Programmable Parameter Descriptions

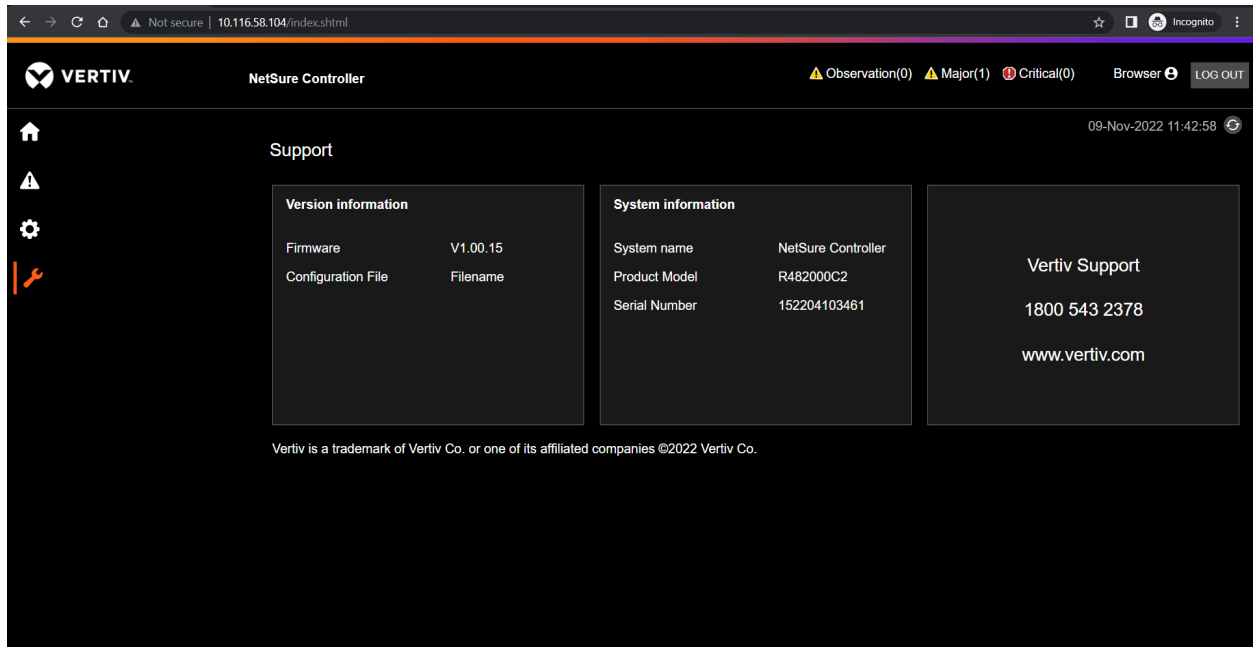
You can view the controller's network parameters.

- IP Address: The controller's IPv4 address.
- Subnet Mask: The controller's IPv4 subnet mask.
- Default Gateway: The controller's IPv4 gateway address.

## Support Page

The software support page gives Vertiv support contact information (Figure 7.27). The page also displays system information that a support person may ask you to supply.

Figure 7.27 Support Page



## 7.5 Accessing the Controller via a Network Management System (NMS)

### 7.5.1 General

The controller has an SNMP agent function.

Users can use a Network Management System (NMS) to perform the following operations:

- Query the operation status and input/output signals of the devices connected to the controller.
- Browse the active alarms.
- Get / Set the float voltage.
- Get / Set the battery current limit.
- Get Ah battery capacity.
- Get / Set battery equipment rated capacity.

When the controller generates alarms, the SNMP agent can be configured to notify the NMS through TRAPS automatically.

### 7.5.2 NMS Supported by SNMP Agent

SNMP is a technology used for network management. The technology is based on implementing an information base called MIB (Managed Information Base). This MIB contains parameters that are of interest from a management perspective. All LAN connected equipment that supports SNMP also supports a default MIB called MIB-II.

The SNMP Agent responds to requests received via the SNMP protocol and also actively sends TRAPS to a specified manager when certain MIB values change state. This is used to actively inform a manager when an alarm situation is recognized.

#### **NMS Supported by SNMP v2**

The SNMP agent of the controller supports SNMPv2.

All the NMS that supports SNMPv2c can be used to access the controller. The NMS includes HP OpenView, IBM NetView, Novell ManageWise, SunNet Manager, and so on.

### 7.5.3 MIB Installation

#### **Installation**

Contact your Vertiv representative for the location on the Web to download the MIB file.

Use the MIB loading function of the NMS to load the MIB database. Refer to the User Manual provided with the NMS for the detailed loading method.

### 7.5.4 Accessing the Controller through an NMS

#### **Apply Administrative Privilege**

In order to use the NMS to manage the devices connected to the controller, the administrative authority needs to be applied for the NMS, that is, add the NMS information to the access list of SNMP agent.

#### **Add NMS through Mobile APP**

Refer to “System Settings Programmable Parameter Descriptions” on page 76 for the method of adding NMS.

## 8 Troubleshooting and Repair

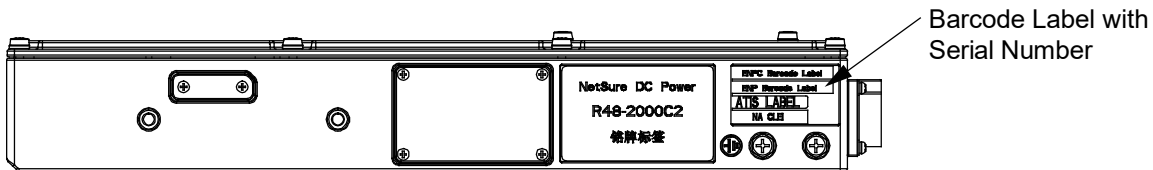
### 8.1 Contact Information

Refer to Section 4.15.4 (provided with your customer documentation) for support contact information.

### 8.2 General

This system is designed for ease in troubleshooting and repair. The controller contains an active alarm list and an alarm log. Also, the rectifier contains various indicators as described below and in “Rectifier Local Indicators” on page 63. These are designed to isolate a failure to a specific fault. Once a failure fault has been identified, refer to “Replacement Information” on page 96 and “Replacement Procedures” on page 96. The serial number of the rectifier can be accessed remotely via either Bluetooth App or LAN. On the rectifier readings screen there is a field labeled “Barcode”, which displays the barcode number that is on the physical label of the rectifier. The first 11 digits of this number is the serial number for the device. The remaining digits are composed of the rectifier model and revision (NOTE: this model number does not contain the suffix identifying the regional model, -6 in North America). EXAMPLE: If the “barcode” field reads 032110001991R482000C2A05, the serial number is 03211000199. The barcode also appears on a label affixed to the side of the rectifier (see Figure 8.1).

Figure 8.1 Barcode Label with Serial Number



### 8.3 Alarm Conditions Identified by the Controller

Table 8.1 lists the possible alarms that display in the alarm screens on the Web Interface. Table 8.1 also provides guidelines for fixing the condition that caused the alarm. Programmable external alarm relays are also available. Refer to “Rectifier Digital Output (DO) Dry Relay Contacts” on page 53 for the alarm relay configurations.

Table 8.1 Available Alarms

Table 8.1

Alarm Name	Alarm Level	Alarm Description	Action to Correct
AC-A Volt Low	OA	Voltage is below Phase A low voltage alarm setting. (Note: See '120 VAC Operation' alarm notation in "1.5.1 DC Output Ratings" on page 3 of this manual.	Check why voltage is low.  V1.00.18 and later, when operated with 120VAC input, ensure the AC Input Voltage selection in the BT APP is set to 120V (note 230V is default setting). See "Setting Icon and Setting Screen" on page 75.
AC-A Volt High	OA	Voltage is above Phase A high voltage alarm setting.	Check why voltage is high.
AC-A Curr High	OA	Current is above Phase A high current alarm setting.	Check why current is high.
AC-A Ph-A Fail	OA	AC voltage less than 80 VAC.	Check why voltage is low.
AC Freq Low	OA	AC frequency is below low frequency alarm setting.	Check why AC frequency is low.
AC Freq High	OA	AC frequency is above high frequency alarm setting.	Check why AC frequency is high.
Mains Failure	MA	Mains Failure	Rectifier commercial AC input power failure.
DC Volt Low-	CA	DC output voltage is lower than the Low- alarm setting.	Check why DC output voltage is low. Check the alarm setting.



**Table 8.1**

Alarm Name	Alarm Level	Alarm Description	Action to Correct
DC Volt Low	CA	DC output voltage is lower than the Low alarm setting.	Check why DC output voltage is low. Check the alarm setting.
DC Volt High	CA	DC output voltage is higher than the High alarm setting.	Check why DC output voltage is high. Check the alarm setting.
DC Volt High+	CA	DC output voltage is higher than the High+ alarm setting.	Check why DC output voltage is high. Check the alarm setting.
Unbalanced Current	OA	Battery current unbalanced.	The currents from groups of batteries are not equal. Check the batteries.
Rectifier Lost	OA	A rectifier cannot be detected by the controller.	Reset the Rectifier Lost alarm. Replace defective rectifier.
HW SelfDetect	OA	Controller self-detection test fails.	Replace the rectifier.
Batt Discharge	OA	Battery is discharging.	There is a mains failure (check that it is not caused by open AC input circuit breaker). The system load is higher than rectifier capacity, causing the batteries to discharge (install additional rectifiers).
Rect Overload	OA	Output overload condition.	Check the load.
Rect1 Fail	CA	A rectifier has a fault condition.	Correct the rectifier fault.
Rect1 Fuse Alarm	MA	Failed rectifier output fuse.	Replace fuse.
<b>Narada Battery Alarms</b>			
BMS T Senr Fail	CR	Battery Management System temperature sensor failure.	Refer to battery manufacturer battery manual for troubleshooting information.
BMS F-E SAM Fail	CR	Battery Management System front end sample error.	
BMS Protect MJ	MA	Battery Management System major alarm.	
BMS Protect CR	CR	Battery Management System critical alarm.	
BMS DIFF Volt	CR	Battery Management System cell voltage unbalance.	
BMS Low SOC	MA	Battery Management System SOC alarm.	
BMS Low Temp	OA	Battery Management System low temperature alarm.	
BMS Over Temp	OA	Battery Management System over temperature alarm.	
BMS Comm Fail	MA	Battery Management System communications failure.	
BMS Inv Graft Error	CR	Battery Management System Inversed Graft Error alarm.	
BMS Module Fail	CR	Battery Management System Module Failure but in Operation alarm.	
BMS Module Not Oprt	CR	Battery Management System Module Out of Operation alarm.	

## 8.4 Alarm Conditions Identified by the Battery

Refer to the battery manual for fault indicators that can be displayed by the battery.

## 8.5 Replacement Information

### 8.5.1 General

When a trouble symptom is localized to a faulty rectifier (other than a fuse), the rectifier should be replaced in its entirety. No attempt should be made to troubleshoot or repair individual components inside the rectifier enclosure (except fuse replacement).

Opening the outer perimeter front panel screws shall void the VERTIV warranty. Screws are tamperproof and not intended for customer access.

### 8.5.2 Rectifier Fuses

Replace rectifier fuses with the same type and rating. Refer to Table 8.2 for fuse part numbers.

**Table 8.2 Fuse Part Numbers**

Fuse	Rating	Part Number
Load (1) 2 kW	70 A	10026786
Load (2) 1 kW	30 A	10026784
Load (3) 1 kW	30 A	10026784
Batt / Load 4	70 A	10026786

## 8.6 Replacement Procedures



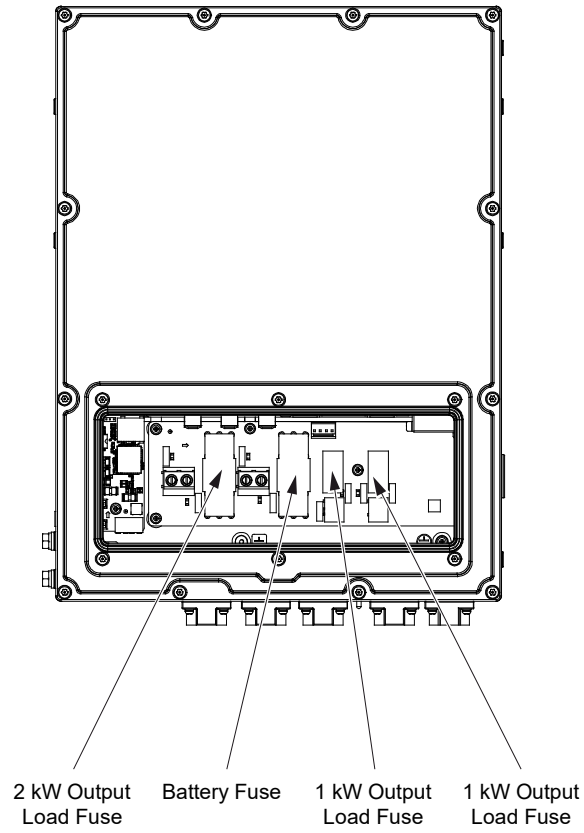
**DANGER!** Adhere to the “Important Safety Instructions” starting on page vii.

### 8.6.1 Replacing a DC Load Fuse or Battery Fuse

#### **Procedure**

1. Identify and clear the fault which caused the fuse to open.
2. Remove AC input and battery power from the rectifier.
3. Refer to “Opening / Closing the Front Access Panel” on page 64, and open the rectifier enclosure front access panel.
4. Refer to Figure 8.2 and replace the appropriate fuse.
  - The 1 kw output load fuses snap into fuse clips.
  - The 2 kW output load and battery fuses are secured with two bolts.  
Torque these to 40 in-lbs after replacing a fuse.
5. Refer to “Opening / Closing the Front Access Panel” on page 64, and close the rectifier enclosure front access panel.
6. With battery power disconnected, apply AC input power to the rectifier by closing the external AC disconnect or protective device. The rectifier starts automatically.
7. Apply battery power to the system.

Figure 8.2 Replacing Fuses



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