



NetSure™ IPE Series -48 VDC Outdoor Rectifier

Installation and User Manual

Specification Number: 1R482000C2-1, 1R482000C2-2, 1R482000C2-3

Model Number: R48-2000C2

BOM: 31014424

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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.

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, explosion, and injury.

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.
- Eye protection should be worn to prevent injury from accidental electrical arcs.
- 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.
- Do not open or mutilate batteries.
- ALWAYS FOLLOW THE BATTERY MANUFACTURER'S RECOMMENDATIONS AND SAFETY INSTRUCTIONS.

Specific Precautions for the Batteries Described in this Document

- Batteries have 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 temperature within -40 °C to +55 °C rating of battery. Otherwise, the battery will overheat which will affect the performance of the battery and shorten the service life of the battery and may catch fire (ignite).
- 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.
- It is recommended to store the battery under the conditions in "Battery Storage Environment" on page 18, otherwise battery performance will be reduced or battery life will be shortened.
- Do not DROP the battery during installation.
- Battery maximum elevation – 3k 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! 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, such as 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.

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.
6. If necessary to repair equipment containing static sensitive components, wear an appropriately grounded wrist strap, work on a conductive surface, use a grounded soldering iron, and use grounded test equipment.

1 Introduction

1.1 General

The Vertiv™ NetSure™ IPE Series Outdoor Rectifier supplies -48 VDC power to critical infrastructure in harsh environments. 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. 1R482000C2-1: Quick Connect Type, with controller and NB-IoT.
- Spec. No. 1R482000C2-2: Quick Connect Type, with controller.
- Spec. No. 1R482000C2-3: PG Terminal Type, with controller.

1.2 Packing List

1.2.1 1R482000C2-1 Packing List

Refer to Table 1.1.

Table 1.1 1R482000C2-1 Packing List

Description	Qty	Notes
Rectifier, Quick Connect Type, with controller	1	--
Mounting Bracket – Part A	2	For pole and wall mounting (P/N: 63240ETT).
Mounting Bracket – Part B	1	For pole mounting only (P/N: 63240ETS).
Cross Recessed Countersunk Screw	2	For pole mounting.
Phillips Outer Hex Screw	6	For pole and wall mounting.
Pole Mounting Bands	2	Pole diameters from 60 mm to 120 mm OD.
User Manual	1	For 1R482000C2-1, 1R482000C2-2, and 1R482000C2-3.
Connector, DC 2kW Output (Customer Side)	2	One used for 2kW load, one used for 2kW battery landing, if required.
Connector, DC 1kW Output (Customer Side)	2	--
Connector, AC Input (Customer Side)	1	--
Connector, DB-15 Output (Customer Side)	1	--
Connector, DB-9 I/O (Customer Side)	1	--
RF Antenna	1	--



NOTE! The rectifier is equipped with plug-in customer cable connectors. Mating halves to these connectors are furnished as detailed above. Customer to supply and connect the cables to these mating half connectors. Cable assemblies with the appropriate mating half connector are available. See “Accessories” on page 3 for part numbers.

1.2.2 1R482000C2-2 Packing List

Refer to Table 1.2.

Table 1.2 1R482000C2-2 Packing List

Description	Qty	Notes
Rectifier, Quick Connect Type, with controller	1	--
Mounting Bracket – Part A	2	For pole and wall mounting (P/N: 63240ETT).
Mounting Bracket – Part B	1	For pole mounting only (P/N: 63240ETS).
Cross Recessed Countersunk Screw	2	For pole mounting.
Phillips Outer Hex Screw	6	For pole and wall mounting.
Pole Mounting Bands	2	Pole diameters from 60 mm to 120 mm OD.
User Manual	1	For 1R482000C2-1, 1R482000C2-2, and 1R482000C2-3.
Connector, DC 2kW Output (Customer Side)	2	One used for 2kW load, one used for 2kW battery landing, if required.
Connector, DC 1kW Output (Customer Side)	2	--
Connector, AC Input (Customer Side)	1	--
Connector, DB-15 Output (Customer Side)	1	--
Connector, DB-9 I/O (Customer Side)	1	--



NOTE! The rectifier is equipped with plug-in customer cable connectors. Mating halves to these connectors are furnished as detailed above. Customer to supply and connect the cables to these mating half connectors. Cable assemblies with the appropriate mating half connector are available. See “Accessories” on page 3 for part numbers.

1.2.3 1R482000C2-3 Packing List

Refer to Table 1.3.

Table 1.3 1R482000C2-3 Packing List

Description	Qty	Notes
Rectifier, PG Terminal Type, with controller	1	--
Mounting Bracket – Part A	2	For pole and wall mounting (P/N: 63240ETT).
Mounting Bracket – Part B	1	For pole mounting only (P/N: 63240ETS).
Cross Recessed Countersunk Screw	2	For pole mounting.
Phillips Outer Hex Screw	6	For pole and wall mounting.
Pole Mounting Bands	2	Pole diameters from 60 mm to 120 mm OD.
User Manual	1	For 1R482000C2-1, 1R482000C2-2, and 1R482000C2-3.



NOTE! The rectifier is equipped PG terminal type cable connectors. Customer to supply and connect the cables to these terminals.

1.2.4 Battery Packing List

Refer to Table 1.4.

Table 1.4: Battery Packing List

Description	Qty	Notes
20Ah or 50Ah battery	1	--
Connector, DB-9 I/O	1	--
Connector, DC 2kW Output	2	--

1.3 Accessories

1.3.1 Mounting Kits

Refer to Table 1.5.

Table 1.5 Mounting Kits

Part Number	Description
(included with rectifier)	Mounting Kit for Single Rectifier Installation (standard)
02236200	Mounting Kit for One (1) Rectifier and One (1) Battery Flag Installation (optional)
02236201	Mounting Kit for One (1) Rectifier and One (1) Battery Flat Installation (optional)

1.3.2 Customer Wiring Selection

Refer to Table 1.6 and Table 1.7.

Table 1.6 Customer Wiring Selection - China Market

P/N	Description	Usage
04119776	Cable set, 10m AC input cable.	AC input cable.
04119782	Cable set, 3m AC input cable.	
04119779	Cable set, 3m DC power cable, rectifier to customer load, 1kW.	1kW DC load cable.
04119780	Cable set, 3m DC power cable, rectifier to customer load, 2kW.	2kW DC load cable.
04119783*	Cable set, 10m comm cable, rectifier to customer, DB15.	4 x DOs for customer use.
04119777	Cable set, 0.8m DC power cable, rectifier to battery, 2kW.	Battery to rectifier.
04119781*	Cable set, 0.8m comm cable, rectifier to battery, DB9.	RS 485 communication.

* The raw cable used is NOT CE marked.

Table 1.7 Customer Wiring Selection - EMEA Market

P/N	Description	Usage
RPM629065-10	IP65 QC RECTIFIER TO BATTERY 2X10 0.8M	Battery charge and discharge, power cable.
RPM629065-11	IP65 QC MAIN R RS485_2 CAN DI DB9 0.8M	Used for main rectifier under parallel mode
RPM629065-12	IP65 QC R-R DB9 CAN EXTN 0.8M	Used for CAN communication between rectifiers under parallel installation ONLY.
RPM629065-14	IP65 QC MAIN R DB15 4DO RS485_1 2.5M	4 x DOs and a north bound RS485 for customer use.
RPM629065-13	IP65 QC SINGLE R-BAT RS485 DB9 0.8M	Used for RS485 communication between battery and rectifier. (for single rectifier + single battery ONLY!)



NOTE! For 1kW load cables, 2kW load cable, and AC input cables:

For PG Gland Rectifier: Customer to provide raw DC and AC power cords and wire ferrules for termination into rectifier.

For Quick Connect Rectifier: Customer to use connectors supplied with rectifier, and supply ferrules and raw cords.

Customer to terminate wires in the field to the connectors furnished with the rectifier.

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 -56.4 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 so as 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 unit 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 -56.4 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.
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. Between 85 VAC and 176 VAC the output power derating linearly based on the input voltage as follows:
 - At input voltage of 85 VAC with output >48 VDC, maximum output power is 1000 W.
 - At input voltage of 176 VAC with output >48 VDC, maximum output power is 2000 W.

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

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 temporary¹ basis only.

- ¹ 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):

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

Figure 1.1 Output Voltage vs. Output Current

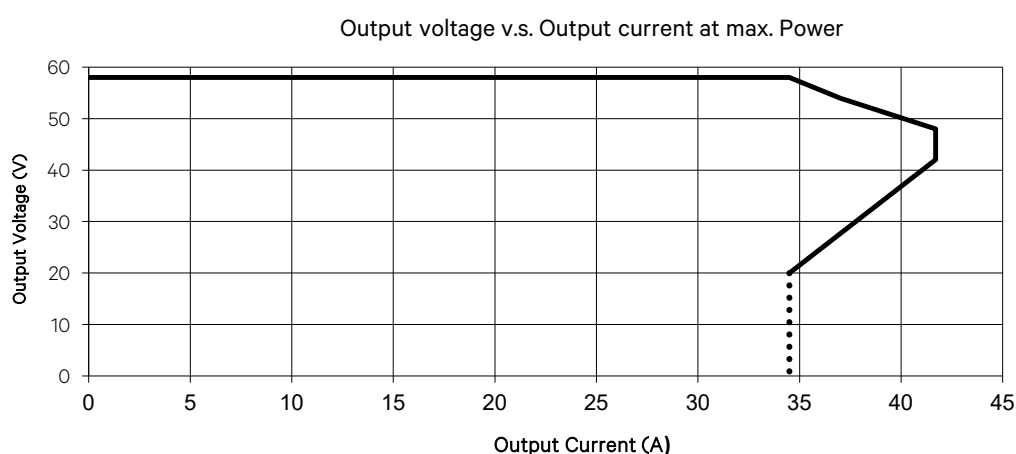


Figure 1.2 Power Derating Based on Input Voltage

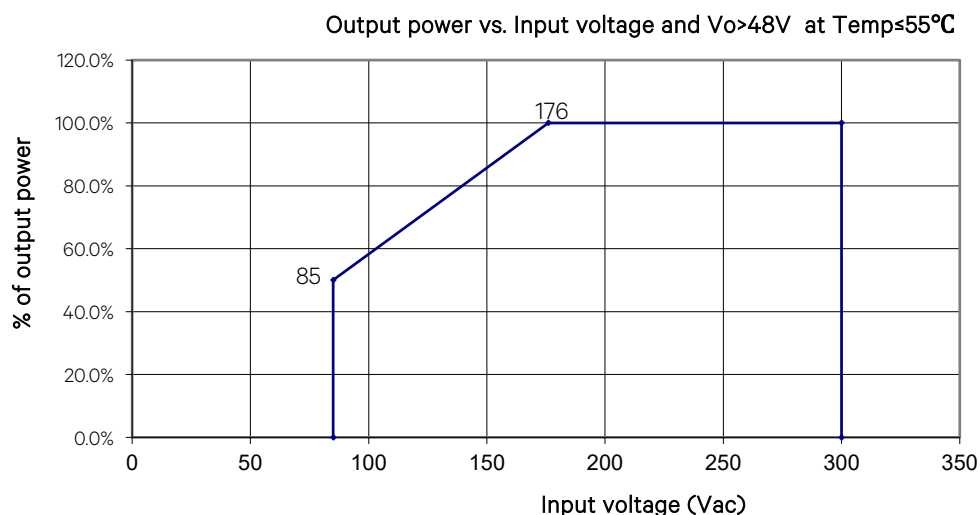
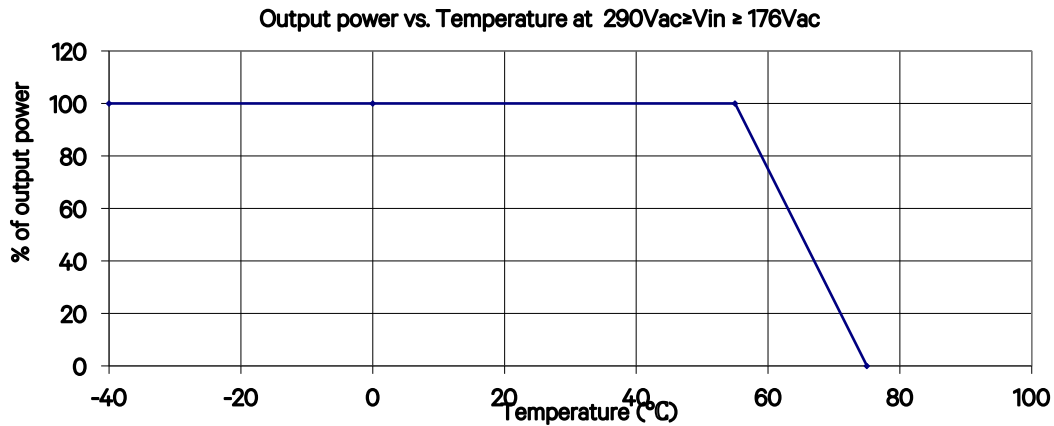


Figure 1.3 Power Derating Based on Temperature

6. Regulation:

- a) 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.
- b) Dynamic: Response time ≤ 200 μ s 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 ± 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 ≤ 200 mV at 0 MHz to 20 MHz and normal output voltage.
- b) Wide Band Noise: Wideband noise voltage is ≤ 50 mV at 3.4 kHz to 150 kHz and ≤ 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 1.8.
 - b) Maximum Input Current: Refer to Table 1.9.
 - c) Efficiency Curve: Refer to Figure 1.4.
5. Typical Input Data: 60 Hz input.
 - a) Refer to Table 1.10.
 - b) Maximum Input Current: Refer to Table 1.11.
 - c) Efficiency Curve: Refer to Figure 1.5.

Table 1.8 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 W
120	0	0.387	46.65	16.93			16.930
	25	4.233	507.03	504.05	0.994	93.60	32.271
	50	8.364	999.04	996.08	0.997	94.99	49.907
	75	12.647	1505.74	1501.70	0.997	94.71	79.447
	100	--	--	--	--	--	--
220	0	0.622	137.00	17.33	0.231	--	17.330
	25	2.319	510.03	500.44	0.981	94.39	28.060
	50	4.509	991.15	984.13	0.993	96.18	37.550
	75	6.740	1480.05	1474.08	0.996	96.47	52.07
	100	9.793	2147.70	2143.99	0.998	96.10	83.691
240	0	0.673	16.16	17.14	0.106	--	17.140
	25	2.146	515.05	500.64	0.972	94.23	28.877
	50	4.143	993.62	983.46	0.990	96.27	36.691
	75	6.184	1481.90	1473.96	0.995	96.55	50.905
	100	8.971	2147.12	2141.83	0.998	96.23	80.7245



NOTE! At 100% of full load with output at 56.4V as measured at the output terminals.

Table 1.9 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 56.4V as measured at the output terminals.

Table 1.10 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 W
120	0	0.448	53.80	16.90	0.314	--	--
	25	4.234	507.12	503.98	0.994	93.54	32.546
	50	8.365	999.10	996.14	0.997	94.99	49.955
	75	12.644	1505.31	1501.07	0.997	94.74	78.924
	100	--	--	--	--	--	--
220	0	0.757	166.83	29.66	0.170	--	29.662
	25	2.338	514.04	500.56	0.973	94.41	27.982
	50	4.519	993.32	984.16	0.991	96.19	37.531
	75	6.748	1481.92	1474.51	0.995	96.46	52.187
	100	9.806	2150.63	2146.230	0.998	96.17	82.168
240	0	0.804	193.16	17.36	0.089	--	17.360
	25	2.171	521.01	500.32	0.960	94.28	28.640
	50	4.157	996.94	983.31	0.986	96.26	36.801
	75	6.194	1484.25	1473.47	0.993	96.53	51.121
	100	8.980	2148.920	2142.43	0.997	96.27	79.869

NOTE! At 100% of full load with output at 56.4V as measured at the output terminals.

Table 1.11 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 56.4V as measured at the output terminals.

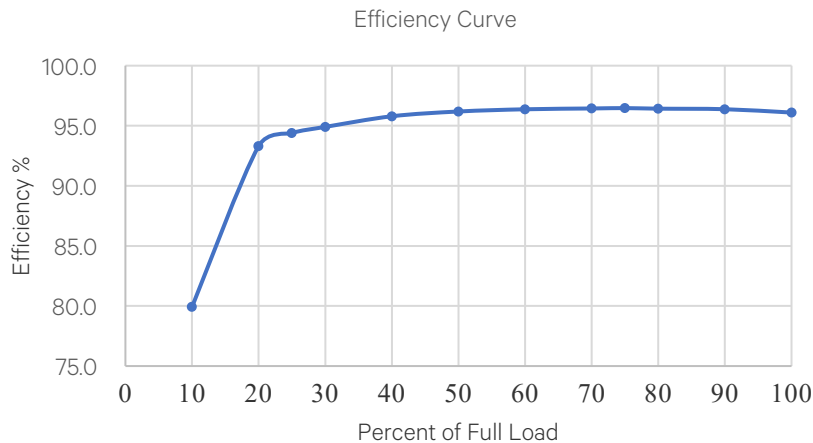
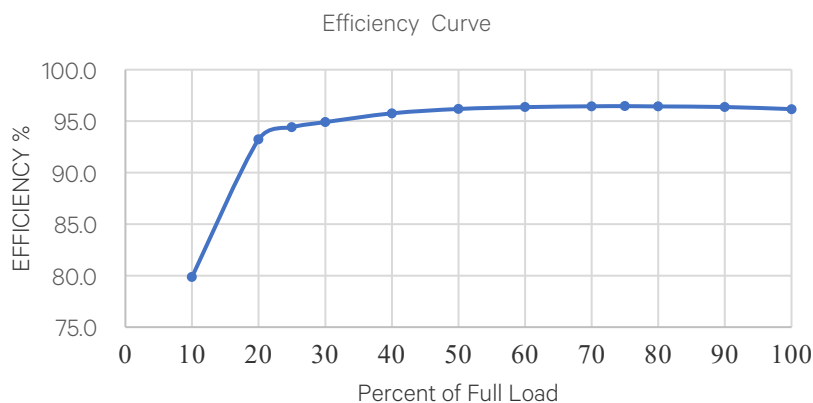
Figure 1.4 Efficiency Curve (@ 220 VAC, 50 Hz)


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

1.5.3 Environmental Ratings

- Operating Ambient Temperature Range:
 - 40 °C (-40 °F) to +55 °C (+131 °F) with full power performance.
 - +55 °C (+131 °F) to +75 °C (+167 °F) with derating output.
 - Output Regulation Temperature Coefficient: ±0.02% per degrees Celsius.
- Storage Ambient Temperature Range: -25 °C (-13 °F) to +55 °C (+131 °F).
- Relative Humidity: This rectifier is capable of operating in an ambient relative humidity range of 0% to 95%.
- Altitude: 3000 m (9842 feet). Derating operating ambient temperature range by 3 °C per 300 m above 3000 m.
- 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	1.2/50	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 1.2/50us 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 ≤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. Pollution Degree: Degree 3, as per UL/ IEC/EN62368-1.

1.5.4 Digital Output (DO) Dry Relay Contacts

Refer to Figure 1.6 and Table 1.12 for the dry contact settings.

NOTE! The contact operation can be changed by moving the jumpers for each of the connectors to the alternate location.

Figure 1.6 Dry Contact and Connector Circuit

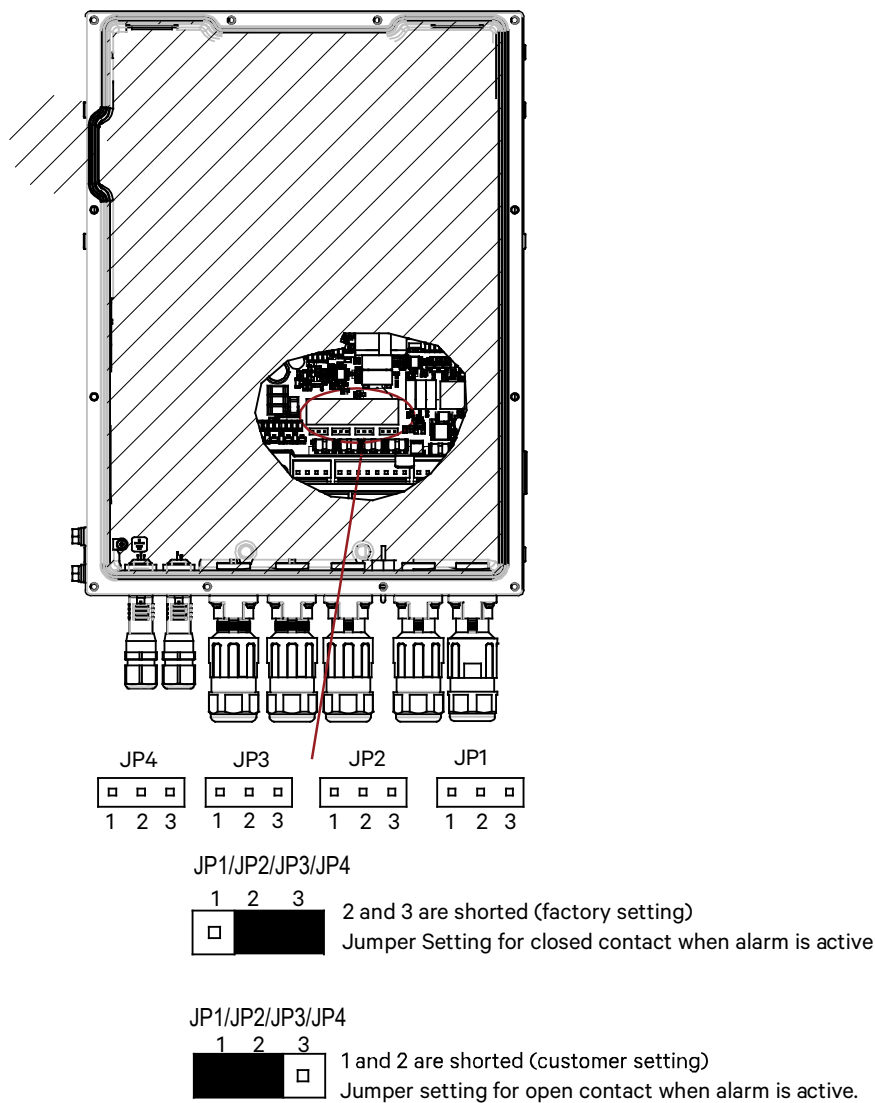


Table 1.12 Dry Contact and Connector Circuit

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

1.5.5 Compliance Information

1. EMC:
 - a) The rectifier conforms to the requirements of FCC rules Part 15, Class B for radiated and input conducted emissions limits (R48-2000C2-2, R48-2000C2-3), Class A for radiated and input conducted emissions limits (R48-2000C2-1).
 - b) The rectifier conforms to the requirements of European Norm, EN55032, Class B for radiated and input conducted emissions limits (R48-2000C2-2, R48-2000C2-3), Class A for radiated and input conducted emissions limits (R48-2000C2-1).
2. EMI Load Range: 5% to 100%.
3. Safety: CE, UL 62368-1, UL 62368-22, EN 62368-1, IEC 62368-1.

1.5.6 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, ± 5 V; hysteresis is at least 15 VAC for restart.

High Voltage Disable Point: 305 VAC, ± 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 ± 1.5 A when the output voltage is in the range from 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.



CAUTION! Double pole/neutral fusing.

1.5.7 Mechanical Specifications

Dimensions

- a) Millimeters: 400 (Height) X 300 (Width) X 62 (Depth)
- b) Inches: 15.7 (Height) X 11.8 (Width) X 2.4 (Depth)

Weight

<9 kg.

Color

Vertiv EG123, per RAL9003 Signal white, or equivalent.

Indicators

The following indicators are located behind a clear plastic window on the left-hand side of the rectifier. See also “Local Indicators” on page 74.

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

1.6 Battery

1.6.1 Battery Appearance

There are two types of batteries.

- 20AH Battery (see Figure 1.7 and Figure 1.8).
- 50AH Battery (see Figure 1.9 and Figure 1.10).

Figure 1.7 20AH Battery Side View

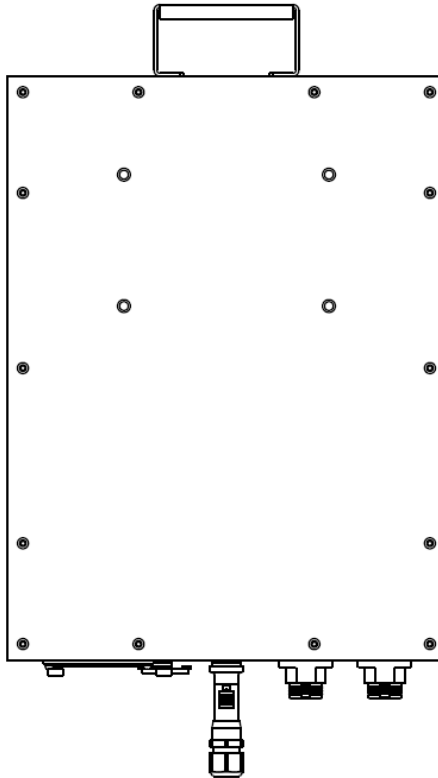


Figure 1.8 20AH Battery Bottom View

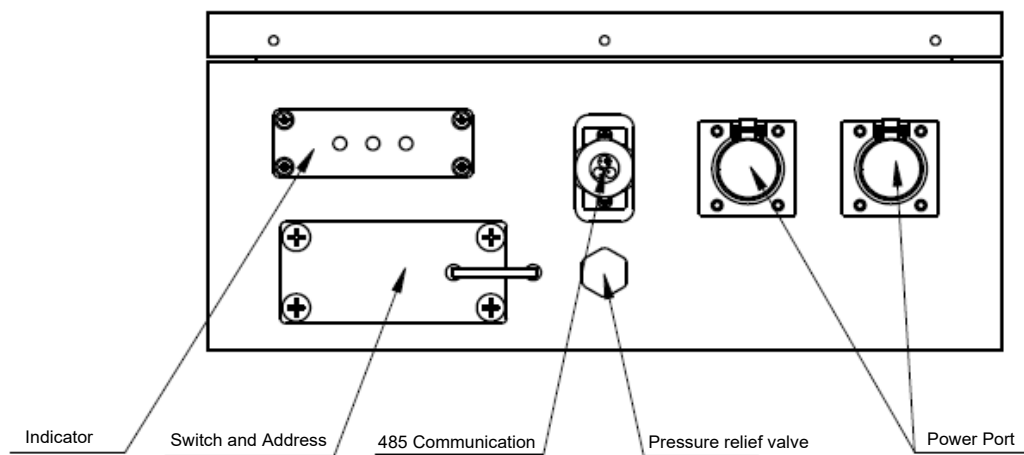


Figure 1.9 50AH Battery Side View

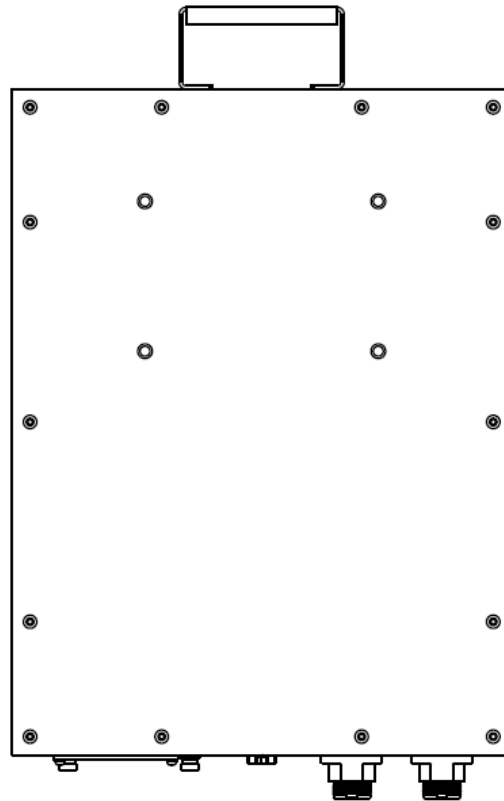
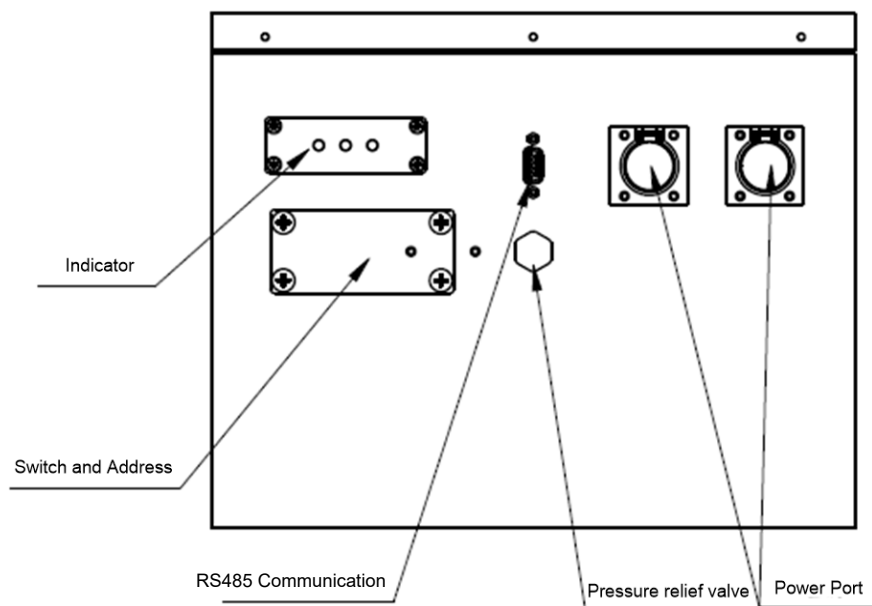


Figure 1.10 50AH Battery Bottom View



1.6.2 Battery Specifications

Refer to Table 1.13 and Table 1.14.

Table 1.13 Battery Specification

Battery Model	20AH	50AH
Material Type	Lithium Iron Phosphate	Lithium Iron Phosphate
Rated Voltage	51.2V	51.2V
Rated Capacity	20Ah	50Ah
Cell Combination	16S1P	16S1P
Max Discharge Current	20A	50A
Discharge cut-off voltage	43.2V	43.2V
Recommended Charge current	5A	10A
Charge voltage	56.4V	56.4V
Recommended Charge ways	CC-CV	CC-CV
Cycle life	At an ambient temperature of 25°C, the battery pack's 100% DOD cycle life should be no less than 700 times. When the ambient temperature is 40°C, the battery pack's 100% DOD cycle life should be no less than 600 times	At an ambient temperature of 25°C, the battery pack's 100% DOD cycle life should be no less than 700 times. When the ambient temperature is 40°C, the battery pack's 100% DOD cycle life should be no less than 600 times
Size	400x300x130mm	400x300x240mm
Work Temperature Range	-40°C~+55°C	-40°C~+55°C
Work Humidity	5%~95%	5%~95%
Heating	Under low temperature, heating will be enabled automatically. 100-150W	Under low temperature, heating will be enabled automatically. 100-150W
BMS Protection Function	Over-voltage, under-voltage, over-temperature, over-current and other alarms and protection	Over-voltage, under-voltage, over-temperature, over-current and other alarms and protection
Protection Level	IP65	IP65
Application	Outdoor	Outdoor
Communication	RS485, MODBUS protocol	RS485, MODBUS protocol
Certification	Tyre、CE	Tyre、CE

Table 1.14 Recommended Maximum Load Power (1 Rectifier + 1 Battery System)

Battery Capacity	Max Battery Charge Current	Recommended Power for Customer Equipment
20Ah	5A	860 W *
50Ah	10A	1520 W

* Limited by Maximum Allowable Discharge Current of 20Ah battery (in this case, it's 20A), the recommended power for customer equipment is much less than rectifier capacity.

1.6.3 Battery Storage Environment

- Store for 20 days: -20 °C ~ +55 °C
- Store for 30 days: -20 °C ~ +45 °C
- Store for 90 days: -20 °C ~ +35 °C

When the battery pack needs to be stored for a long time, please charge the battery pack to 80% state, and use the charger to recharge it every once in a while, according to the storage temperature.



CAUTION! Due to Li-ion battery shipping regulations, battery shall be typically only charged to 30% SOC. A freshening charge must be applied in a timely manner, or else damage may occur to cells. SEE MANUFACTURER RECOMMENDATIONS.

1.6.4 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 also 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.

If the terminals of the battery pack become dirty, wipe them with a dry cloth before use. Otherwise, the battery pack will have poor contact, causing energy loss or failure to charge.

1.6.5 Precautions for Battery Use

1. Batteries have ON/OFF switch. Disconnect power at battery via ON/OFF switch until all connections are made.
2. Do not immerse the battery in water.
3. Do not approach a heat source.
4. Do not short-circuit the positive and negative poles of the battery.
5. Do not reverse charge.
6. 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. Otherwise, the battery will overheat and may catch fire (ignite), which will affect the performance of the battery and shorten the service life of the battery.
7. DO NOT OPEN THE BATTERY ENCLOSURE due to high hazard inside. Battery is only intended to be replaced, not repaired if faulty.
8. If needing replacement, battery must be returned in HAZ MAT approved Class 9 packaging.
9. It is recommended to store the battery under the conditions in “Battery Storage Environment” above, otherwise it will reduce battery performance or shorten battery life.
10. Do not DROP the battery during installation.
11. Battery maximum elevation – 3000 Meters.

2 Installation

2.1 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.

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

If the access panel is opened during installation, ensure the access panel is securely closed and the screws are torqued to 2.5 Nm.

2.2 Tools Required for Installation

Refer to Table 2.1 for a list of tools required for installation.

Table 2.1 Tools Required for Installation

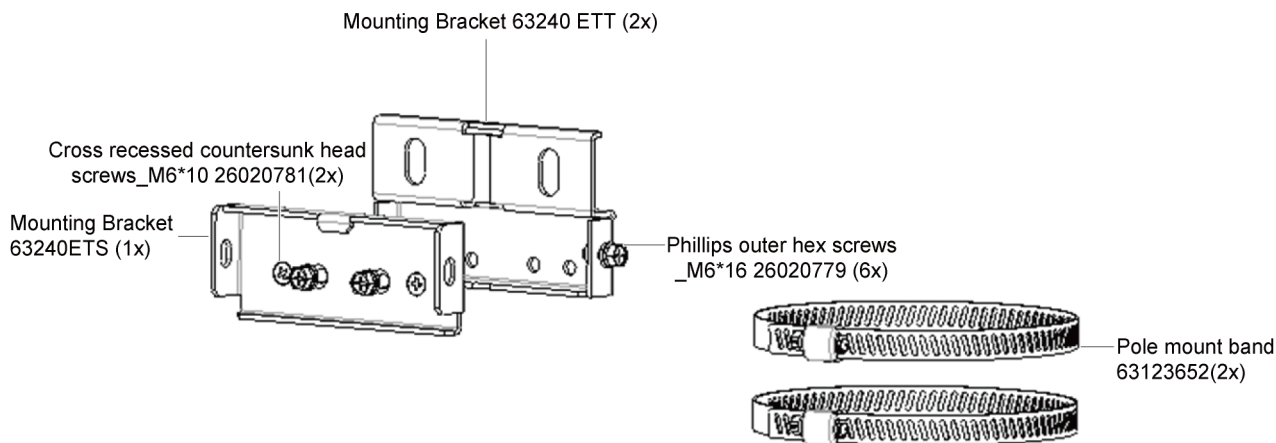
Tool	Specification	Tool	Specification
Combination wrench (hatch, club)	Wrench set (10#, 13#, 16#, 18#, 21#)	Torque wrench	As required
Electrician diagonal pliers	150 mm	Insulated screwdriver set	Cross screwdriver: #1, #2 Slotted screwdriver: 3 mm, 5 mm
Electrician sharp nose pliers	150 mm	Non-contact voltage tester	/
Tape measure	5 m	Wire stripper	Max. 16mm ²
Level	Normal type	Crimping tools	Max. 16mm ² (Both ferrule and lug crimping tools)
Ladder	As required	Digital multimeter	Three-and-a-half-bit digital display
Lifting equipment	As required	Impact electric drill	As required
Lifting sling	As required	ESD wrist strap	/
Cable gland wrench	As required		

2.3 Mounting Kits

2.3.1 Standard Mounting Kit for Single Rectifier Installation

The rectifier comes standard with this mounting kit. This kit allows the rectifier to be mounted to a pole or wall in either a “flag” or “flat” orientation. See Figure 2.1.

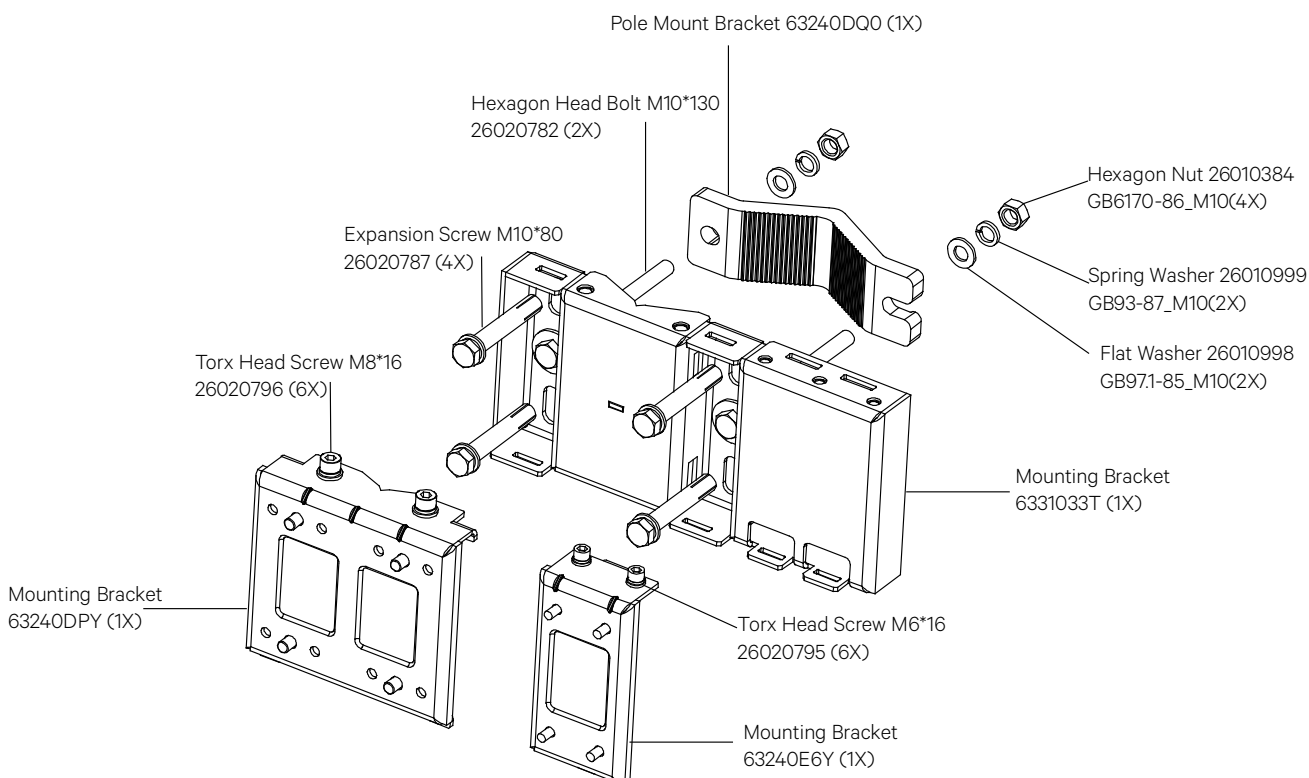
Figure 2.1 Standard Mounting Kit for Single Rectifier installation



2.3.2 Optional Mounting Kit P/N 02236200 for One (1) Rectifier and One (1) Battery Flag Installation

This optional kit allows a battery and rectifier to be mounted to a pole or wall in a “flag” orientation. See Figure 2.2.

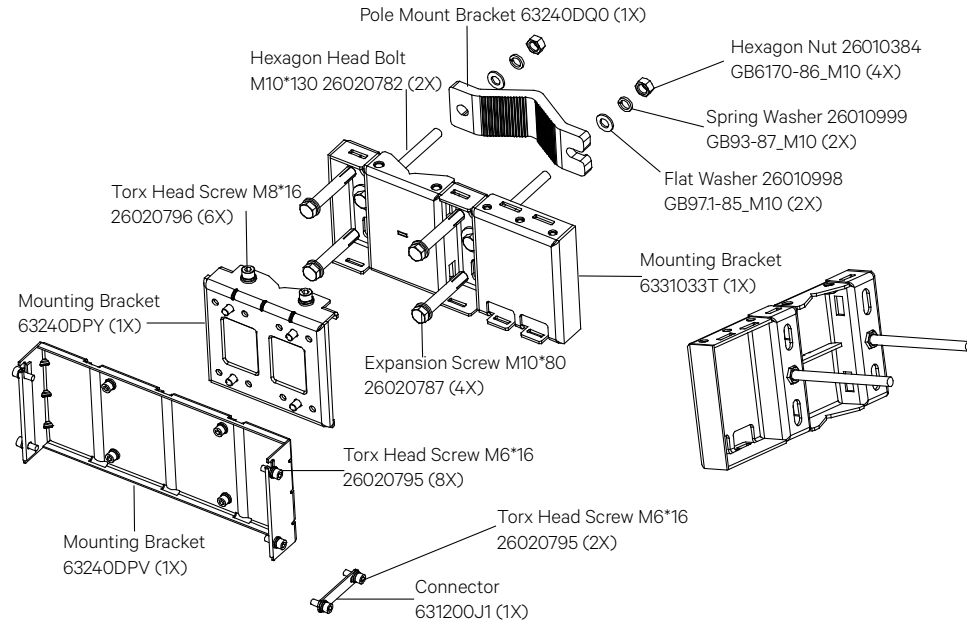
Figure 2.2 Optional Mounting Kit P/N 02236200 for One (1) Rectifier and One (1) Battery Flag Installation



2.3.3 Optional Mounting Kit P/N 02236201 for One (1) Rectifier and One (1) Battery Flat Installation

This optional kit allows a battery and rectifier to be mounted to a pole or wall in a “flat” orientation. See Figure 2.3.

Figure 2.3 Optional Mounting Kit P/N 02236201 for One (1) Rectifier and One (1) Battery Flat Installation



2.4 Mounting the Rectifier to a Pole or Wall Using the Standard Rectifier Mounting Kit

2.4.1 General

The rectifier can be pole mounted or secured to a suitable wall using the standard rectifier mounting kit. See “Mounting Kits” on page 20.

- For wall mounting, the customer needs to supply four (4) 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 2.5 Nm.

2.4.2 Pole Mounting Procedure



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

- Unpack the rectifier and mounting accessories and kits.
- Install the mounting bracket (63240ETT) in the appropriate top position on the pole with the supplied pole mount band. Securely tighten the pole mount band to the pole. The pole mount band accommodates poles from 60mm to 120mm in diameter. Refer to Figure 2.4.
- Install mounting brackets to the rear panel of the rectifier with the supplied hardware (do this on the ground first). Refer to Figure 2.5 and Figure 2.6.
- Secure the top of the rectifier to the pole by securing the mounting bracket (63240ETS) to the mounting bracket (63240ETT) with the supplied M6 bolts. Refer to Figure 2.7 and Figure 2.8.
- Secure the bottom of the rectifier to the pole by securing the mounting bracket (63240ETT) to the pole with the supplied pole mount band. Refer to Figure 2.9 and Figure 2.10.

Figure 2.4 Installing the Mounting Bracket to the Pole with the Pole Mount Band

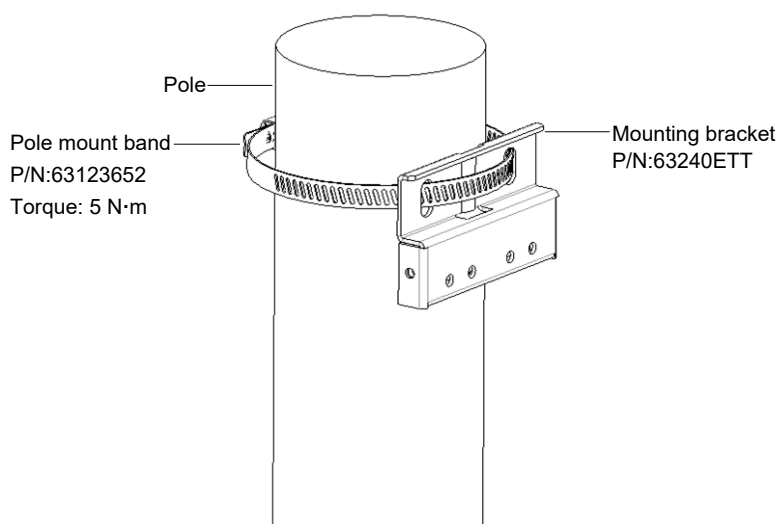


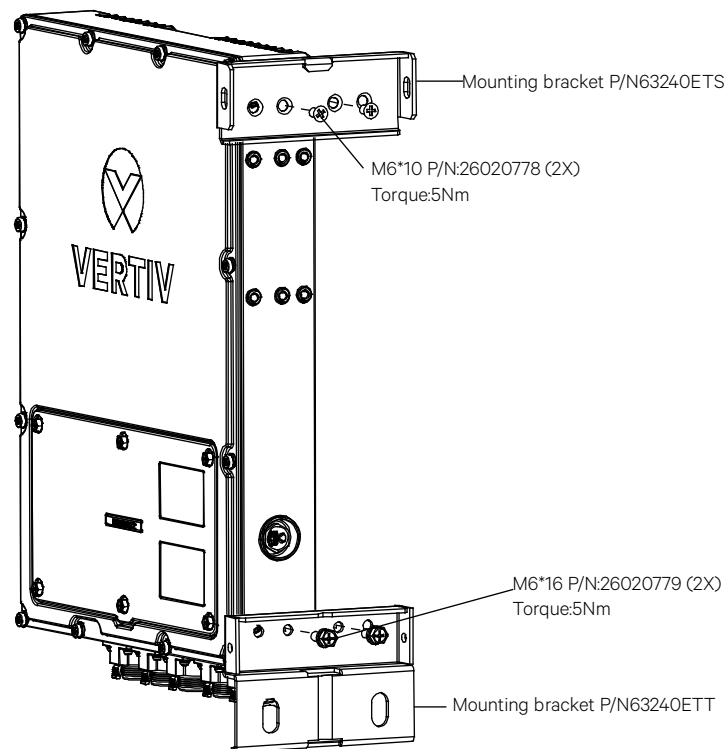
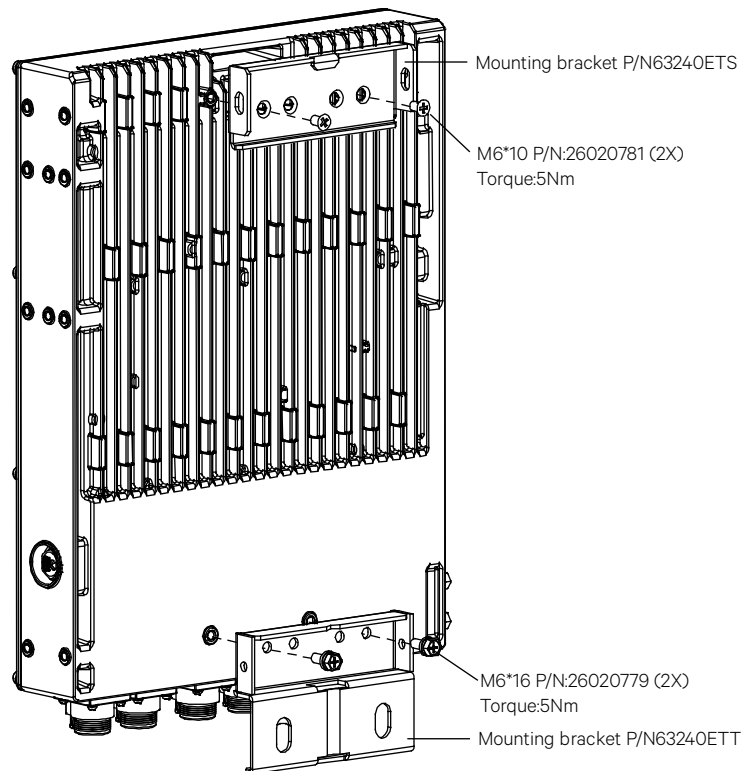
Figure 2.5 Installing the Mounting Brackets to the Rear Panel of the Rectifier (Flag)**Figure 2.6 Installing the Mounting Brackets to the Rear Panel of the Rectifier (Flat)**

Figure 2.7 Securing the Rectifier to the Pole at the Top (Flag)

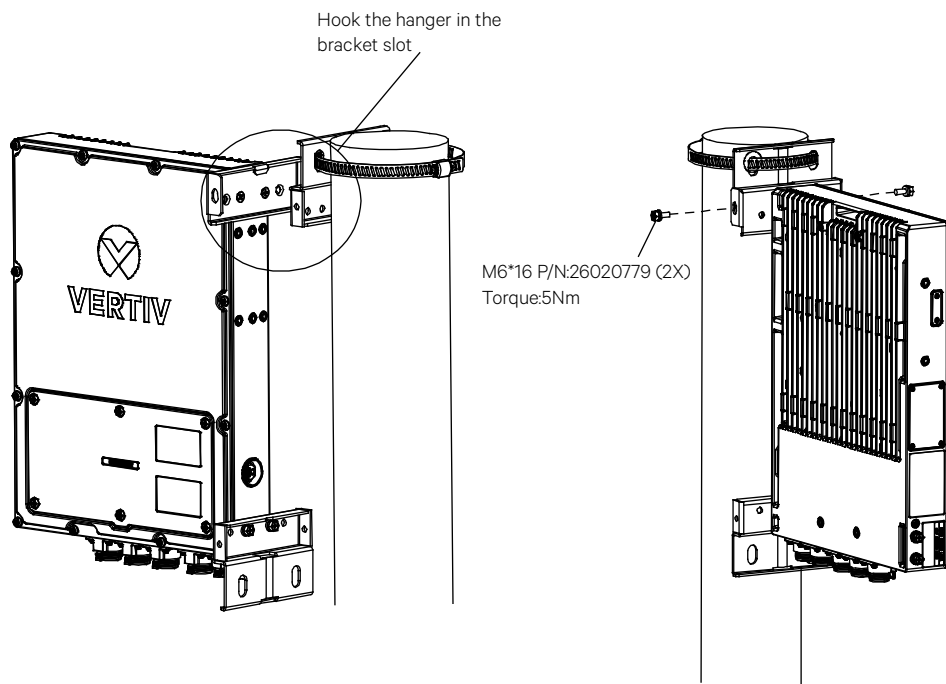


Figure 2.8 Securing the Rectifier to the Pole at the Top (Flat)

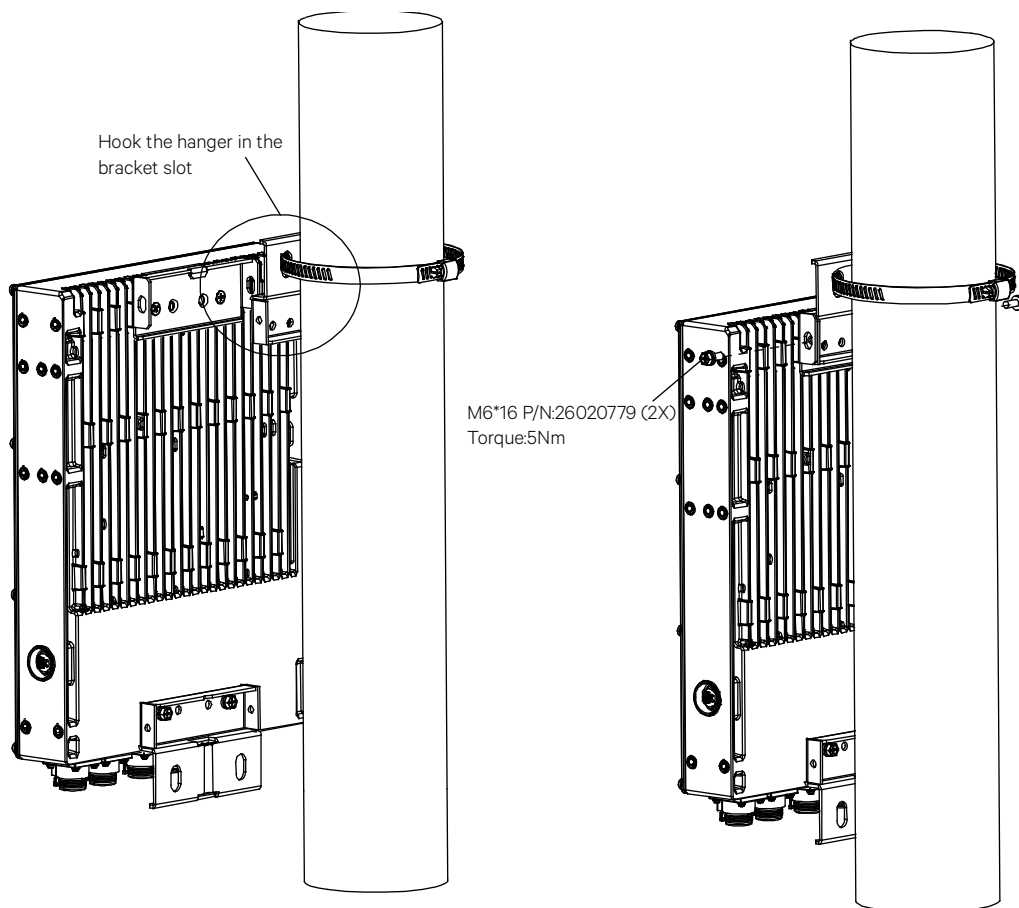


Figure 2.9 Securing the Rectifier to the Pole at the Bottom (Flag)

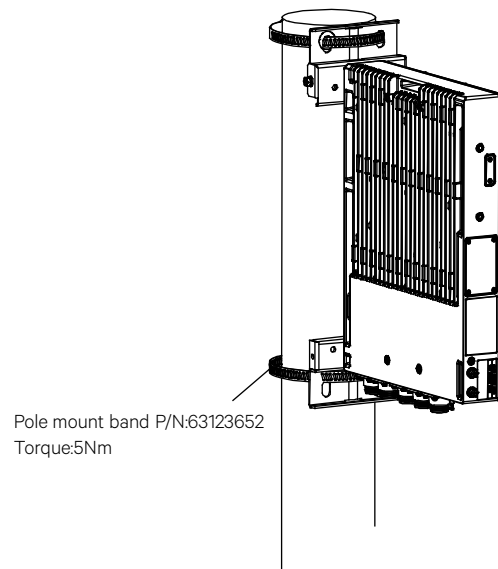
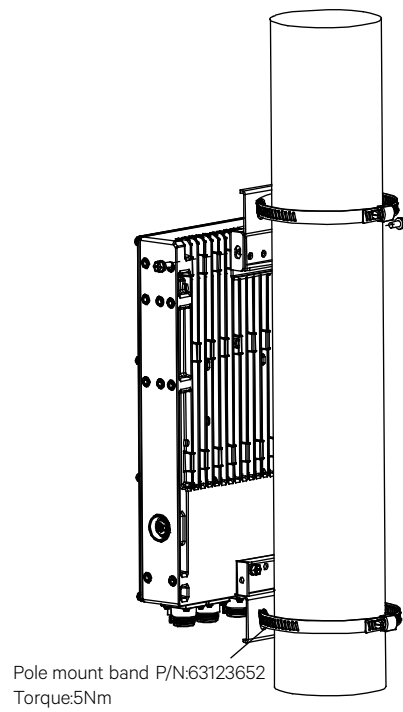


Figure 2.10 Securing the Rectifier to the Pole at the Bottom (Flat)



2.4.3 Wall Mounting Procedure



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

1. Unpack the rectifier and mounting accessories and kits.
2. Drill appropriately sized holes for the customer provided M10 wall anchors being used into the wall as shown in Figure 2.11. Install the M10 wall anchors into the holes (Figure 2.12).
3. Install the mounting brackets to the rectifier. Refer to Figure 2.13 and Figure 2.14.
4. Install the rectifier to the wall. Refer to Figure 2.15 and Figure 2.16.

Figure 2.11 Wall Mounting Hole Positions (Unit: mm)

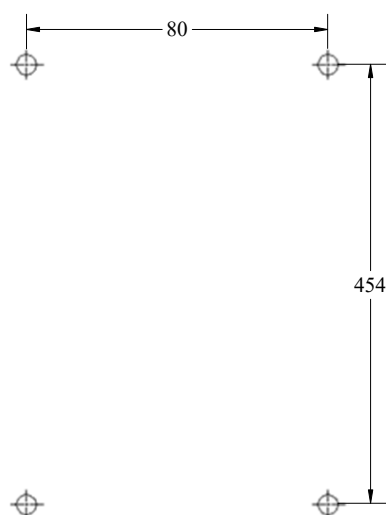
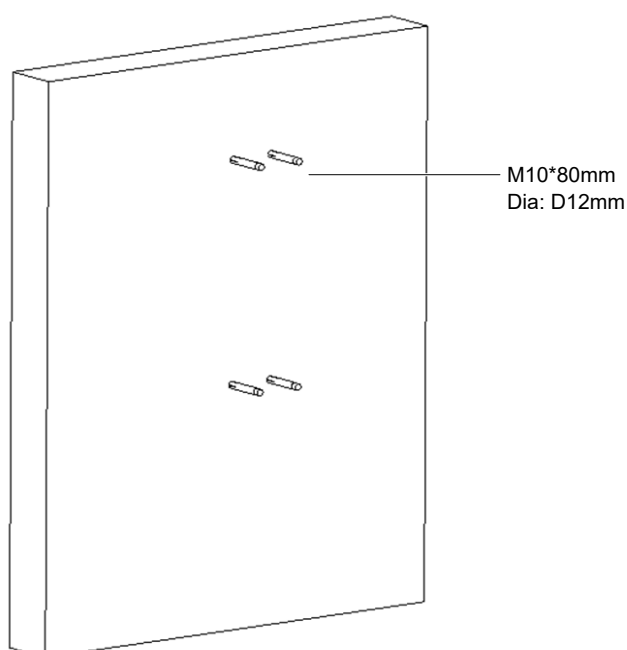


Figure 2.12 Expansion Bolt Installation



NOTE! The expansion bolts are customer supplied.

Figure 2.13 Installing the Mounting Brackets to the Rectifier (Flag)

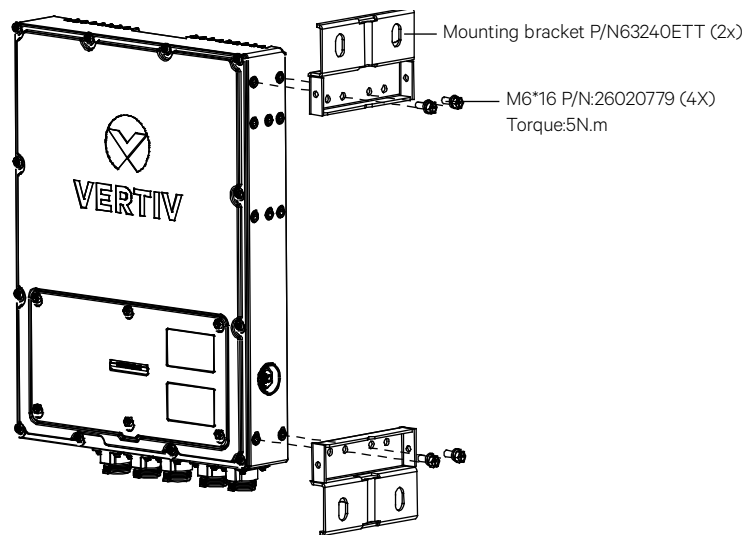


Figure 2.14 Installing the Mounting Brackets to the Rectifier (Flat)

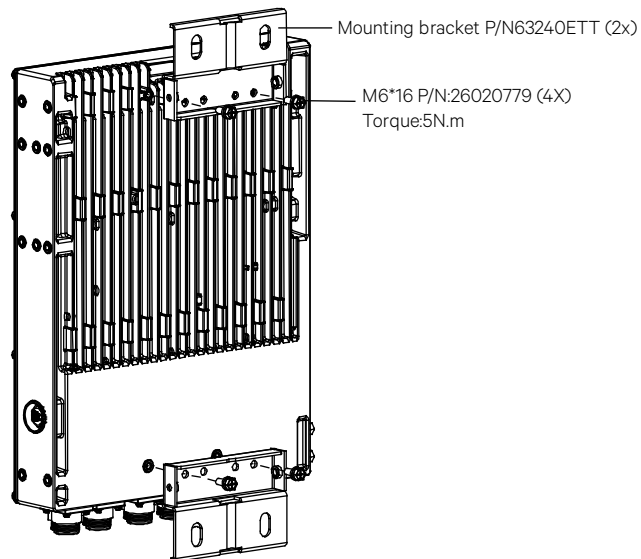


Figure 2.15 Installing the Rectifier to the Wall (Flag)

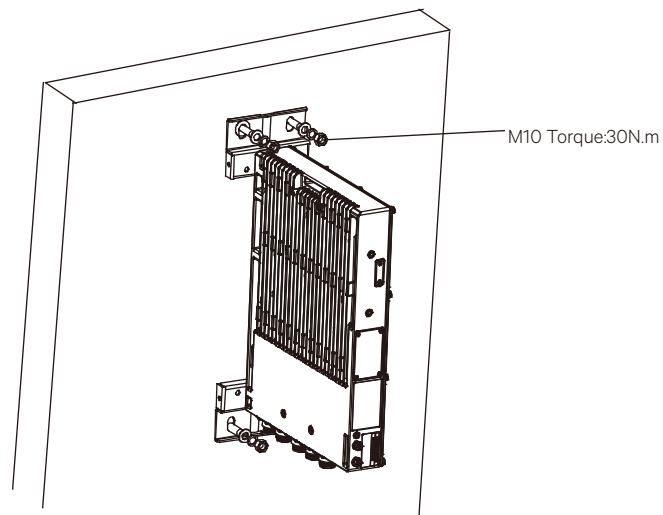
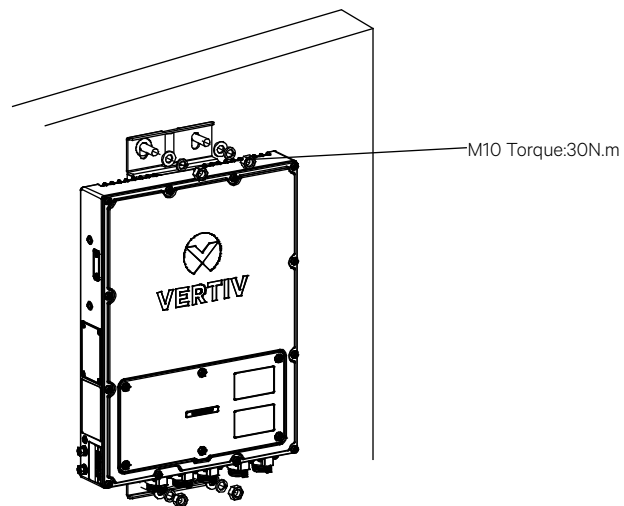


Figure 2.16 Installing the Rectifier to the Wall (Flat)



2.5 Mounting the Rectifier with a Lithium-Ion Battery to a Pole or Wall Using Optional Rectifier/Battery Mounting Kit P/N 02236200 (Flag Installation)

2.5.1 General

The rectifier and battery can be pole mounted or secured to a suitable wall (Flag Orientation) using optional rectifier/battery mounting kit P/N 02236200. See “Mounting Kits” on page 20.

- For wall mounting, the customer needs to supply four (4) wall anchors capable of supporting the weight of the rectifier and battery.



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 2.5 Nm.

2.5.2 Pole Mounting Procedure



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

1. Unpack the rectifier, Li-ion battery and mounting accessories.
2. Install mounting brackets to pole. Refer to Figure 2.17.
3. Install mounting brackets to Li-ion battery. Refer to Figure 2.18.
4. Install mounting brackets to rectifier. Refer to Figure 2.19.
5. Install Li-ion battery to pole. Refer to Figure 2.20.
6. Install rectifier to pole. Refer to Figure 2.21.

Figure 2.17 Install Mounting Brackets to Pole

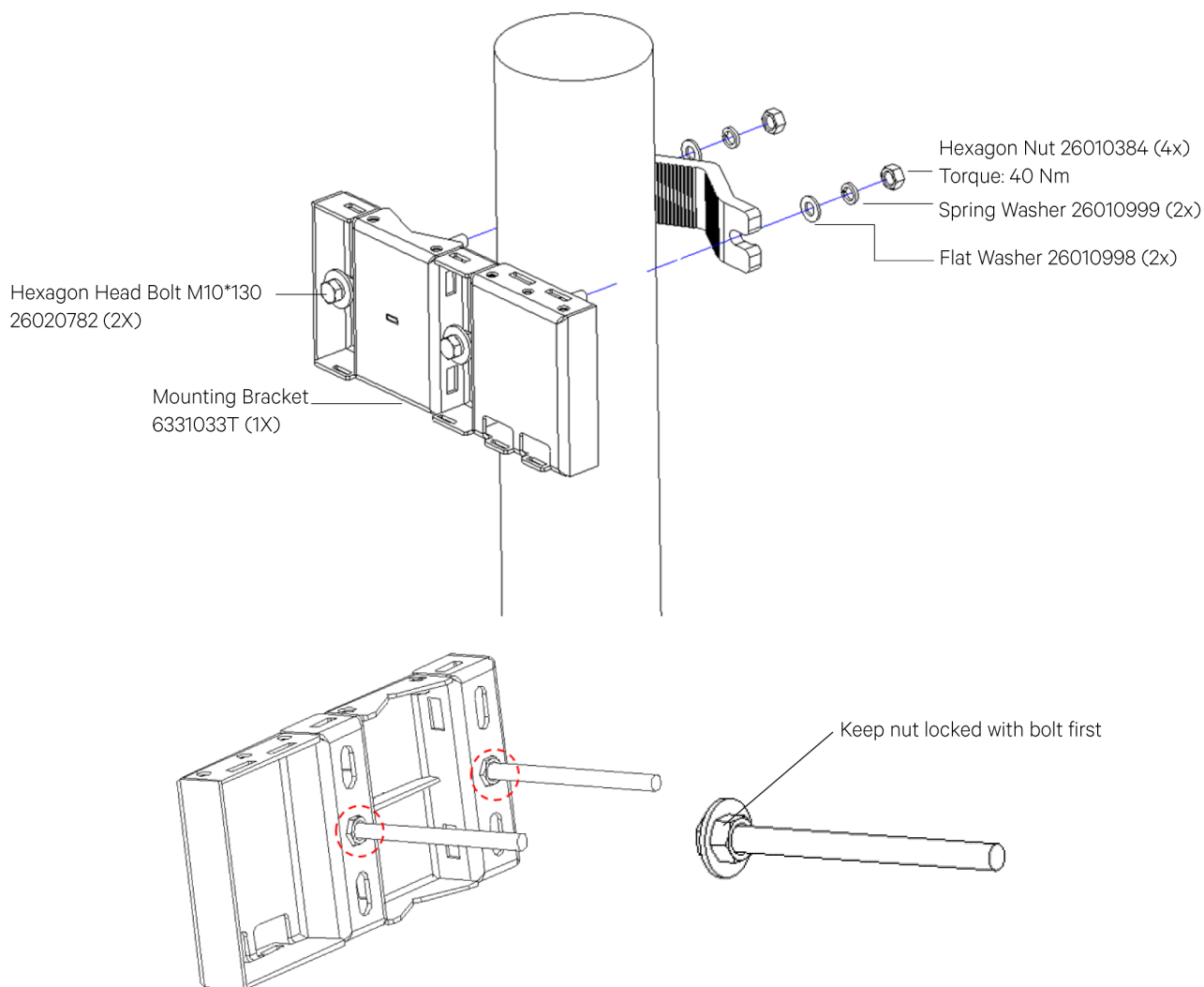


Figure 2.18 Install Mounting Brackets to Li-ion Battery

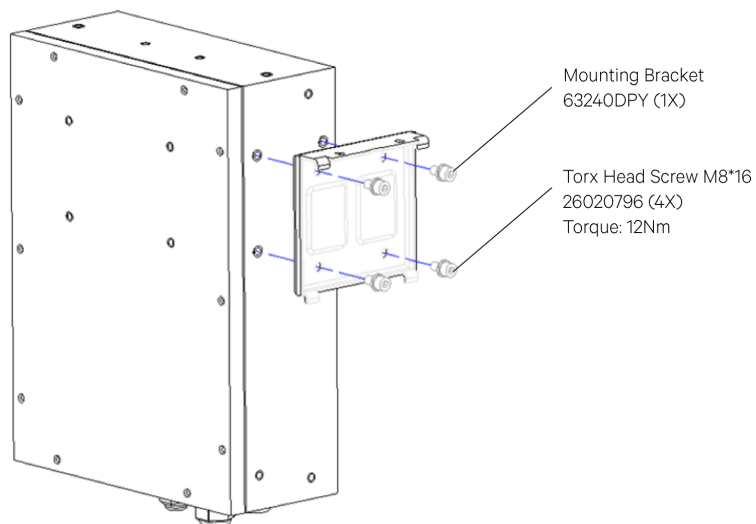


Figure 2.19 Install Mounting Brackets to Rectifier

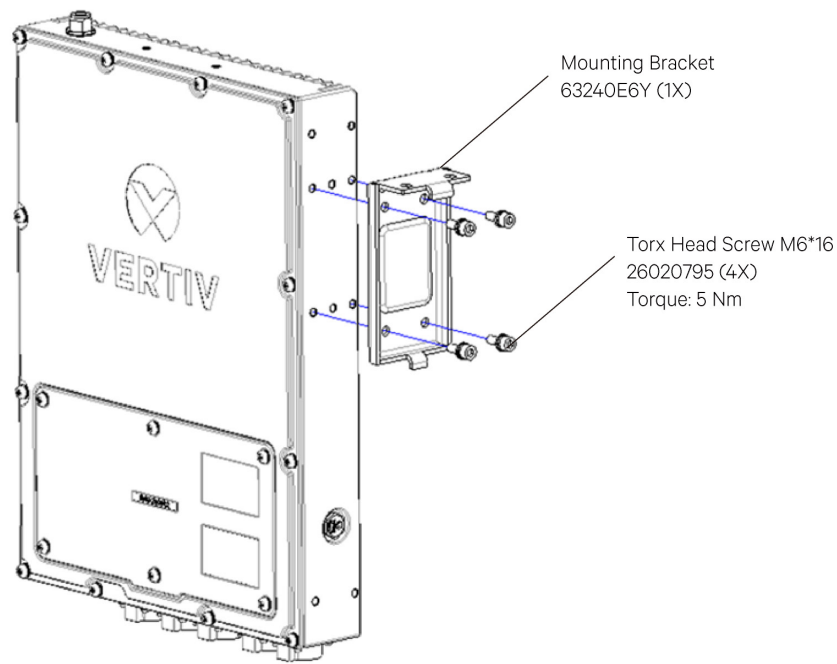


Figure 2.20 Install Li-ion Battery to Pole

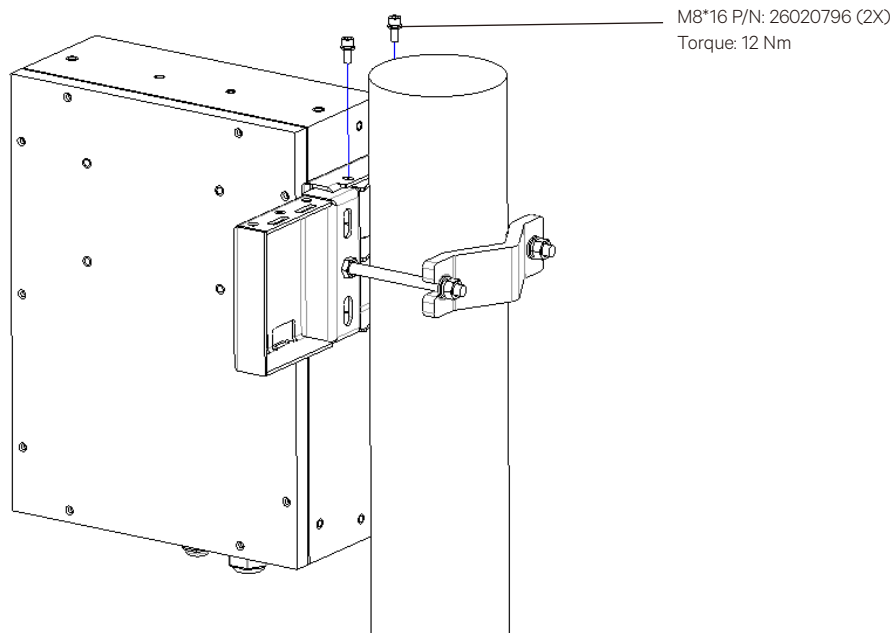
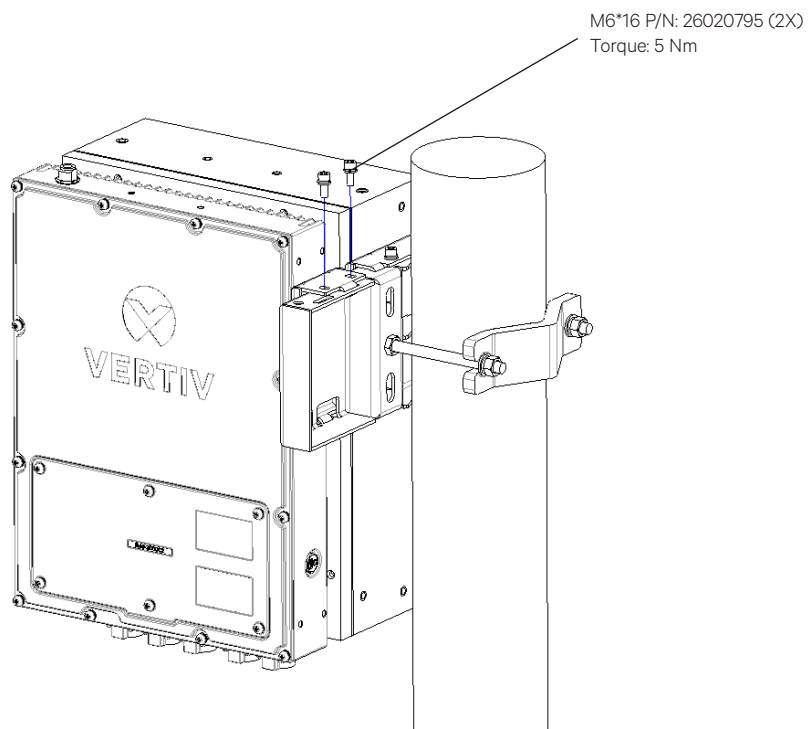


Figure 2.21 Install Rectifier to Pole



2.5.3 Wall Mounted Procedure



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

1. Unpack the rectifier, Li-ion battery and mounting accessories.
2. Drill appropriately sized holes for the customer provided M10 wall anchors being used into the wall as shown in Figure 2.22. Install the M10 wall anchors into the holes (Figure 2.23).
3. Install mounting bracket to wall. Refer to Figure 2.24.
4. Install mounting bracket to Li-ion battery. Refer to Figure 2.25.
5. Install mounting bracket to rectifier. Refer to Figure 2.26.
6. Install Li-ion battery to wall. Refer to Figure 2.27.
7. Install rectifier to wall. Refer to Figure 2.28.

Figure 2.22 Wall Hole Distance (Unit: mm)

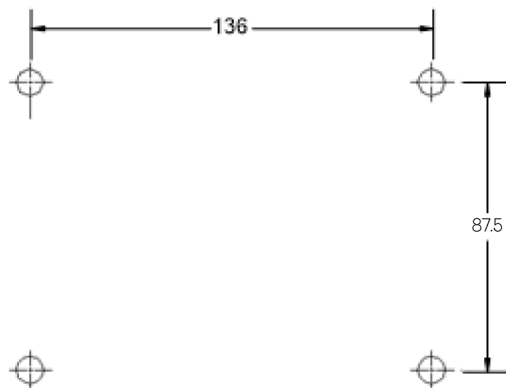


Figure 2.23 Expansion Bolt Installation

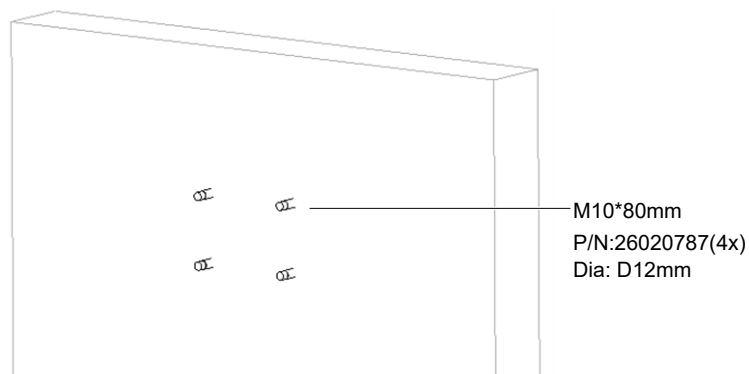


Figure 2.24 Install Mounting Bracket to Wall

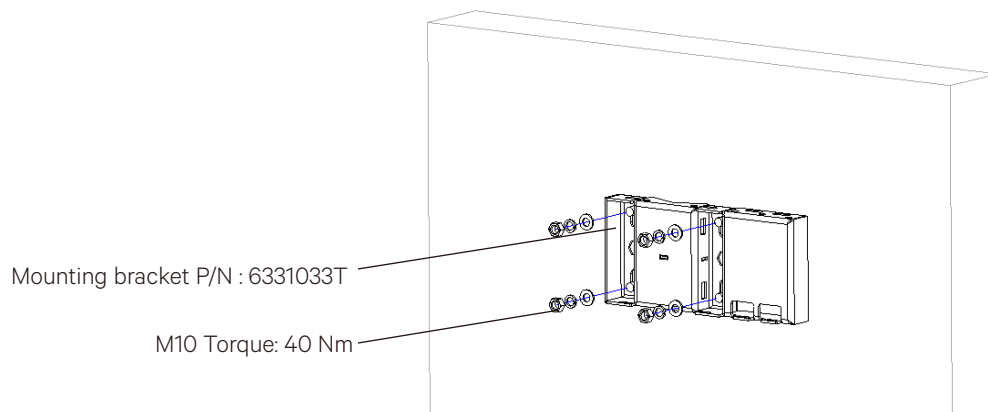


Figure 2.25 Install Mounting Bracket to Li-ion Battery

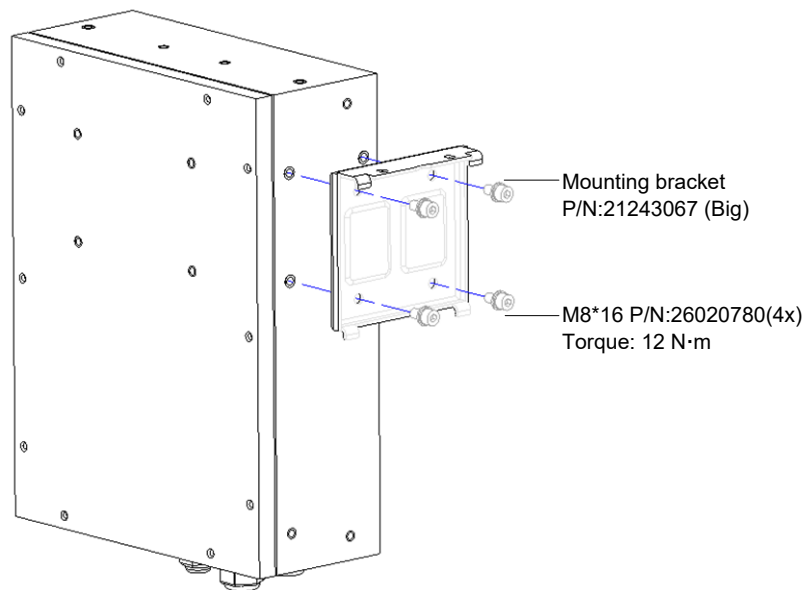


Figure 2.26 Install Mounting Bracket to Rectifier

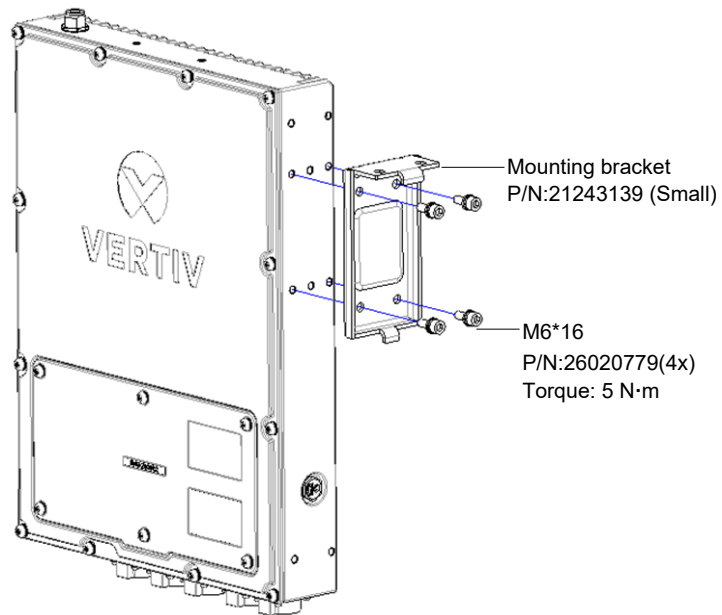


Figure 2.27 Install Li-ion Battery to Wall

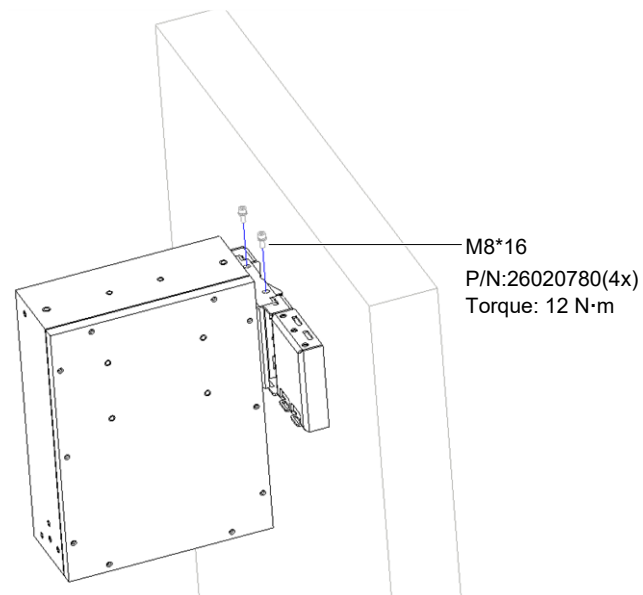
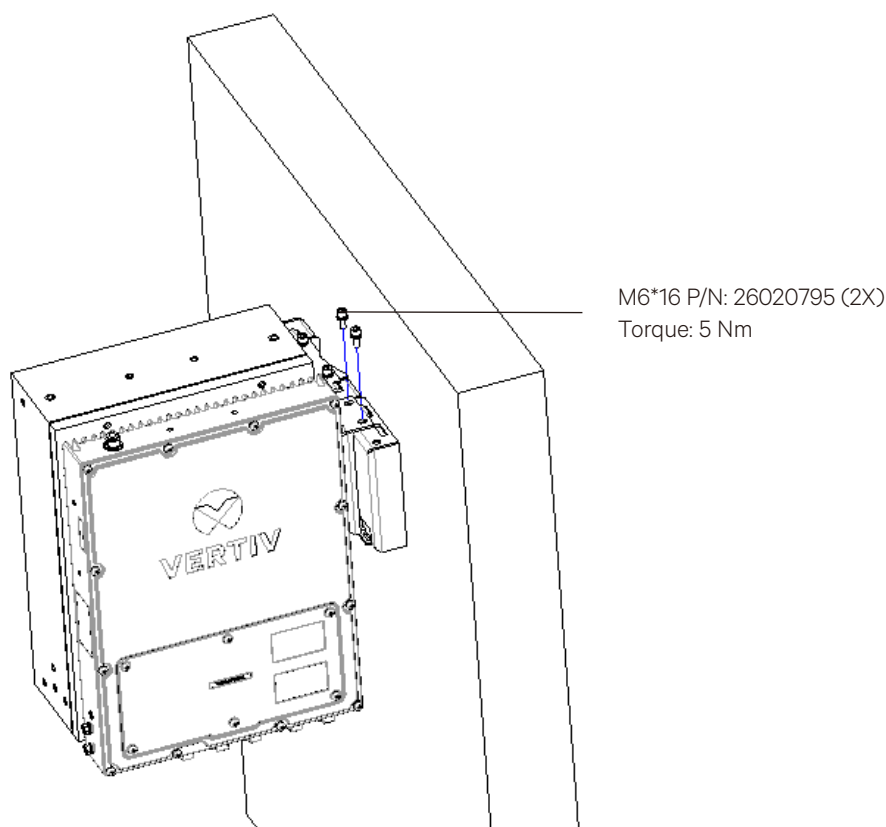


Figure 2.28 Install Rectifier to Wall



2.6 Mounting the Rectifier with a Lithium-Ion Battery to a Pole or Wall Using Optional Rectifier/Battery Mounting Kit P/N 02236201 (Flat Installation)

2.6.1 General

The rectifier and battery can be pole mounted or secured to a suitable wall (Flat Orientation) using optional rectifier/battery mounting kit P/N 02236201. See “Mounting Kits” on page 20.

- For wall mounting, the customer needs to supply four (4) wall anchors capable of supporting the weight of the rectifier and battery.



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 2.5 Nm.

2.6.2 Pole Mounting Procedure



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

- Unpack the rectifier, Li-ion battery and mounting accessories.
- Install mounting bracket to pole. Refer to Figure 2.29.
- Install Li-ion battery optional mounting bracket (if required). Refer to Figure 2.30.
- Install pole mounting bracket to Li-ion battery. Refer to Figure 2.31.
- Install rectifier mounting bracket to Li-ion battery. Refer to Figure 2.32.

6. Install top mounting screws to rectifier. Refer to Figure 2.33.
7. Install Li-ion battery to pole. Refer to Figure 2.34.
8. Install rectifier to Li-ion battery. Refer to Figure 2.35.
9. Install bottom mounting screws to rectifier. Tighten top and bottom rectifier mounting screws. Refer to Figure 2.36.
10. Install rectifier and Li-ion battery connector. Refer to Figure 2.37.

Figure 2.29 Install Mounting Bracket to Pole

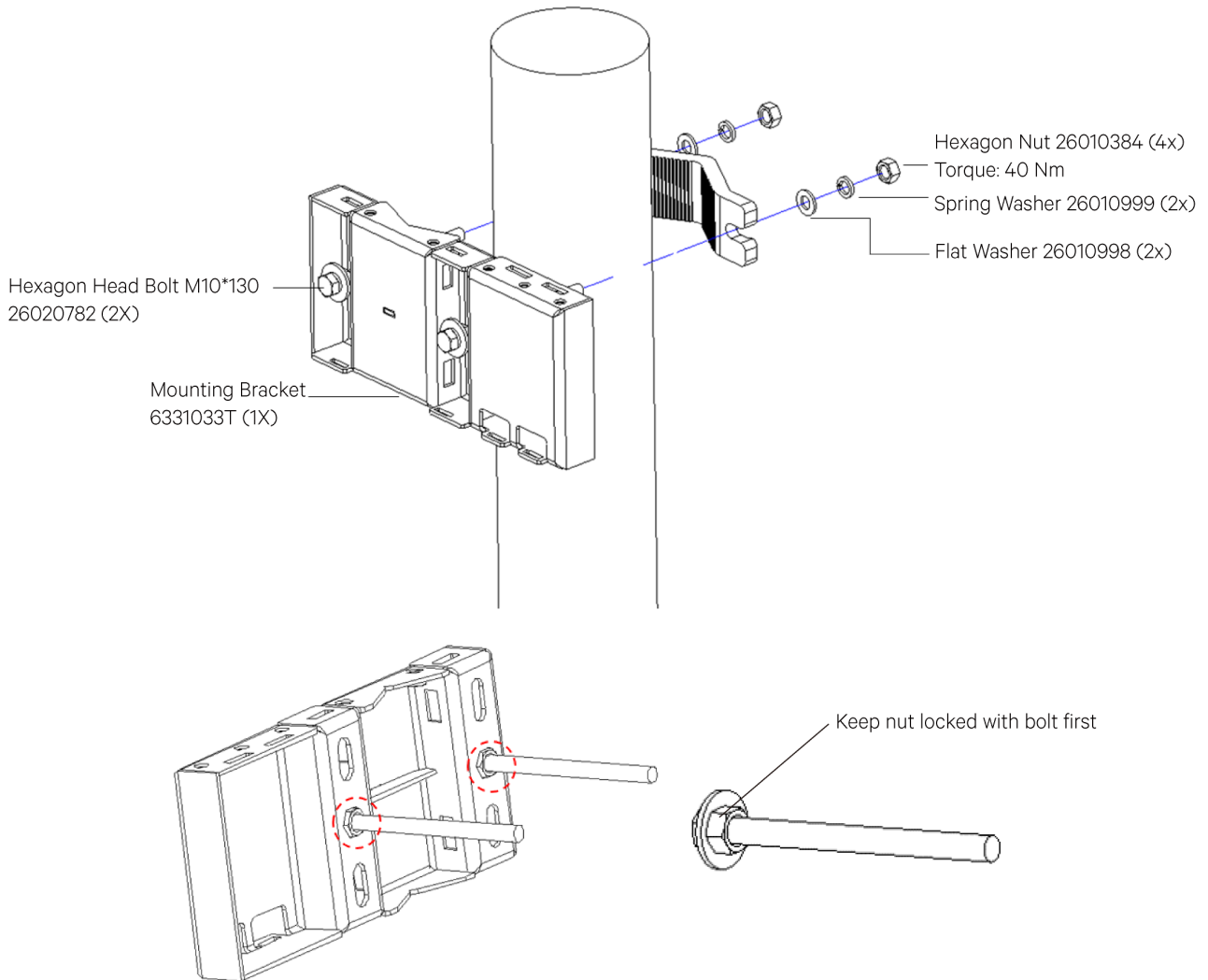


Figure 2.30 Install Li-ion Battery Optional Mounting Bracket (if required)

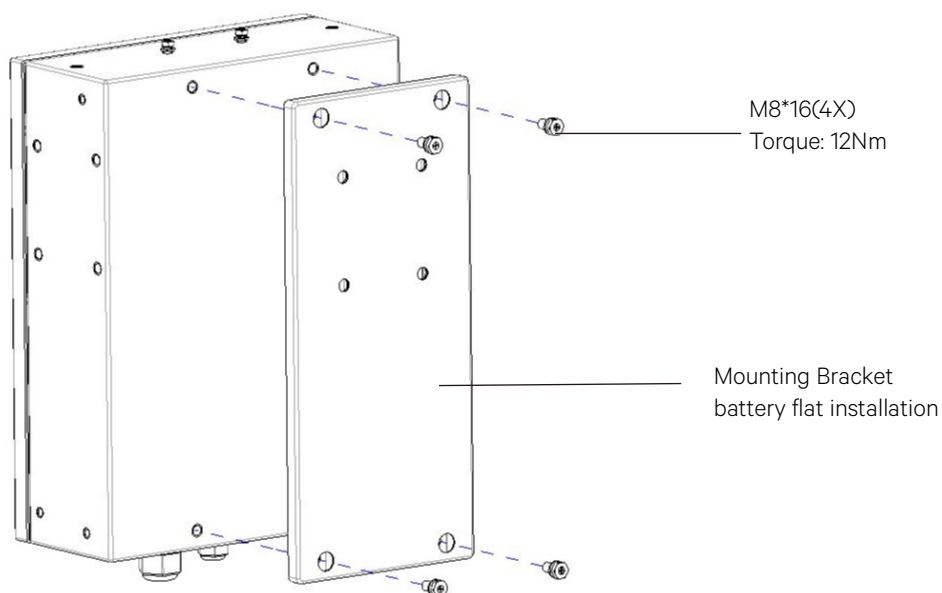


Figure 2.31 Install Pole Mounting Bracket to Li-ion Battery

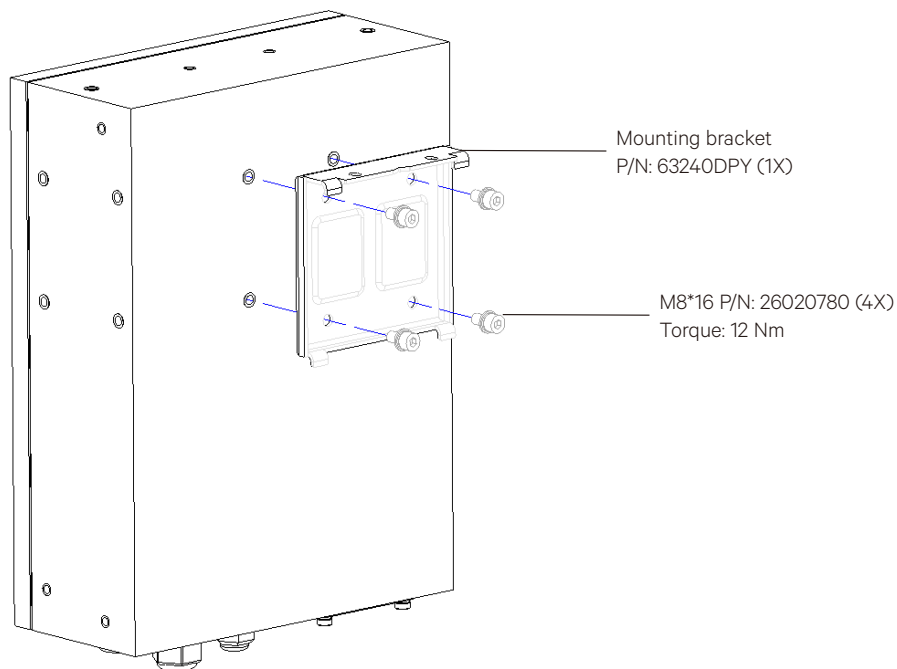


Figure 2.32 Install Rectifier Mounting Bracket to Li-ion Battery

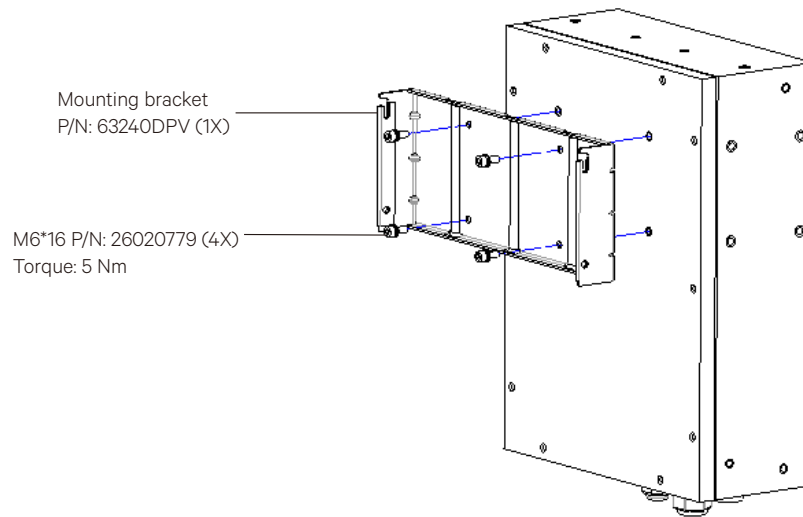


Figure 2.33 Install Top Mounting Screws to the Rectifier

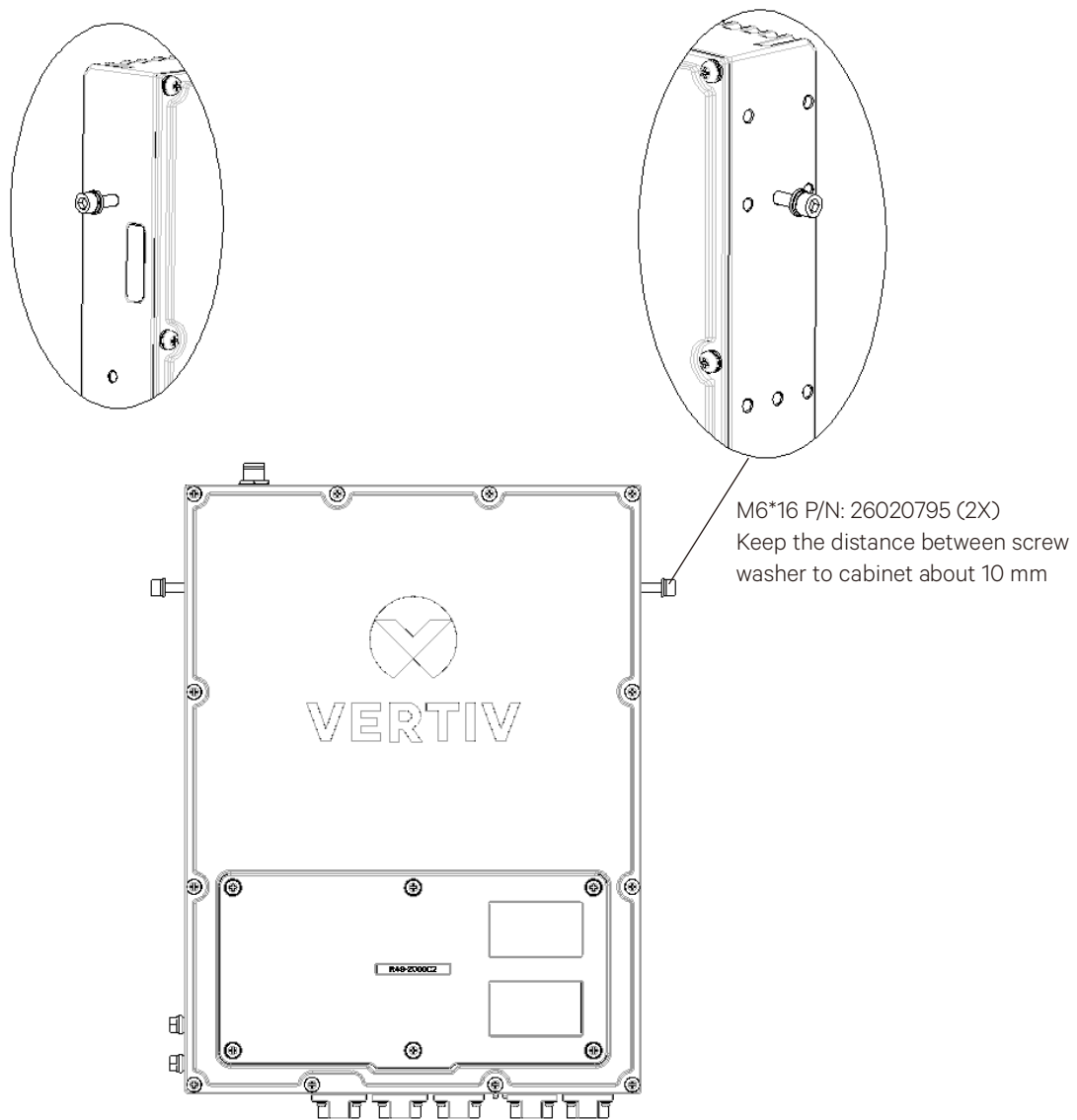


Figure 2.34 Install Li-ion Battery to Pole

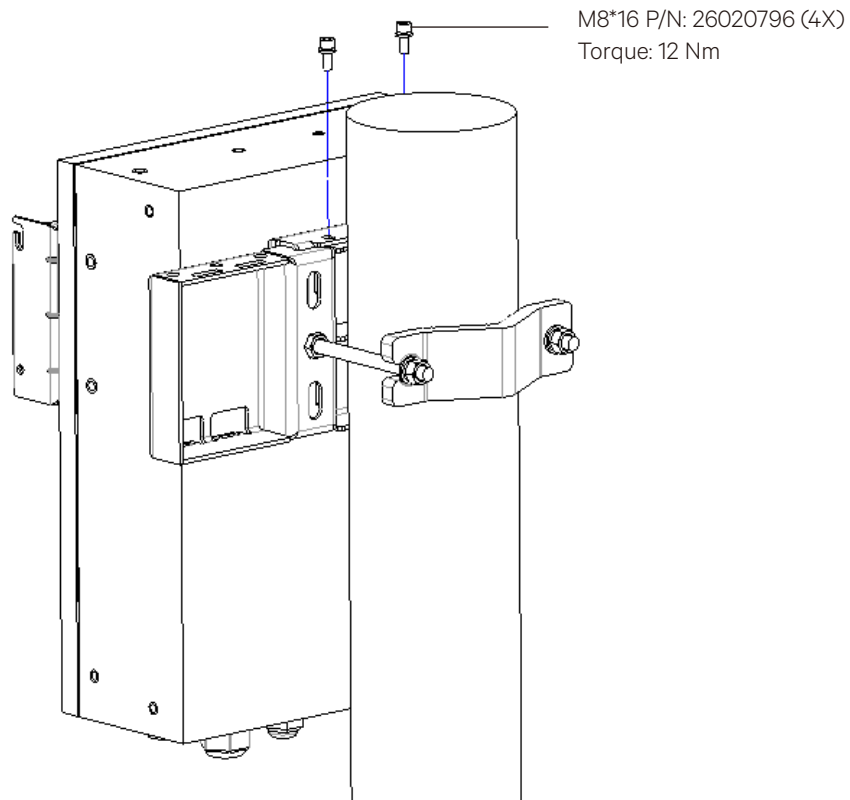


Figure 2.35 Install Rectifier to Li-Battery

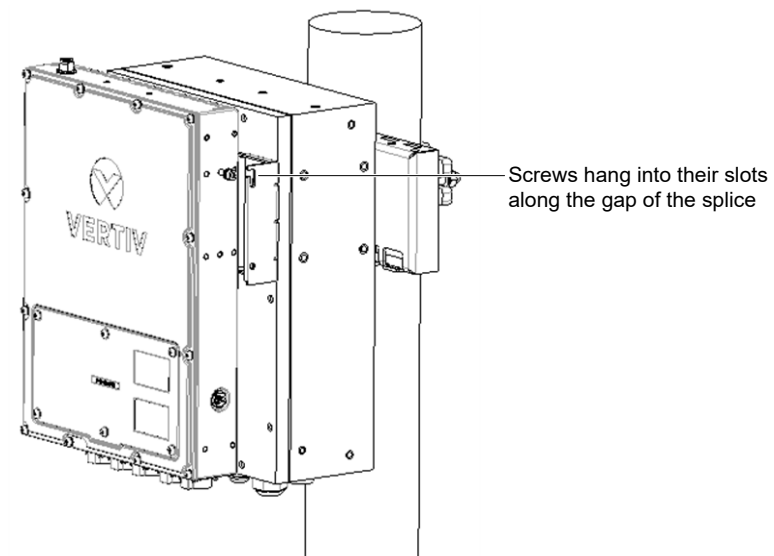


Figure 2.36 Install Bottom Mounting Screws to Rectifier and Tighten Top and Bottom Rectifier Mounting Screws

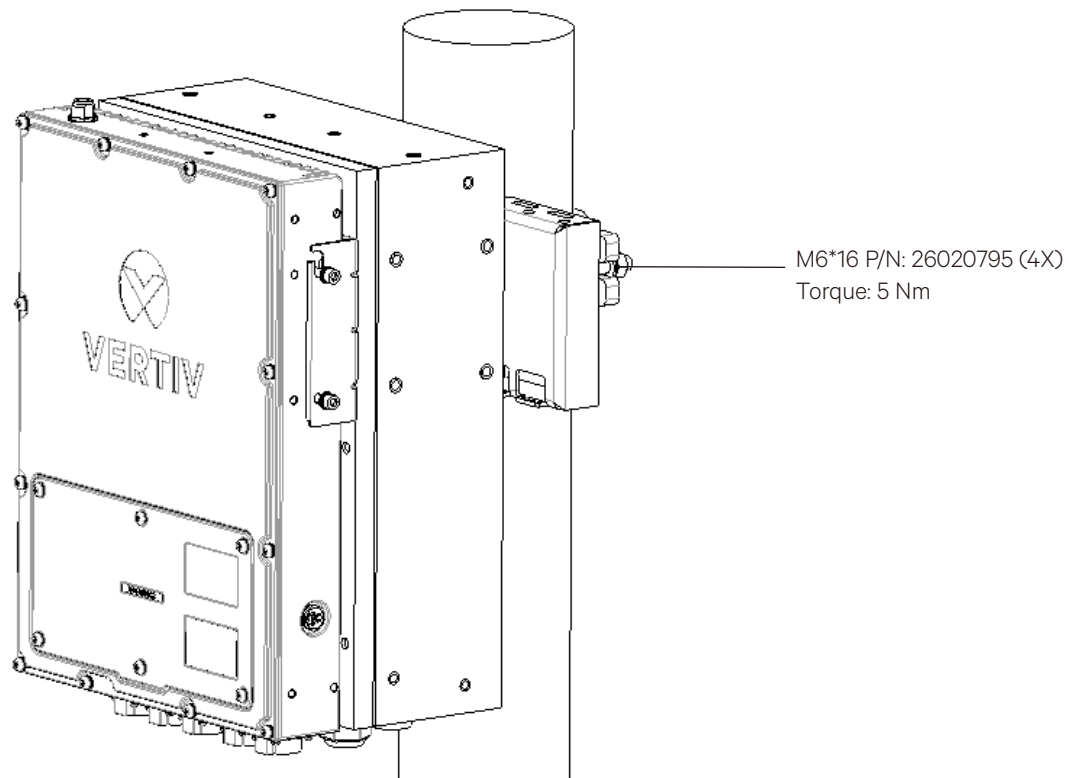
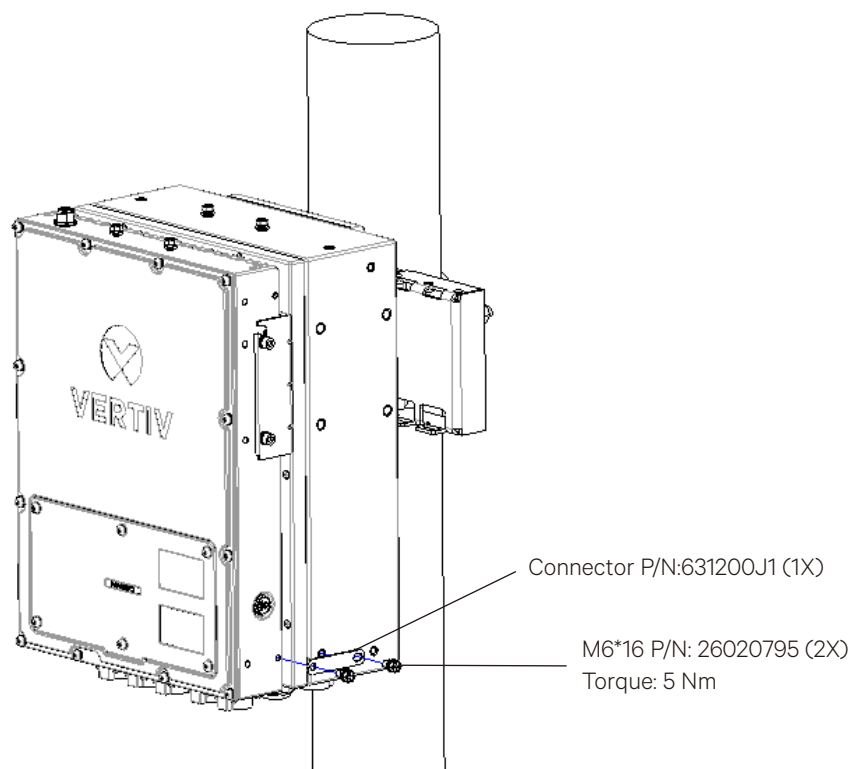


Figure 2.37 Install Rectifier and Li-ion Battery Connector



2.6.3 Wall Mounted Procedure



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

1. Unpack the rectifier, Li-ion battery and mounting accessories.
2. Drill appropriately sized holes for the customer provided M10 wall anchors being used into the wall as shown in Figure 2.38. Install the M10 wall anchors into the holes (Figure 2.39).
3. Install mounting bracket to wall. Refer to Figure 2.40.
4. Install Li-ion battery optional mounting bracket (if required). Refer to Figure 2.41
5. Install wall mounting bracket to Li-ion battery. Refer to Figure 2.42.
6. Installing rectifier mounting bracket to Li-ion battery. Refer to Figure 2.43.
7. Install top mounting screws to rectifier. Refer to Figure 2.44.
8. Install Li-ion battery to wall. Refer to Figure 2.45.
9. Install rectifier to Li-ion battery. Refer to Figure 2.46.
10. Install bottom mounting screws to rectifier. Tighten top and bottom rectifier mounting screws. Refer to Figure 2.47.
11. Install rectifier and Li-ion battery connector. Refer to Figure 2.48.

Figure 2.38 Wall Hole Distance (Unit: mm)

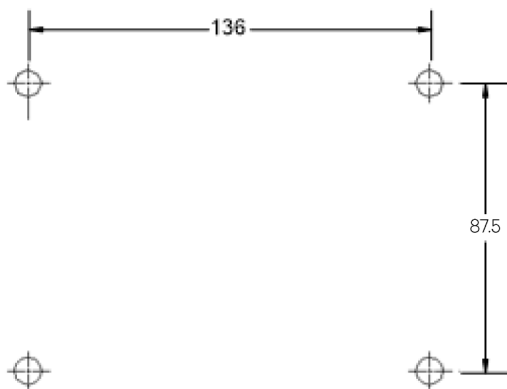


Figure 2.39 Expansion Bolt Installation

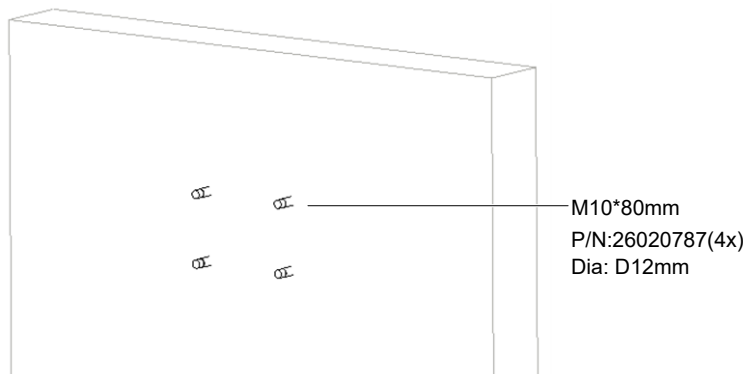


Figure 2.40 Install Mounting Bracket to Wall

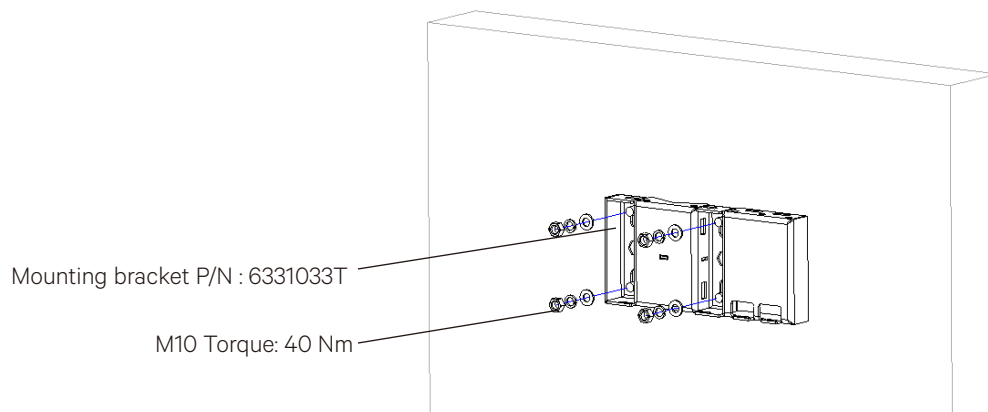


Figure 2.41 Install Li-ion Battery Optional Mounting Bracket (if required)

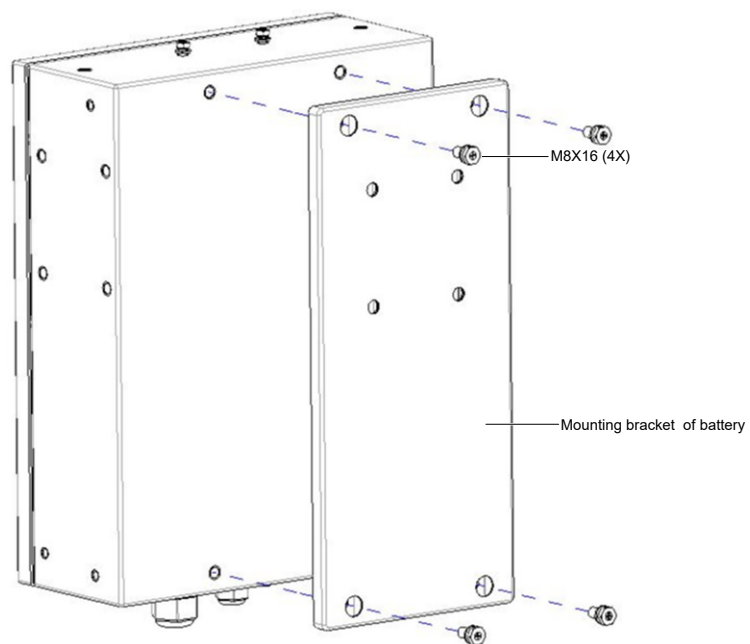


Figure 2.42 Install Wall Mounting Bracket to Li-ion Battery

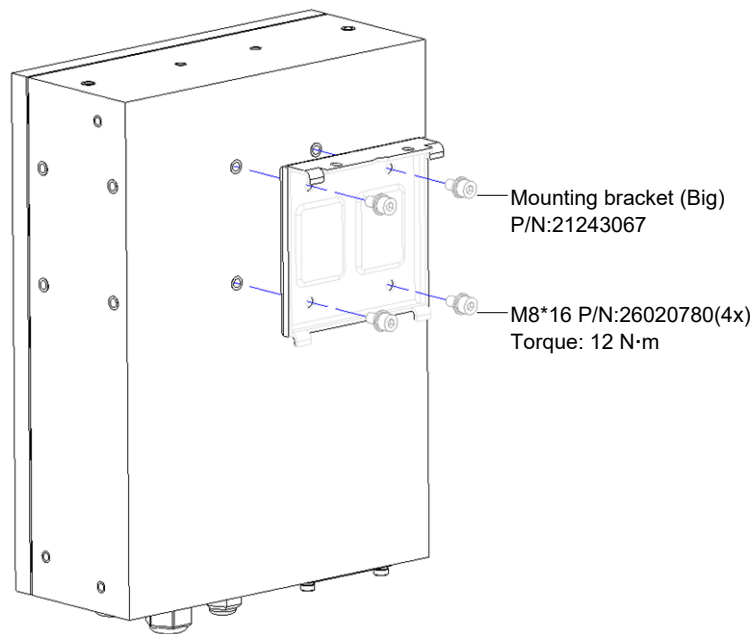


Figure 2.43 Install Rectifier Mounting Bracket to Li-ion Battery

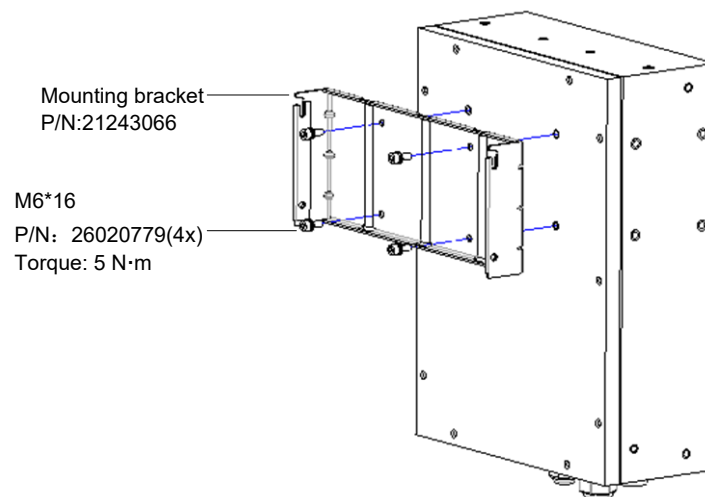


Figure 2.44 Install Top Mounting Screws to Rectifier

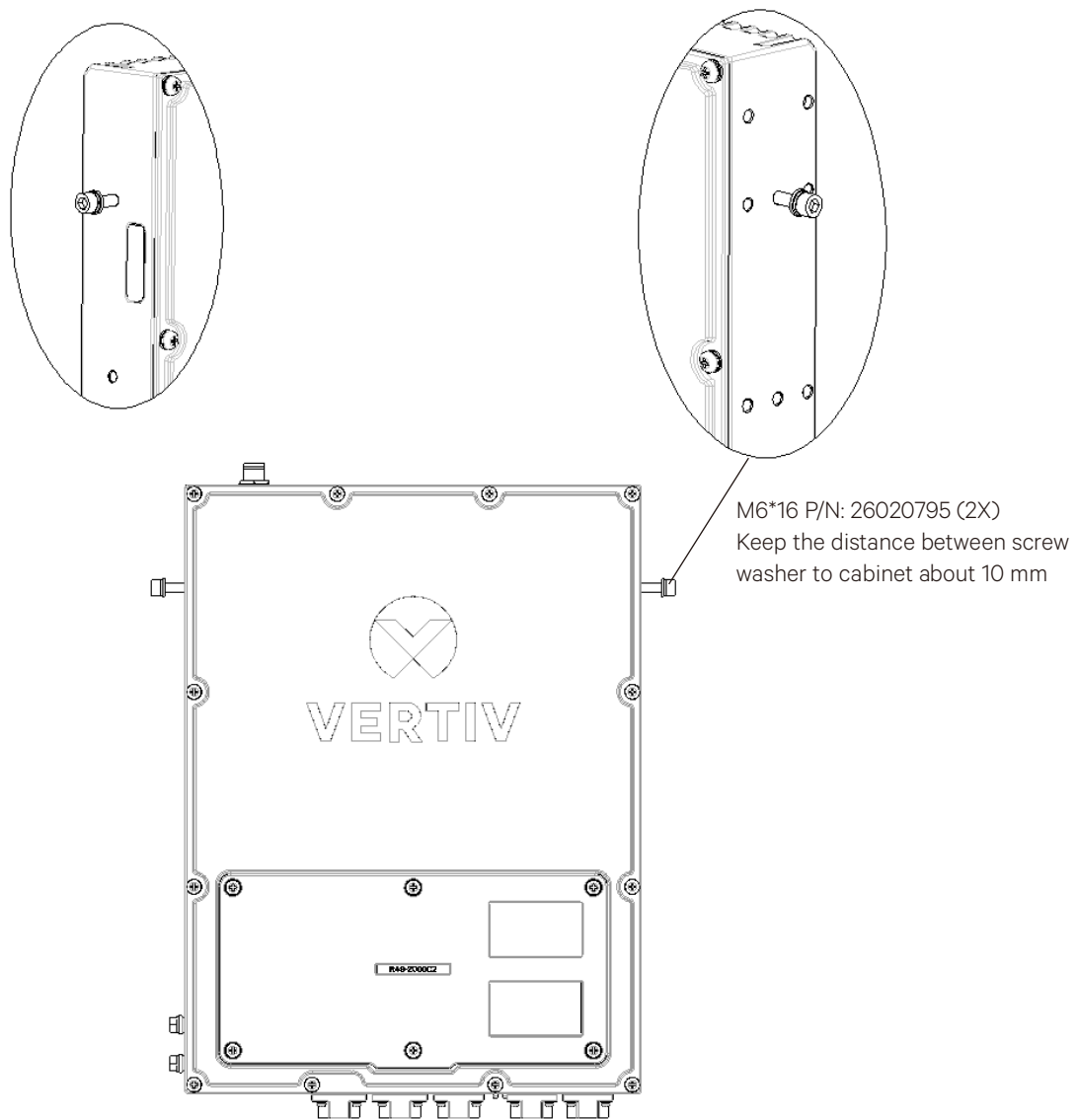


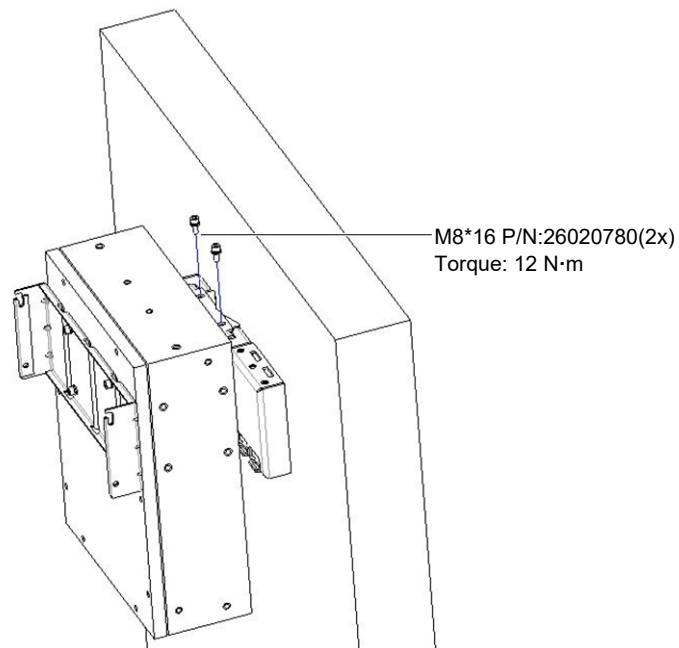
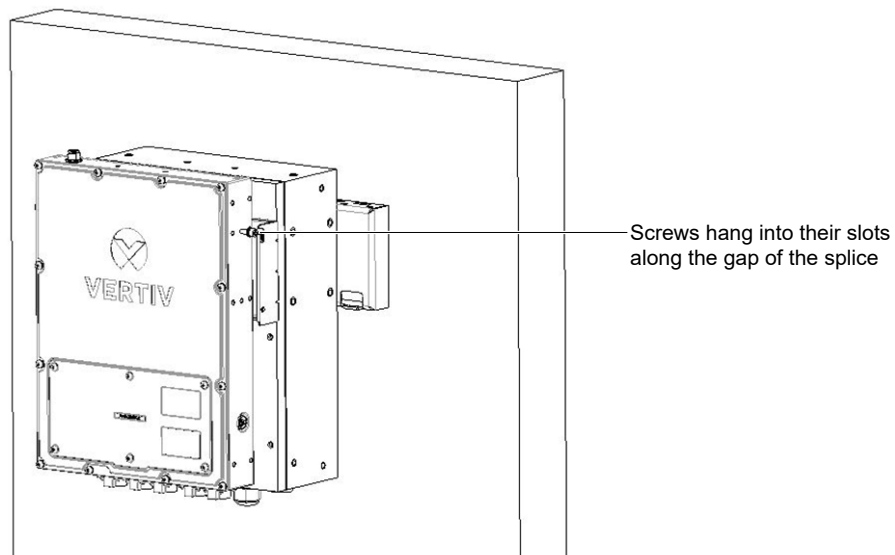
Figure 2.45 Install Li-ion Battery to Wall**Figure 2.46 Install Rectifier to Li-ion Battery**

Figure 2.47 Install Bottom Mounting Screws to Rectifier and Tighten Top and Bottom Rectifier Mounting Screws

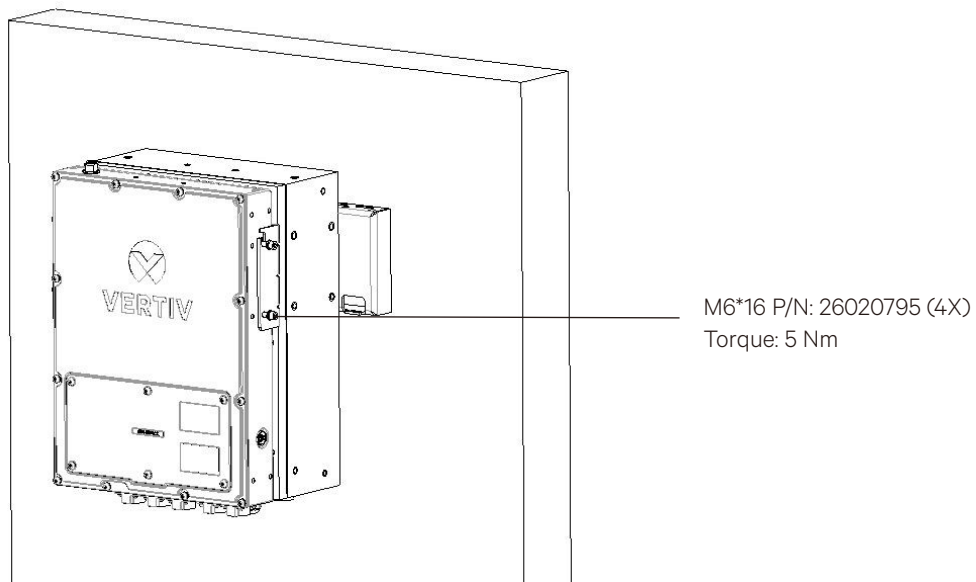
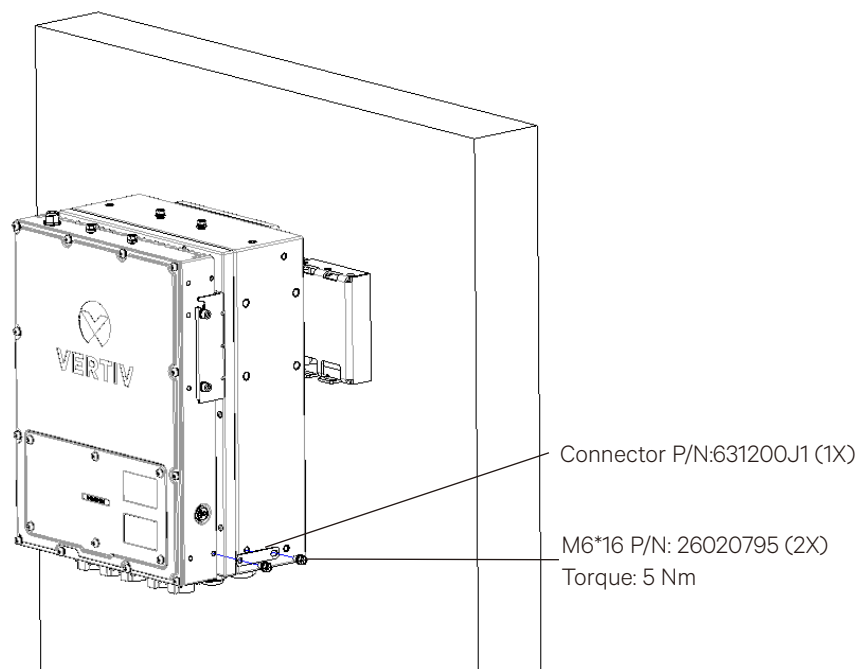


Figure 2.48 Install Rectifier and Li-ion Battery Connector



2.6.4 Lashing of Cords and Cables

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" (305mm) of the cord connection, so as not to transfer tension or pull on the physical connector termination or joint.

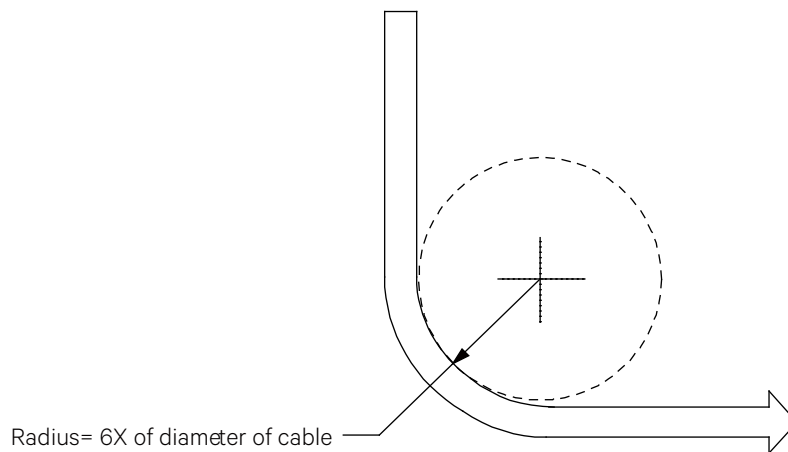
Connectors are IP65 rated when not accommodating installation cord or cable tension or pull.

At installation, use only approved outdoor rated devices and fittings, so as 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 ft (1000 mm).

Vertiv recommends a minimum cable bend radius of 6X of the cable diameter. Example: 20mm cable outer diameter, shall be installed using a 6 x 20mm or 120mm inside bend radius, minimum.

Figure 2.49 Lashing of Cords and Cables



3 Making Electrical Connections

3.1 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 2.5 Nm.

3.2 Wiring Considerations

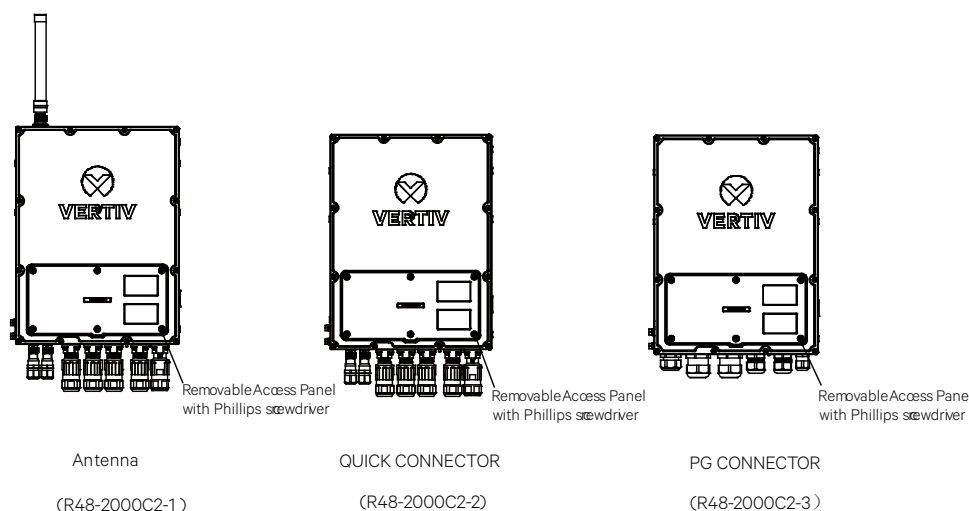
All wiring and branch circuit protection should follow the local national electrical building standards.

3.3 Rectifier Interface Overview Diagrams

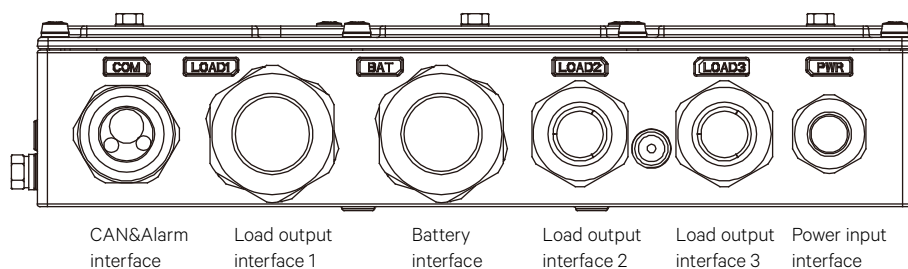
Refer to Figure 3.1 for rectifier interface overview diagrams showing electrical connection points.

Figure 3.1 Rectifier Interface Overview Diagrams

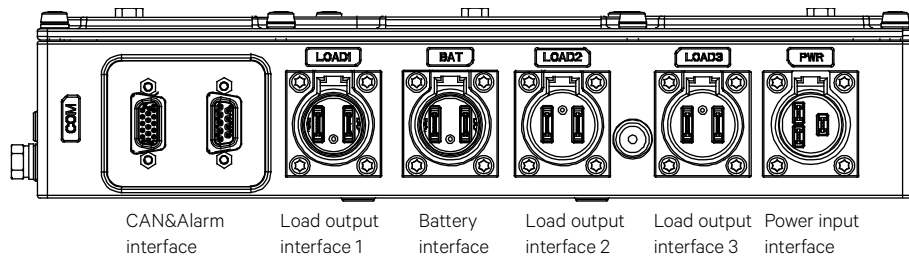
Front View



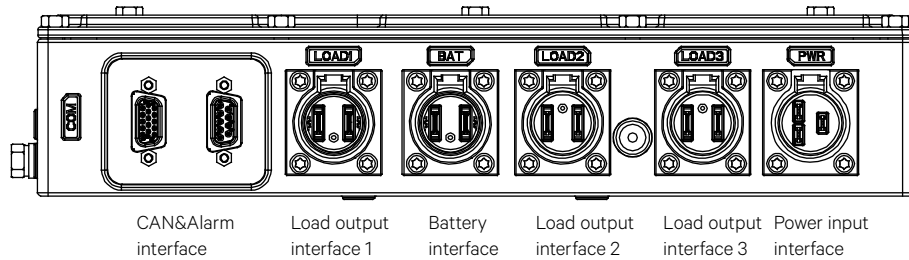
Bottom View (PG Terminal)



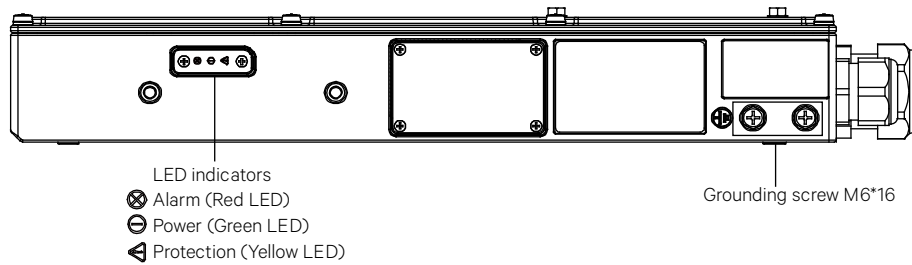
Bottom View (Quick Connect)



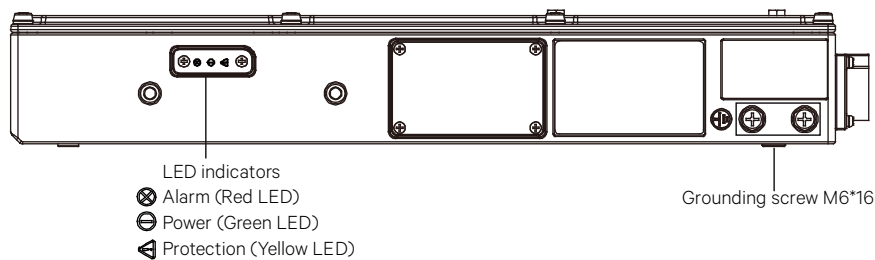
Bottom View (Antenna) (R48-2000C2-1 only)



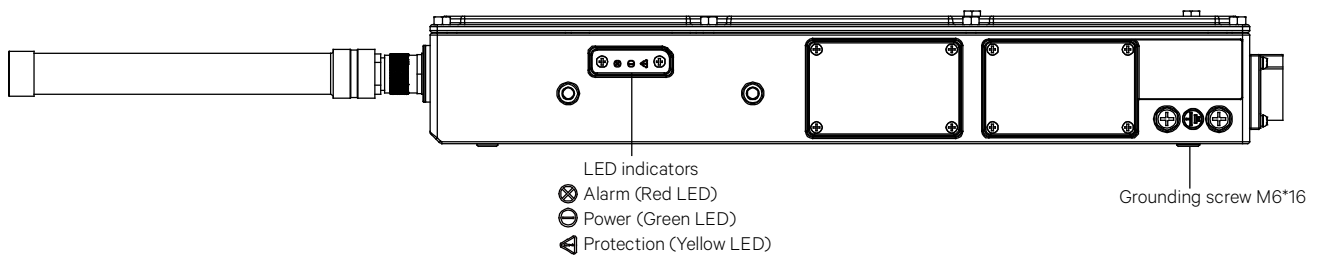
Side view (PG Terminal): Two grounding screws are pre-installed on the rectifier.



Side View (Quick Connect)



Side View (Antenna) (R48-2000C2-1 only)



3.4 Rectifier Ground Connection

3.4.1 General

For grounding requirements, refer to current edition of building installation, local codes and your specific site requirements.

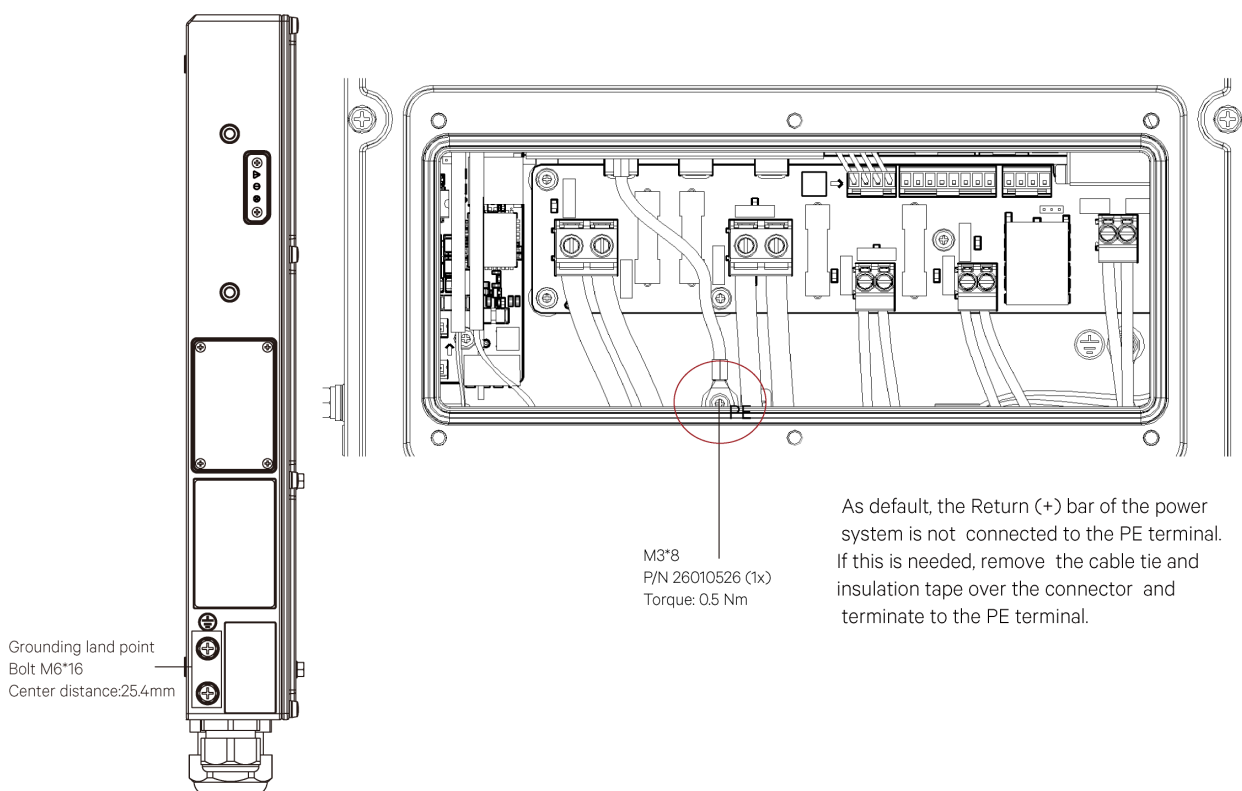
3.4.2 Positive Grounding

As default, the power system is not positive grounded. Connect the grounding wire as shown in Figure 3.2 to ground positive, if required.

3.4.3 Chassis Grounding

Connect the rectifier Chassis to the site grounding point with a two-hole lug. Lugs should be crimped per lug manufacturer's specifications. Refer to Figure 3.1 for location.

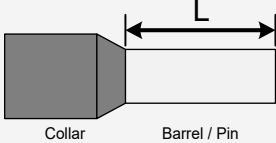
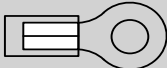
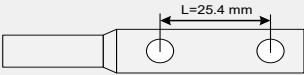
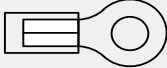
Figure 3.2 Rectifier Grounding Location



3.5 Terminal List

3.5.1 PG Version

Table 3.1 PG Version Terminal List

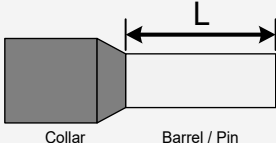
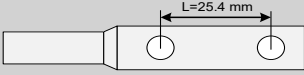
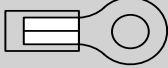
Cable	Wire Size	Terminal Size	Illustration
1 kW DC Output	6 mm ²	L = 12 mm	
2 kW DC Output	10 mm ²	L = 12 mm	
AC Input – L & N	2.5 mm ²	L = 12 mm	
AC Input – PE	2.5 mm ²	Φ stud: M3	
PE	10 mm ²	L = 25.4 mm Φ screw: M6	 or 



NOTE! Terminals to be customer supplied.

3.5.2 Quick Connect Version

Table 3.2 Quick Connect Version Terminal List

Cable	Wire Size	Dimension	Illustration
1 kW DC Output	6 mm ²	L = 12 mm	
2 kW DC Output	10 mm ²	L = 12 mm	
AC Input	2.5 mm ²	L = 12 mm	
PE	10 mm ²	L = 25.4 mm Φ screw: M6	 or 



NOTE! Terminals to be customer supplied.

3.6 Customer Wiring Selection

Refer to Table 1.6 on page 4 and Table 1.7 on page 4.

3.7 Digital Output (DO) Relay Functions

Refer to “Digital Output (DO) Dry Relay Contacts” on page 12.

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

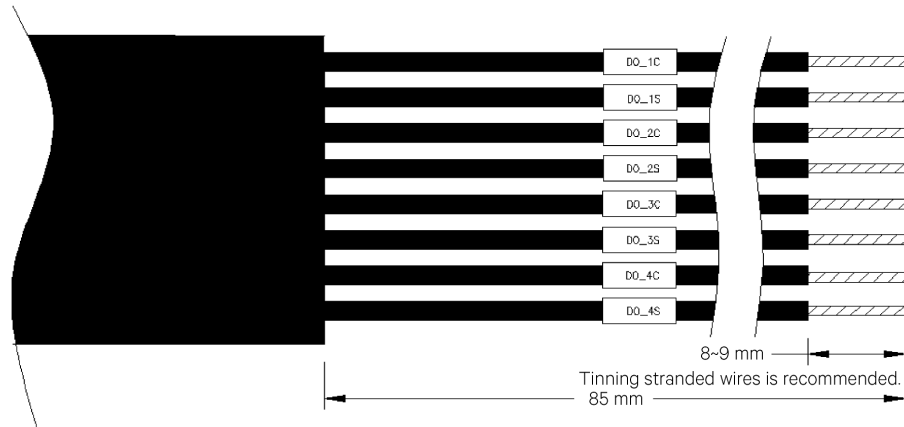
The alarm relay contact configurations can be changed. Refer to the following procedure.

Procedure

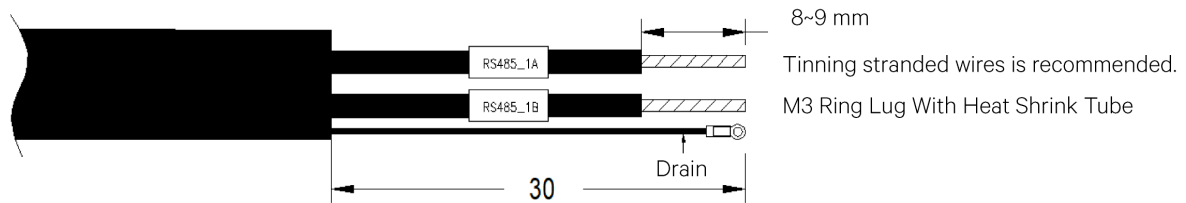
1. Refer to “Opening / Closing the Front Access Panel” on page 75, and open the rectifier enclosure front access panel.
2. Locate jumpers JP1, JP2, JP3, and JP4. Set the jumpers per site requirements. See Table 1.12 on page 12 and Figure 1.6 on page 12.
3. Refer to “Opening / Closing the Front Access Panel” on page 75, and close the rectifier enclosure front access panel.

3.9 Wire Preparation

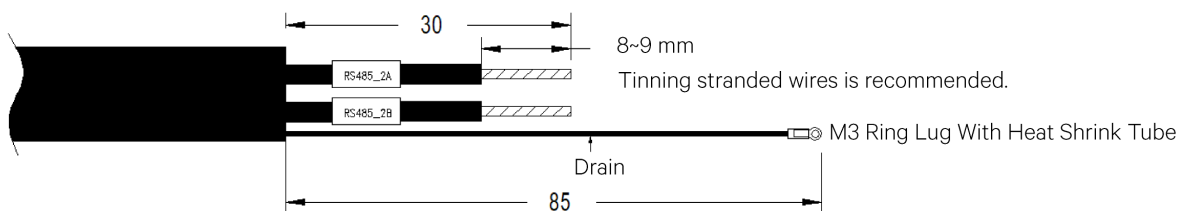
Figure 3.3 Strip insulation off the wires for RELAY OUTPUT and COMM as required (This is for PG Gland Wiring version only.)



8-Conductor Cable: 24 AWG to 26 AWG leads, 4 PR DO's (Recommended Shielded Twisted Pair (STP) Cable)



2-Conductor Cable: Battery-Rectifier RS-485 Communication, 24 AWG or 26 AWG leads, Shielded Twisted Pair (STP)



2-Conductor Cable: Rectifier to Customer Equipment Communication, RS-485 Northbound, 24 AWG or 26 AWG leads, Shielded Twisted Pair (STP) Cable / DI only used for MCB alarm detection under parallel mode.

Figure 3.4 Strip insulation off the wires for RECTIFIER AC INPUT as required for PG gland version (mm)

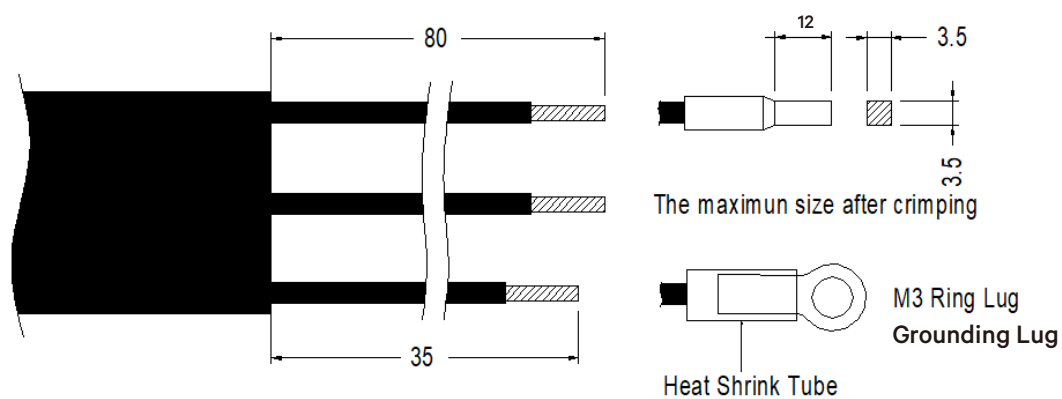
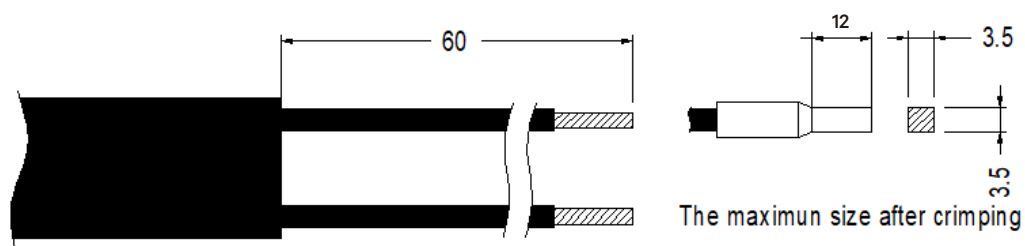
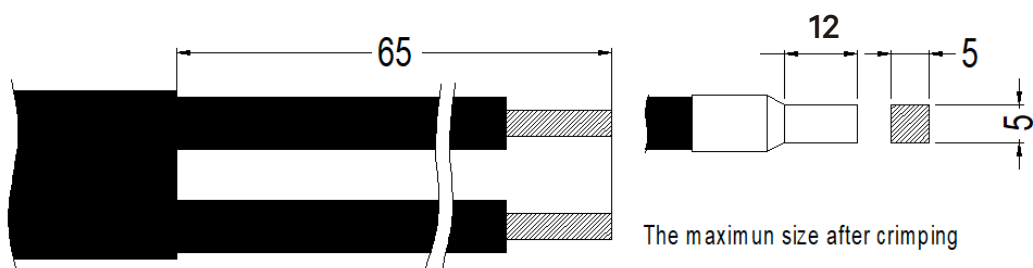


Figure 3.5 Strip insulation off the wires for DC OUTPUT as required (mm)



1KW DC Output



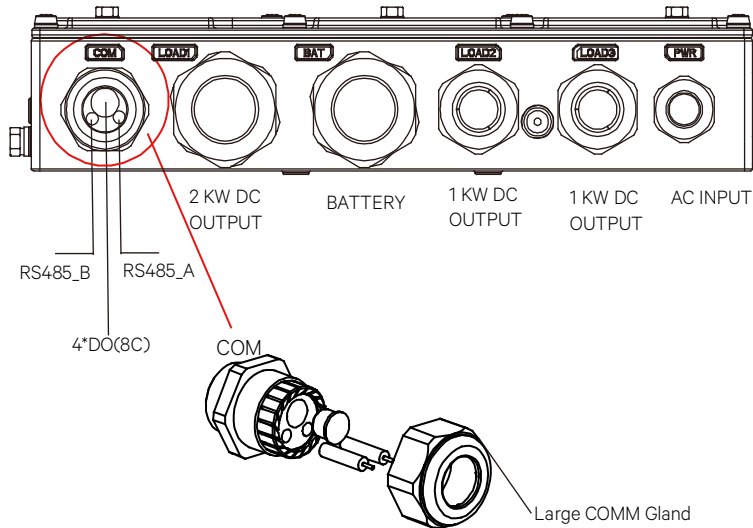
2KW DC Output

3.10 Customer Wiring Connection Procedure

3.10.1 Customer Wiring Connection Procedure for PG Terminal

After finishing pre-install of customer cables, remove the rectifier access panel and connect power cord and wire harnesses according to the following procedures. Refer to Figure 3.6 and the illustrations in the following procedure. Refer also to Table 3.3.

Figure 3.6 Customer Wiring Connection Interface



Note: The holes for COM can be changed appropriately according to the hole diameter.

Table 3.3 Designation for Customer Wiring Connection

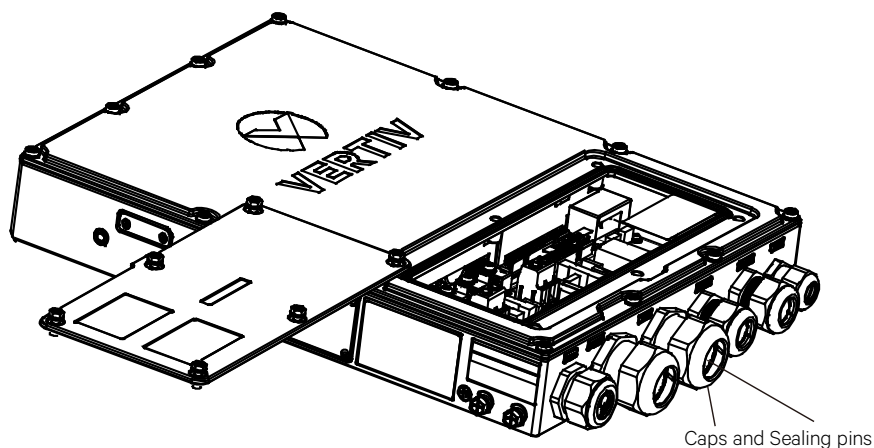
Designation	Cable Gland Connector	Acceptable Cable Outer Diameter Range (mm)	Connect to
COM	M25 Cable Gland	< 11	4 x DO
		< 5.6	/
		< 5.6	/
LOAD1	PG29 Cable Gland	13~20	2KW DC Output1+ and Output1-
BAT	PG29 Cable Gland	13~20	2KW BAT Input Output2+ and Output2-
LOAD2	PG21 Cable Gland	9~16	1KW DC Output3+ and Output3-
LOAD3	PG21 Cable Gland	9~16	1KW DC Output4+ and Output4-
PWR	PG13.5 Cable Gland	6~12	AC Input L+N+PE

Procedure

1. Refer to “Opening / Closing the Front Access Panel” on page 75, and open the rectifier enclosure front access panel. Tighten the hardware indicated in the procedure to secure the access cover in the open position.
2. Remove the cable gland caps and sealing pins from the connectors to be used. Refer to Figure 3.7.



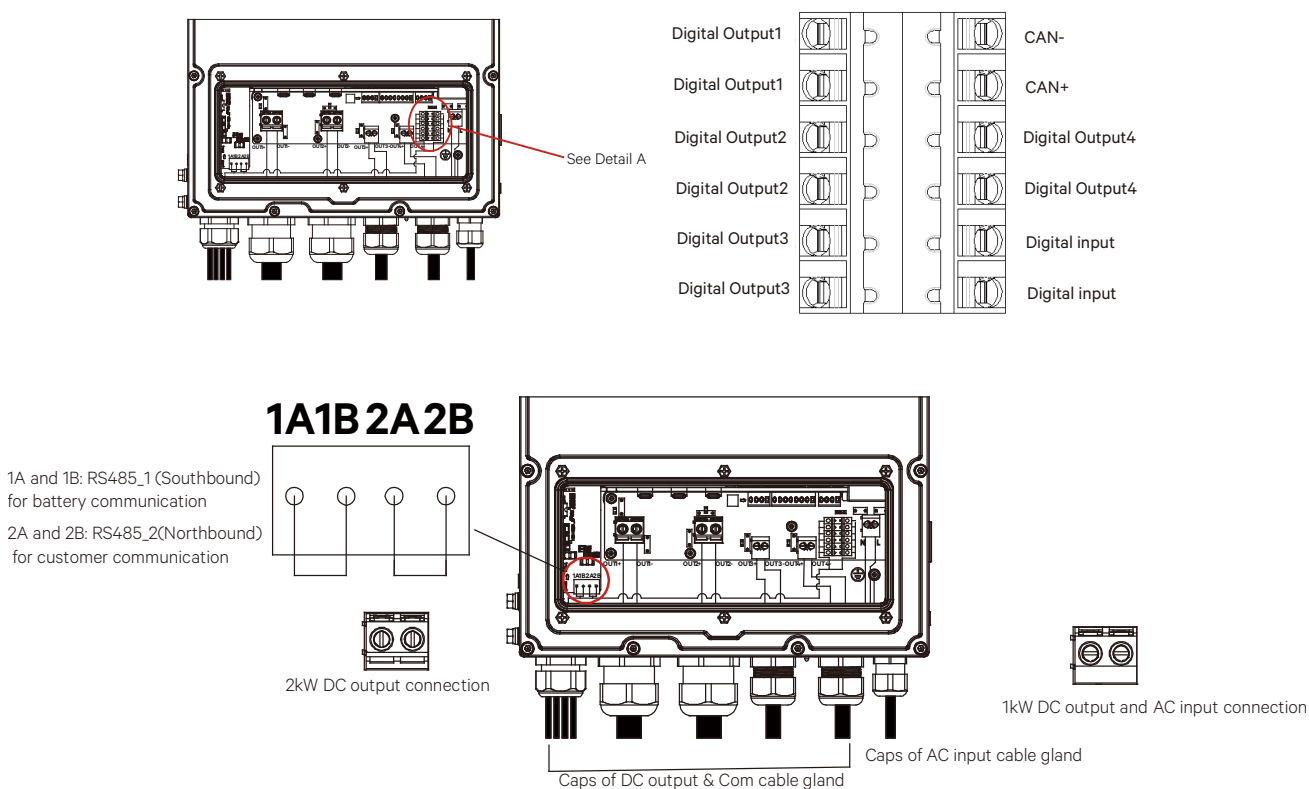
DANGER! If the connector will not be used, DO NOT remove the caps and sealing pins as they are necessary to ensure IP65 compliance.

Figure 3.7 Remove the Cable Gland Caps and Sealing Pin from Cable Gland Connectors to be Used

3. Feed the cables through the cable glands.
4. Slide appropriate cable into the designation position of the terminal block. Refer to Figure 3.8.

NOTE! All cables shall always have the outer sheath firmly fixed to places where appropriate to stop the wires pulling out of the terminals/connectors, and avoid sheath degrades.

5. Tighten the screw of the terminal block as required.
6. Tighten the caps of cable gland connectors as required.

Figure 3.8 Customer Wiring Connection

7. Refer to “Opening / Closing the Front Access Panel” on page 75, and close the rectifier enclosure front access panel. Torque the screws to 2.5 Nm.

3.10.2 Customer Wiring Connection Procedure for Quick Connect Terminal

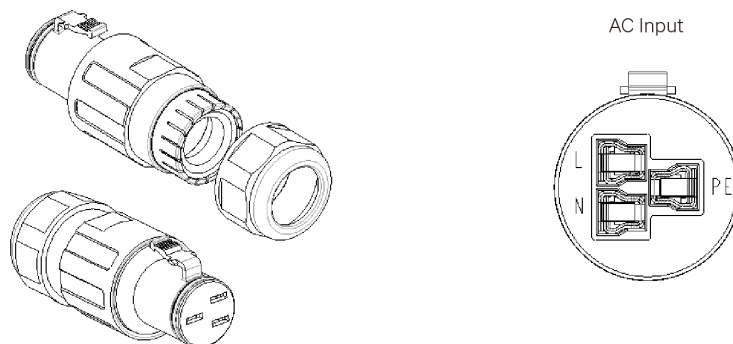
Refer to the illustrations in the following procedures. Refer also to Table 3.4.

Table 3.4 Designation for Customer Wiring Connection

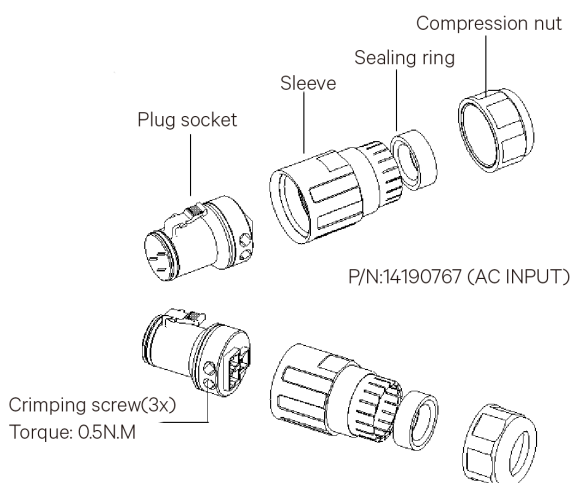
Designation	Connector	Acceptable Cable Outer Diameter Range (mm)	Connect to
COM 1	DB15 COM Quick Connector	8.5-10	4 x DO
COM 2	DB9 COM Quick Connector	<5.5	CAN extension
LOAD1	2KW DC Quick Connector	11 - 17	2KW BAT Input Output2+&Output2-
LOAD2	1KW DC Quick Connector	11 - 17	1KW DC Output3+&Output3-
LOAD3	1KW DC Quick Connector	11 - 17	1KW DC Output4+&Output4-
PWR	AC Quick Connector	10 - 16	AC Input L+N+PE

Power Input Interface

Figure 3.9 AC Power 3-Terminal Input Interface

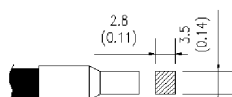
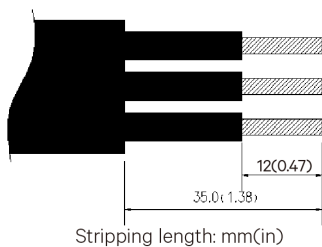


- 1.Cable type: Outdoor 3-conductor cable,300V,105℃.
- 2.Adapter wire diameter of the connector crimping terminal:
4mm²~6mm²
- 3.Sealing ring is adapted to the outer diameter of the cable:
ø10~ ø16mm



Wiring steps:

- 1)Strip the cable insulation 10±0.5mm and use tubular terminals for crimping.
- 2)Remove the sleeve and compression nut from the plug connector.
- 3)Insert the cable into the corresponding terminal of the plug and tighten the crimping screw. (torque=0.5 N-m)
- 4)Insert the sleeve and compression nut and tighten. (Sleeve tightening torque=5 N-m) (Tail compression nut lock torque=5 N-m)
- 5)Insert the plug into the corresponding socket



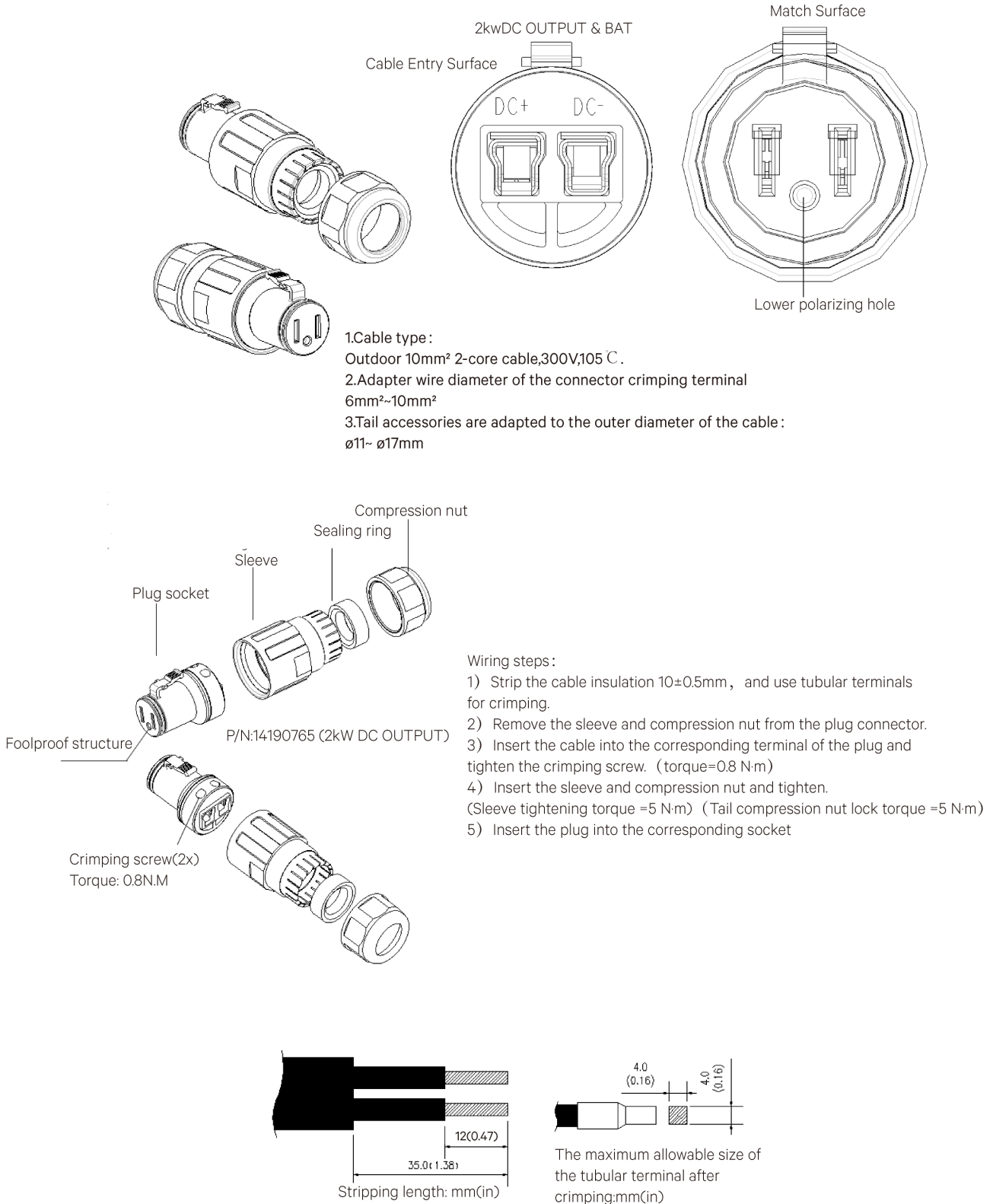
The maximum allowable size of the tubular terminal after crimping:mm(in)

Battery / Load Output Interface 1



NOTE! If the connector is not be used, then the sealing pins and cap must not be removed!

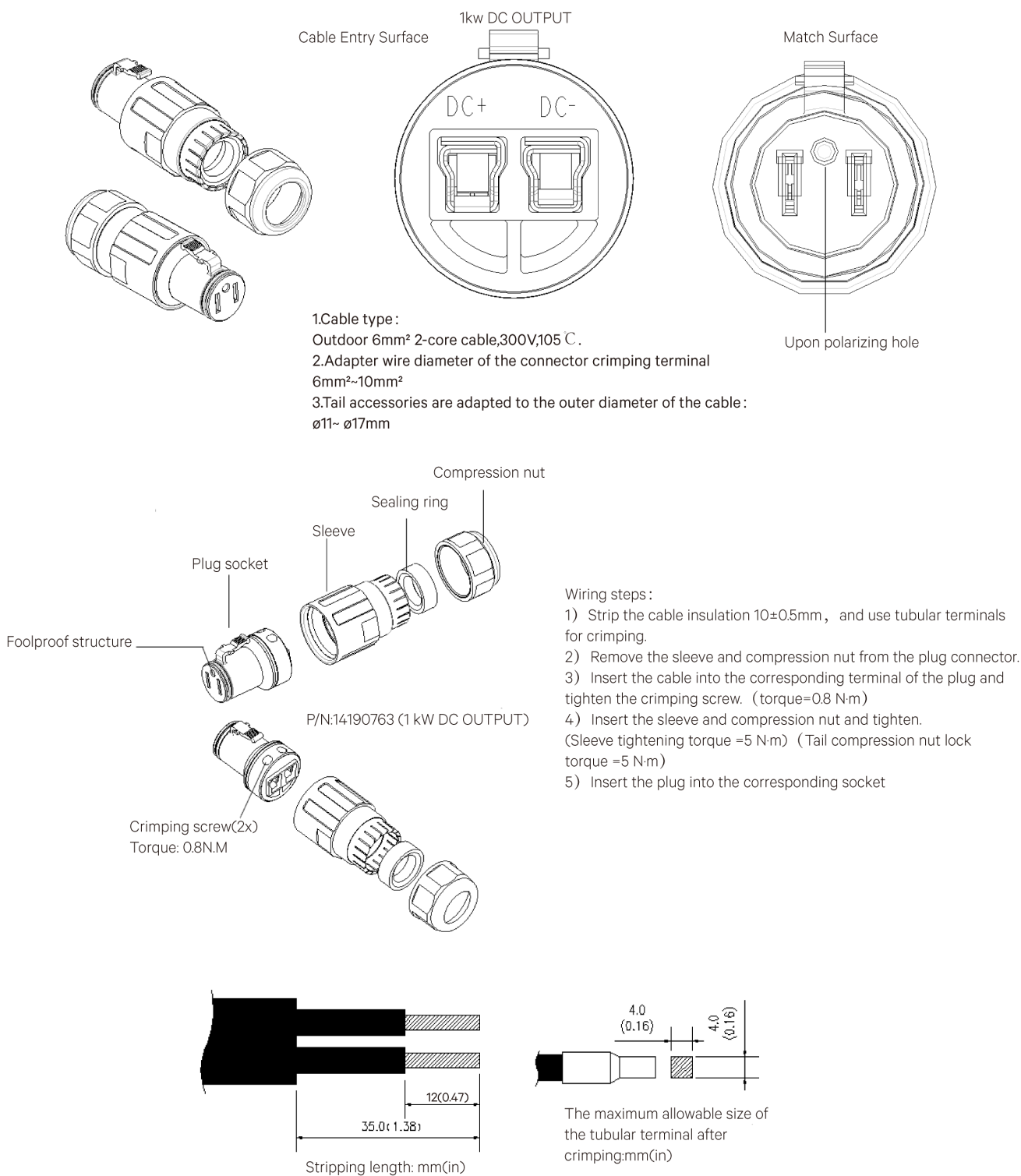
Figure 3.10 Battery Output Interface / Load Output Interface 1



Load Output Interface 2 / Load Output Interface 3

NOTE! If the connector is not be used, then the sealing pins and cap must not be removed!

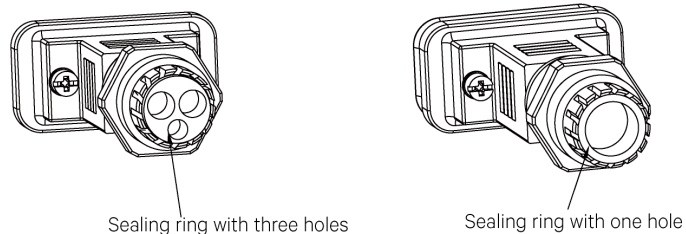
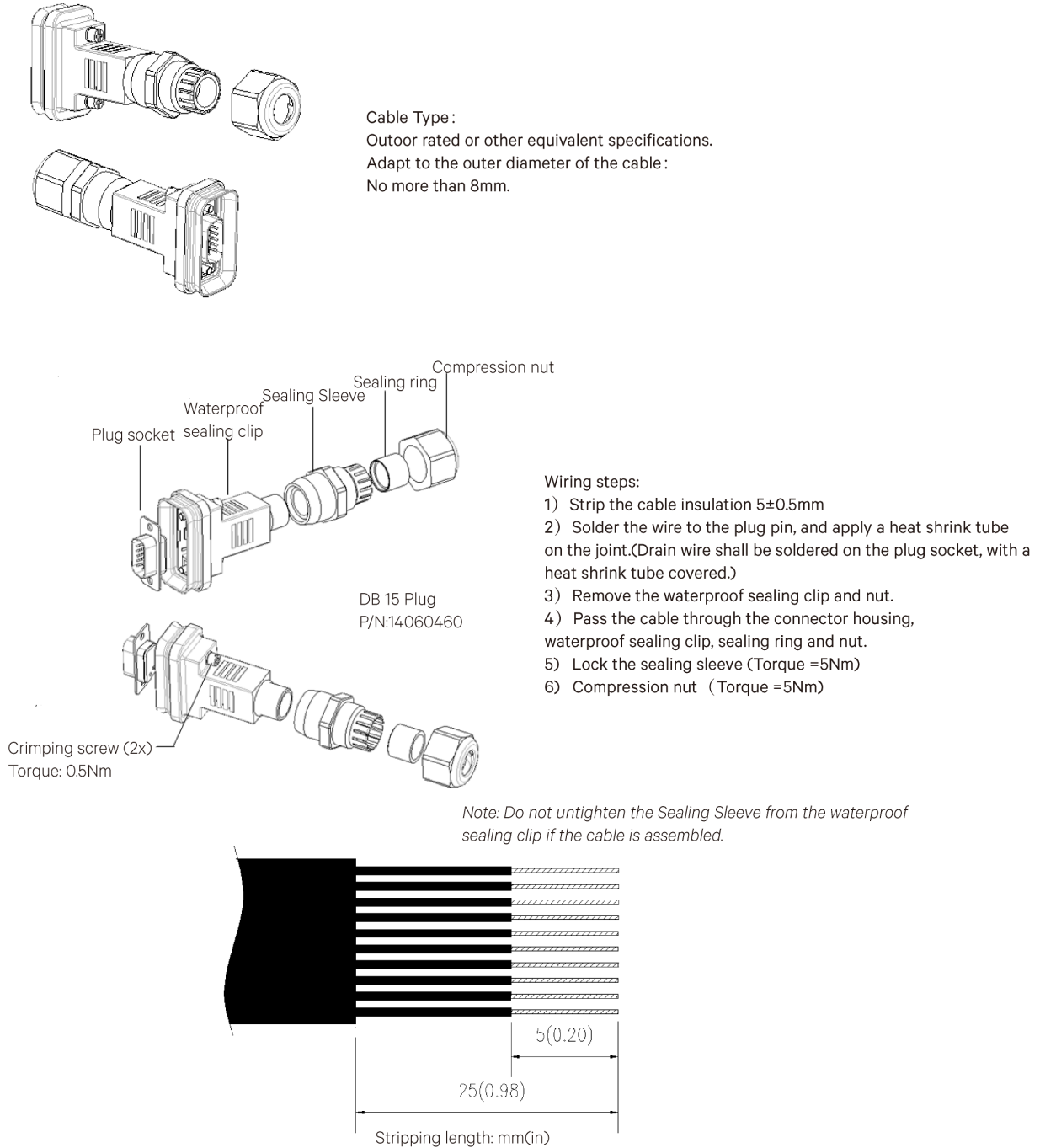
Figure 3.11 Load Output Interface 2 / Load Output Interface 3



CAN and Alarm Interface

DB15 Wiring Instruction

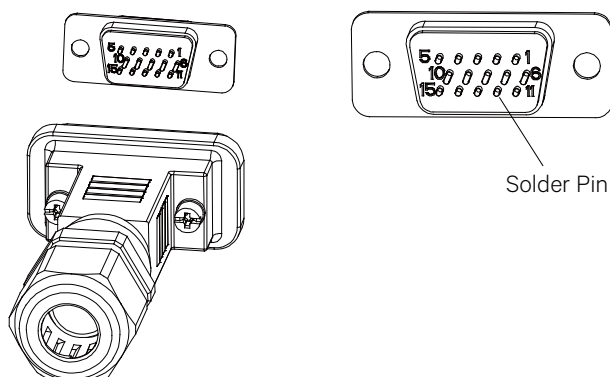
Figure 3.12 DB15 Wiring

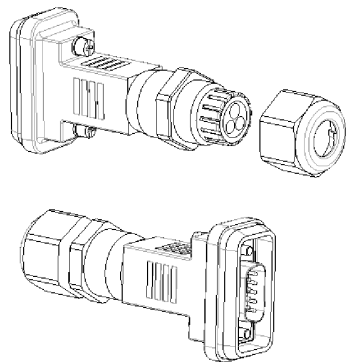


Note: Select sealing rings with three or one hole as cable need.

Table 3.5 DB15 Pin Definition

Pin	Signal Name	Description
1	Digital Output1+	Alarm output
2	Digital Output 1-	Alarm output
3	Digital Output 2+	Alarm output
4	Digital Output 2-	Alarm output
5	Digital Output 3+	Alarm output
6	RS485_2A	The northbound interface to the NMS (Network Management System).
7	RS485_2B	the northbound interface to the NMS (Network Management System).
8	Digital Output 4+	Alarm output
9	Digital Output 4-	Alarm output
10	Digital Output 3-	Alarm output
11	/	/
12	/	/
13	/	/
14	/	/
15	/	/

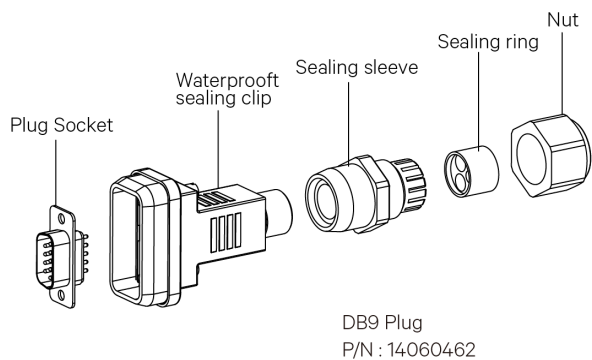
Figure 3.13 DB15 Plug Solder Pin Diagram

DB9 Wiring Instruction**Figure 3.14 DB9 Wiring****Cable Type :**

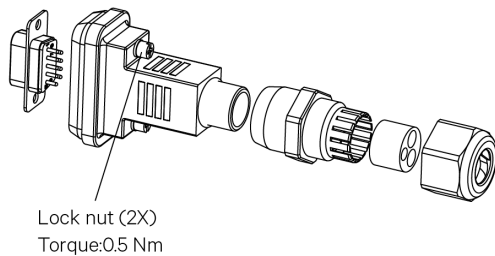
Output rated or other equivalent specifications.

Adapt to the outer diameter of the cable:

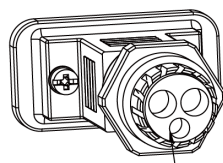
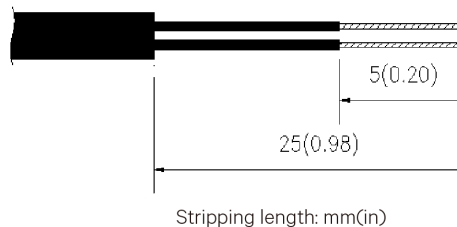
1. The two small cable holes do not exceed 4.0mm.
2. A large wire hole does not exceed 4.5mm

**Wiring steps:**

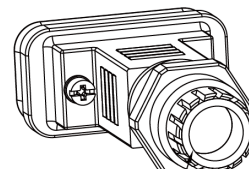
- 1) Strip the cable insulation $5 \pm 0.5\text{mm}$
- 2) Solder the wire to the plug pin, and apply a heat shrink tube on the joint. (Drain wire shall be soldered on the plug socket, with a heat shrink tube covered.)
- 3) Remove the waterproof sealing clip and nut.
- 4) Pass the cable through the connector housing, waterproof sealing clip, sealing ring and nut.
- 5) Lock the sealing sleeve (Torque = 5Nm)
- 6) Lock nut (Torque = 5Nm)



Note: Do not untighten the Sealing Sleeve from the waterproof sealing clip if the cable is assembled.



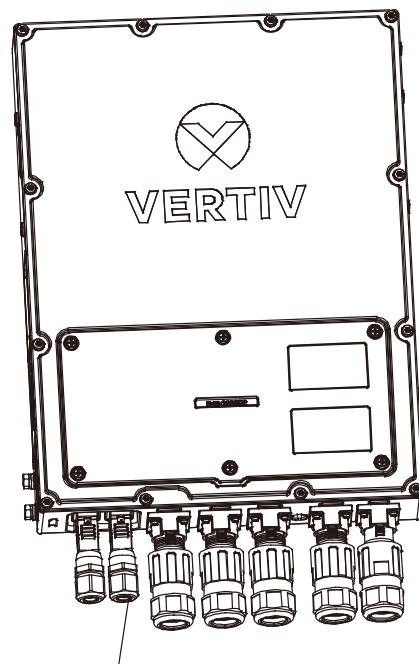
Sealing ring with three holes



Sealing ring with one hole

Note: Select sealing rings with three or one hole as cable need.

Figure 3.15 DB9 Connector IP65 Compliance

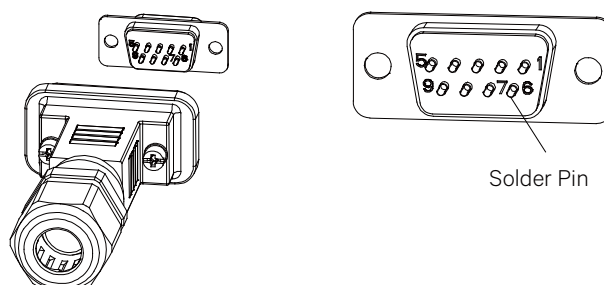


Keep the DB9 connector locked when no cable useable to ensure IP65 compliance.

Table 3.6 DB9 Pin Definition

Pin	Signal Name	Description
1	RS485_1A	The southbound RS485 interface to the LIB
2	RS485_1A	The southbound RS485 interface to the LIB
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.

Figure 3.16 DB9 Plug Solder Pin Diagram



3.11 Battery Connections

3.11.1 General

Batteries are designed to be connected to the adjacent rectifier only, via the rectifier to “BAT” connector.

If more than one rectifier + battery is required to be used, then a SYSTEM BOX shall be introduced into the wiring system. In this case, a CAN wiring extension cable is used to cable between rectifiers. Also, the rectifier 2kW output shall be wired to the SYSTEM BOX. Once wired in this manner, both the rectifiers and batteries can be considered in parallel. There is active load sharing between rectifiers. There is no active load sharing (during discharge) among batteries in this parallel system with SYSTEM BOX.

When two (2) or more batteries are connected in parallel, the battery protection is triggered for the unbalanced discharge current between the pre-discharged batteries. When connecting in parallel, the following coefficients are required.

Table 3.7 Battery Parallel Connection

Battery Quantity in Parallel	Two (2) Batteries in Parallel	Three (3) Batteries in Parallel	≥ Four (4) Batteries in Parallel
Discharge Power Coefficient	0.7	0.7	0.7

For example: For two (2) batteries connected in parallel; the maximum discharge current of a single battery is 70 A, and the maximum discharge current of the two (2) batteries connected in parallel is $70\text{ A} \times 2 \times 0.7 = 98\text{ A}$.

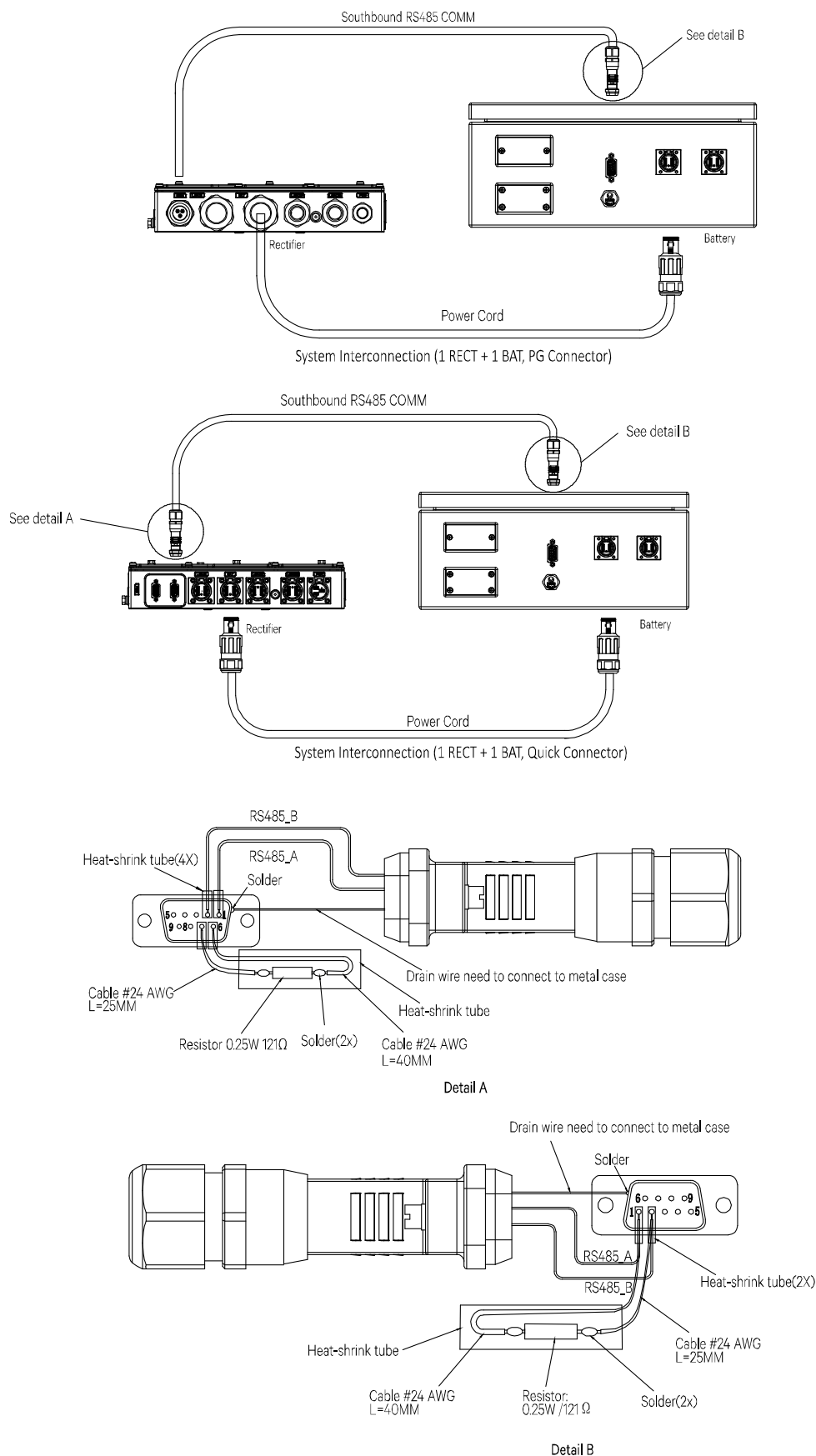
3.11.2 Battery DB9 Pin Definition

Table 3.8 Battery DB9 Pin Definition

Pin	Signal Name	Description
1	RS485_2A	Communicate with rectifier by connecting to DB-9 on rectifier.
2	RS485_2B	Communicate with rectifier by connecting to DB-9 on rectifier.
3	/	/
4	/	/
5	/	/
6	/	/
7	/	/
8	RS485_2A	Communicate with rectifier by connecting to DB-9 on rectifier.
9	RS485_2B	Communicate with rectifier by connecting to DB-9 on rectifier.

3.11.3 Rectifier and Battery Wire Diagram

Figure 3.17 Rectifier and Battery Wire Diagram



3.12 Battery DIP Switch and Power Switch

3.12.1 DIP Switch

The battery DIP switch is provided to customize the address of multi-batteries in one system. For system with only one battery, factory setting can be maintained. While in a system with multi-batteries, the DIP switch setting in each battery shall be different from each other. Refer to Figure 3.18 for DIP switch location.



NOTE! System with multi batteries is only applicable for EMEA region. Please find your local sales agent for detail information.

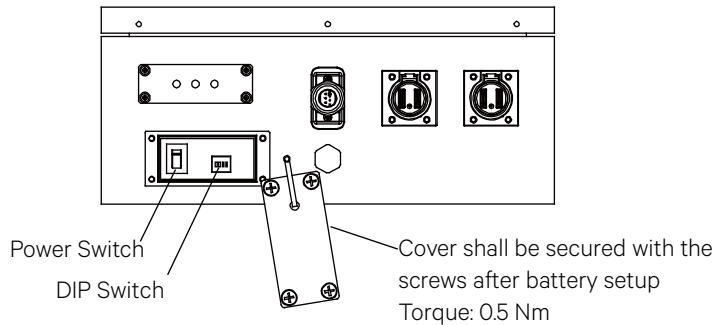
3.12.2 Power Switch

The power (rocker) switch is provided to perform on/off control for the battery. The "I" represents power ON and the "O" represents power OFF. Refer to Figure 3.18 for power switch location.



NOTE! The cover of DIP switch and power switch shall be secured with the screws after battery setup, to maintain IP65 rating. Refer to Figure 3.18 for cover location.

Figure 3.18 DIP Switch, Power Switch, and Cover



4 Micro SIM Card Installation, Bluetooth Jumper Setup, and Antenna Installation

4.1 Installing the Micro SIM Card (if required)



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

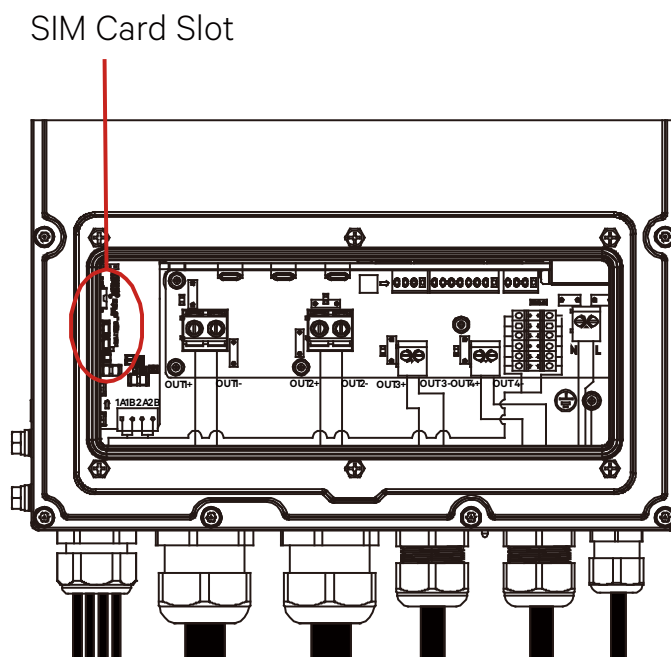


NOTE! You only need the Micro SIM card if you are using NB-IoT (1R482000C2-1 only).

Procedure

1. Refer to “Opening / Closing the Front Access Panel” on page 75, and open the rectifier enclosure front access panel.
2. Insert the Micro SIM card into the Micro SIM card slot along the arrow direction. Refer to Figure 4.1.
3. Refer to “Opening / Closing the Front Access Panel” on page 75, and close the rectifier enclosure front access panel.

Figure 4.1 Insert the Micro SIM Card into Slot



4.2 Setting Bluetooth Jumper Position (if required)



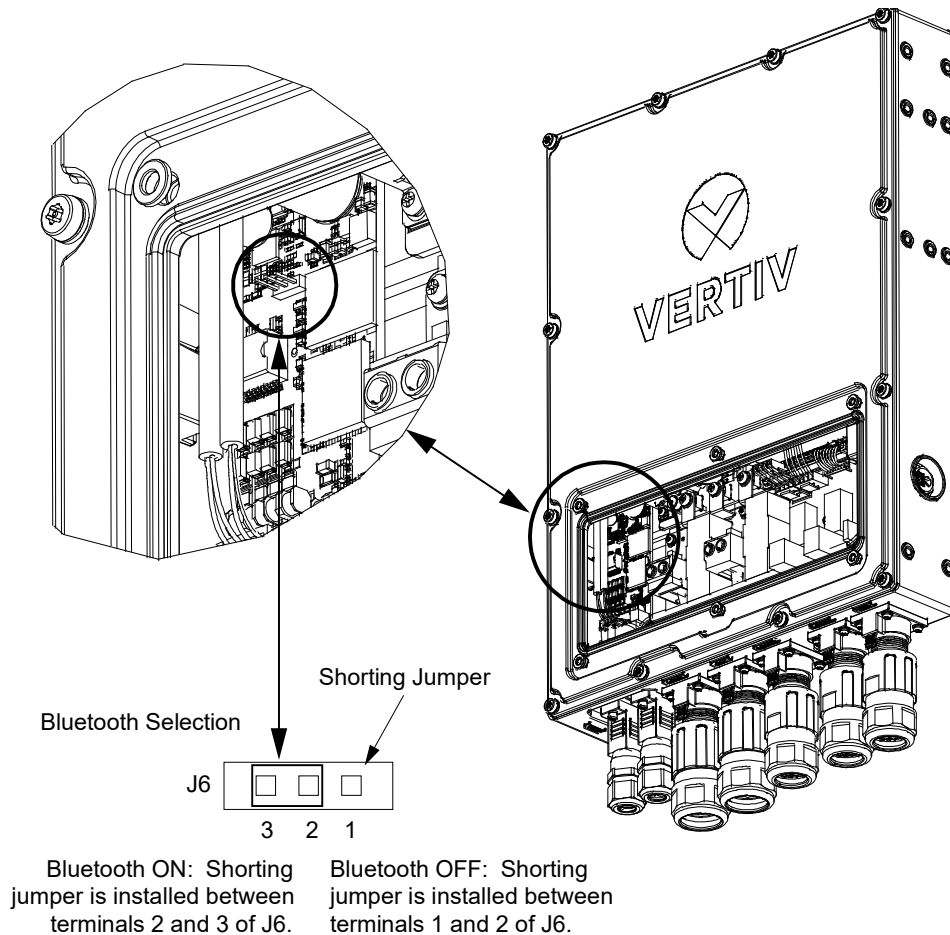
DANGER! Hazardous voltages are exposed when the cover is opened, and power is applied to the unit.

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 75, and open the rectifier enclosure front access panel.
2. Refer to Figure 4.2 and set the Bluetooth ON or OFF, as desired. Bluetooth is ON 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 75, and close the rectifier enclosure front access panel.

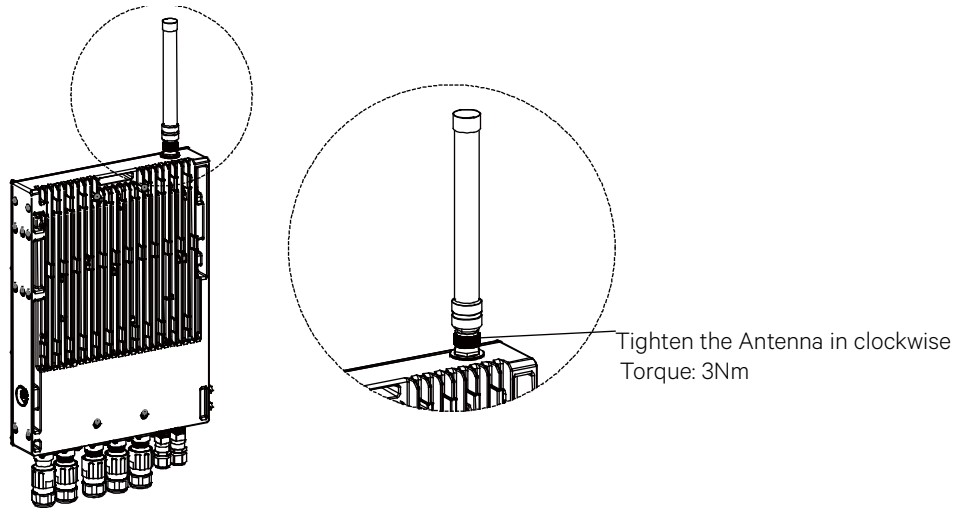
Figure 4.2 Bluetooth Jumper Setting



4.3 Antenna Installation (For R48-2000C2-1 Only)

See Figure 4.3.

Figure 4.3 Antenna Installation



5 Initially Starting and Checking Rectifier Operation

5.1 Initially Starting the Rectifier

Procedure

1. 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.
2. With battery power disconnected by placing the battery ON/OFF switch to the Off position, apply AC input power to the rectifier by closing the external AC disconnect or protective device. The rectifier starts automatically.
3. Apply battery power to the system by placing the battery ON/OFF switch to the ON.

5.2 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 5.1. See Figure 6.1 for location.

Table 5.1 Status and Alarm Indicators

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

5.3 Checking Battery Status

The battery connection and charging status can be verified via Bluetooth APP.

6 Operation

6.1 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

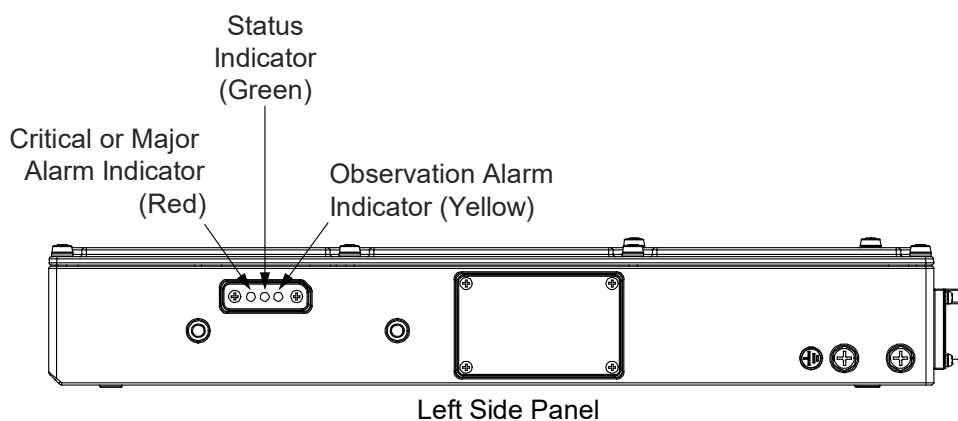


Table 6.1: Local Indicators

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.

6.2 Battery Local Indicators

Three (3) LED indicators are located on the bottom side of the battery. These indicate the battery operating status.

- Green LED: Normal operation.
- Yellow LED: Communication failure or battery alarm issued.
- Red LED: Battery protected or battery fault.

6.3 Opening / Closing the Front Access Panel



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

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

6.3.1 Opening the Front Access Panel

Procedure

1. Rotate the access panel clockwise 180° around the hardware of the top left corner. Refer to Figure 6.2 and Figure 6.3. Tighten the hardware circled in Figure 6.3 to secure the access cover in the open position.

Figure 6.2 Remove the Access Panel with Phillips Screwdriver

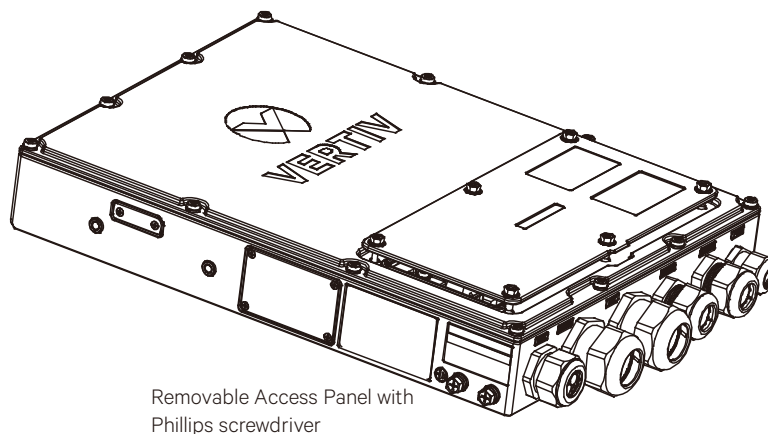
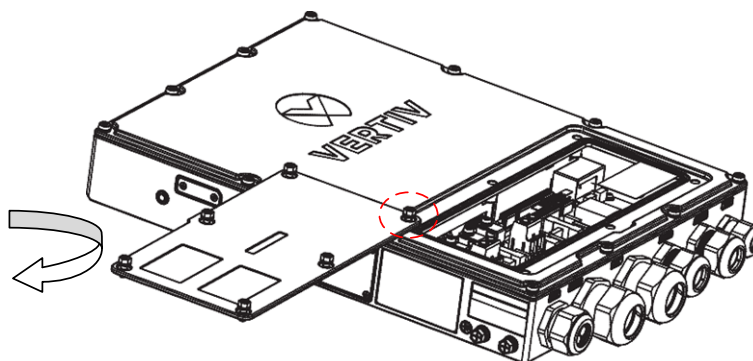


Figure 6.3 Rotate the Panel Clockwise 180° Around the Hardware of the Top Left Corner, Tighten the Hardware Circled Below to Secure Open

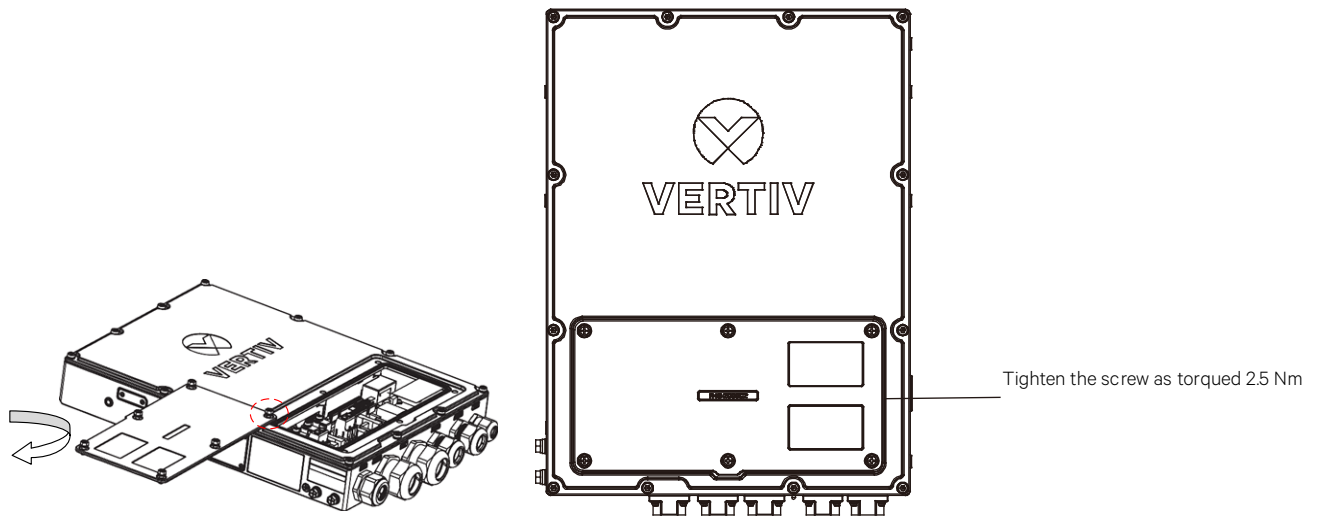


6.3.2 Closing the Front Access Panel

Procedure

1. Close the access cover and torque the screws to 2.5 Nm. See Figure 6.4.

Figure 6.4 Close the Access Cover

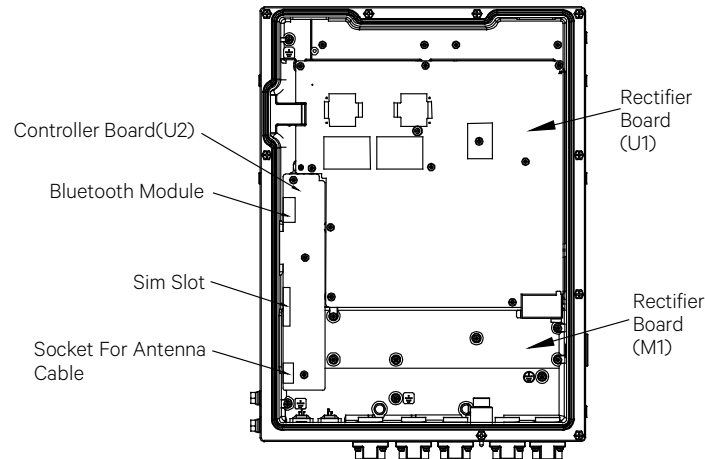


7 Controller and Controller Interface

7.1 General

Integrated inside the rectifier enclosure is a controller. See Figure 7.1.

Figure 7.1 Rectifier Assembly Drawing



7.2 Specifications

The controller board has two RS485 ports, which are used for northward and southward communication.

The controller board has one (1) CAN bus port, which is used to communicate with the rectifier board and other external parallel rectifiers (maximum 4).

The controller supports on site access via a cell phone APP through Bluetooth. The communication distance is up to 10 meters (dependent on interference sources at the installation site).

The controller acquires batteries and rectifiers information, analyses and processes these to monitor and manage the healthy operation of power system in real time.

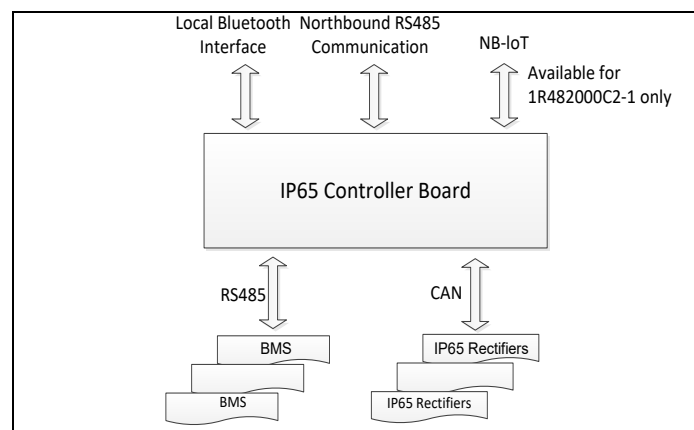
Battery Management: The battery management function is implemented by Li-ion battery BMS.

Alarm Management: The controller provides function of active alarm list and an alarm log.

The controller supports at least 5000 history alarms, 5000 history events, and 5000 history data.

See Figure 7.2 for a controller functional diagram.

Figure 7.2 Functional Schematic Diagram of the Controller Board



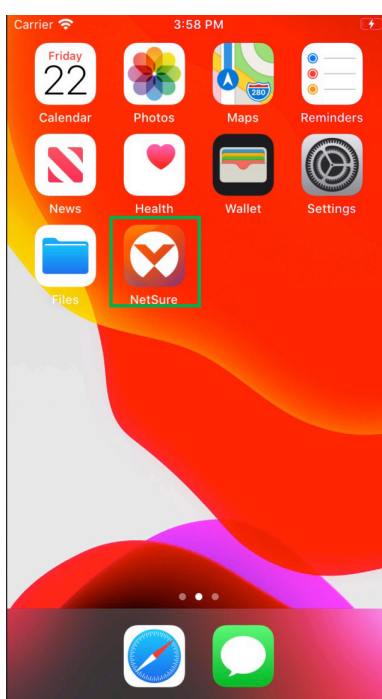
7.3 Accessing the Rectifier via Bluetooth

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 (except for iOS13).
 - iOS Phone: Screen size of 4.7" or larger, excluding the iPhone XS.
- Android Model
 - Android Version: Android 4.4 and above.
 - Android Phone: Screen size of 4.7" or larger.

Figure 7.3 APP Running on an IOS Device



7.3.2 Bluetooth APP

General

The controller provides a mobile wireless communication connection.

Setting Up the Bluetooth Connection

Procedure

1. Acquire the 'NetSure' App and install the App on the mobile device.
 - iOS APP: Acquire the 'NetSure' app from Apple App Store.
 - Android APP: Acquire the 'NetSure' app from Vertiv product web site.
2. Power up the rectifier before trying to connect to it with the mobile device.
3. Ensure mobile device, such as Cellphone, has Bluetooth Communications ON and ready to pair to other devices.
 - The app supports one-to-one Bluetooth connection only.

4. Bluetooth Pairing – password is required in app for controls.

- Read Only Account: password (browser): 123456
- Read-Write Account: password (admin): 640275

Using the Bluetooth Application

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

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

- Read Only Account: password (browser): 123456
- Read-Write Account: password (admin): 640275

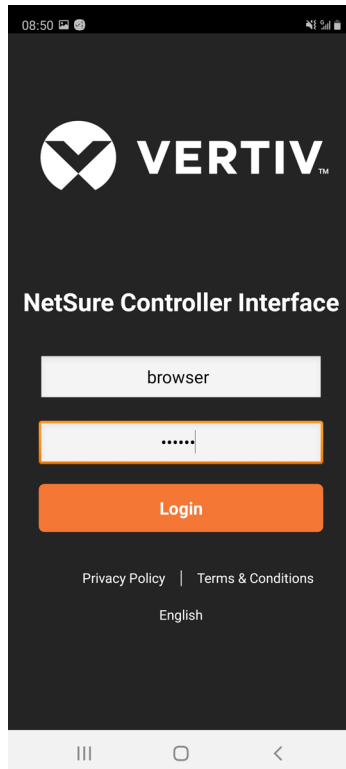


NOTE! It is a best practice to change the password using a combination of upper-case letters, lower-case letters and numbers.

Procedure

1. Open the Vertiv app on the mobile device. The following login screen appears.

Figure 7.4 Login Screen



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



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

Figure 7.5 Privacy Policy Page

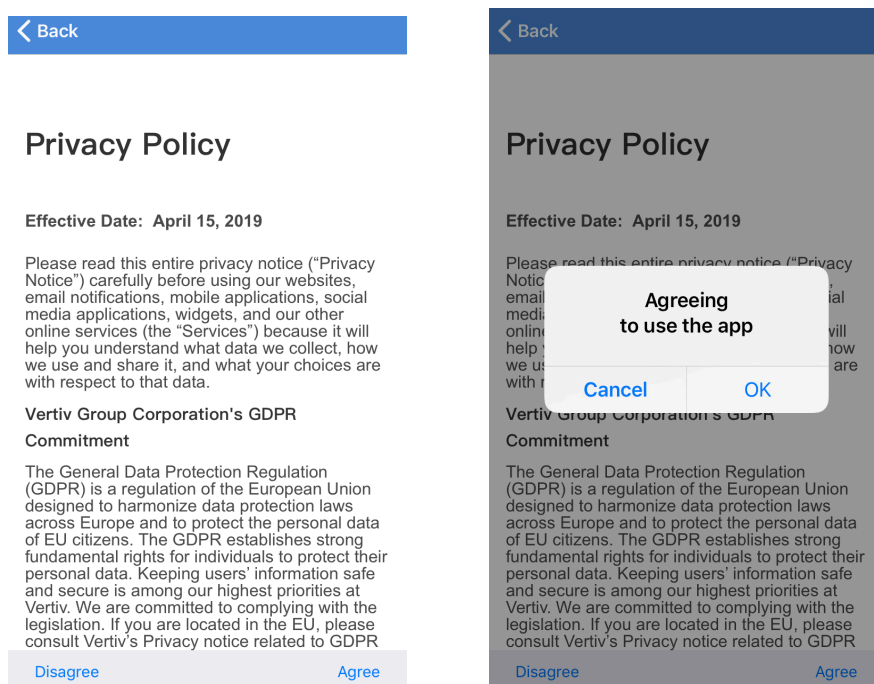
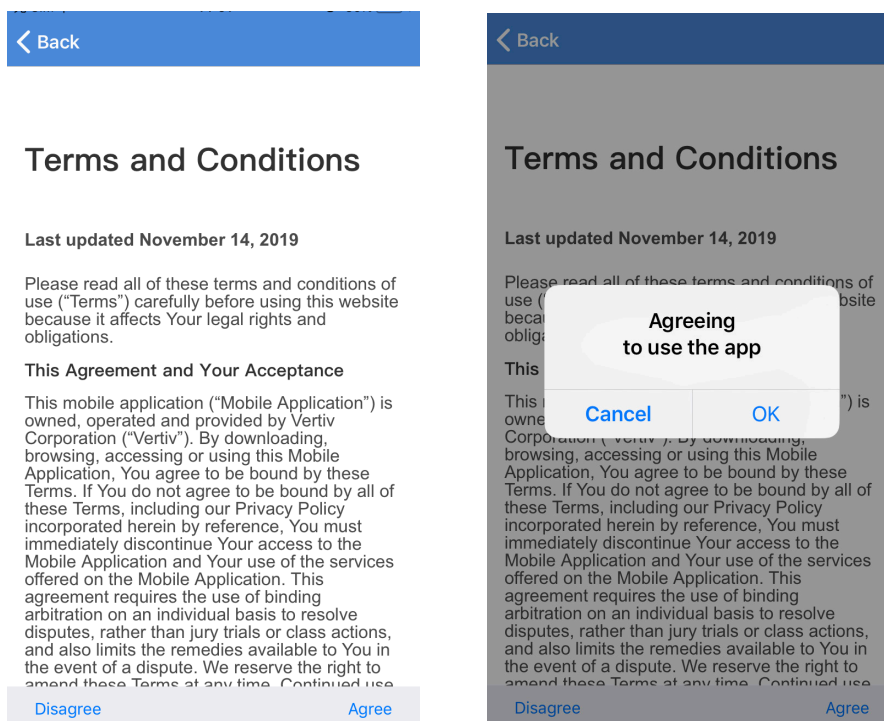


Figure 7.6 Terms & Conditions Page

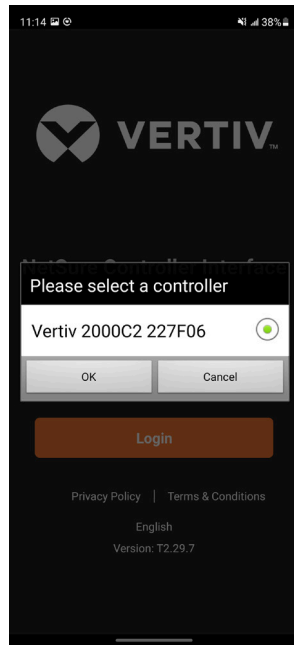


Bluetooth Connection

Procedure

1. After logging into the controller via the App, click "Bluetooth Connection".
2. A list of supported controllers found in the Bluetooth connection appears. Select a controller from the list to connect to (see Figure 7.7).

Figure 7.7 Bluetooth Connection

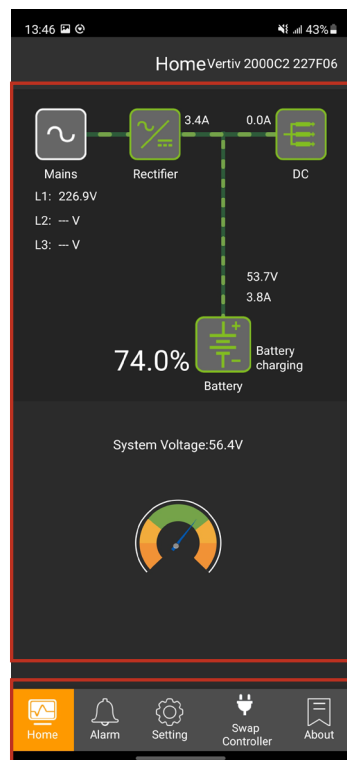


3. The Homepage screen appears (see Figure 7.8).

Homepage Screen

1. The Homepage screen includes a Menu Navigation and a System Status Information area (see Figure 7.8).
2. From the Menu Navigation area, you can navigate to the other screens, as shown below.
3. From the System Status Information area, you can obtain information on the rectifier and battery by touching the “Rectifier” and “Battery” icon, as shown below.

Figure 7.8 Homepage Screen



2. System Status Information Area

1. Menu Navigation

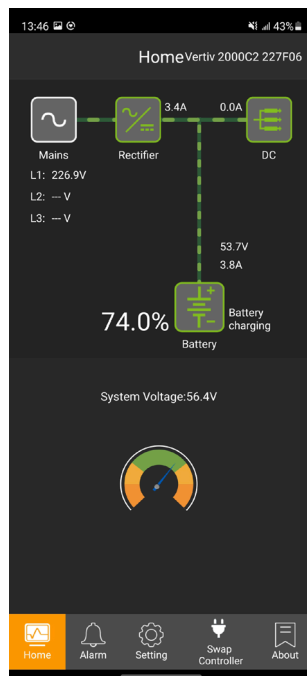
Menu Navigation

The Menu Navigation area contains the following icons: Home, Alarm, Setting, Swap Controller, and About. The Menu Navigation area appears in the Home screen, Alarm screen, Setting screen, Swap Controller screen, and About screen.

Home Icon

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

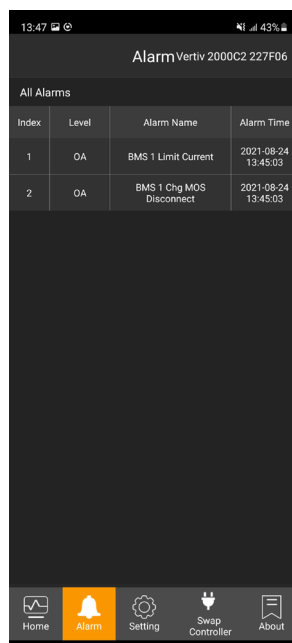
Figure 7.9 Homepage Screen



Alarm Icon

In the Menu Navigation area, click on the Alarm Icon () to go to the Alarm screen. The Alarm screen displays active alarms.

Figure 7.10 Alarm Screen



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.

The possible alarms that display in the Alarm screen are listed in Table 7.1.

Table 7.1 Available Alarms

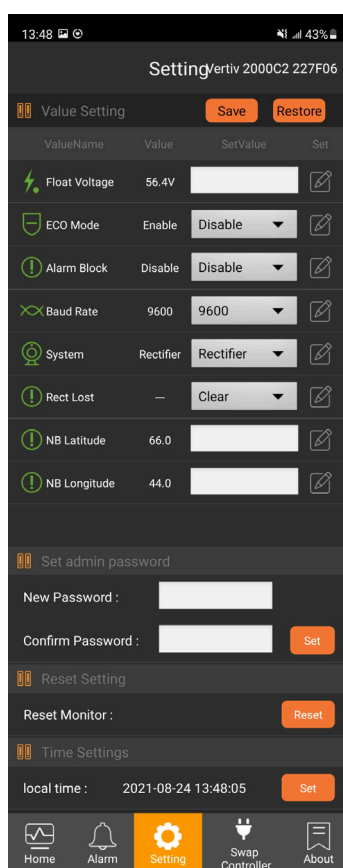
Alarm Name	Alarm Level
Phase A Voltage Low	OA
Phase A Voltage High	OA
Phase B Voltage Low	OA
Phase B Voltage High	OA
Phase C Voltage Low	OA
Phase C Voltage High	OA
AC Freq Low	OA
AC Freq High	OA
Mains Failure	MA
SPD Alarm	MA
DC Volt Low-	CA
DC Volt Low	CA
DC Volt High	CA
DC Volt High+	CA
Load Fuse Alarm	CA
Battery Fuse Alarm	CA
Over Battery Current	OA
Unbalanced Current	OA
Battery Temp Low-	OA
Battery Temp Low	OA
Battery Temp High	OA
Battery Temp High+	OA
Battery T No Probe	OA
Battery T Probe Error	OA
CAN Communication Failure	MA
Rectifier Lost	OA
HW SelfDetect	OA
Manual Mode	OA
Batt Discharge	OA
Rect Overload	OA
Save Power	OA
MultiRect Alarm	
DIO Alarm	OA
Rectifier Failure	CA
Rectifier Protected	MA
Rectifier Fan Failure	MA

Alarm Name	Alarm Level
Rectifier Over Temperature	MA
Rectifier Power Limited	OA
Rectifier AC Failure	MA
Rectifier Sharing Current Alarm	OA
Rectifier HVSD (AC Over Voltage Shut Down)	MA
Rectifier No Response	MA
Alarm-Block Level	None
MPPT Overwork Alarm	None

Setting Icon

In the Menu Navigation area, click on the Setting Icon () to go to the Setting screen. The settings are divided into Value Setting, Set Admin Password, Reset Setting, and Time Setting. The Value Setting supports save and restore function.

Figure 7.11 Setting Icon



Setting Screen

To change a setting, go to the “Set Value” column, enter or select a value and then click Save () to save the value. If the value is none, ‘—’ displays.

The parameter settings are as shown in Table 7.2.

Table 7.2 Settings Value

Number	Parameter Name	Default Value	Value Range
1	Float Voltage	53.5V	42 - 58V
2	ECO Mode	1 - Enable	0 - Disable, 1 - Enable
3	Alarm Block	0 - No	0 - No, 1 - YES
4	Baud Rate	0 - 9600	0 - 9600, 1 - 19200
5	System	Rectifier	Rectifier
6	Rect Lost	1 - Clear	1 - Clear
7	NB Latitude	66.0	0 - 90°
8	NB Longitude	44.0	-180° - 180°

Description of Settings

Float Voltage: Sets the value of float voltage.

ECO Mode: Enables or disables the ECO Mode.

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.

Baud Rate: Selects the baud rate for the RS-485: 9600 or 19200 (data bit, parity, and stop bit of 8, n, 1 are fixed).

System: The only system is rectifier.

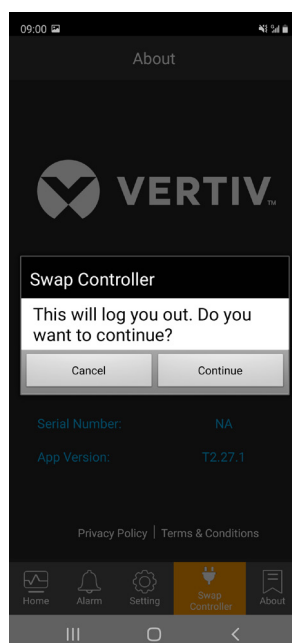
Rect Lost: Clears the Rectifier Lost Alarm (i.e., when rectifier is removed and replaced).

NB Latitude: Sets the latitude value for NB.

NB Longitude: Sets the longitude value for NB.

Swap Controller Icon

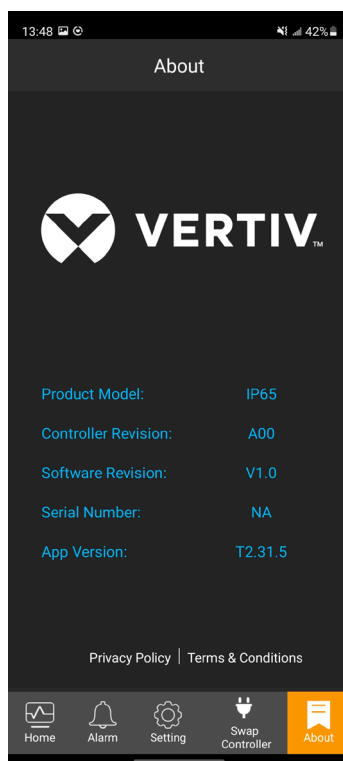
In the Menu Navigation area, click on the Swap Controller Icon () to go to the Swap Controller screen.

Figure 7.12 Swap Controller Screen

About Icon

In the Menu Navigation area, click on the About Icon () to go to the About screen.

Figure 7.13 About Screen



About Screen

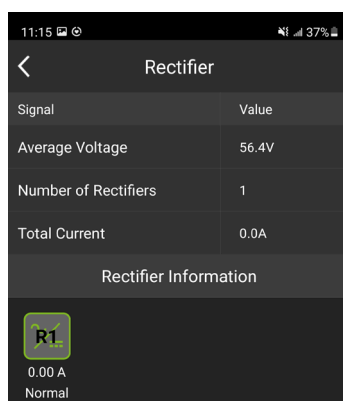
The About screen displays the Product Model, Controller Revision, Software Revision, Serial Number, and App Version.

System Status Information

Rectifier Icon

In the Homepage screen, click on the Rectifier Icon () to go to the Rectifier screen.

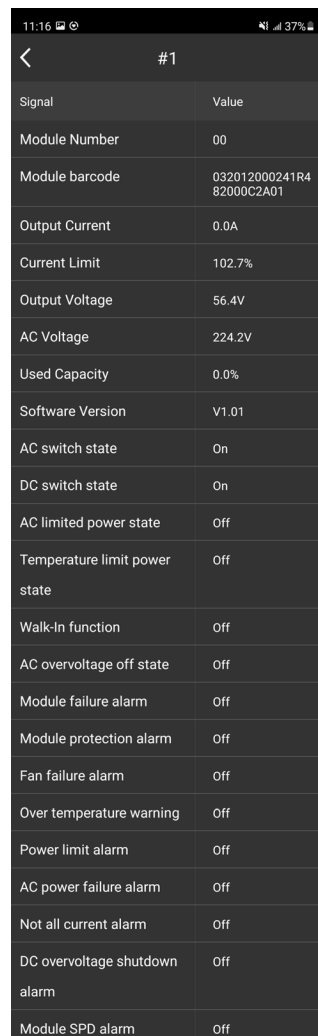
Figure 7.14 Rectifier Screen



Rectifier Information Screen

From the Rectifier screen, click on “Rectifier Information” to go to the Rectifier Information screen.

Figure 7.15 Rectifier Information Screen

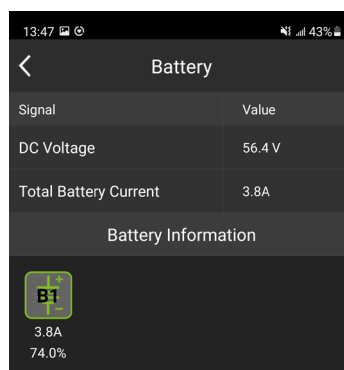


Signal	Value
Module Number	00
Module barcode	032012000241R4 82000C2A01
Output Current	0.0A
Current Limit	102.7%
Output Voltage	56.4V
AC Voltage	224.2V
Used Capacity	0.0%
Software Version	V1.01
AC switch state	On
DC switch state	On
AC limited power state	Off
Temperature limit power state	Off
Walk-in function	Off
AC overvoltage off state	Off
Module failure alarm	Off
Module protection alarm	Off
Fan failure alarm	Off
Over temperature warning	Off
Power limit alarm	Off
AC power failure alarm	Off
Not all current alarm	Off
DC overvoltage shutdown alarm	Off
Module SPD alarm	Off

Battery Icon

In the Homepage screen, click on the Battery Icon () to go to the Battery screen.

Figure 7.16 Battery Screen

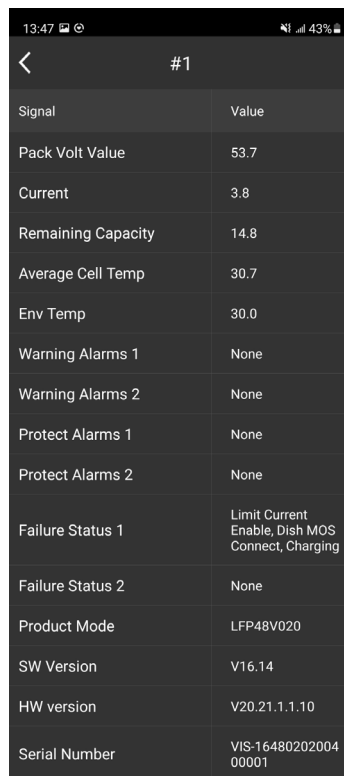


Signal	Value
DC Voltage	56.4 V
Total Battery Current	3.8A
Battery Information	
 3.8A 74.0%	

Battery Information Screen

From the Battery screen, click on “Battery Information” to go to the Battery Information screen.

Figure 7.17 Battery Information Screen



The screenshot shows a mobile application interface for battery information. At the top, the status bar displays the time 13:47, signal strength, and battery level at 43%. Below the status bar is a header with a back arrow and the label '#1'. The main content is a table with two columns: 'Signal' and 'Value'.

Signal	Value
Pack Volt Value	53.7
Current	3.8
Remaining Capacity	14.8
Average Cell Temp	30.7
Env Temp	30.0
Warning Alarms 1	None
Warning Alarms 2	None
Protect Alarms 1	None
Protect Alarms 2	None
Failure Status 1	Limit Current Enable, Dish MOS Connect, Charging
Failure Status 2	None
Product Mode	LFP48V020
SW Version	V16.14
HW version	V20.21.1.1.10
Serial Number	VIS-16480202004 00001

8 Troubleshooting and Repair

8.1 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 “Local Indicators” on page 74. These are designed to isolate a failure to a specific fault. Once a failure fault has been identified, refer to “Replacement Information” on page 91 and “Replacement Procedures” on page 91.

8.2 Alarm Conditions Identified by the Controller

The controller displays alarm conditions as listed under “Alarm Icon” on page 82. Programmable external alarm relays are also available. Refer to “Digital Output (DO) Dry Relay Contacts” on page 12 for the alarm relay configurations. Refer to Table 8.1 for a list of possible alarms and corrective actions.

Table 8.1 Available Alarms

Table 8.1

Alarm Name	Alarm Description	Action to Correct
Phase A Voltage Low	Voltage is below Phase A low voltage alarm setting.	Check why voltage is low.
Phase A Voltage High	Voltage is above Phase A high voltage alarm setting.	Check why voltage is high.
Phase B Voltage Low	Voltage is below Phase B low voltage alarm setting.	Check why voltage is low.
Phase B Voltage High	Voltage is above Phase B high voltage alarm setting.	Check why voltage is high.
Phase C Voltage Low	Voltage is below Phase C low voltage alarm setting.	Check why voltage is low.
Phase C Voltage High	Voltage is above Phase C high voltage alarm setting.	Check why voltage is high.
AC Freq Low	AC frequency is below low frequency alarm setting.	Check why AC frequency is low.
AC Freq High	AC frequency is above high frequency alarm setting.	Check why AC frequency is high.
Mains Failure	Mains Failure	Rectifier commercial AC input power failure.
SPD Alarm	Surge protection device needs attention.	Check surge protection device.
DC Volt Low-	DC output voltage is lower than the Low- alarm setting.	Check why DC output voltage is low. Check the alarm setting.
DC Volt Low	DC output voltage is lower than the Low alarm setting.	Check why DC output voltage is low. Check the alarm setting.
DC Volt High	DC output voltage is higher than the High alarm setting.	Check why DC output voltage is high. Check the alarm setting.
DC Volt High+	DC output voltage is higher than the High+ alarm setting.	Check why DC output voltage is high. Check the alarm setting.
Load Fuse Alarm	A load fuse is open.	Find out and eliminate the reason the fuse is open before replacing. Check for overload or short circuit.
Battery Fuse Alarm	A battery fuse is open.	Find out and eliminate the reason the fuse is open before replacing. Check for overload or short circuit.
Over Battery Current	Battery is in over current.	--
Unbalanced Current	Battery current unbalanced.	The currents from groups of batteries are not equal. Check the batteries.
Battery Temp Low-	Battery temperature is lower than Low- alarm setting.	Check why temperature is low.
Battery Temp Low	Battery temperature is lower than Low alarm setting.	Check why temperature is low.

Table 8.1

Alarm Name	Alarm Description	Action to Correct
Battery Temp High	Battery temperature is higher than High alarm setting.	Check why temperature is high.
Battery Temp High+	Battery temperature is higher than High+ alarm setting.	Check why temperature is high.
Battery T No Probe	Battery temperature sensor port is not used.	Temperature probe is enabled but not plugged in.
Battery T Probe Error	Battery temperature sensor failure.	Replace temperature probe.
CAN Communication Failure	CAN bus communications failure. No devices communicating on CAN bus.	Check communications cables.
Rectifier Lost	A rectifier cannot be detected by the controller.	Reset the Rectifier Lost alarm. Replace defective rectifier.
HW SelfDetect	Controller self-detection test fails.	Replace the rectifier.
Manual Mode	Controller in manual mode.	--
Batt Discharge	Battery is discharging.	A battery test is active (the discharge test will stop automatically). 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	Output overload condition.	Check the load.
Save Power	Rectifier in Save Power mode.	--
MultiRect Alarm	More than one rectifier has failed or a Mains Failure.	Check input voltage to rectifiers. Replace rectifiers.
DIO Alarm	Digital input DIO alarm is active.	Check why alarm is active.
Rectifier Failure	A rectifier has a fault condition.	Correct the rectifier fault.
Rectifier Protected	A rectifier is in protected mode.	--
Rectifier Fan Failure	A rectifier's fan has failed.	Replace fan.
Rectifier Over Temperature	A rectifier has a high temperature condition.	Check why temperature is high.
Rectifier Power Limited	NOT IMPLEMENTED AT THIS TIME	NOT IMPLEMENTED AT THIS TIME
Rectifier AC Failure	No AC input power to a rectifier.	Check why no AC input power available.
Rectifier Sharing Current Alarm	A rectifier has a current sharing alarm.	--
Rectifier HVSD (AC Over Voltage Shut Down)	A rectifier has an overvoltage condition.	Correct the rectifier fault.
Rectifier No Response	A rectifier has lost communications with the controller.	Check communications cables. Replace the rectifier.
Alarm-Block Level	--	--
MPPT Overwork Alarm	--	--

8.3 Alarm Conditions Identified by the Battery

Refer to Table 8.2 for fault indicators that can be displayed by the battery and a list of possible causes and corrective actions.

Table 8.2 Battery Troubleshooting

Symptom	Possible Cause(s)	Suggested Action(s)
Power Indicator (Green) Off	Power switch turned off.	Turn on the power switch.
	Internal CB off.	Replace the battery.
Protection Indicator (Yellow) On	Battery protected.	Check the battery protection status by controller to decide how to recover the battery.
Protection Indicator (Yellow) Flashing	Communication interruption.	Check the RS485 wiring and the address settings.
Alarm Indicator (Red) On	BMS or battery cell damage.	Replace the battery.

8.4 Replacement Information

8.4.1 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).

8.4.2 Rectifier Fuses

Replace rectifier fuses with the same type and rating. Refer to Table 8.3 for fuse part numbers.

Table 8.3 Fuse Part Numbers

Fuse	Rating	Part Number
Load (1) 2 kW	63A	10026717
Load (2) 1 kW	30A	10026704
Load (3) 1 kW	30A	10026704
Battery	63A	10026717

8.5 Replacement Procedures

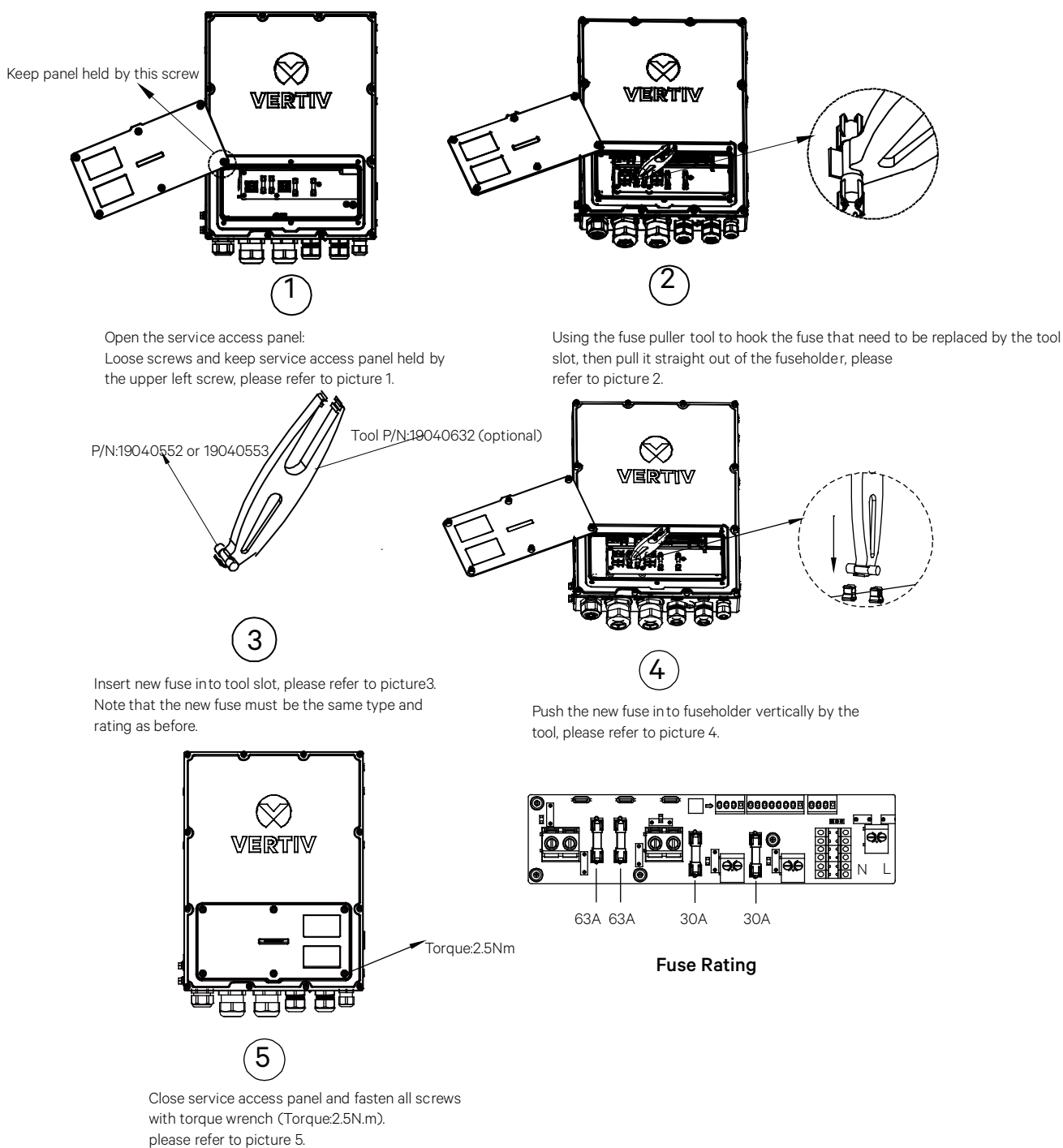


DANGER! Adhere to the “Important Safety Instructions” starting on page vii.

8.5.1 Replacing a DC Load Fuse or Battery Fuse

Procedure

1. Remove AC input and battery power from the rectifier.
2. Refer to “Opening / Closing the Front Access Panel” on page 75, and open the rectifier enclosure front access panel.
3. Refer to Figure 8.1 and replace the appropriate fuse.
4. Refer to “Opening / Closing the Front Access Panel” on page 75, and close the rectifier enclosure front access panel.
5. With battery power disconnected, apply AC input power to the rectifier by closing the external AC disconnect or protective device. The rectifier starts automatically.
6. Apply battery power to the system.

Figure 8.1 Replacing Fuses

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