



# NetSure™

R48-2000C Outdoor Rectifier

Installation and User Manual (UM1R482000C), Revision A

Model Number: R48-2000C

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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

## 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 Voltages



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



**DANGER!** Follow local lockout/tagout procedures to ensure DC branch circuit protection devices remain de-energized during installation at loads, as required.

## 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 contained on the Static Warning Page.

## 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 conductive or anti-static material such as conductive foam, conductive plastic, or aluminum foil. 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.



# INTRODUCTION

The R48-2000 C provides a rectifier mounted inside an environmentally protective enclosure. The R48-2000 C can be wall or pole mounted.

## Ordering Structure

What is in the Box

Refer to Table 1.

Table 1:

ITEM
(1) 21505943 Pole/Wall mount Kit(1x)
①63240BQ0 Mounting Bracket (Small)(1x)
②63240BPY Mounting Bracket (Big)(2x)
③63126330 Pole Mount Band(2x)
④26011356 M5 Flat Head Screws(3x)
⑤26011153 M8 Bolts w/ Flat Washer and Lock Washer(2x)
⑥26011018 M5 Bolts w/ Flat Washer and Lock Washer(6x)
(2) 21505942 Front Side shield Kit(1x)
①26011383 M6 Bolts w/ Flat Washer and Lock Washer(4x)
②63240BPM Front Side Shield(1x)
③63128427 Securing Colume(4x)
(3) UM1R482000C Installation and User Manual(1x)

## Rectifier Overview

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

- **Constant Voltage Mode:** For any initial output voltage setting from -42 VDC to -58 VDC (factory set at -54 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.

## Rectifier Specifications

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

## DC Output Ratings

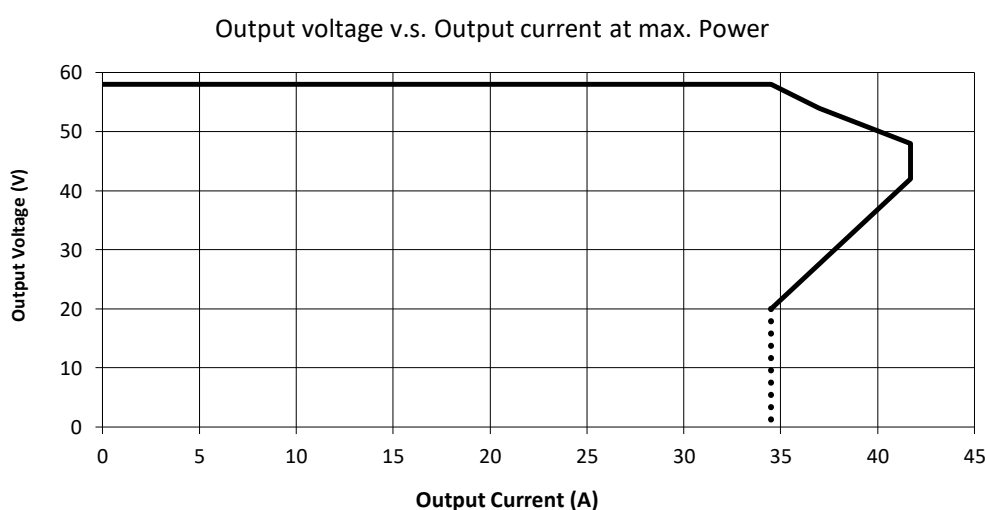
1. **Voltage:** -42 VDC to -58 VDC, positive ground. Output voltage is factory set at -54 VDC.

## 2. Output Power and Current:

a) 2000 W (41.7 A) @ 200 VAC to 250 VAC input and -48 VDC output.

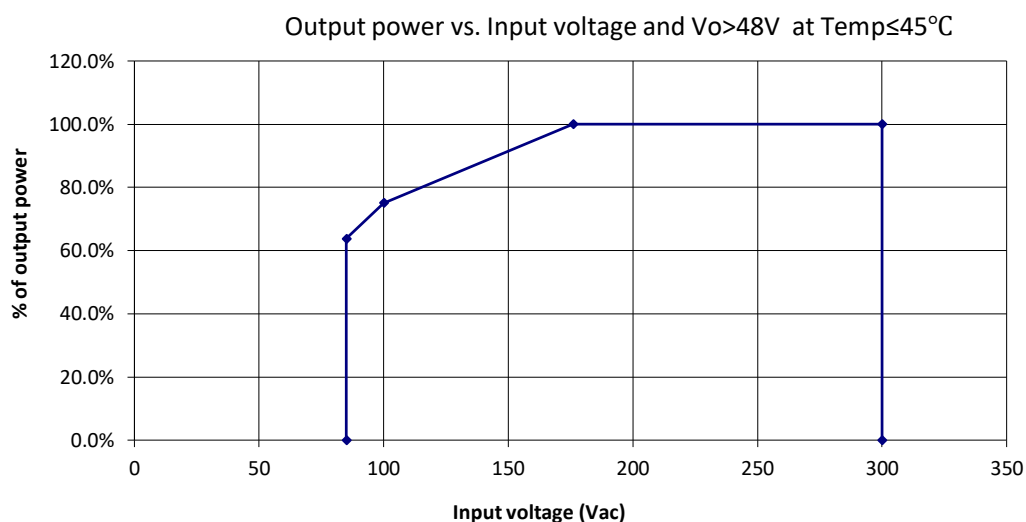
3. **Output Characteristics:** Refer to Figure 1 for a graph of output voltage vs. output current.

Figure 1: Output Voltage vs. Output Current



4. **Power Derating Based on Input Voltage:** The rectifier power varies with changes in input voltage. It uses an advanced power limitation method. The lower input threshold is 85 VAC. The rectifier can provide its maximum rated power (2000 W) as long as the input voltage is within the range of 176 VAC to 300 VAC. Below 176 VAC, and down to 85 VAC, the rectifier will continue to operate normally but will be in a power derating mode. The relationship between the output power and input voltage is illustrated in Figure 2.

Figure 2: Power Derating Based on Input Voltage



**5. Power Derating Based on Temperature:** The rectifier delivers full power when operating at an ambient temperature of +50 °C (+122 °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 +50 °C (+122 °F), the rectifier will not shut down. Rather, the rectifier limits its maximum output power to maintain the temperature of the power conversion circuit within design parameters. Operation between +50 °C (+122 °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 +50 °C (+122 °F). Refer to Figure 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 +50 °C (+122 °F). Operation between +50 °C (+122 °F) and +75 °C (+167 °F) will result in output power decrease. Operation above +75 °C (+167 °F) is considered abnormal and should be used on a temporary<sup>1</sup> basis only.

**6. 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. (This refers to a total of 120 hours in any given year, but no more than 15 occurrences in that one-year period.)

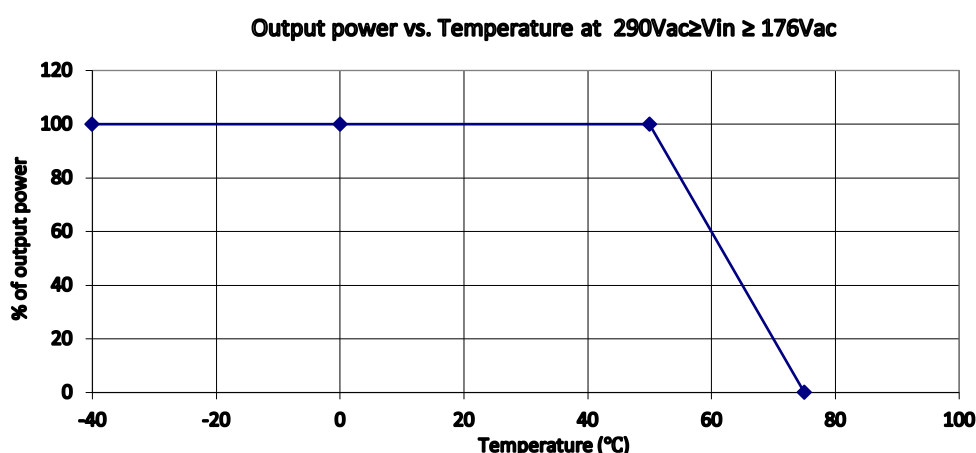
Other power rating values are as follows (refer to Figure 3):

- a) At an ambient temperature of +65 °C (+149 °F), the power delivered by the rectifier is 800 W.
- b) At an ambient temperature of +75 °C (+167 °F), the power delivered by the rectifier is 0 W.



**NOTE!** If used outdoors under full solar radiation, all the operation temperature ratings are decreased by 15 °C.

Figure 3: Power Derating Based on Temperature



## 7. Regulation:

a) **Static:** Steady state regulation is ±0.6 % as controlled within the rectifier for any and all combinations of load from no load to full load, input voltage, and input frequency at a constant ambient temperature.

b) **Dynamic:** Response time ≤200 us and overshoot ≤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 ms, per Telcordia GR-947-CORE, the maximum voltage transient will not exceed 5 % of the initial steady state voltage within 50±10 us. Recovery to within 1 % of the initial steady state voltage does not exceed 1 milliseconds.

## 8. 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.

## AC Input Ratings

1. **Voltage:** Nominal 120 VAC / 208 VAC / 220 VAC / 230 VAC / 240 VAC, single phase, 3-wire, 50 Hz / 60 Hz, with an operating range of 85 VAC to 300 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. ≤5 % from 50 % to 100 % of rated output current at 220 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, 220 VAC input voltage, and for any duration of AC input interrupts. Under the above conditions, standard AC distribution circuit breakers will not trip.

4. **Typical Input Data:** 50 Hz input.

a) Refer to Table 2.

b) **Maximum Input Current:** Refer to Table 3.

c) **Efficiency Curve:** Refer to Figure 4.

5. **Typical Input Data:** 60 Hz input.

a) Refer to Table 4.

b) **Maximum Input Current:** Refer to Table 5.

c) **Efficiency Curve:** Refer to Figure 5 and Figure 6.

*Table 2: Typical Input Data with 50 Hz Input*

Nominal Input Voltage	Percent of Full Load	Input Current (Amperes)	Input VA	Input Watts	Power Factor	Efficiency %	Heat Dissipation BTU/Hr
208	0	0.747	156.234	13.38	0.08	--	45.654
	25	2.559	534.2	514.9	0.96	90.901	159.854
	50	4.85	1012.9	992.3	0.9786	93.979	203.849
	75	7.13	1485.3	1475.8	0.9934	94.642	269.828
	100	9.503	1973.8	1962.1	0.99416	94.736	352.417
	110	10.457	2170.5	2159.9	0.9951	94.543	402.201

240	0	0.861	207.6	12.9	0.06	--	44.017
	25	2.311	557.9	513.76	0.923	91.524	148.579
	50	4.206	1012	989.1	0.9773	94.318	191.752
	75	6.18	1485.7	1471.1	0.9902	94.944	253.791
	100	8.195	1967.1	1955.3	0.994	94.907	339.803
	110	9.01	2162	2152	0.9953	94.872	376.540


 **NOTE!** System output is initially adjusted to 54 volts DC as measured at the system sense point at 50% of full load and nominal input. "Percent of Full Load" refers to percent of 17.24 amperes.

Table 3: Maximum Input Current with 50 Hz Input

NOMINAL INPUT VOLTAGE	INPUT VOLTAGE	INPUT CURRENT (AMPERES)
208/240	176	11.98


 **NOTE!** At 100% of full load with output adjusted to 58 volts DC as measured at the output terminals.

Table 4: Typical Input Data with 60 Hz Input

NOMINAL INPUT VOLTAGE	PERCENT OF FULL LOAD	INPUT CURRENT (AMPERES)	INPUT VA	INPUT WATTS	POWER FACTOR	EFFICIENCY %	HEAT DISSIPATION BTU/HR
120	0	0.533	64.05	18.64	0.283	0	63.6023
	25	4.403	528.6	524.8	0.994	90.028	178.5656
	50	8.438	1006.9	1005.8	0.9989	92.735	249.3239
	75	12.66	1503	1501.9	0.999	92.945	361.5329
	100	--	--	--	--	--	--
	110	--	--	--	--	--	--
208	0	0.8959	187.4	13.36	0.07	0.000	45.5862
	25	2.615	545.9	517	0.947	90.968	159.3375
	50	4.84	1010.36	991.9	0.982	94.052	201.3062
	75	7.15	1487.7	1475.7	0.992	94.648	269.4866
	100	9.506	1974.8	1961.7	0.9939	94.720	353.4051
	110	10.4596	2171.1	2159.6	0.9946	94.679	392.1081
240	0	1.031	248.9	13.04	0.05	0.000	44.4943
	25	2.376	575.8	517.3	0.907	91.333	152.9745
	50	4.241	1020.7	989.2	0.969	94.309	192.0934
	75	6.198	1489.7	1471.3	0.987	94.931	254.4731
	100	8.203	1969.9	1955.1	0.993	95.040	330.8850
	110	9.018	2163.5	2152.1	0.9947	95.009	366.5170

**NOTE!** System output is initially adjusted to 54 volts DC as measured at the system sense point at 50% of full load and nominal input. "Percent of Full Load" refers to percent of 17.24 amperes.

Table 5: Maximum Input Current with 60 Hz Input

NOMINAL INPUT VOLTAGE	INPUT VOLTAGE	INPUT CURRENT (AMPERES)
208/240	176	11.98

**NOTE!** At 100% of full load with output adjusted to 58 volts DC as measured at the output terminals.

Figure 4: Efficiency Curve (@ 230 VAC, 50 Hz)

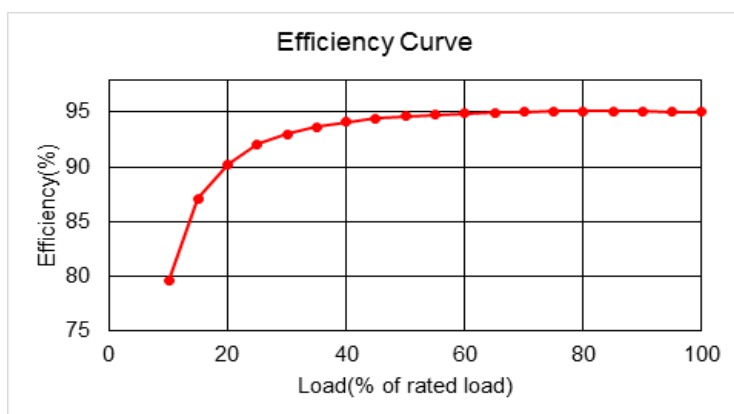


Figure 5: Efficiency Curve (@ 240 VAC, 60 Hz)

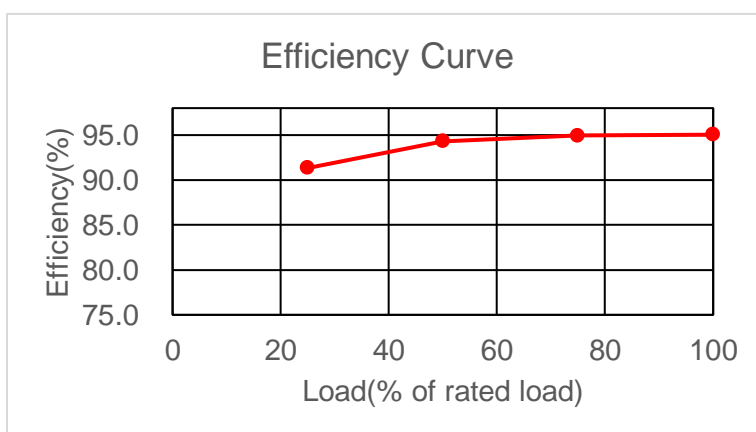
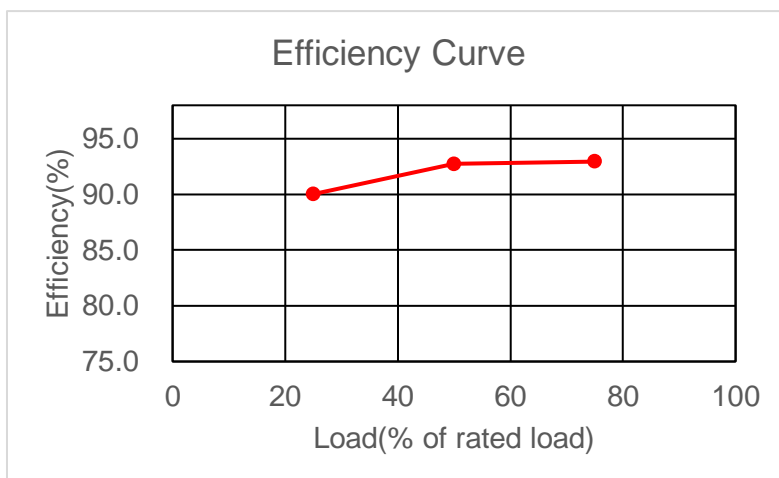


Figure 6: Efficiency Curve (@ 120 VAC, 60 Hz)



#### Environmental Ratings

##### 1. Operating Ambient Temperature Range:

a) -40 °C (-40 °F) to +50 °C (+122 °F) with full power performance.

b) +50 °C (+122 °F) to +75 °C (+167 °F) with derating output.

c) **Temperature Coefficient:** 0.02 % per degrees Celsius.

##### 2. Storage Ambient Temperature Range: -20 °C (-4 °F) to +55 °C (+131 °F).

3. **Relative Humidity:** This rectifier is capable of operating in an ambient relative humidity range of 0 to 90 %.

4. **Altitude:** 3048 m (9842 feet).

5. **Surge Protection:** EN61000-4-5 up to level 4, Telcordia GR-1089-Core, IEEE C62.41-2002, YD/T 731-2002.

#### Performance Criteria B.

##### 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

##### 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.

6. **Single Rectifier Audible Noise:** At 25 °C ≤45 dB(A). Measurement made at 0.6 m distance in front of rectifier and at same horizontal line of the middle of rectifier.

**7. High Voltage Category (per UL60950):** III

**8. Power Distribution System:** TN/TT/IT

**9. EMI/RFI Suppression:**

a) The rectifier conforms to the requirements of FCC rules Part 15, Class B for radiated and conducted emissions limits.

b) The rectifier conforms to the requirements of European Norm, EN55022, Class B for radiated and conducted emissions limits.

**10. Pollution Degree:** Degree 3.

Compliance Information

**1. EMC:** ETSI EN 300 386, FCC CFR 47 Part 15 class B, Telcordia GR-1089-CORE.

**2. EMI Load Range:** 5 % to 100 %.

**3. Safety:** IEC 60950, EN 60950.

Standard Features

**1. Type of Power Conversion Circuit:** High frequency.

**2. Input Protection:**

a) **Input Over/Under Voltage Protection:** The rectifier will shut down at low or high voltage input; based on the following voltage levels:

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

**High Voltage Disable Point:** 305 VAC,  $\pm 5$  V; hysteresis is at least 10 VAC for restart.

b) Between 85 VAC and 176 VAC the output power will be derated 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.

**3. Output Protection:**

a) **Overload / Reverse Current:** The rectifier has a fuse wire in the negative output DC bus. This fuse is not customer replaceable.

b) **Current Limiting:** The rectifier has a current limit function. The current limit point is factory set at 41.7 A. The current limit accuracy is  $\pm 1.5$  A when the output voltage ranges from 42 VDC to 58 VDC.

c) **Advanced Current Limit Function:** The rectifier has an advanced Current Limit Function. When a short circuit occurs at the rectifier output terminals, the rectifier will keep its output current at a constant value (factory set at 34.5 A). This function effectively protects the rectifier and the equipment connected to the rectifier. When the short circuit fault is cleared, the rectifier will automatically restore back to normal operation.

d) **High Voltage Shutdown:**

- **Fixed Control:** If rectifier output voltage exceeds a factory set value of 59.5 VDC and the rectifier is delivering more than 10 % of its rated current, the rectifier shuts down. (The restart hysteresis is 0.5 V  $\pm$  0.2 V.)



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 until the LEDs on the rectifier extinguish, 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.

If two or more rectifiers are paralleled, only the rectifier causing the high voltage condition shuts down.

- **Backup:** If rectifier output voltage exceeds 59.5 VDC  $\pm 0.5$  V (non-adjustable), 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 until the LEDs on the rectifier extinguish, then turning power to the rectifier on).

**4. Over-Temperature Protection:** The rectifier provides over temperature protection by derating output power and recovers automatically.

**5. Active Load Sharing:** The rectifier uses advanced digital active load sharing technology that maintains balancing to within 5 % of rated current.

**6. Paralleling:** Up to three (3) rectifiers can be connected in parallel in one system. Do not exceed the load rating of a single rectifier.

**7. Rectifier Output Current Imbalance:** When the average current of the system is greater than 10% of full rated current, and a load sharing severe imbalance occurs (such as an output fuse opens) and the output current drops to zero, then the red fault indicator illuminates.

**8. Monitoring Function:** The rectifier has a built-in advanced DSP that monitors and controls the operation of the rectifier.



**WARNING!** This product is not intended for oil exposure.



**CAUTION!** Double pole/neutral fusing.

#### Mechanical Specifications

**1. Dimensions:** Refer to Figure 7.

a) **Millimeters:** 400 (Height) X 380 (Width) X 90 (Depth)

b) **Inches:** 15.7 (Height) X 14.96 (Width) X 3.5 (Depth)

**2. Weight:** 11 kg (24 lbs)

**3. Indicators (located behind door):**

a) Power (Green LED)

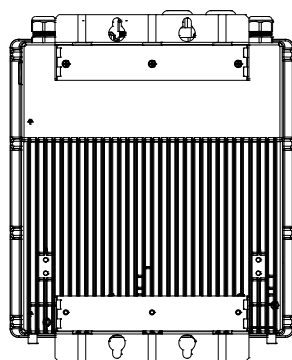
b) Protection (Yellow LED)

c) Alarm (Red LED)

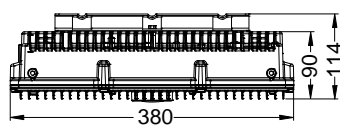
Figure 7: Overall Dimensions

Note:

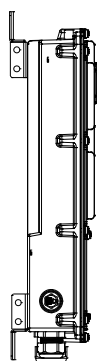
1. Dimensions are in millimeter(mm), unless otherwise specified.
2. Finish: Aluminum with Powder Painted.
3. Weight:  
Net: 11 kg  
Shipping:



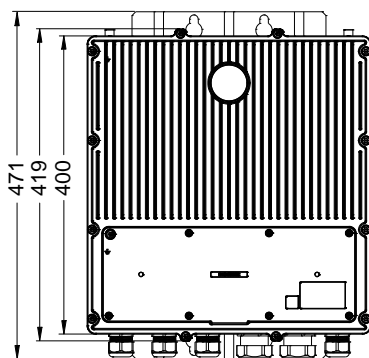
Rear view



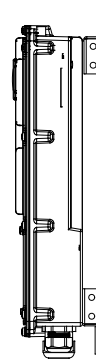
Top view



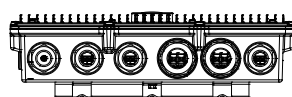
Left side view



Front view



Right side view



Bottom view

# INSTALLATION

## Installing the Rectifier

### General

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

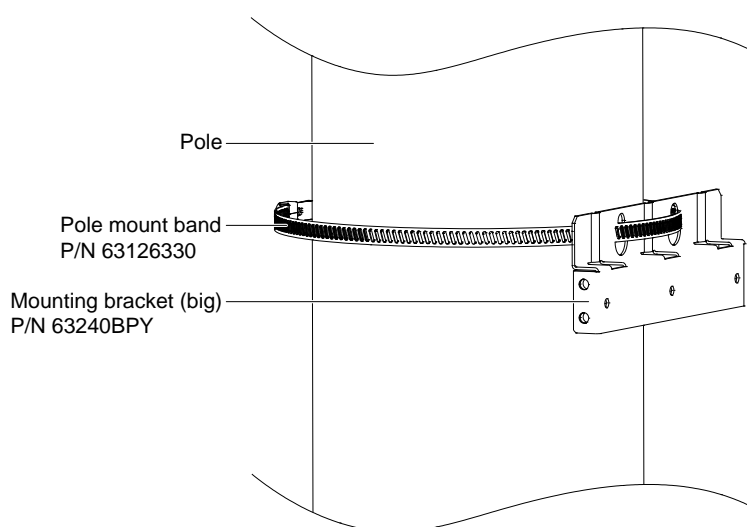
For mounting; use a corrosion inhibiting compound (CIC) inside the tapped mounting holes to keep water away or use organically plated stainless steel bolts. See Figure 9 and Figure 14.

If the front door is opened during installation, ensure the front door is securely closed and the screws are torqued to 29 Kgf cm (2.9 Nm) (25 in-lbs).

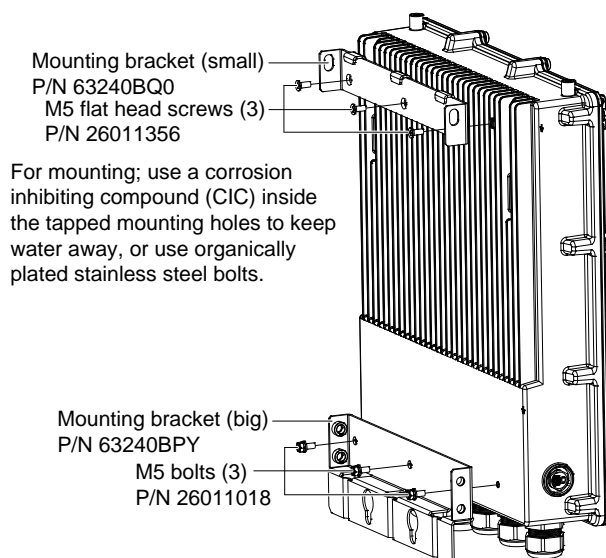
### Pole Installation Procedure

1. Unpack the rectifier and mounting accessories.
2. Install the mounting bracket (big) 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 6" to 12" in diameter. Refer to Figure 8.
3. Install mounting brackets to the rear panel of the rectifier with the supplied hardware. Refer to Figure 9.
4. Secure the top of the rectifier to the pole by securing the mounting bracket (small) to the mounting bracket (big) with the supplied M8 bolts. Refer to Figure 10.
5. Secure the bottom of the rectifier to the pole by securing the mounting bracket (big) to the pole with the supplied pole mount band. Refer to Figure 11.
6. Secure the front side shield to the rectifier with the supplied M6 bolts. Refer to Figure 12.

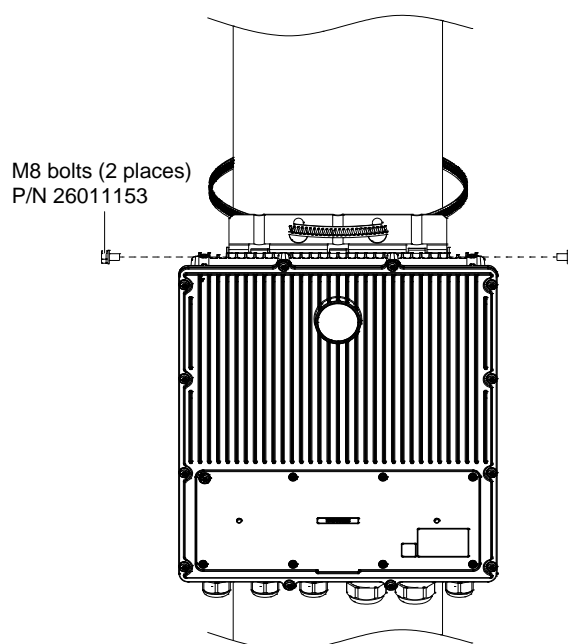
*Figure 8: Installing the Mounting Bracket to the Pole with the Pole Mount Band*



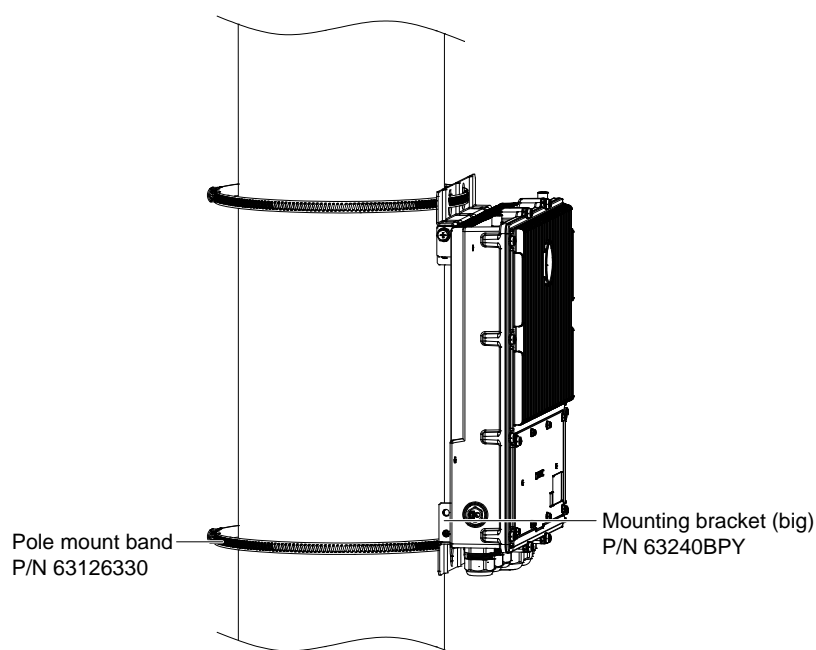
*Figure 9: Installing the Mounting Brackets to the Rectifier*



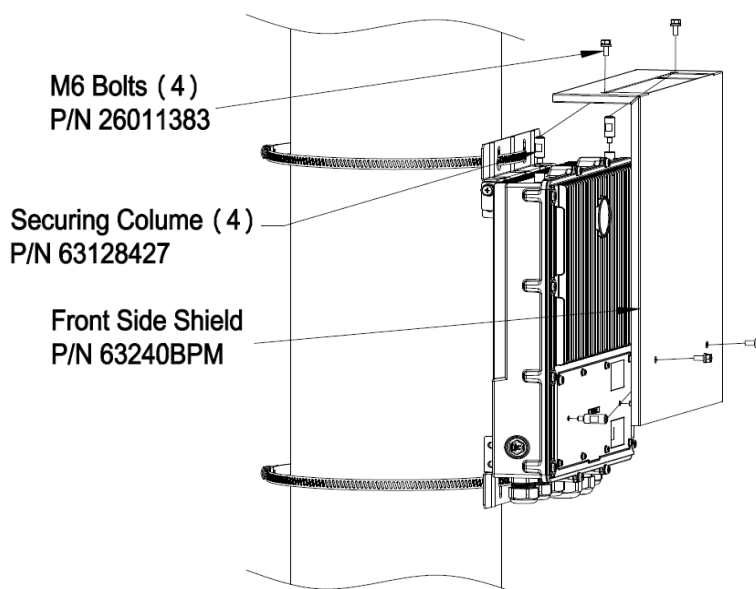
*Figure 10: Securing the Rectifier to the Pole at the Top*



*Figure 11: Securing the Rectifier to the Pole at the Bottom*



*Figure 12: Securing the front side shield to the rectifier.*



### Wall Installation Procedure

1. Drill appropriately sized holes for the customer provided M8 wall anchors being used into the wall as shown in Figure 13. Note that the rectifier can be mounted horizontal or vertical. Figure 13 shows horizontal mounting. Install the M8 wall anchors into the holes.
2. Install mounting brackets to the rear panel of the rectifier. Refer to Figure 14.
3. Secure the rectifier to the wall using the wall anchors previously installed. Refer to Figure 15.
4. Secure the front side shield to the rectifier with the supplied M6 bolts. Refer to Figure 12.

Figure 13: Wall Mounting Hole Positions

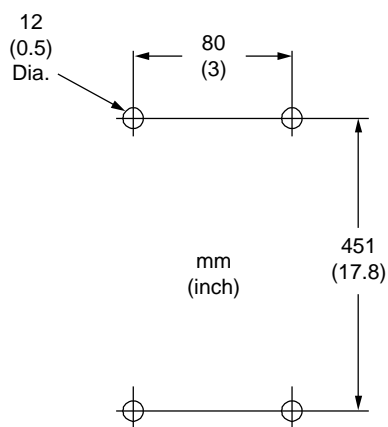
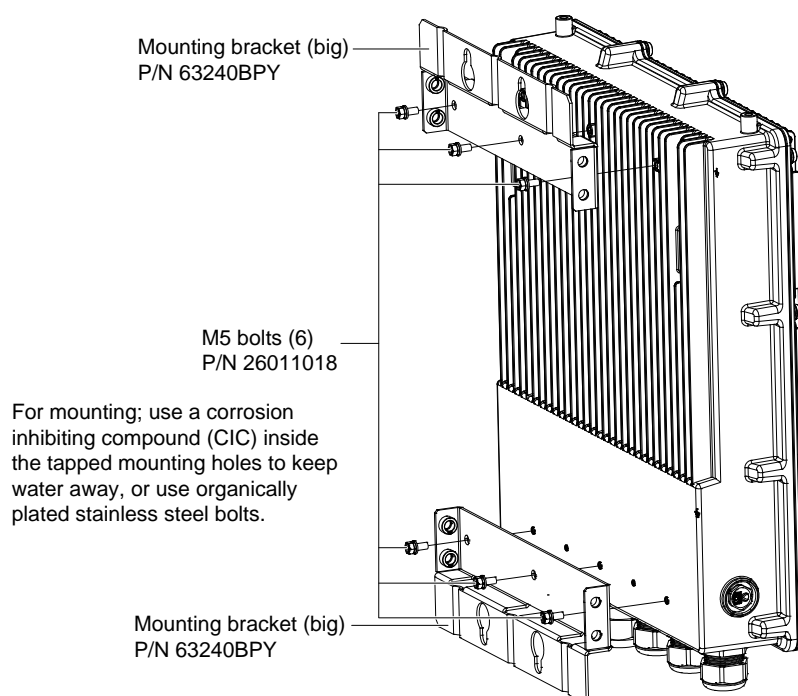
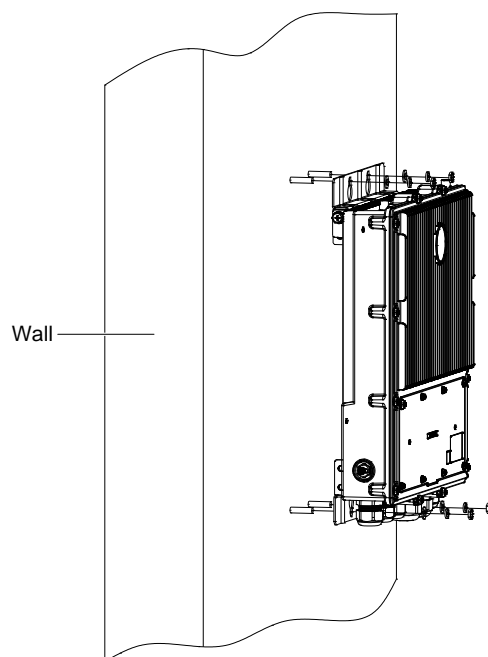


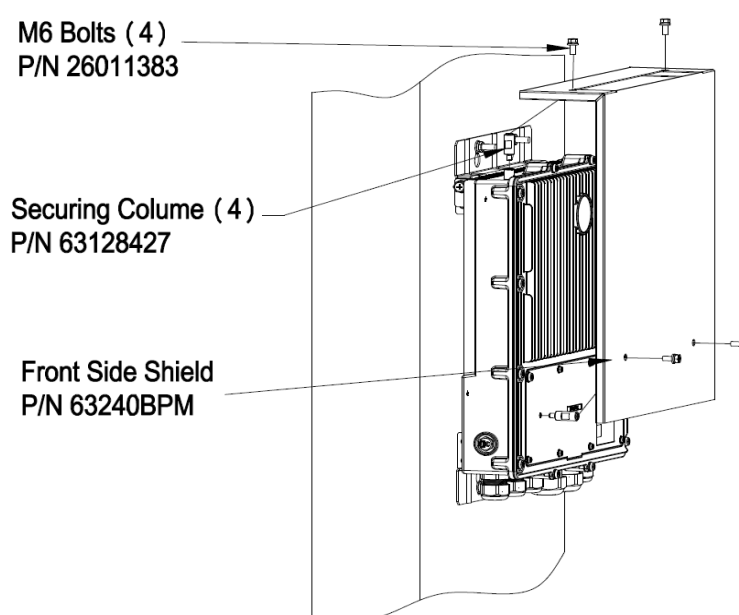
Figure 14: Installing the Mounting Brackets to the Rectifier



*Figure 15: Securing the Rectifier to the Wall*



*Figure 16: Securing the front side shield to the rectifier*



# MAKING ELECTRICAL CONNECTIONS

## Important Safety Instructions



**DANGER!** Adhere to the “Important Safety Instructions” presented at the front of this document.

## Wiring Considerations

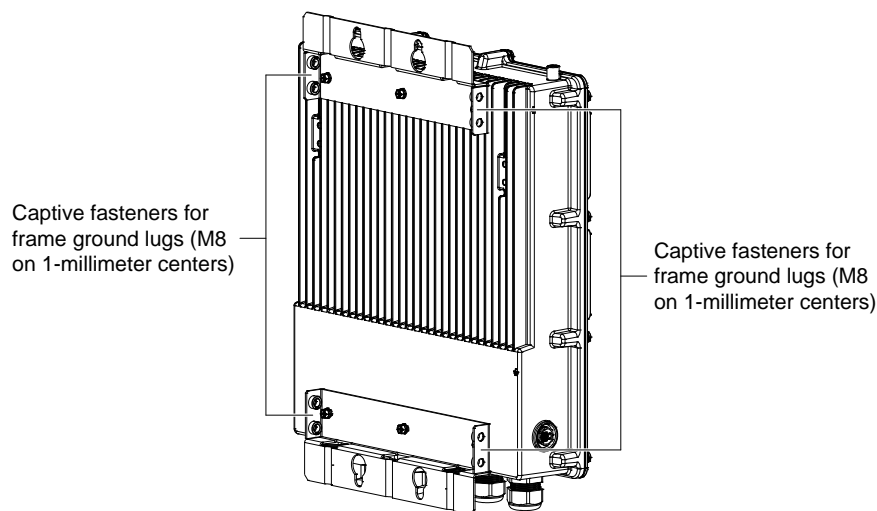
All wiring and branch circuit protection should follow the current edition of the American National Standards Institute (ANSI) approved National Fire Protection Association's (NFPA) National Electrical Code (NEC), and applicable local codes. For operation in countries where the NEC is not recognized,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

## Frame Ground Connection

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

Captive fasteners (for M8 bolts) for frame ground lugs are located on each mounting bracket. Holes are spaced on 1-inch centers. Refer to Figure 17 for location.

*Figure 17: Frame Grounding Location*



## External Alarm and Control Connections

The rectifier is equipped with plug-in alarm connectors located on the bottom of the enclosure. Mating connectors are provided. Customer must provide wiring to the mating connector. Maximum wire size is 22 AWG. See Figure 18. Refer also to Figure 19 through Figure 21. See also “Customer Wiring to the Mating Connectors” starting on page 25.

## Contact Ratings (UL / CSA Rating):

- Maximum Switching Power: 60 W, 125 VA.
- Maximum Switching Voltage: 220 VDC, 250 VAC.
- Maximum Switching Current: 2 A.



- Maximum Carrying Current: 2 A.

### Rectifier Fail Alarm

A rectifier fail alarm activates if any of the conditions listed in Table 7 under “Red (Alarm)” indicator occur.

Contacts close between terminals 1 and 2 on the alarm connector during a rectifier fail alarm condition.

### AC Fail Alarm

An AC fail alarm activates if AC input voltage is lost.

Contacts close between terminals 3 and 4 on the alarm connector during an AC fail alarm condition.

### CAN

Terminal 5 on the Alarm Connector: CAN\_H.

Terminal 6 on the Alarm Connector: CAN\_L.

## Nominal 120 VAC / 208 VAC / 220 VAC / 230 VAC / 240 VAC Input and AC Input Equipment Grounding Connections

The rectifier is equipped with plug-in AC input connectors located on the bottom of the enclosure. Mating connectors are provided. Customer must provide wiring to the mating connector. See Figure 21. Refer also to Figure 18 through Figure 27. See also “Customer Wiring to the Mating Connectors” starting on page 25.

- Recommended AC input wire size is 14 AWG.
- This rectifier requires an external AC input branch circuit protective device rated for 15 A.

## -48 VDC Output Connections



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

The rectifier is equipped with plug-in DC output connectors located on the bottom of the enclosure. Mating connectors are provided. Customer must provide wiring to the mating connector. See Figure 18 and Figure 19. Refer also to Figure 20 through Figure 21. See also “Customer Wiring to the Mating Connectors” starting on page 25.

## Customer Wiring to the Mating Connectors

### Procedure




**NOTE!** Refer to Figure 18 through Figure 27 as this procedure is performed.



**NOTE!** If the sleeve and sealing cable adapter housing are not separated before installing the cable, the cable may twist inside the connector housing as the sleeve is tightened to the connector housing. Perform these steps in the correct order to prevent this from happening.

1. Install the ferrule or Ring lug. Refer to Figure 18, Figure 19 .
2. Unscrew seven M4 screws from small top cover. Refer to Figure 22.
3. Unscrew the M6 screw in the upper left corner of the small cover about 22mm and rotate the cover clockwise 180° around the M6 screw. Refer to Figure 23.
4. Unscrew the Cable Gland Cap from the Cable Gland until customer's wires are through the Cable Gland successfully before the wires installed to the connectors on the PCBA. Refer to Figure 24.

5. Slide the cable(s) through the rear Cable gland nut, then slide the appropriate cables into the appropriate pins of connector(s) on the PCBA board, finally tighten two screws on the top of the connector(s) to fix customer's cable. Refer to Figure 25.

 **NOTE!** If multiple sealing cable adapters are furnished, select and install the appropriate sealing cable adapter.

6 Tighten the cable gland nut to secure the wire by wrench. Torque to 7.5 N m (66 in-lbs). Refer to Figure 26.

7. Rotate small cover counterclockwise 180° around the M6 screw and tighten all screws on the cover. Refer to Figure 27.

## Paralleling Rectifiers for Redundancy

DO NOT EXCEED THE LOAD RATING OF A SINGLE RECTIFIER.

To parallel rectifiers, connect the CAN bus of each rectifier together. Connect CAN\_H to CAN\_H and CAN\_L to CAN\_L.

## Final Step

If any of the six (6) connectors located on the bottom of the unit are left unused, screw the provided connector dust cover onto the unused connector.

## Customer Cable Pre-install Procedure

1. Strip cord insulation as required.
2. Install Ferrule or Ring lug as required.

*Figure 18: Strip cord insulation as required.*

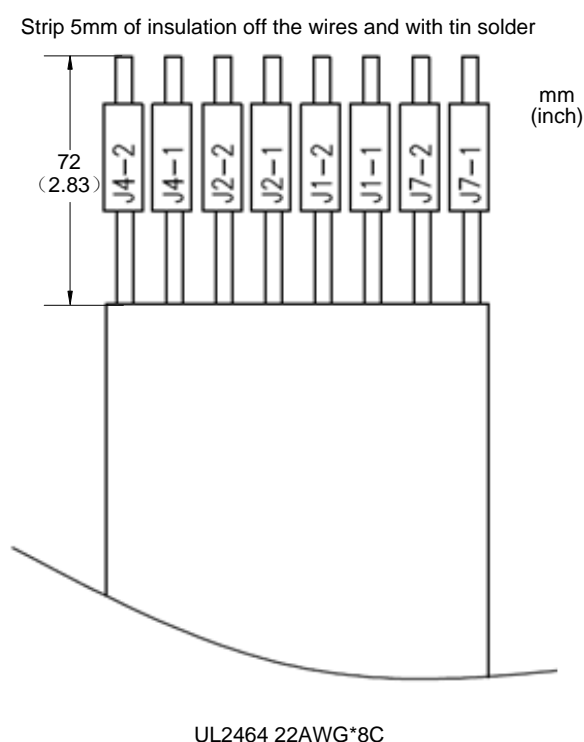
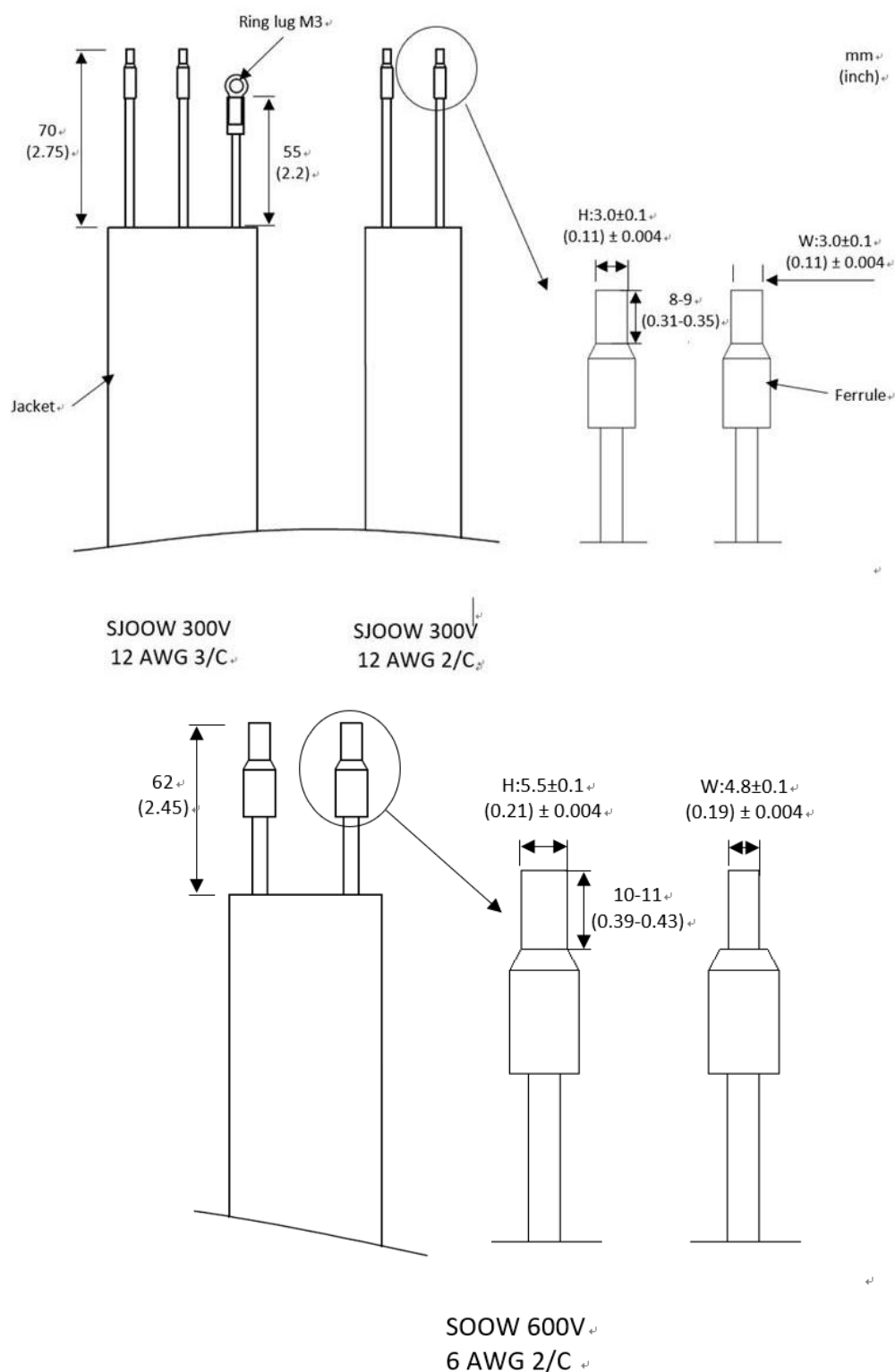


Figure 19: Strip cord insulation and install Ferrule and ring lug as required

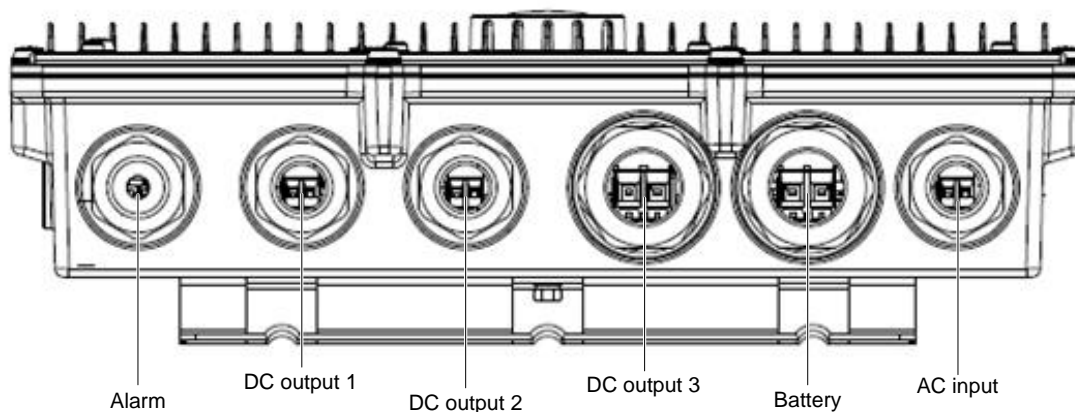


Customer Wiring Connection procedure.

1. Unscrew the screws of the small top cover and open it. Refer to Figure 22.
2. Rotate the cover clockwise 180° around the M6 screw. Refer to Figure 23.
3. Unscrew the Cable Gland Caps.

4. Install the cord to the Terminal block then screw the screws of the terminal block as required.

Figure 20: Customer Wiring Diagram.



Cable gland information	
Designation	Vertiv P/N
Alarm	63204186
DC OUTPUT1	63204183
DC OUTPUT2	63204183
DC OUTPUT3	63204185
Battery	63204185
AC INPUT	63204183

#### Alarm

Cable info: UL2464 22AWG 8/C  
Maximum cable diameter is 6mm (0.24inch)

#### DC OUTPUT1、DC OUTPUT2

Cable info:SJOOW 12AWG 2/C  
Maximum cable diameter is 9mm to 16mm (0.35inch to 0.63inch)

#### DC OUTPUT3、Battery

Cable info:SOOW 6AWG 2/C  
Maximum cable diameter is 18mm to 25mm (0.71inch to 1inch)

#### AC INPUT

Cable info:SJOOW 12AWG 3/C  
Maximum cable diameter is 9mm to 16mm (0.35inch to 0.63inch)

Figure 21: Customer Cable Location Diagram

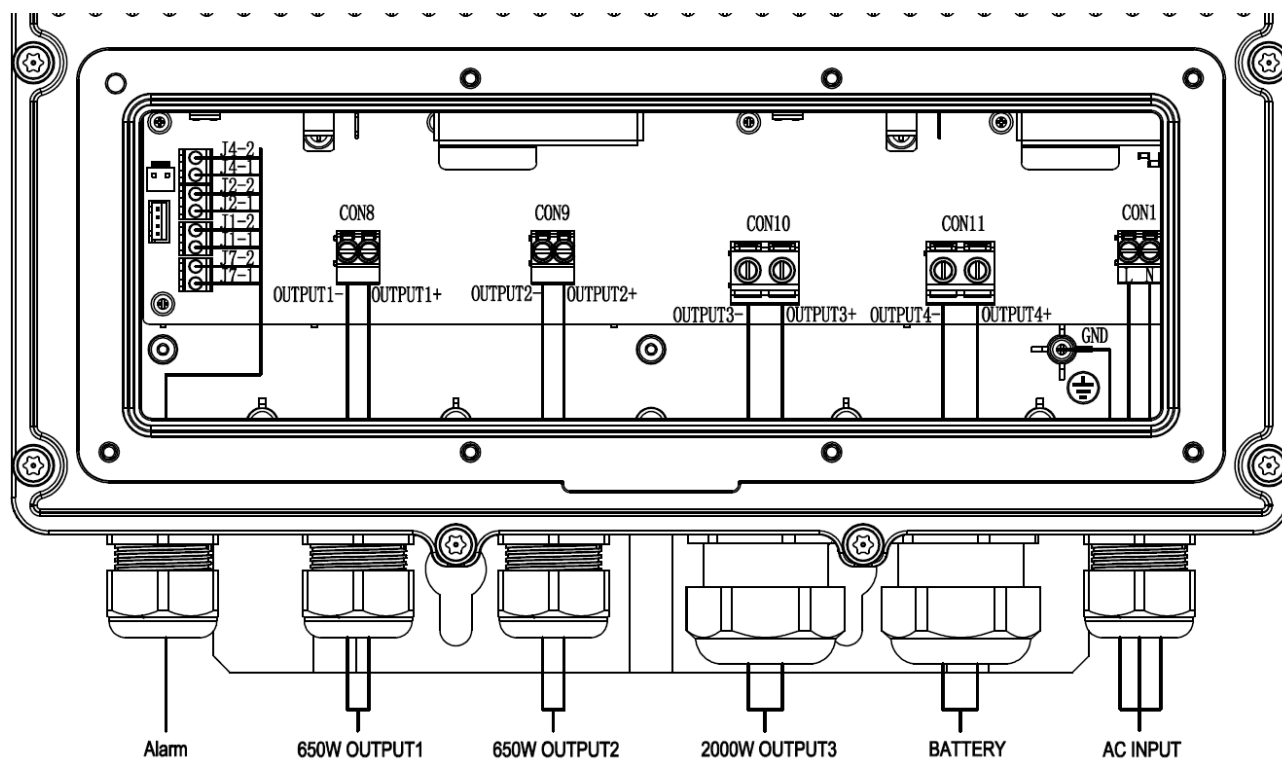
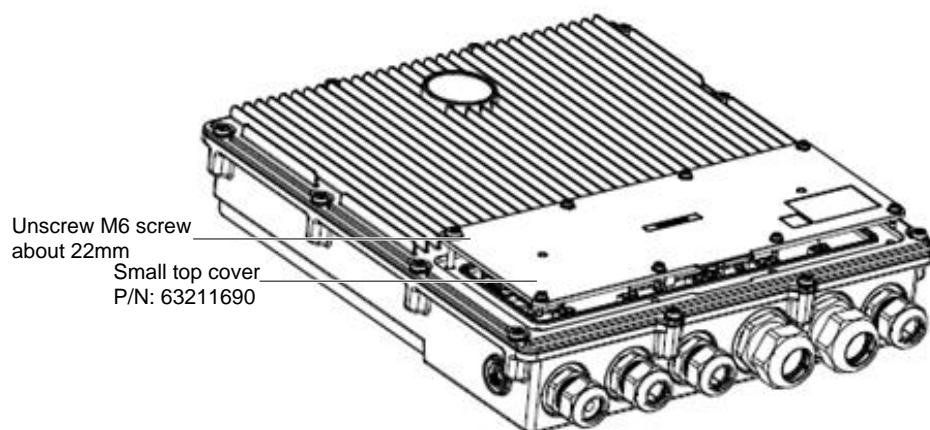


Figure 22: Unscrew the screws of small top cover



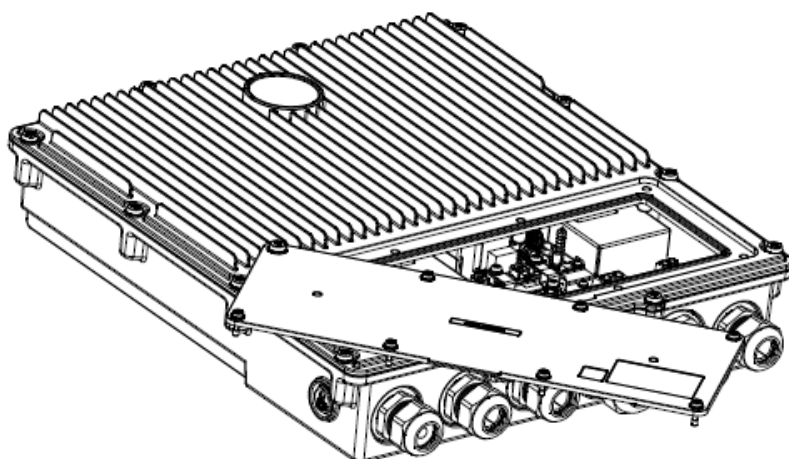


Figure 23: Rotate the small top cover clockwise  $180^{\circ}$  around the M6 screw

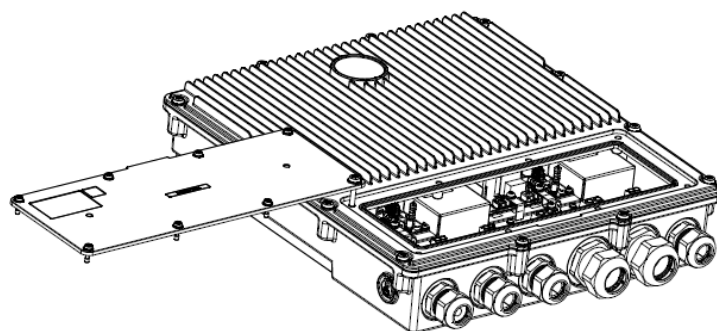


Figure 24: Unscrew the Cable Gland Caps

Remark: Remove the sealing pin in sealing cable adapter.

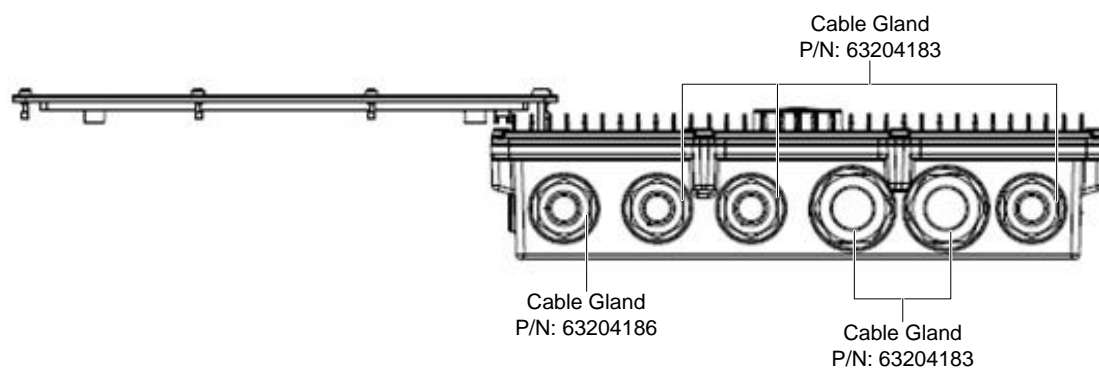


Figure 25: Slide appropriate cable into the appropriate pins of the connector housing.

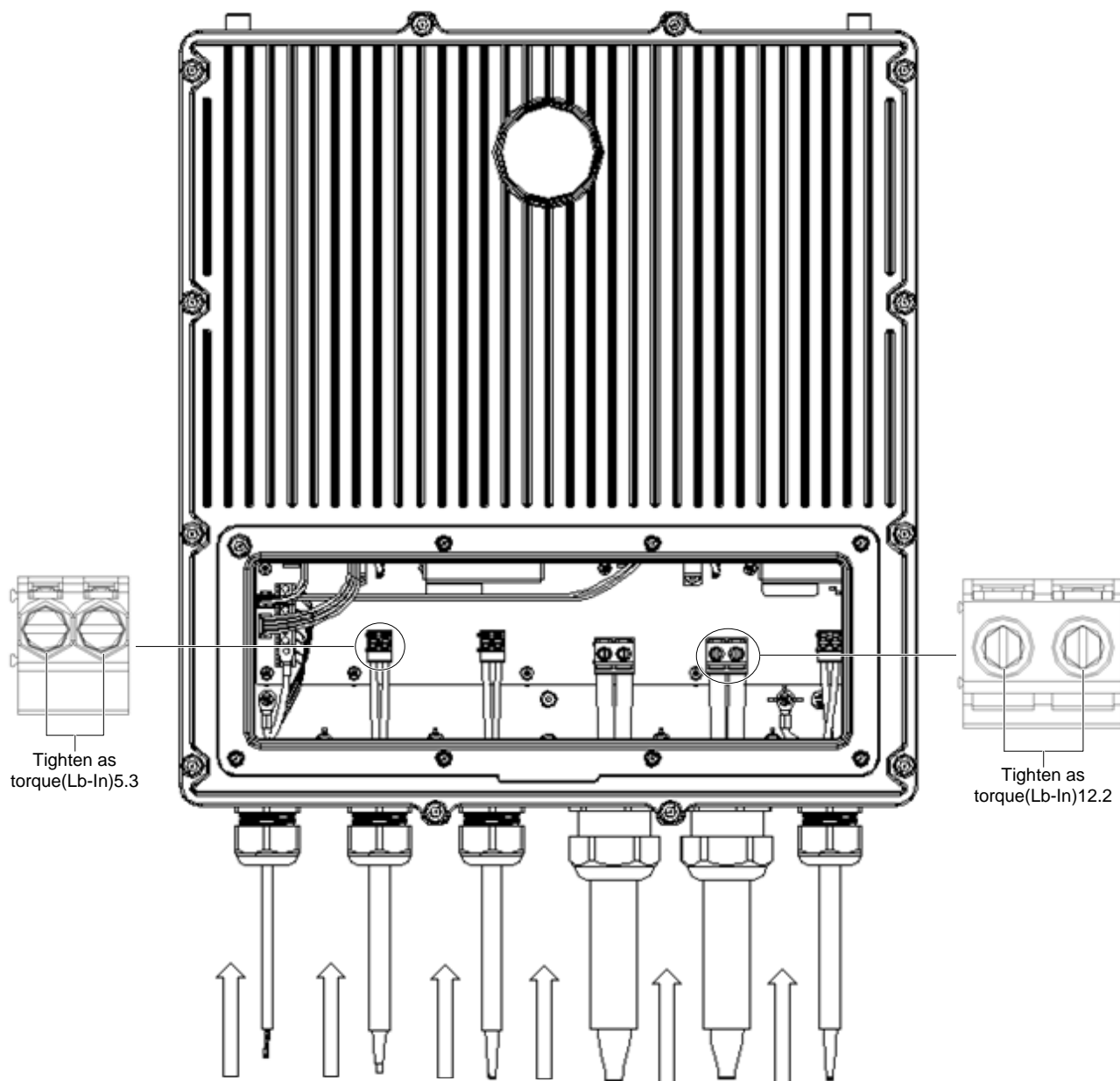


Figure 26: Tighten all of the cable gland caps as required torque

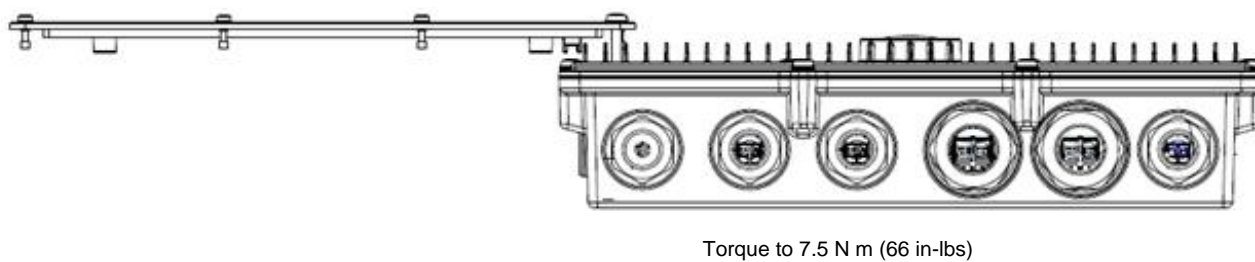


Figure 27: Secure the small top cover

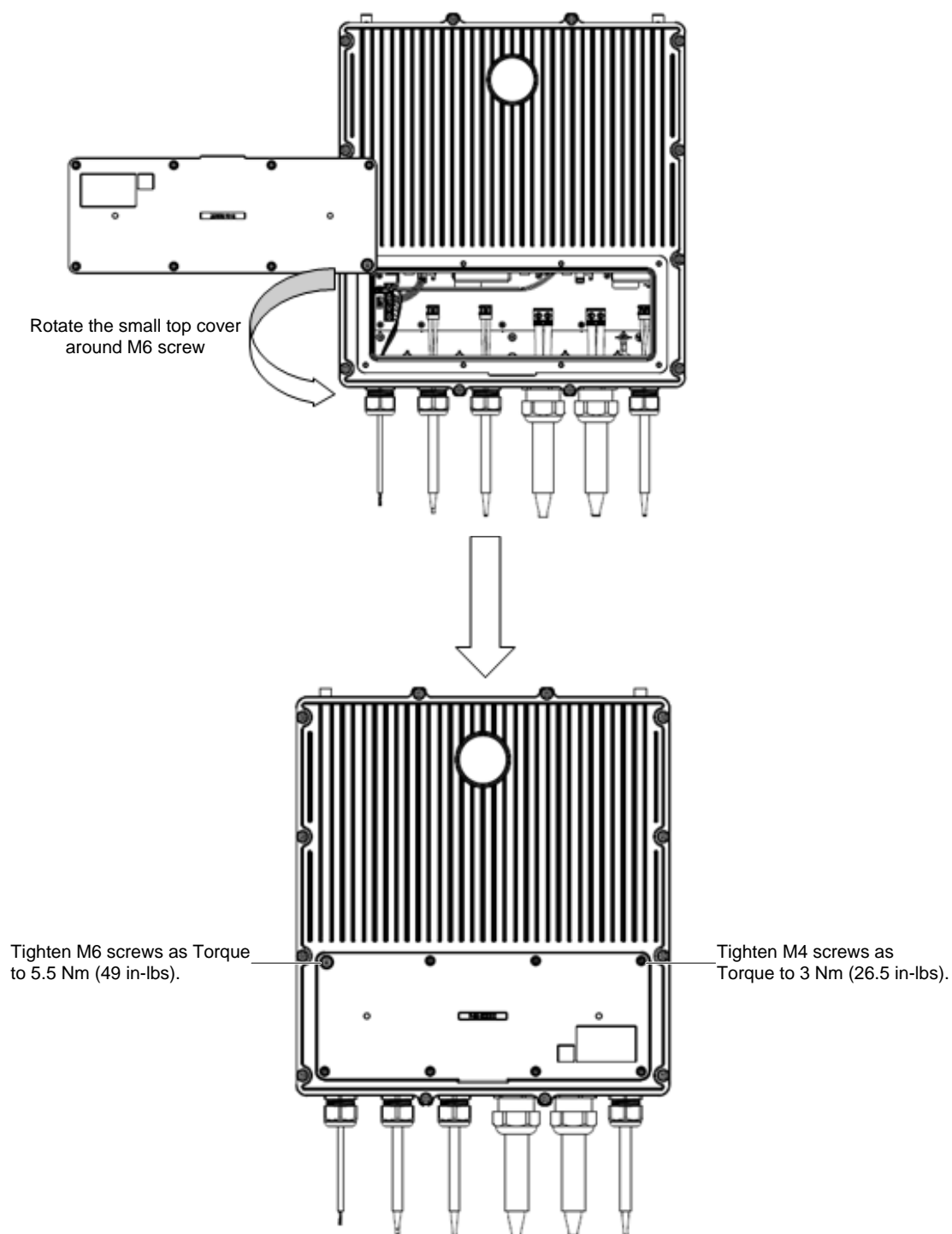
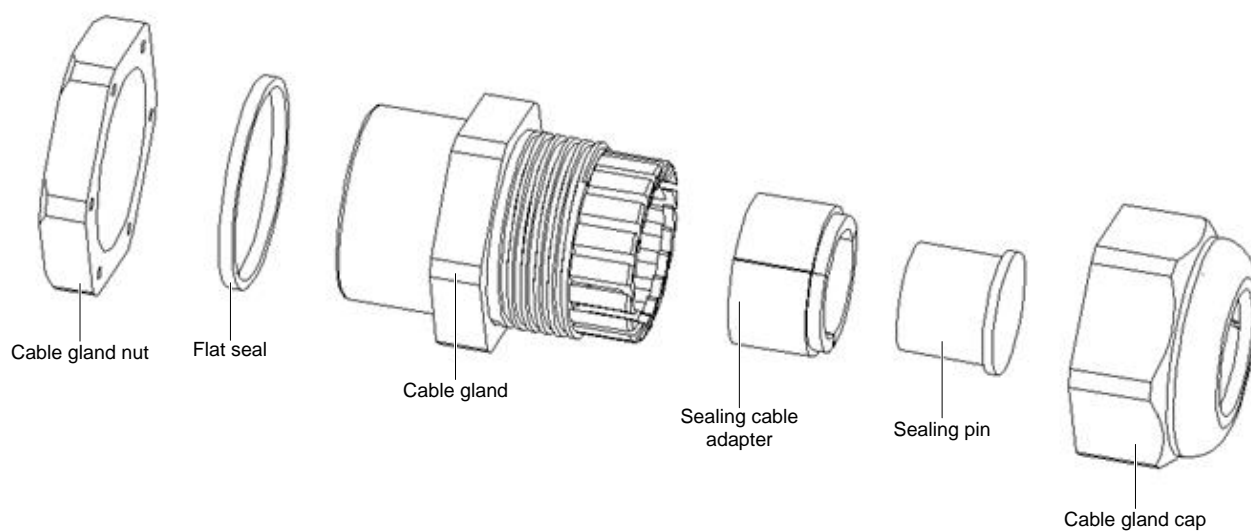




Figure 28: Cable Gland Diagram.



# INITIALLY STARTING AND CHECKING RECTIFIER OPERATION

## Initially Starting the Rectifier

1. Apply rectifier AC input power to the system by closing the external AC disconnect or protective device. The rectifier automatically starts.

## Checking System Status

### Procedure

1. Observe the status of the rectifier's local indicators. If operating normally, the status of these is as shown in Table 6. See Figure 29 for location.
2. Ensure the front door is securely closed and the screws are torqued to 29 Kgf cm (2.9 Nm) (25 in-lbs).

*Table 6: Status and Alarm Indicators*

INDICATOR	NORMAL STATE
Power (Green)	On
Protection (Yellow)	Off
Alarm (Red)	Off

# OPERATION

## Local Indicators

There are three (3) indicators located inside the rectifier enclosure. See Figure 29 for location and Table 7 for indicator functions.


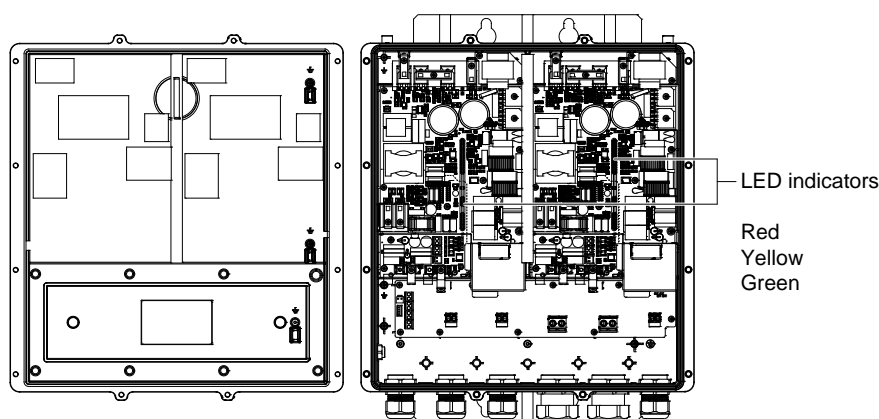
 **NOTE!** AC voltage must be present at the rectifier input terminals for indicators to be functional.

Figure 29: Local Indicator Locations



## Rectifier High Voltage Shutdown and Lockout Restart

### Procedure

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

Table 7: Rectifier Indicators

INDICATOR	NORMAL STATE	ALARM STATE	ALARM CAUSE
Power (Green)	On	Off	No input voltage. Internal input fuse open.
Protection (Yellow)	Off	On	AC input under/over voltage. PFC output under/over voltage. Moderate load sharing imbalance. Rectifier over-temperature protection. Rectifier operating in an output power derating mode (rectifier derates when rectifier temperature rises above or input voltage falls below acceptable values).
Alarm (Red)	Off	On	Severe load sharing imbalance. Rectifier output disabled for any reason, including overvoltage shutdown and internal output fuse open.

# TROUBLESHOOTING AND REPAIR

## Troubleshooting

### Rectifier Current Sharing Imbalance

When multiple rectifiers are operating in parallel and the load is greater than 20 %, if the current sharing imbalance among them is greater than 3 %, replace the rectifier exhibiting the current imbalance.

### Rectifier Fault Symptoms and Troubleshooting

The fault indicators that can be displayed by the rectifier are as follows. Refer to Table 8 for a list of possible causes and corrective actions.

- Power Indicator (Green) Off
- Protection Indicator (Yellow) ON
- Alarm Indicator (Red) ON

## Repair

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

*Table 8: Rectifier Troubleshooting*

SYMPTOM	POSSIBLE CAUSE(S)	SUGGESTED ACTION(S)
Power Indicator (Green) Off	No input voltage.	Make sure there is input voltage.
	Internal input fuse open.	Replace the rectifier.
Protection Indicator (Yellow) On	AC input under/over voltage.	Correct the AC input voltage to within the acceptable range.
	PFC under/over voltage.	Replace the rectifier.
	Moderate load sharing imbalance.	Replace the rectifier.
	Rectifier over-temperature protection.	Ambient temperature too high.
Alarm Indicator (Red) On	Severe load sharing imbalance. Rectifier output disabled for any reason, including overvoltage shutdown and internal output fuse open.	Remove then re-apply AC input power to the rectifier. If rectifier fails to start or shuts down again; replace the rectifier.



