NetSure™ 4015
30kW 400V DC Power System

User Manual

Specification Number: 584000300
Model Number: 4015-X003

COMPONENT	SPEC. NO. 584000300	MODEL
INTEGRATED SYSTEM	LIST R3, R4	4015-X003
LOAD DISTRIBUTION SUB-RACK HRMG Configuration (w/ row breaker) HRMG Configuration (w/out row breaker)	 LIST 25 LIST 27	--
POWER AND CONTROL SUB-RACK HRMG Configuration	 LIST 13	4015-X003
BATTERY TRAY HRMG Configuration	 LIST 93	--

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Technical Support Site

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

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

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Admonishments Used in this Document

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

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

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

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

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

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

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

Important Safety Instructions

Safety Admonishments Definitions

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

Safety and Regulatory Statements

Refer to Section 4154 (provided with your customer documentation) for Safety and Regulatory Statements.

Déclarations de Sécurité et de Réglementation

Reportez-vous à la Section 4154 (fourni avec les documents de votre client) pour les déclarations de sécurité et de réglementation.

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1 Customer Documentation Package

This document (UM584000300) provides *Operation Instructions* for Vertiv™ NetSure™ 4015 400V DC Power System Model 4015-X003, Spec. No. 584000300.

The complete Customer Documentation Package consists of…

Power System Installation Manual

- Power System Installation Instructions: IM584000300

Power System Operation Manual

- Power System Operation Instructions: UM584000300
- Rectifier Instructions: UM1R40015000e
- Power System "System Application Guide": SAG584000300

Controller Operation Manual

- ACU+ Controller Operation Instructions: UM1M820NNB-1

USB Drive with All Customer Documentation

- Power System Installation Instructions: IM584000300
- Power System Operation Instructions: UM584000300
- Rectifier Instructions: UM1R40015000e
- Power System "System Application Guide": SAG584000300
- ACU+ Controller Operation Instructions: UM1M820NNB-1
- Also provided on the USB drive is an ACU+ configuration drawing and the ACU+ configuration files loaded into the ACU+ as shipped.

2 System Description

400V DC Output @ up to 30kW Power System

The Vertiv™ NetSure™ 4015, 30kW 400V DC Power System is a complete integrated power system containing rectifiers, intelligent control, metering, monitoring, and distribution. The individual system sub-racks can be factory integrated into a standard IT rack or provided separately for customer integration into an existing IT rack.

This power system is capable of operating either with or without batteries online.

This system consists of the following components.

2.1 Power and Control Sub-Rack (List 13)

The system contains one (1) "power and control sub-rack", which houses up to two (2) rectifiers and the system control and monitoring components.

Rectifier(s)

The system contains one (1) or two (2) rectifiers, which provide load power, battery float current, and battery recharge current during normal operating conditions. Refer to the rectifier instructions (UM1R40015000e) for more information.

Controls

ACU+ (Advanced Control Unit Plus) Controller

The system controller provides power system control, rectifier control (including a charge control function), metering functions, monitoring functions, and local/remote alarm functions. Power system control includes battery low voltage disconnect (BLVD) functionality to remotely trip battery circuit breakers which protects batteries against over-discharge. The system can also be equipped with one (1) or two (2) temperature probe(s). Any combination of the two (2) temperature probes can be programmed to monitor ambient air temperature and/or battery temperature. A temperature probe set as a battery probe can also be designated to be used for the rectifier battery charge temperature compensation feature. A temperature probe designated to be used for the battery charge temperature compensation feature can also be used for controlling against battery thermal runaway (BTRM feature). The controller also provides data acquisition, system alarm management, and advanced battery and energy management. The controller contains an LCD display and keypad for local access. The controller provides Ethernet connection and supports software upgrade via its USB port. It also comes with a comprehensive web page and SNMP capability for remote system management. Refer to the ACU+ controller instructions (UM1M820NNB-1) for more information.

System Shutdown

A “System Shutdown” pushbutton is located on the front of the power and control sub-rack. When momentarily depressed, the rectifier’s AC input circuit breakers and the provided battery trays’ battery disconnect circuit breakers are tripped open to isolate the system from all electrical sources. Manual intervention is required to restart the system.

2.2 Load Distribution Sub-Rack(s) (List 25, 27)

The system may contain up to two (2) “load distribution sub-racks”, which provide DC distribution through circuit breakers. Optional main row breaker available. Distribution can also be bulk with no “distribution sub-rack”.

2.3 Battery Tray(s) (List 93)

The system may contain up to five (5) battery trays, each housing one (1) 400V battery string consisting of twenty-eight (28) 12V battery blocks (336V nominal). Customer supplied external battery strings can be connected to the system. The total number of internal and external battery strings cannot exceed five (5).

2.4 IT Rack Integration (List R3, R4)

Choice of 24U or 42U rack and includes factory installation and integration of other components.

2.5 Available Grounding Configurations

HRMG (High Resistance Midpoint Ground) Configuration (+/- 200V DC)

The HRMG configuration provides system voltages to ground at half of the output system voltage, for additional personnel safety. That is, the HRMG version of 400V DC produces +/-200V DC to ground potentials. This configuration is used in applications where an internal high resistance path is required between the positive output busbar and site ground and also the negative output busbar and site ground.

The DC bus is continuously monitored for ground fault (insulation fault) conditions. If the insulation resistance between the +BUS or -BUS to ground goes below a set value, a ground fault (insulation fault) alarm is generated.

3 Operating Procedures

3.1 Controller and Rectifiers

For operation instructions on these units, refer to the following documents.

- ACU+ Controller Operation Instructions (UM1M820NNB-1)
- Rectifier Instructions (UM1R40015000e)

3.2 Local Controls and Indicators

Refer to the controller and rectifier instructions for descriptions of the local controls and indicators located on these units.

Refer to this section for descriptions of the local controls and indicators located on the system's sub-racks. Refer to **Figure 3.1** for location.

Power and Control Sub-Rack

"AC Input" Circuit Breaker: The AC input circuit breaker feeds both rectifier positions.

"System Shutdown" Pushbutton: When momentarily depressed, opens the rectifier's AC input circuit breakers and the battery trays' battery disconnect circuit breakers.

"Output Voltage Present" Indicator: Illuminates green to indicate voltage is present on the system's DC output bus.

"PS1" Indicator: Illuminates green to indicate converter power supply #1 is functioning. (If off when system is in operation, contact Vertiv Technical Support.) (This power supply provides 48V for controls.)

"PS2" Indicator: Illuminates green to indicate converter power supply #2 is functioning. (If off when system is in operation, contact Vertiv Technical Support.) (Redundant 48V power supply for controls.)

"Ground Fault Alarm" Indicator: Illuminates red to indicate a ground fault (insulation fault) related alarm condition exists. (See "Ground Fault (Insulation Fault) Detection Circuit Operation (HRMG Configurations)" on page 5.)

Load Distribution Sub-Rack

"Row Breaker" (if furnished): The distribution sub-rack's row circuit breaker feeds the distribution circuit breakers located in the distribution sub-rack.

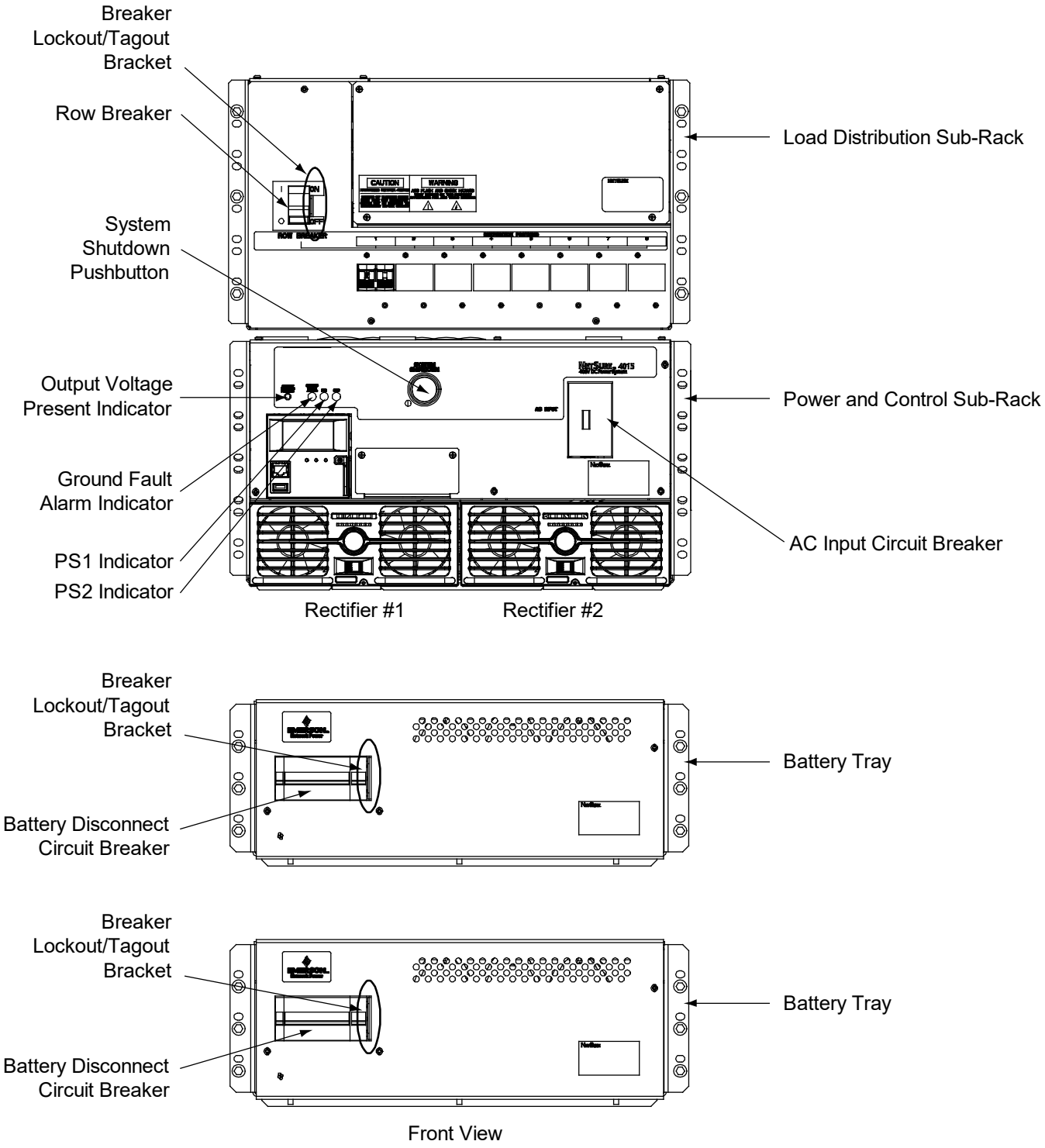
Battery Tray

Battery Disconnect Circuit Breaker: Disconnects the battery tray from the system.

3.3 Lockout/Tagout (LOTO)

The "Row Breaker" (if furnished) on a load distribution sub-rack and the "Battery Disconnect Circuit Breaker" on a battery tray contains a bracket which allows the circuit breaker to be padlocked in the off position.

Figure 3.1 Controls and Indicators



3.4 Ground Fault (Insulation Fault) Detection Circuit Operation (HRMG Configurations)

3.4.1 Overview

The ground fault (insulation fault) detection circuit in a High Resistance Mid-Point Ground (HRMG) configuration detects the insulation condition of the positive and negative DC bus to ground.

If a ground fault (insulation fault) is detected, a local indicator illuminates (located on the front of the power and control sub-rack). The ground fault (insulation fault) circuit also sends a signal to the ACU+ Controller which activates local and remote controller alarms.

High Resistance Mid-Point Ground (HRMG) Configuration Benefits

- Continuous bus operation with a single pole ground fault (insulation fault).

However; it is important to locate and isolate any ground faults (insulation faults) that occur in order to preserve these benefits. The voltages between the +Bus and –Bus will shift when an insulation breakdown occurs and benefits above will be negated. In the extreme case, the voltage on an ungrounded pole may be elevated to 400V DC and present a safety hazard to personnel.

Ground Fault (Insulation Fault) Detection Alarms

The ground fault (insulation fault) detection circuit monitors for three different types of ground faults (insulation faults).

- Bus Voltage Imbalance: Bus to ground voltage imbalance. The voltage difference between the +Bus to ground and the –Bus to ground is more than the "Voltage Imbalance Alarm Limit" parameter set in the ACU+ Controller. The default setting for this parameter is 84V.
- Missing Ground: The HRMG grounding lead that exits the power and control sub-rack is not connected to ground.
- Ground Fault (Insulation Fault) Alarm: The resistance between the +Bus to ground OR the –Bus to ground is less than the "Ground Fault (Insulation Fault) Alarm Limit" parameter set in the ACU+ Controller. The default setting for this parameter is 39.2K.

NOTE! *The "Normal Operation Site" impedance to ground for both the positive and negative output to ground should be determined. Set the Ground/Insulation setpoint below your site's impedance to ground value. See UM1M820NNB-1 for instructions on how to set this parameter.*

3.5 Adding or Replacing a DC Distribution Circuit Breaker

NOTE! *Circuit breakers are mounted left to right.*

Distribution circuit breakers are added or replaced by adding or replacing the complete factory wired circuit breaker assembly.

Procedure

Refer to **Figure 3.2** as this procedure is being performed.

1. Place the distribution sub-rack's ROW BREAKER (if furnished) to the OFF position. A lockout/tagout bracket is furnished to allow the breaker to be locked in the OFF position. If a ROW BREAKER is not furnished, the system MUST be completely powered down and isolated from all power sources (AC and battery).

DANGER! If a ROW BREAKER is not furnished, hazardous DC voltage (400V DC) is present behind the access cover being removed in this procedure. The system MUST be completely powered down and isolated from all power sources (AC and battery).

2. Remove the distribution sub-rack's top front cover to access the distribution circuit breaker mounting positions.
3. Remove the distribution sub-rack's inside shield by sliding the front of the shield up then out of the distribution sub-rack.
4. Remove the distribution sub-rack's blank distribution position cover from the distribution position to be populated. Save the screws for installation of the circuit breaker.
5. Install the circuit breaker using the screws removed above. Ensure when the circuit breaker is in the OFF position, the handle is in the down position.
6. HRMG (High Resistance Midpoint Ground) Configuration: Connect the circuit breaker leads to the distribution sub-rack's busbars located in the lower section of the distribution sub-rack. Use the hardware provided with the circuit breaker. Connect the lead labeled positive (+) to the bottom busbar. Connect the lead labeled minus (-) to the top busbar. Torque to 84 in-lbs.
7. Loosen the right DIN-rail stop and slide it to the right.
8. Install the DIN-rail terminal blocks furnished with the circuit breaker to the distribution sub-rack's DIN-rail. Place the top edge of the terminal block onto the DIN-rail and rotate the terminal block down until the bottom of the terminal block snaps into the DIN-rail. Install the black terminal block to the left and the red terminal block to the right.
9. Slide the DIN-rail stop to the edge of the terminal blocks just installed and secure by tightening the screw.
10. Slide the distribution sub-rack's inside shield into place. Note that cutouts in the shield may have to be removed, as required.
11. Connect load wiring to the terminal blocks, observing proper polarity. See **Figure 3.3**.
12. Install the distribution sub-rack's top front cover.
13. Place the distribution sub-rack's ROW BREAKER to the ON position (if furnished) or restart the system if it was powered down.
14. Ensure that there are no local or remote alarms active on the system.

Figure 3.2 Adding or Replacing a DC Distribution Circuit Breaker

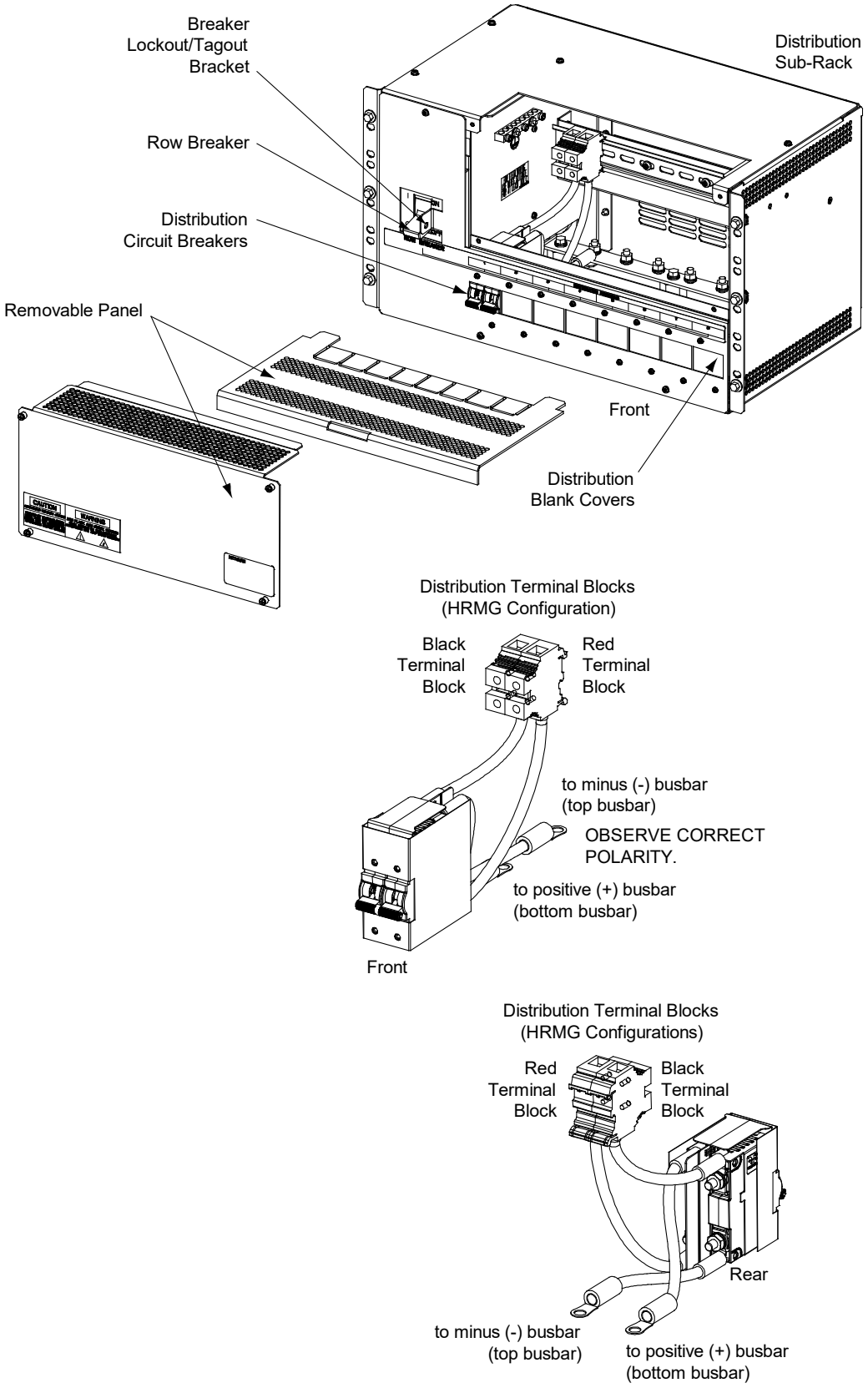
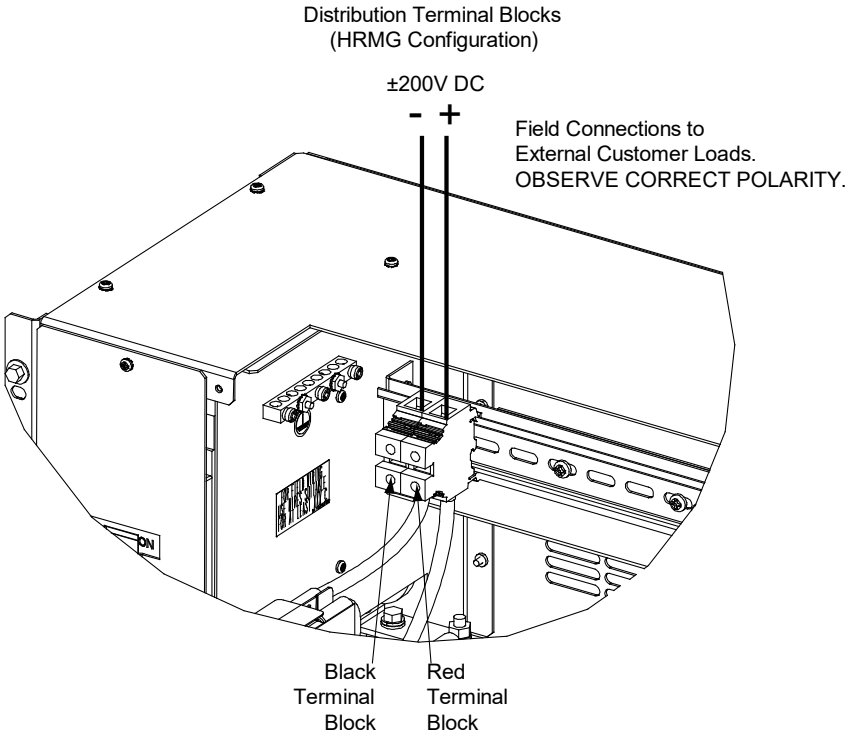


Figure 3.3 Connecting DC Load Distribution Leads



4 Maintenance

Contact Vertiv for all of your maintenance needs.

4.1 Important Safety Instructions

DANGER! Adhere to the "Important Safety Instructions" presented at the front of this document. These procedures are only to be performed by trained personnel.

4.2 System Maintenance Procedures

DANGER! The system MUST be completely powered down and isolated from all power sources (AC and battery) before any maintenance procedure is performed, or use full PPE protection for arc flash.

It is recommended to perform the maintenance procedures listed in **Table 4.1** every 12-months to ensure continual system operation.

4.3 Recommended Battery Maintenance

Lockout/Tagout (LOTO)

The "Battery Disconnect Circuit Breaker" on an battery tray contains a bracket which allows the circuit breaker to be padlocked in the off position.

Maintenance

Inspect the batteries according to battery manufacturer's instructions. Maintain records as required by the battery manufacturer to maintain the battery warranty.

Typical battery life is expected to be 3-5 years (depending on conditions).

Battery life is determined by a variety of factors, including the technology deployed, the charge/discharge cycle history, operating temperature, peak current draw, etc. Battery health should be checked at regular intervals per battery manufacturer's instructions. It is recommended to verify battery string voltage (336V DC nominal) and individual battery block voltages (12V DC nominal). To verify the health of individual battery blocks, it is recommended to isolate and disconnect the battery string from the system (via the battery disconnect circuit breaker).

The ACU+ Controller contains a Battery Test feature to validate batteries. Refer to the ACU+ Controller Operation Instructions (UM1M820NNB-1).

Table 4.1 Maintenance Procedures to be Performed at 12-Month Intervals

Check	Procedure
Ventilation Openings	Check ventilation openings for obstructions such as dust, papers, manuals, etc.
Grounding Connections	Inspect the HDU ground termination (if applicable), tightness of all lugs on the master ground bar and equipment sub-racks, and low ohmic values to the facility ground per local practice.
AC Input Connections	Inspect the AC input mains terminations for proper temperature and/or torque values.
DC Load Connections	Inspect the DC load breaker wiring for proper temperature and/or torque values.
Power and Control Sub-Rack DC Output Connections	Inspect the output lead terminations in the power and control sub-rack for proper temperature and/or torque values.
Battery Connections	Inspect the battery lead terminations for proper temperature and/or torque values.
Power and Control Sub-Rack Battery Connections	Inspect the battery lead terminations in the power and control sub-rack for proper temperature and/or torque values.

5 Troubleshooting and Repair

5.1 Important Safety Instructions

DANGER! Adhere to the "Important Safety Instructions" presented at the front of this document. These procedures are only to be performed by trained personnel.

5.2 Contact Information

Refer to Section 4154 (provided with your customer documentation) for support contact information.

5.3 Controller and Rectifiers

For troubleshooting and repair instructions on these units, refer to the following documents.

- ACU+ Controller Operation Instructions (UM1M820NNB-1)
- Rectifier Instructions (UM1R40015000e)

5.4 ACU+ Controller Configuration

If any ACU+ Controller configuration settings were changed, refer to the ACU+ Operation Instructions (UM1M820NNB-1) and save a copy of the configuration file. This file can be used to restore the ACU+ Controller settings, if required, at a later date.

- Note that provided on a USB drive furnished with the system is an ACU+ configuration drawing (C-drawing) and the ACU+ configuration files loaded into the ACU+ as shipped.

5.5 System Troubleshooting Information

This system is designed for ease in troubleshooting and repair. The various indicators as described in "Operating Procedures" on Page 3 and in the controller and rectifier instructions are designed to isolate failure to a specific component. Once the faulty component has been identified, refer to "Replacement Information" on Page 11 and "Replacement Procedures" on Page 11.

Troubleshooting Alarm Conditions on the ACU+ Controller

The ACU+ Controller displays alarm conditions as listed in the Available Alarms section of the ACU+ Operation Instructions (UM1M820NNB-1). Programmable external alarm relays are also available. Refer to the ACU+ Configuration Drawing (C-drawing) furnished with your system for your alarm relay configurations.

The ACU+'s *Active Alarm* and *Alarm History* submenus allow the User to view alarm details. Refer to the ACU+ Operation Instructions (UM1M820NNB-1) to access these menus.

Clearing a Rectifier Communications Fail Alarm after Removing a Rectifier

If a rectifier is removed from the system, a rectifier communications failure alarm is generated. If the rectifier will not be replaced, the alarm can be cleared as described in the following local LCD interface procedure.

Procedure

1. With the Main screen displayed, press ENT to go to the Main Menu. Navigate to and select "Manual" (ENT).
2. If a password screen opens, a password must be entered to allow the User to make adjustments. If a password was previously entered and has not yet timed out, skip this step and proceed to step 3). Otherwise, to enter a password, with the cursor at the User Name field (default is "Admin"), press the down arrow key to move cursor down to the password line. Press ENT. "0" is highlighted. Press the up arrow key once to change the "0" to"1" (default password is "1"), then press ENT twice. *(**Note:** If you have been assigned a unique User Name and password, follow this procedure to enter these.)*
3. With the Manual menu screen displayed, navigate to and select "Rectifier" (ENT) / "All Rect Ctrl" (ENT).
4. Navigate to "Clear Comm Fail". Press ENT. "Yes" highlights.
5. Press ENT to select the operation. Press ENT again to confirm.
6. Return to the Main screen by repeatedly pressing ESC (escape).

Clearing a Rectifier Lost Alarm

If the ACU+ Controller resets while a rectifier communications fail alarm is active, the rectifier communications fail alarm is replace with a rectifier lost alarm. The alarm can be cleared as described in the following local LCD interface procedure.

Procedure

1. With the Main screen displayed, press ENT to go to the Main Menu. Navigate to and select "Manual" (ENT).
2. If a password screen opens, a password must be entered to allow the User to make adjustments. If a password was previously entered and has not yet timed out, skip this step and proceed to step 3). Otherwise, to enter a password, with the cursor at the User Name field (default is "Admin"), press the down arrow key to move cursor down to the password line. Press ENT. "0" is highlighted. Press the up arrow key once to change the "0" to"1" (default password is "1"), then press ENT twice. *(**Note:** If you have been assigned a unique User Name and password, follow this procedure to enter these.)*
3. With the Manual menu screen displayed, navigate to and select "Rectifier" (ENT) / "All Rect Ctrl" (ENT).
4. Navigate to "Clear Rect Lost". Press ENT. "Clear" highlights.
5. Press ENT to select the operation. Press ENT again to confirm.
6. Return to the Main screen by repeatedly pressing ESC (escape).

5.6 Replacement Information

User Replaceable Components

Refer to SAG584000300 (System Application Guide) for part numbers of User replaceable components.

When a trouble symptom is localized to a faulty rectifier, controller, or User replaceable circuit card; that particular component should be replaced in its entirety. Other than a rectifier fan replacement, no attempt should be made to troubleshoot or repair an individual rectifier, controller, or circuit card.

5.7 Replacement Procedures

DANGER! Adhere to the "Important Safety Instructions" presented at the front of this document. These procedures are only to be performed by trained personnel.

Replacing a Rectifier or Rectifier Fan

Refer to the Rectifier Instructions (UM1R40015000e) for a rectifier replacement procedure and a rectifier fan replacement procedure. Refer also to "System Troubleshooting Information" on Page 10.

The rectifier being replaced is assigned by the ACU+ the lowest available identification number. If desired, you can change the identification number, see "Configuring the ACU+ Identification of Rectifiers" in the separate Power System Installation Instructions (IM584000300).

Replacing the ACU+ Controller

Refer to the ACU+ Operation Instructions (UM1M820NNB-1) for a controller replacement procedure.

Replacing a DC Distribution Circuit Breaker

Replace distribution circuit breakers with the same type and rating. Refer to System Application Guide SAG584000300 for part numbers.

Distribution circuit breakers are replaced by replacing the complete factory wired circuit breaker assembly. Refer to "Adding or Replacing a DC Distribution Circuit Breaker" starting on page 5.

Replacing an AC Input Surge Suppressor

A tripped AC input surge suppressor is indicated by an alarm issued via the ACU+ controller and local indicator on the surge suppressor module.

Refer to System Application Guide SAG584000300 for replacement part numbers.

Refer to **Figure 5.1** as this procedure is being performed.

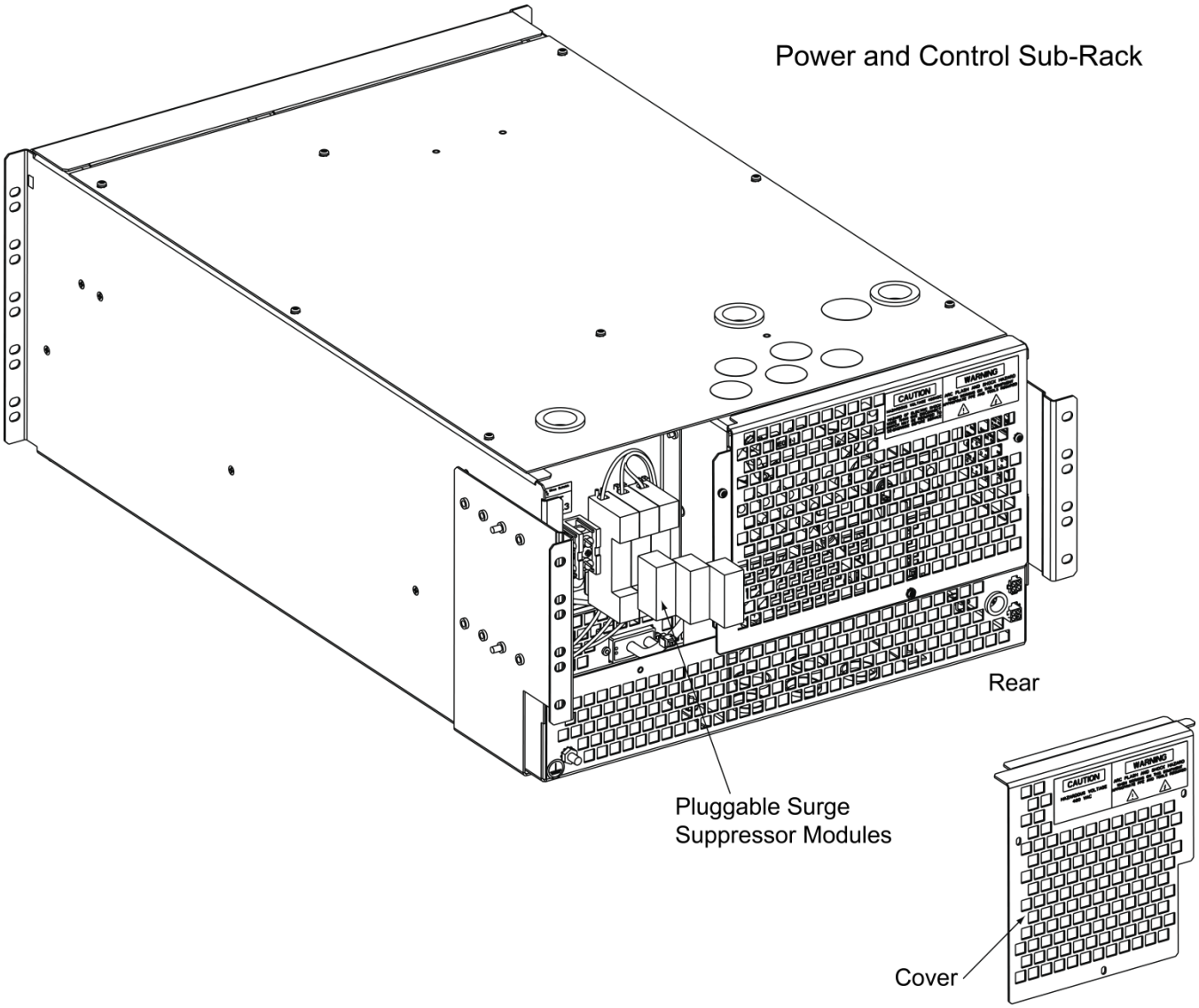
Procedure

DANGER! Hazardous AC voltage (380V/400V/480V AC) is present behind the access cover being removed in this procedure. Ensure you do not touch the terminals on the AC input terminal block if AC power has not been removed from the system.

1. Remove the left rear access cover from the power and control sub-rack.
2. Locate the tripped surge suppressor. The tripped surge suppressor will have a visible red indicator.
3. Gently pull the tripped surge suppressor from its holder.
4. Plug the replacement surge suppressor into the holder.
5. Replace the power and control sub-rack's left rear access cover.

6. Ensure that there are no local or remote alarms active on the system.

Figure 5.1 AC Surge Suppressor Replacement



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