NetSure™ Solar Converter Shelf, 8.6 kW

Installation and User Manual

Specification Number (North America Region): 744900180006, 744900180007
Specification Number (EMEA-Global Region): BMK2257103-002, BMK2257103-004
Model Number: NetSure™ 8.6 kW Solar Add-On Shelf, NetSure™ 8.6 kW Solar Expansion Shelf

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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/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 v. To reduce the chance of accident, read the safety precautions very carefully before operation. The "Caution, Notice, Warning, Danger" in this manual do not represent all the safety points to be observed and are only used as supplement to various operation safety points. Therefore, the installation and operation personnel must be strictly trained and master the correct operations and all the safety points before actual operation. When operating Vertiv products, the local guidelines, the general safety points and special safety instructions specified in this manual must be strictly observed.

General Safety

WARNING! 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. When handling batteries, use gloves.

e) Use certified and well-maintained insulated tools. Use double insulated tools appropriately rated for the work to be performed.

f) Exercise extreme caution not to inadvertently contact or have any tool inadvertently contact an input, output, or battery terminal or exposed wire connected to an input, output, 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.

g) After handling of the enclosure or any such component, such as batteries, wires, cables, busbars, etc., always wash hands immediately after.

h) This product is intended only for installation in restricted access locations.

i) This equipment in not suitable for use in locations where children are present.

Voltages

DC Input Voltages

DANGER! A properly configured solar array can have an open circuit voltage of 400 VDC. The solar array should be disconnected while installing and should only be connected once all electrical connections have been completed and checked.

Hazardous Voltage

DANGER! HAZARD OF ELECTRICAL SHOCK. The voltage from the solar array exceeds 60 VDC.

DANGER! HAZARD OF ELECTRICAL SHOCK. More than one disconnect is required to de-energize the system before servicing.

DANGER! HAZARD OF ELECTRICAL SHOCK.
Safety rules in the industry must be observed when installing the power system. The authorized personnel should be allowed to operate high voltage and DC power. In operation, conductive objects such as watch, bracelet, bangle, ring, etc. are not allowed to be worn. When water is found near or under the shelf, turn off all incoming and outgoing power immediately. In moist environment, precautions must be taken to keep moisture out of the power system. "Prohibit" warning label must be attached to the switches and buttons which are not permitted to be operated on during installation.

DANGER! HAZARD OF ELECTRICAL SHOCK.
High voltage operation may cause fire and electric shock. The connection and wiring of DC wire/cables must be in compliance with the local rules and regulations.

DC Output Voltages

DANGER! This system produces DC power output less than 60 VDC. Although the DC voltage is not hazardously high, the solar converters can deliver large amounts of current.

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 “hazard/risk” 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” or by other national buildings codes and local regulations.

Tools

WARNING! HAZARD OF ELECTRICAL SHOCK.
In high voltage operation, special insulated tools must be used.

Thunderstorm

DANGER! HAZARD OF ELECTRICAL SHOCK.
Do not work by a cell site, a roof top, or by a solar array when a thunderstorm is in the vicinity. Equipment, including the solar array, must have an earthed connection to the ground ring to reduce the harm to people and the equipment as a function of a lightning strike.

Short-Circuit

WARNING! During operation, never short the positive and negative poles of the DC distribution unit of the system or the non-earthing pole and the earth. The power system is always on DC power equipment; short circuit may result in equipment burning and endanger human safety.

Maintenance and Replacement Procedures

ALERT! 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.*

Basic Guidelines

WARNING! Contact the site operations manager or other responsible local personnel before commencing work. Inform all personnel near the equipment that work is in progress.

Reduce the risk of accidents and increase the operation reliability by keeping the power, cabinet, shelter, hut or room clean and clear of any unauthorized material.

While work is in progress, the equipment must also be protected against damages and unauthorized intervention. Busbars, live enclosures, etc., shall be protected during work using protective sheeting.

Do not leave equipment with unprotected parts under power unattended.

Inform the site operations manager or other responsible local personnel when the work is complete.

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 provided below.

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

The Vertiv™ NetSure™ Solar Converter provides additional (supplemental) solar power for -48 VDC telecom loads, with a peak power delivery of 8640 W.

The Solar Add-On Shelf includes intelligent control and metering using the Vertiv™ NetSure™ Control Unit (NCU) (M831).

The Solar Expansion Shelf can be integrated either with the Solar Add-On Shelf or other Vertiv NetSure systems with the NCU (M830 and M831). CAN bus with an extension cable and a software upgrade may be required.

Minimum software revision for Host System NCU when connecting to the Vertiv™ NetSure™ Solar Converter Expansion Shelf:

- NCU 1.2.60, typically associated with North America for M830*
- NCU 2.2.60, typically associated with Europe, Africa for M830*
- NCU 5.2.50, typically associated with Asia for M830*

The Vertiv™ NetSure™ Solar Converter Add-On Shelf ships with NCU M831 rls 7.2.60 (minimum)

The Solar Converter Shelf is 19 inches wide and includes brackets to support flush or recess mounting (5 inch off-set) in either a 19-inch or 23-inch rack. This shelf also supports wall mounting.

Features

4.320 kW Maximum Power Point Tracking (MPPT) Solar Converter Module:

- 4320 W output in a high density pluggable power module.
- Supporting a high current solar array (up to 24 A) with a wide voltage input (70 VDC to 400 VDC), enable support a wide range of solar technology such as HJT, large panels and cells (M12), TOPCon and Tandem with resilience for small arrays and sites with complex site and shadow lines.
- High efficiency converter, with a peak over 97% and MPPT algorithm with an accuracy greater than 99.9%.
- Providing solar (renewables) energy to reduce your operating cost and supporting sustainability targets.

NCU (Solar Add-On only):

- NCU provides control of the solar converter module (S48-4300E4) output and provides alarms and logs.
- Remote secure communications via HTTPS, SNMP v2/v3, and local communications via RS-485, such as Northbound Modbus RTU-485 and EEM.
- Provides cumulative energy reporting.
- Input side lightning protection function (not available in all markets).
- Fault protection and fault alarm functions.

Configuration

Item	Solar Add-On Shelf	Solar Expansion Shelf
MPPT Solar Module	Model: S48-4300E4 2 X 4.3kW	
Controller	Model: M831A x 1	NA
Output Distribution	125A x 2 MCB, UL 1077 Rated	
Input Lightning Protection (Not available in all markets)	Internal DC SPD (DIN mounted with remote indication) x 2	

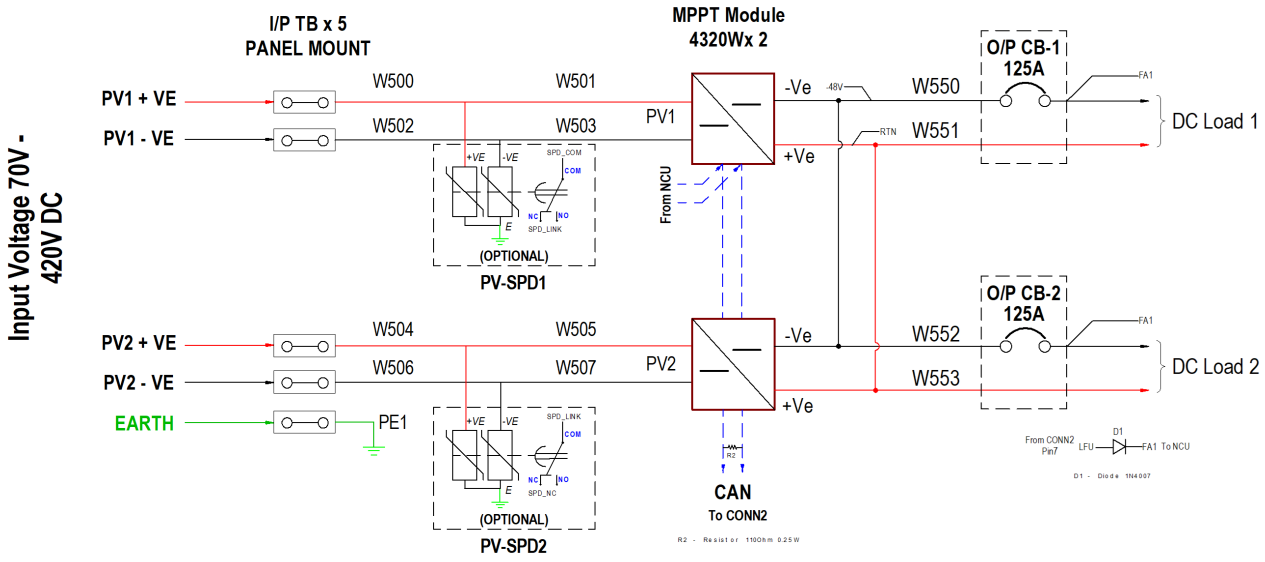
1.1 Technical Specification

Family:	NetSure™
System Parent No.:	North America Region: 744900180006 (Solar Add-On Shelf), 744900180007 (Solar Expansion Shelf) EMEA Region: BMK2257103-002 (Solar Add-On Shelf with SPD), BMK2257103-004 (Solar Expansion Shelf with SPD)
Model/Spec. No:	NetSure™ 8.6 kW Solar Add-On Shelf, NetSure™ 8.6 kW Solar Expansion Shelf
System DC Input Ratings:	70 VDC to 400 VDC
	Maximum Current: 24 A per solar converter module
System DC Output Ratings:	-20 VDC to -58.5 VDC
	163 A (81.5 A @ 53 VDC per solar converter module)
Maximum DC Output Power:	8.640 kW
Framework Type:	19-inch / 23-inch wide rack mount. Will support wall mount.
Mounting Width:	482.6 mm (19 inches)/ 584.2 mm (23 inches)
Mounting Depth:	425 mm (16.73 inches)
Mounting Height:	44.45 mm, 1U (1.75 inches)
Access:	Front access and cabling
Control:	Solar Add-On: Provided by on-board NCU M831 Solar Expansion: Provided by host NetSure System or Solar Add-On
Environment:	Operating Ambient: -40 °C to +55 °C (-40 °F to +131 °F) at full power, derate output from +55 °C to +80 °C (+131 °F to +176 °F)
	Storage Ambient: -40 °C to +80 °C (-40 °F to +176 °F)
	Relative Humidity: 0% to 95%, non-condensing
Optional Internal Surge Protection:	Compliance with IEC 61643-31/ UL 1449, Class II/ Type 2.

2 Electrical and Mechanical Overview

2.1 Electrical Configuration

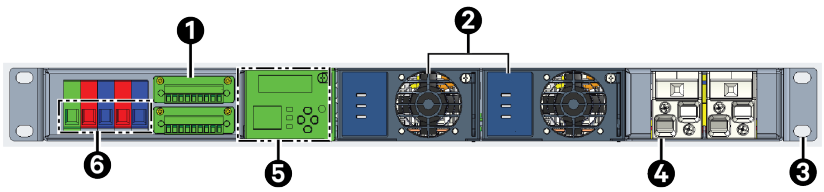
Figure 2.1 Power Electrical Diagram



2.2 Key Components

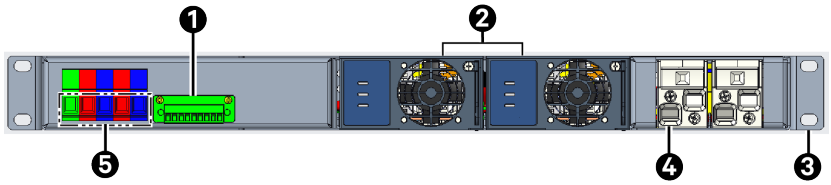
The NetSure Solar Converter Shelf is an indoor rack/panel/wall mount system that provides supplemental power to existing systems. Only the front side needs to be accessible to the operator for installation and operation. For replacing the internal input solar SPD protection, the top cover needs to be removed.

Figure 2.2 Front View: Solar Add-On Shelf



Item	Description
1	Signal Connectors CONN1 and CONN2 for Alarms, DI Solar Off, Temperature Probe and CAN bus Termination
2	Two (2) Vertiv™ eSure™ S48-4300E4 4.32 kW MPPT Solar Converter
3	Mounting Brackets (several options are available-see Figure 2.6 to Figure 2.18 for different configurations)
4	Two (2) UL 1077 MCB 125A
5	NCU (with release 7.2.60 or later software loaded)
6	Solar Input and Earthing Terminal Block

Figure 2.3 Front View: Solar Expansion Shelf with 19-inch Mounting Brackets



Item	Description
1	Signal Connector CONN3 for Alarms and CAN bus Termination
2	Two (2) Vertiv™ eSure™ S48-4300E4 4.32 kW MPPT Solar Converter
3	Mounting Brackets (several options are available-see Figure 2.6 to Figure 2.18 for different configurations)
4	Two (2) UL 1077 MCB 125A
5	Solar Input and Earthing Terminal Block

2.3 Mechanical Structure and Configuration

The following images illustrate the various mounting options, with the internal views showing the optional SPDs and no internal wires.

- Not all systems or regions (marketplace) include the optional internal SPDs.
- From the factory, the NCU and two outgoing CB are installed.
- The S48-4300E4 Solar MPPT Converter is shipped separately and installed at the site.
- Each shelf can function with one or two S48-4300E4 Solar MPPT Converters. If just one S48-4300E4 is installed, any slot can be used.
- Each S48-4300E4 must be connected to its own solar array.
- The top cover can be removed for servicing after the incoming and outgoing power supplies are disconnected.
- The shelf can be installed immediately above or below other operating equipment.

Figure 2.4 Isometric View: Solar Expansion Shelf with 19-inch Mounting Brackets

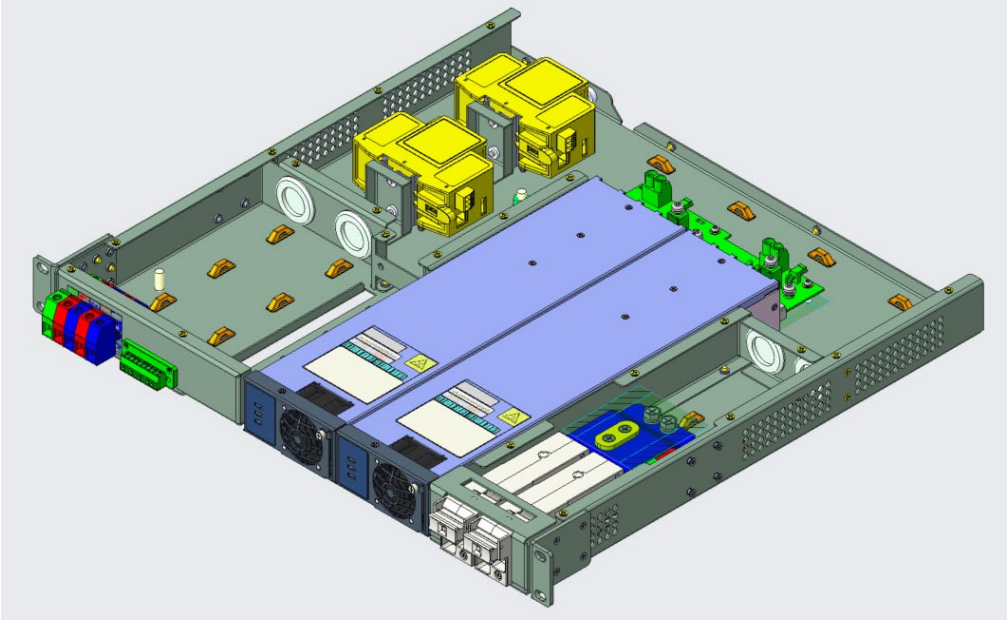
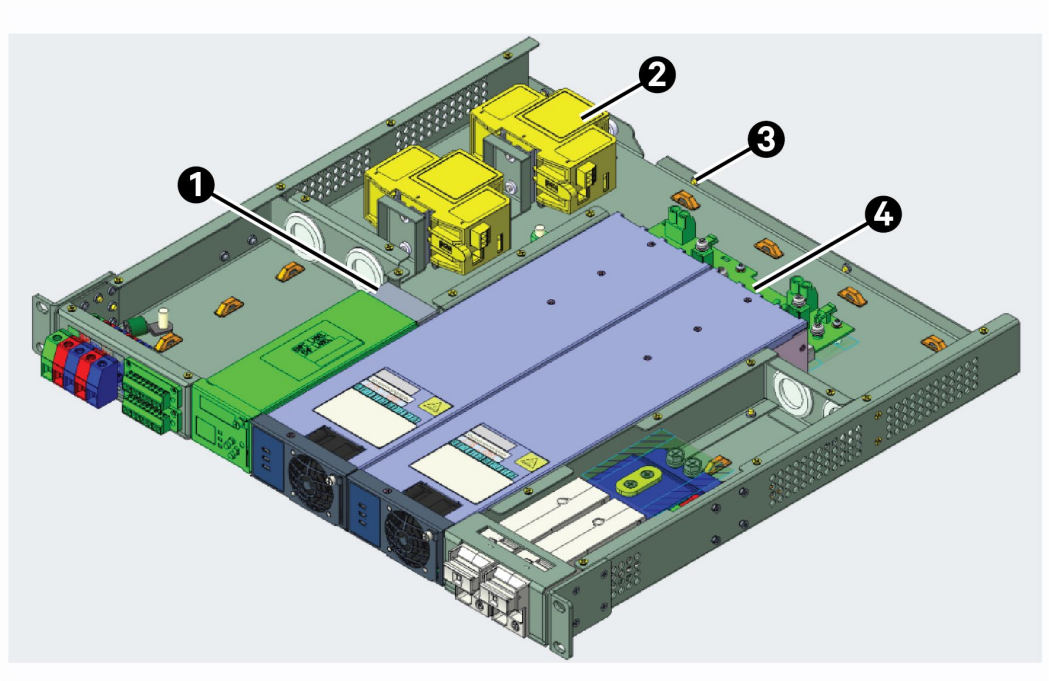


Figure 2.5 Front Isometric View: Solar Add-On Shelf with Top Service Cover Removed



Item	Description
1	NCU Backplane Connector
2	Two (2) PV SPD-Type 2 /Class II (not available in all markets)
3	Rear Side Earthing Termination Using M6 Barrel
4	S48 Backplane

Figure 2.6 Top View: Solar Add-On Shelf with 19-inch Mounting Brackets

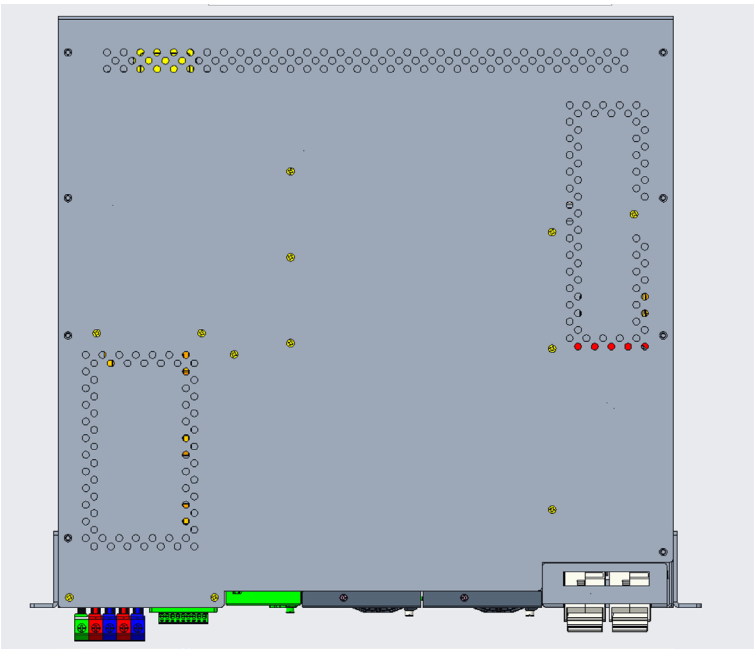


Figure 2.7 Top View Rack Mount: Solar Add-On Shelf with 19-inch Mounting Brackets with 5-inch Recess

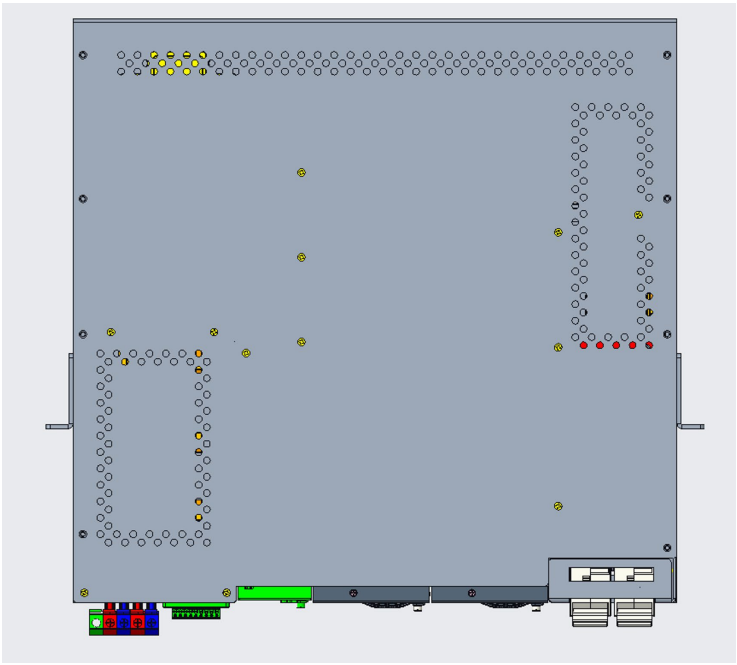


Figure 2.8 Isometric View Rack Mount: Solar Add-On Shelf with 19-inch Mounting Brackets with 5-inch Recess

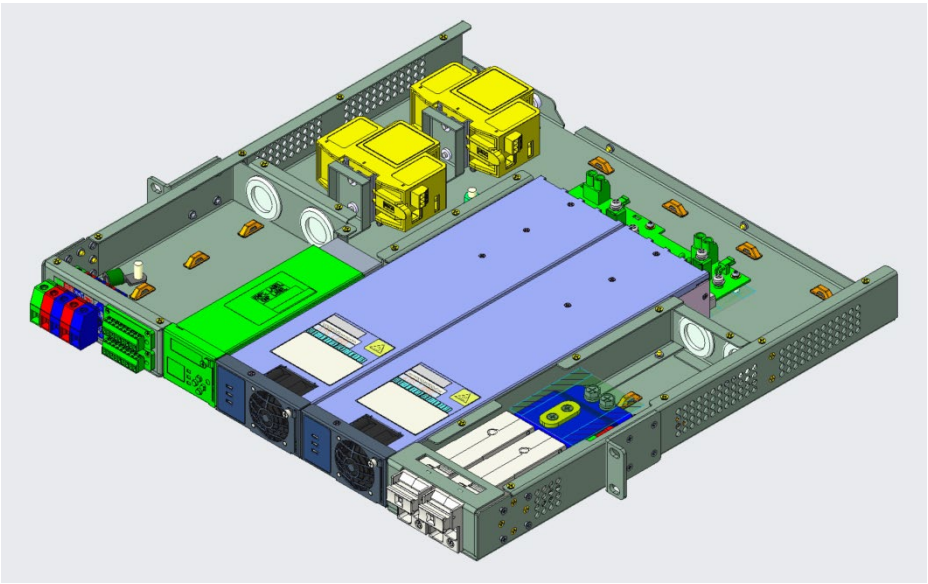
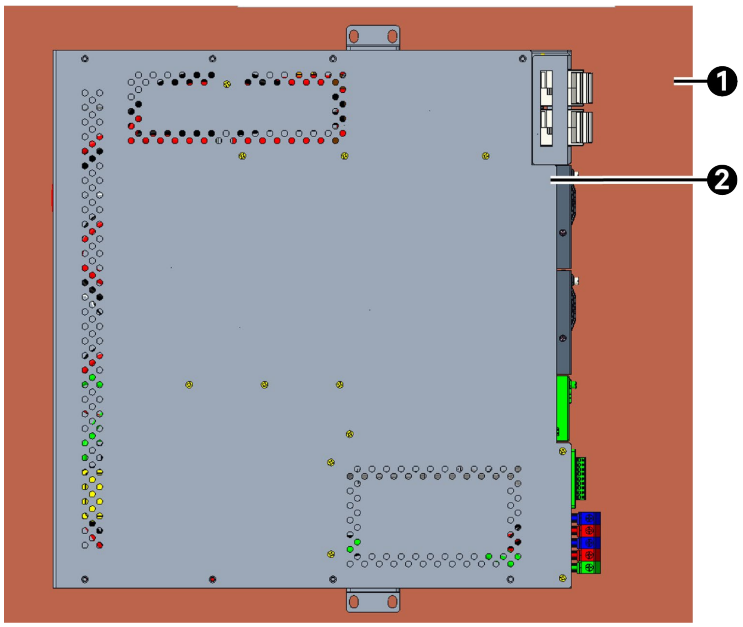


Figure 2.9 Side View Wall Mount: Solar Add-On Shelf with 19-inch Mounting Brackets



Item	Description
1	Wall
2	Solar Converter Shelf

Figure 2.10 Front View Wall Mount: Solar Add-On Shelf with 19-inch Mounting Brackets

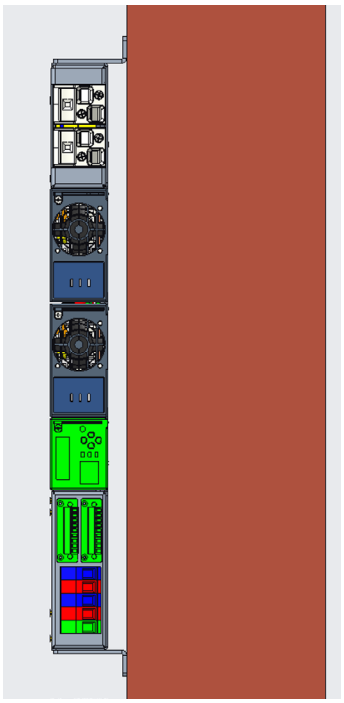
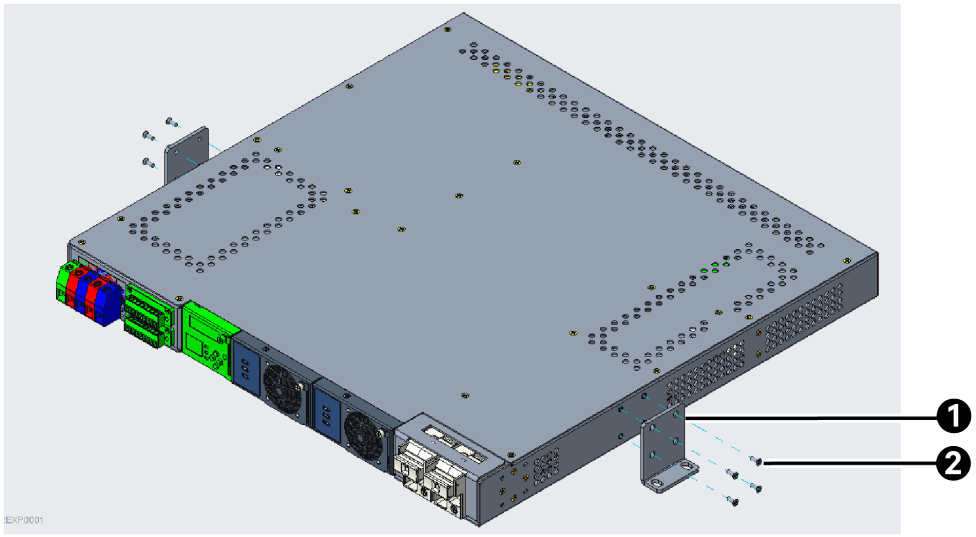


Figure 2.11 Exploded View Wall Mount: Solar Add-On Shelf with 19-inch Mounting Brackets



Item	Description
1	Two (2) 19-inch Brackets
2	Eight (8) M3 x 8 mm CSK Screws (provided with shelf)
Note: Four (4) M6 x 20 mm screws are required for mounting the shelf on the wall. These screws are not provided with the shelf.	

Figure 2.12 Front View: Solar Add-On Shelf with 23-inch Mounting Brackets

Figure 2.13 Top View: Solar Add-On Shelf with 23-inch Mounting Brackets

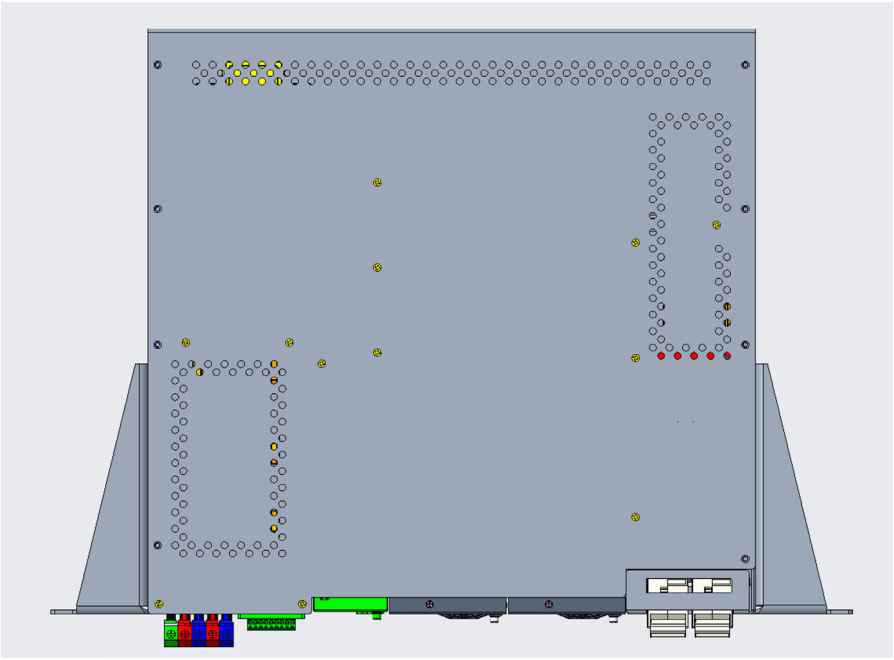


Figure 2.14 Isometric View: Solar Add-On Shelf with 23-inch Mounting Brackets

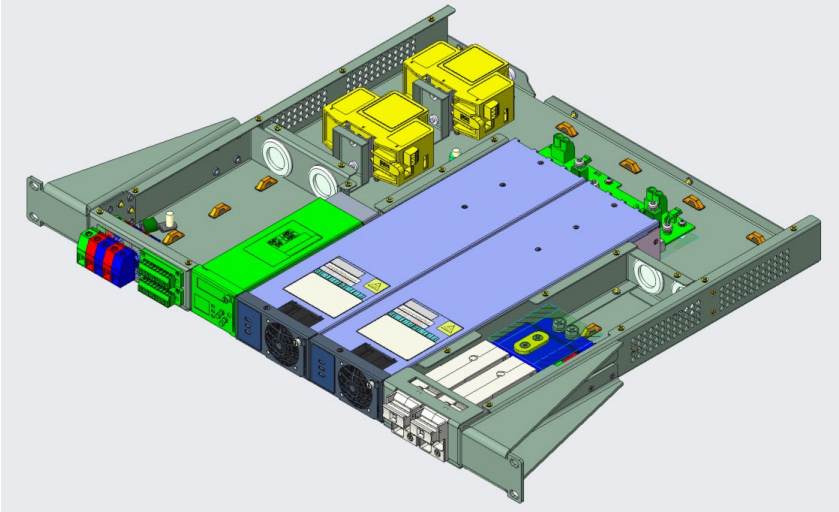
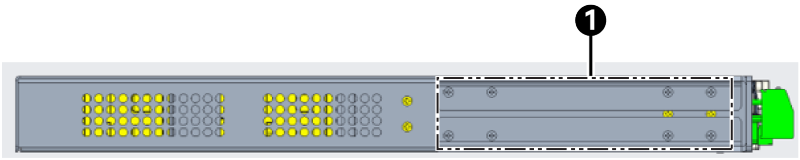


Figure 2.15 Side View: Solar Add-On Shelf with 23-inch Mounting Brackets



Item	Description
1	Use eight (8) M3 x 8 mm CSK screws to mount the bracket on one side of the shelf.

Figure 2.16 Top View Rack Mount: Solar Add-On Shelf with 23-inch Mounting Brackets with 5-inch Recess

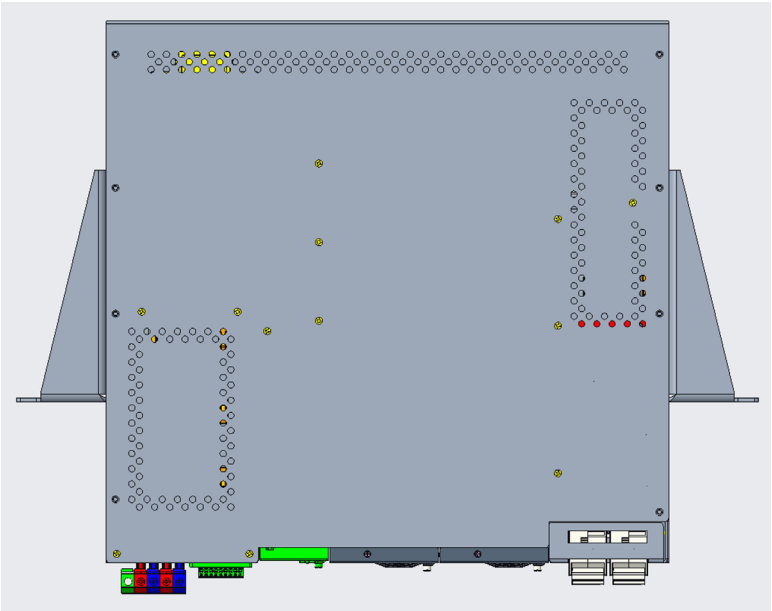


Figure 2.17 Isometric View Rack Mount: Solar Add-On Shelf with 23-inch Mounting Brackets with 5-inch Recess

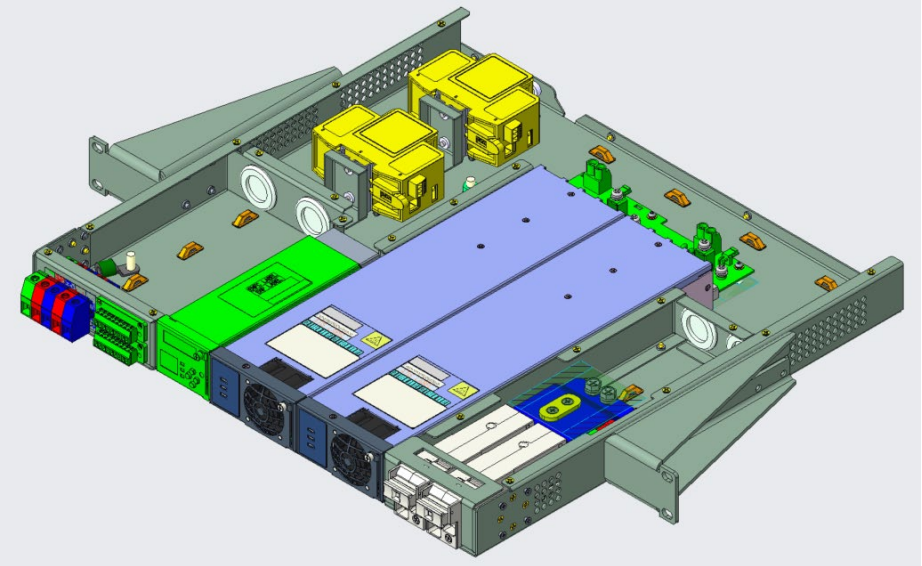
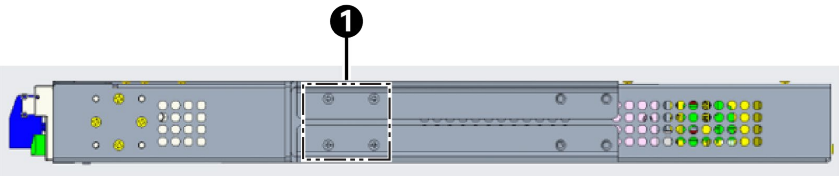


Figure 2.18 Side View: Solar Add-On Shelf with 23-inch Mounting Brackets with 5-inch Recess



Item	Description
1	Use four (4) M3 x 8 mm CSK screws to mount the bracket on one side of the shelf.

3 Installation Acceptance Checklist

Provided below is an Installation Acceptance Checklist. This checklist helps ensure proper installation and initial operation of the system. As the procedures presented in this document are completed, check the appropriate box in this list. If the procedure is not required for your installation site, also check the box in this list to indicate that the procedure was read. When installation is done, ensure that each block in this list has been checked.

NOTE! *The system should not powered up until the end of this checklist.*

Installing the System

- ❑ Visual Inspection
- ❑ Inspect the Host System and Verify Operational Voltage and DC Power Connections can be Safely Made
- ❑ System Secured into Cabinet, Rack, or on Wall (as required)

Making Electrical Connections (Solar Add-On Shelf or Solar Expansion Shelf)

- ❑ Earthing Connections Made
- ❑ External Alarm, Reference, Monitoring, and Control Connections (including CAN bus) Made
- ❑ DC Output Connections Made
- ❑ DC Input Connections Made

Installing the Modules

- ❑ Install the Solar Converter Modules

Initially Starting the System

- ❑ System Started, Configured, and Checked

4 Installing the System

4.1 General Requirements

- This product is intended only for installation on or above a non-combustible dry surface.
- This product must be located in a controlled environment with access limited to authorized personnel only.
- The installer should be familiar with the installation requirements and techniques to be used in mounting the system to a rack/wall.
- The installer must be familiar with the host system and have an approved plan on where to add the solar power (physical location) and where on the DC bus.
- Cabinet ventilating openings must not be blocked and temperature of air entering solar converters must not exceed their rated operating ambient temperature range.
- Recommended minimum space clearance for the front of the shelf from the rack door is 120 mm (5 inches).

4.2 Unpacking the System

When the equipment arrives, make sure that all the boxes included in the shipping specification are delivered and that they have their correct numbers. Report any missing items to the carrier and your local Vertiv representative immediately.

While the system is still on the truck, inspect the equipment and shipping container(s) for any signs of damage or mishandling. As the equipment is moved off the truck and unpacked, visually examine the system for transit damage. Do not attempt to install the system if damage is apparent.

If any damage is noted, file a damage claim with the shipping agency within 24 hours and contact Vertiv to inform them of the damage claim and the condition of the equipment.

Do not unpack the equipment until the installation is to begin, thus avoiding the lose of loose parts. Keep equipment in a secure, dry protected warehouse, with a temperature limit of –40 °C to +80 °C (-40 °F to +176 °F) until the installation.

Record the serial number after unpacking the equipment.

4.3 Mounting the Shelf

After unpacking the equipment, follow the below steps for the installation:

1. Rack/Panel Mounting: The shelf has two options for rack/panel mounting – 19-inch and 23-inch. Mounting brackets are provided with the shelf. Attach the mounting brackets on the shelf with the provided M3 x 8 mm CSK screws, as required. Refer to “Mechanical Structure and Configuration” on page 4 for mounting configurations. Secure the shelf on the rack with four (4) screws, such as M6 x 20 mm (mounting screws are not included).
2. Wall Mounting: The shelf also supports wall mounting using the 19-inch brackets supplied for rack/panel mounting. Attach the mounting brackets on the shelf with the provided eight (8) M3 x 8 mm CSK screws as shown in Figure 2.11. Mount the shelf on the wall with four (4) screws, such as M6 x 20 mm (mounting screws are not included).
3. For Vertiv EMEA's DC power cabinet, order and install the mounting kit (P/N BMY1100004-8S).

5 Making Electrical Connections

5.1 Important Safety Instructions

DANGER! Adhere to the “Important Safety Instructions” starting on page vi before proceeding.

NOTE! *All the input and output to the system are to be turned OFF or disconnected before making any connections.*

5.2 Understanding the Host System

The Vertiv™ NetSure™ Solar Converter Shelf is used as a supplemental power shelf to a host power system (Vertiv or other). As a supplemental power system, the key function is to reduce the loads dependency on the grid-generator or support the load if the grid is absent, thus reducing the discharge of the battery.

As a supplementary power shelf, it neither provide support for any load/battery distribution nor manage any battery recharge. Though it can reduce the rate of discharge, extending the backup time at the site.

With respect to traditional telecom batteries (such as lead and NiCd) that do not provide any current limiting, one must consider the new solar resources may over-current the installed batteries. If no battery current limiting is in-place on the battery branch, it is recommended that the solar array output is less than the un-protected battery current limit. The next generation of batteries (such as Lithium-Ion and others with a BMS) do provide current limiting and thus simplify installation and setup.

As the number of variables of the host system are effectively infinite, installation personnel are responsible to assess the existing host system, understand the expectations and safely implement. Before the installation, the installer should have answers to the following points.

- Understanding the primary power system including configuration, available space, and thermal conditions.
- Voltage and any current limits or restrictions in place, such as those associated with the battery, load, contactor, and shunts.
- Available location and placement of any power connections from the supplemental solar power shelf, and relationship to load, batteries, shunts, and contactors.
- Existing voltage on the bus(es), batteries, and any algorithm that may adjust the voltage, such as temperature compensation and equalize.
- Size, power and current capability of the solar array.

Though this solution asks for awareness and consideration of the host system, the NetSure Solar Converter Shelf provides a cost effective path to introduce high density solar solution to existing installations and reduce operating cost. Thus, eliminating the cost to replace an existing power system.

5.3 Wiring Considerations

All wiring and branch circuit protection must follow the current edition of applicable local standards/codes. As a reference, the cable sizes listed in Table 5.1 should be considered, given ampacity, operating temperature, and managing voltage drop.

Table 5.1 Cables and Tools

Input and Output Cable		Tool Required
Input Earth	8 AWG (10 mm^2)- Yellow Green Lug Type – Ring with M6 Screw of 15 mm Thread Length and Plain and Spring Washer or Pin Type	For Ring - Philips Screwdriver For Pin - Slotted Screwdriver
Signal Cable	22 AWG-16 AWG (0.34 mm^2 -1.5 mm^2), Lug Type - Pin	Slotted Screwdriver
DC Output	4 AWG (25 mm^2) /2 AWG (35 mm^2)*, Lug Type – Pin * 2 AWG (35 mm^2) can only be used with bare wire or ferrule without plastic sleeve.	Philips Screwdriver
Solar DC Input +ve and -ve (The wire/cable is rated for outdoor solar application)	12 AWG (4 mm^2) Cable up to 10 m (33 feet) 10 AWG (6 mm^2) Cable up to 20 m (66 feet) 8 AWG (10 mm^2) Cable up to 30 m (98 feet) Lug Type - Pin	Slotted Screwdriver

Notes:

1. Warranty will be void if incorrect cables are used.
2. Vertiv recommends the voltage drop (efficiency loss) from the solar array to the converter be less than 1% at peak power/current.
3. Vertiv recommends the voltage drop from the shelf to the host system be less than 0.5 VDC (approximately 1%) at peak current.
4. In the event, the physical separation between the solar shelf from the solar array and/or host system is such that these recommendations cannot be maintained with a single wire, it is recommended that the site technician add junction boxes at each termination that would allow larger wire between terminations.

5.4 Host Breaker Consideration

WARNING! To prevent nuisance tripping and maintain operational electrical safety, it is the responsibility of the installer to ensure the correct breaker and wires are used, acknowledging the installation-application including the host system, company policies, and country and local regulations.

The maximum current from a S48-4300E4 is 81.5 ADC.

For host systems with breakers that do not derate as a function of stacking and/or temperature (such as a hydraulic magnetic breakers), Vertiv recommends the host system is configured with a 100 ADC CB. A smaller CB may be appropriate for a smaller solar array.

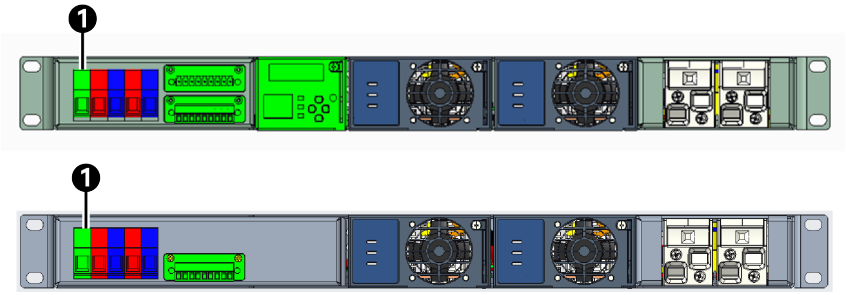
For host systems with breakers that do derate as a function of stacking and/or temperature (such as a thermal breakers), Vertiv recommends the host system considers a 125 ADC CB. A smaller CB may be appropriate for a smaller array and/or the actual breaker derating in the host system is negligible.

5.5 Earthing Connection

Procedure

1. Connect the earthing cable to the earth terminal block present at the front.

Figure 5.1 Earthing Connection for the Solar Add-On and Expansion, respectively



Item	Description
1	Input Terminal Block for Earth

5.6 CAN Bus, External Alarm, and Other Control Connections

5.6.1 CAN bus Communications

CAN bus (also called CAN) is the communication data-path between Vertiv's controllers (M830, M831) and the solar converters (S48-4300E4). This CAN connection is necessary to provide effective and stable power delivery. Thus, each Solar Expansion Shelf needs a CAN connection back to the controller, whether it is an M830 in a Vertiv NetSure System or a M831 in the Vertiv Netsure Solar Add-On.

NOTE! *The CAN bus extension cable should be of high twist type (1 turn per 1 cm or 2.5 turns per inch) with a maximum length of 12 m (39.37 ft).*

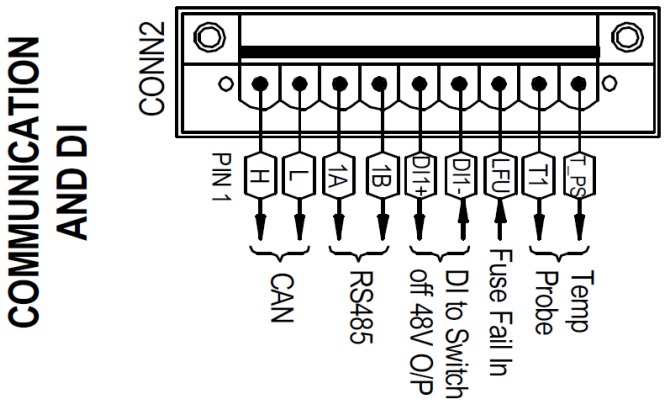
NOTE! *CAN bus is a daisy chain of connections with the end point of the chain terminated with a 110 Ω resistor (4 Band Colour band code: Brown, Brown, Black, *).*

Solar Add-On CAN Bus CONN2

The Solar Add-On shelf ships with a 110 Ω CAN bus terminator. When installing a single Solar Add-On, no additional action effort should be needed.

If the site solution includes one or more Expansion Shelves, then the CAN bus extension begins from the Solar-Add-On and ends with the last Expansion Shelf.

Figure 5.2 Communications — Solar Add-On CONN2



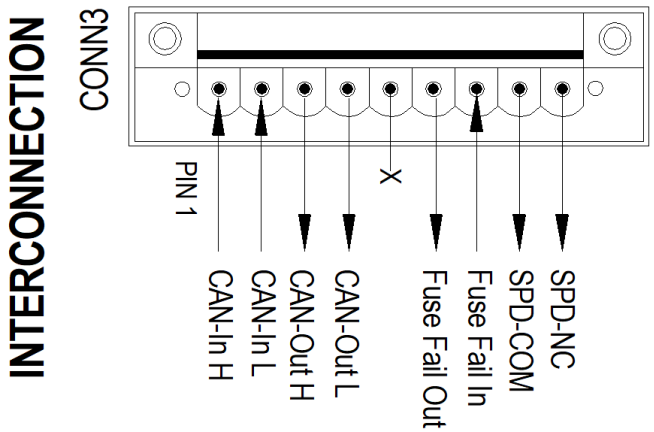
Solar Expansion CAN Bus CONN 3

A Solar Expansion shelf needs to have a CAN bus connection back to the controller, a M831 in a Solar Add-On or a M830 in a host Vertiv NetSure system – directly or through another Expansion Shelf.

The Solar Expansion shelf ships with termination on Pins 1 and 2. Thus, when adding one Solar Expansion shelf, the controller's CAN bus (M831 or M830) is connected to Pins 3 and 4.

If the Solar Expansion Shelf is connecting to another Expansion Shelf, the preceding shelf (Solar Add-On or Expansion) is connected on Pin 3 and 4, and the CAN daisy chain is continued to the next shelf from Pins 1 and 2. On the last Expansion Shelf in the CAN bus, termination shall be on Pins 1 and 2. Refer to Figure 5.4.

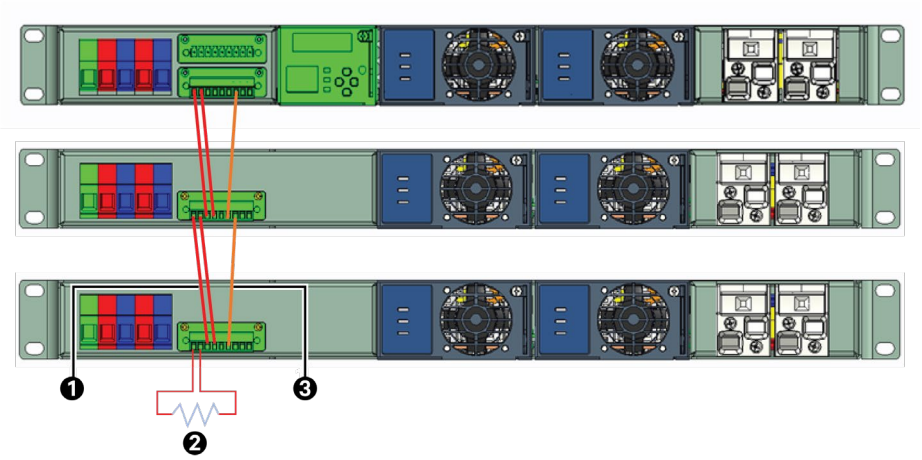
Figure 5.3 Communications — Solar Expansion CONN3 Interconnections of Solar Expansion Shelf Connector CONN3



Solar Shelf CAN bus Daisy Chain

To daisy chain multiple shelves, extend the CAN bus from Pins 1 and 2 to Pins 3 and 4, and continue. With the last shelf, apply a CAN bus terminator on Pins 1 and 2.

Figure 5.4 Daisy Chain of CAN Bus and Fuse Fail with Solar Add-On Shelf



Item	Description
1	CAN bus Interconnection
2	Termination Resistor for CAN 110 Ohm 1/4W
3	Fuse Fail Interconnection

Notes:

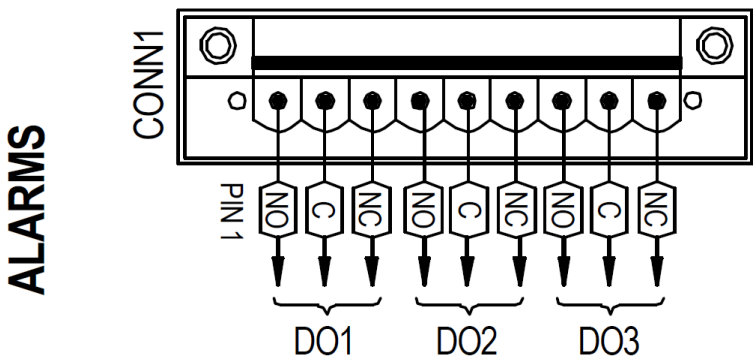
1. Use of the Solar Add-On Shelf is an example of a host system. The Expansion Shelf can be connected to a Solar Add-On with an M831 controller or a NetSure / PowerDirect 7100 Energy system with an M830 Controller.
2. If using a NetSure / PowerDirect 7100 Energy system, the fuse fail alarm can be tied into a Digital Input (DI) on the host system. For more details on the "DI" and how to assign it to an alarm, refer to the Host System's manuals and drawings.

For support in connecting a NetSure M830 Controller (such as one installed in a NetSure 5100) to a Solar Expansion shelf, contact your local Vertiv representative for details to confirm CAN connection location, and the actual connector that is required. As illustrated in Figure 5.12, the CAN connection may be behind the NCU requiring access with the system off or may be on an extension board that is easily and safely accessible when the host system is in service.

5.6.2 Solar Add-On External Alarms, CONN1

Three (3) dry contacts are configured as alarms: Critical, Major and Minor. With the NCU, the user can assign/change the alarms. For more details on Alarm Management, refer to the NCU User Manual (UM1M831ANA or UM1M831A7.2.71)

Figure 5.5 Alarms Configurations — Solar Add-On CONN1

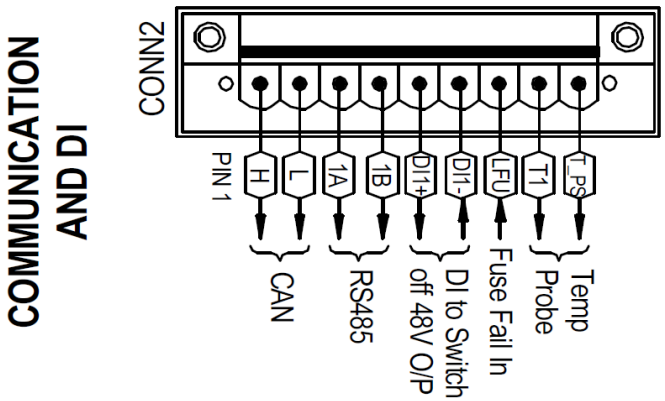


5.6.3 Solar Add-On RS-485 CONN 2

An RS-485 Port is available for future use, upon request for M2M communications, such as EMM or Northbound Modbus Communications. For additional information, refer to the Controller Manual or contact Vertiv for additional support.

NOTE! *RS-485 Port Polarity is 1A+ and 1B-.*

Figure 5.6 Communications and DI — Solar Add-On CONN2



5.6.4 Solar Add-On DI – Solar Switch Off CONN2

An external 48 VDC Solar Off DI when enabled, will stop the delivery of solar power to the host system. This DI can be activated by another controller or from an external AC Off Relay (optional).

Question: Why is there a Solar Switch Off?

Answer: The Solar Add-On and Expansion is a solar supplementary solution to provide power to the load and relies on the host system to manage battery recharging, including recovery from a power outage. When AC is lost and the load goes to battery, solar can slow down the rate of discharge. Nevertheless, as solar is a variable power source, it is not a reliable source to recover from an extended outage. The phenomena of unstable power recovery on solar only is called a Power YoYo.

Question: Why is a Power YoYo significant?

Answer: When a load repeatability constantly starts up and soon there-after shuts down, a Power YoYo can affect network performance and reduce battery life.

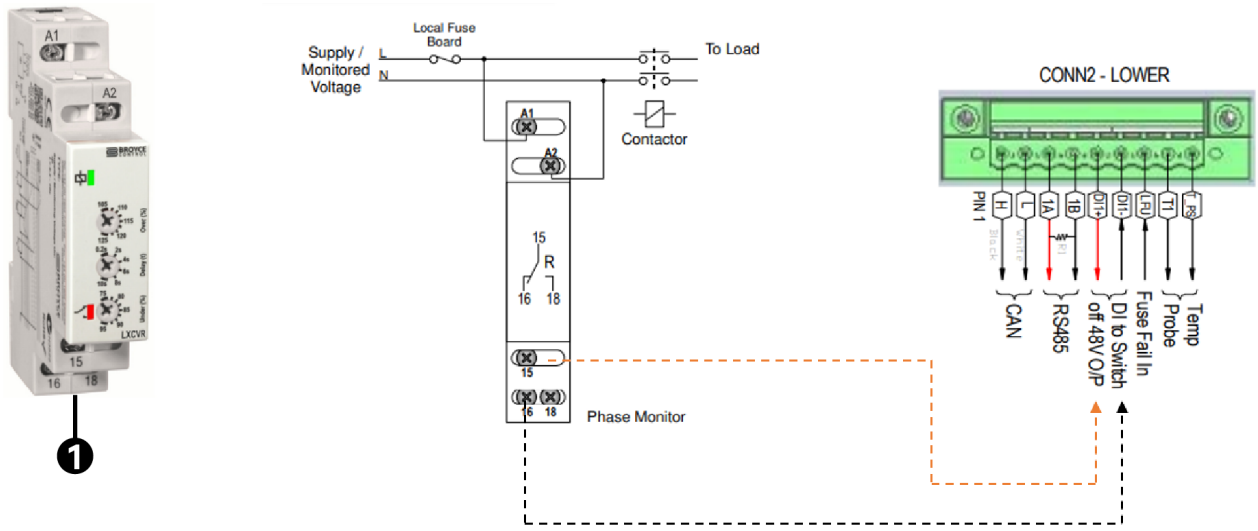
NOTE! *The Solar Add-On M831 has a software solar off function, refer to "Settings > Solar Tab" on page 27 for more details.*

A hardware enabled Solar DI Off can be implemented with an AC sense relay provided by Vertiv as an option, as illustrated in Figure 5.7. With AC Sense wires connected to terminals A1 and A2, the relay contacts at 15 and 16 will change state at 160VAC (on drop) and then return at 170 VAC (on rise) (10 VAC hysteresis).

When "Solar Converters Off by DI" is enabled in the NCU (relay IB0-IB1) (see "Settings > Solar Tab" on page 27), the solar converters will turn on-off at approximately 160-170 VAC, respectively with this optional AC Relay.

NOTE! *A site technician can also use other signals and relays to initiate this function, such as the host controller's response to AC Fail or opening up a contactor (LVD).*

Figure 5.7 AC Off Relay Connection



Item	Description
1	AC Sense Relay

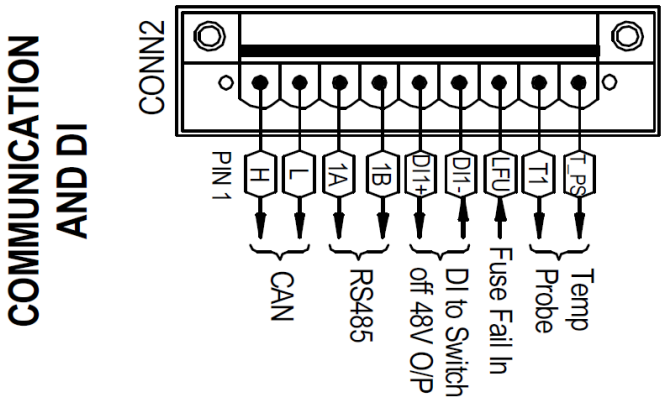
NOTE! *If using the optional AC Sense Relay, install in accordance with company policies and local regulations. As illustrated above, this may need to include a fuse and/or disconnect.*

5.6.5 Daisy Chain Fuse Fail Alarms

To enable Expansion Shelves to report on MCB Status, one can daisy chain the Fuse Fail Alarm. Refer to Figure 5.4.

5.6.6 Solar Add-On Temperature Probe

Figure 5.8 Communication and DI connections — CONN2



The Solar Add-On NCU provides optional support for one Vertiv Temperature Sensor to enable battery temperature compensation (this is applicable to lead acid and other batteries that may be installed in harsh conditions, and where solar power can be greater than the load). If the sensor is ordered to support battery compensation, mount the sensor on the battery in the middle on the hottest battery shelf (usually the top).

Do not mount the sensor where it will be impacted by other components, such as cooling fans or air conditioners.

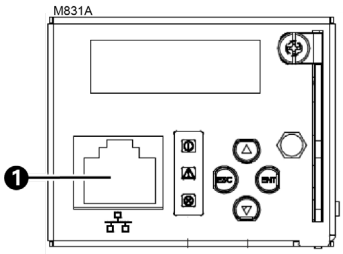
5.7 Solar Add-On NCU Ethernet Connection

The NCU provides an Ethernet RJ-45 port with a default address of 192.168.1.2 that may be used to be integrated into the carrier's network. If a permanent Ethernet connection is to be left in-place, use a shielded cable at both ends.

The Ethernet is also available as a local craft user interface, this means that the user can connect their laptop to the NCU to enable a user-friendly web GUI to monitor and manage the solution. For more details, refer to the NCU User Manual (UM1M831ANA or UM1M831A7.2.71).

NOTE! *You can access the Web pages of the power system locally by using a "crossover" or "straight" cable connected directly between your PC and the NCU.*

Figure 5.9 NCU Ethernet Port



Item	Description
1	10/100M Ethernet Port (RJ-45)

5.8 -48 VDC Output Connections to the Host

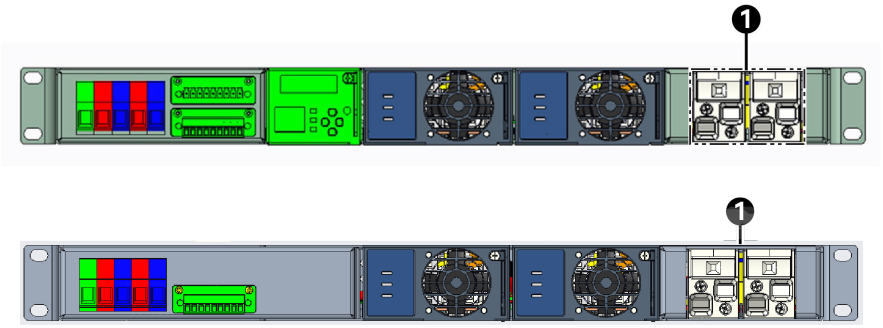
CAUTION! Interconnection to a host system as outlined in this procedure may lead to a service interruption and/or the extension of alarms in the host system. Notify any appropriate personnel before starting these procedures. Also, notify personnel when these procedures are completed.

5.8.1 Solar Add-On Shelf and Expansion Output Connections

Procedure

1. The -48 VDC output connection is provided by the UL 1077 125A MCB highlighted in Figure 5.10.

Figure 5.10 DC Output Connections for Solar Add-On and Expansion, respectively



Item	Description
1	-48 VDC Output Cables to be Connected to UL 1077 125A MCB

NOTE! *The site technician is responsible for the connecting output wires/cables to terminate on the DC distribution bus of the host system.*

2. Before connecting the output wires/cables to a host system, verify and record the output voltage of the host system using a DC voltmeter. This voltage should be between -47 VDC and -58 VDC. Then, proceed to connect each DC output wire from the shelf to the host return bar and open breaker.
3. All DC wires/cables should be of equal length and construction (wire gauge, strand, and insulation).
4. Wires with ferrules without plastic sleeves are preferred, but not a requirement.
5. Noting and following polarity, insert each DC output wire into the UL 1077 125A MCB. Secure each wire using the associated screw.
6. Make sure to connect the DC output wires/cables to the return bar and the designated busbar circuit breaker in the host system. Ensure proper polarity when connecting the wires/cables.

NOTE! *The best method to maintain UL 62638 system compliance of the host system is using a UL 489 125A or smaller host breaker.*

NOTE! *Circuit breakers are required to protect the wire. When servicing, circuit breakers isolate the host power and wires from the solar converter shelf, providing a convenient path for safe maintenance.*

In some jurisdictions, a disconnect at the host system will be a safety requirement that can be solved with a contactor, plug or breaker rated for a hot (live) connect-disconnect.

The installing technician must consider and calculate the anticipated maximum voltage drop using tools/methods as approved by the carrier and any local regulations. This information is required for the final setup.

NOTE! *It is recommended that the voltage drop at maximum current be less than 0.5 VDC (~1%).*

As a reference AS/NZS 3008 calculations are available at https://www.jcalc.net/voltage-drop-calculator-as3008, and SouthWire also makes available a free tool to estimate voltage drop. As a default value, use a maximum of 81.5 A at 54 VDC.

5.8.2 Host Power in Connections

Figure 5.11 Solar Add-On Shelf Interconnections

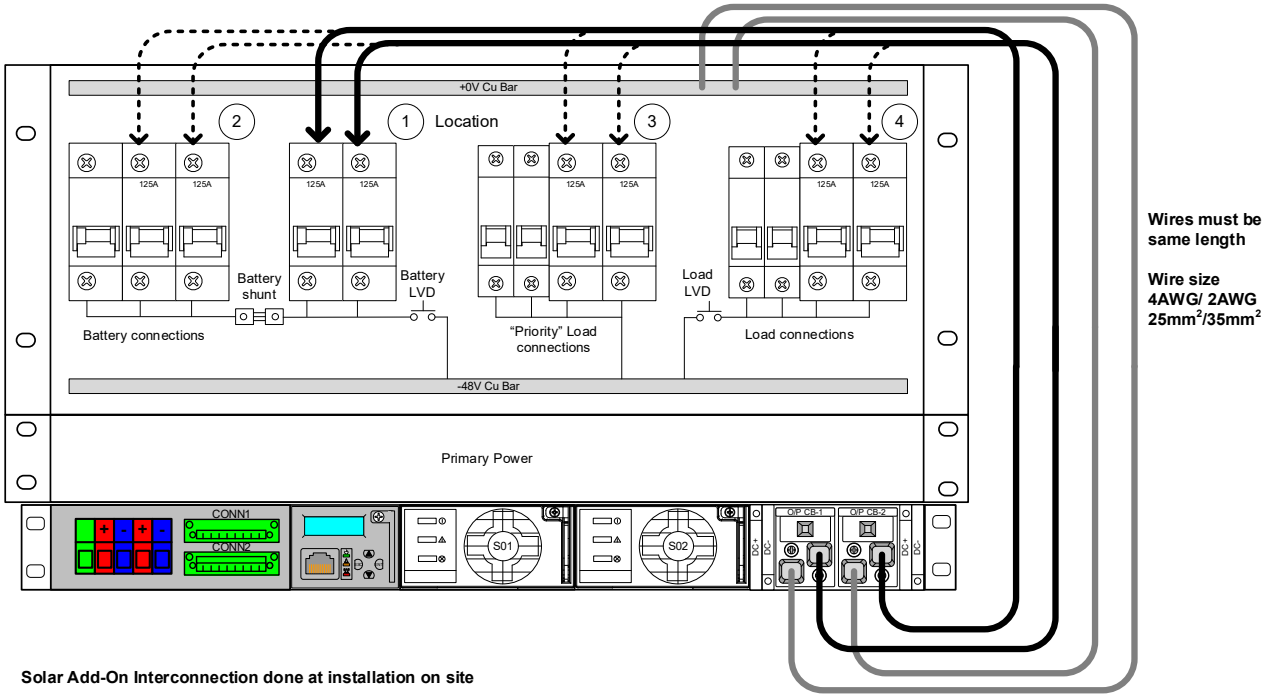
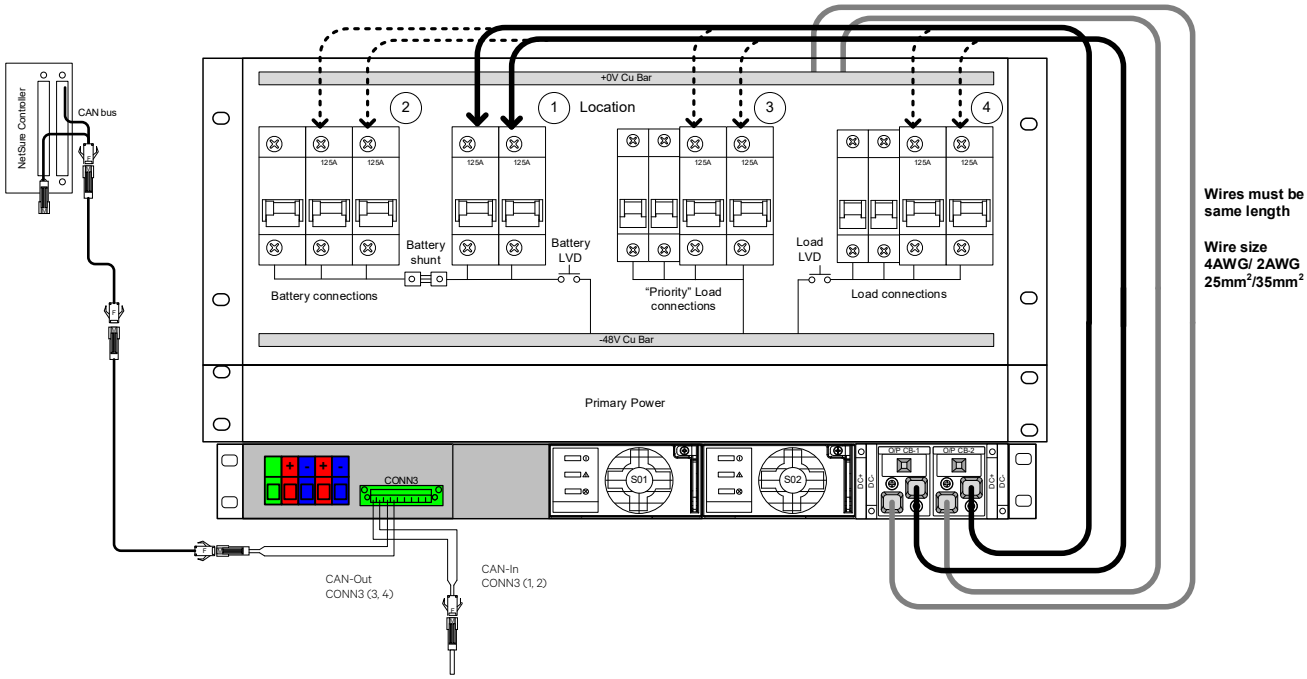


Figure 5.12 Solar Expansion Shelf Interconnections



NOTE!

1. The NetSure Controller M830, as illustrated in the top left of Figure 5.12 resides in the host system, such as a NetSure 5100, NetSure 7100, or PowerDirect 7100 Energy. Actual CAN bus cabling is dependent on the system. Example: A separate CAN bus connection may be easily accessible on a separate extension board, or a pigtail may or may not be available at the rear of the M830 Controller. Refer to the host system documentation to determine the best location to extend the CAN bus to the Expansion Shelf.

2. CAN Bus color coding is typically:
   a. CAN Bus Out High: Orange or Black
   b. CAN Bus Out Low: Orange/White, White, or Red
   c. CAN Bus In High: Orange or Black
   d. CAN Bus In High: Orange/White, White, or Red

3. Solar Expansion Shelf is typically shipped with a CAN bus termination resistor installed. This resistor can be removed and replaced by another terminator assembly or the CAN bus can be extended to the next Expansion Shelf. Ensure that a CAN bus termination resistor is installed at the end of the communication line.

NOTE! *CAN bus connection points from host NCU do differ by system, refer to your local Vertiv team for support.*

NOTE! *Figures illustrate the maximum 125 ADC CB Host Breaker, but consider application and breaker performance-derating, as a smaller breaker maybe a better choice, recognizing the maximum current of 81.5A from each S48-4300E4.*

Location 1 – Independent DC Port:

The typical best location is on the main bus, which may be the battery bus on the load side of any battery shunt. If there is a battery LVD, if it is preferred, the connection is between the shunt and battery LVD, so the solar converter can charge the battery.

The advantage of this location is that the battery functions as an alternate load (or dump load) for the solar array.

CAUTION! In the event the solar array output is greater than the battery's stated maximum recharge limit, the technician should use the Solar Off feature when the load is disconnected.

Example: A single common 200Ahr AGM lead standby battery can support a maximum of 50 A charge, but a full 4.3 kW solar converter can generate a peak current of 82 A and thus exceed the original manufacturer's limit of the battery. In the event the load is disconnected, such as when a load LVD is open as the battery is on discharge, the solar array could over current the battery; thus, necessitating the use of the Solar Off function. The alternative is to reduce the size of the solar array. For example, create a solar array that cannot generate current more than 50 A to the battery.

Location 2 - Battery Bus:

Similar to location 1 as stated above, with the additional consideration that the solar energy going into the battery will not be counted.

CAUTION! If the battery shunt is important or critical in monitoring the battery, this location should not be used.

Example: In a hybrid application where the battery state of charge (SOC) is calculated and used as a function of the current through the shunt, then this connection should not be used. In a time base hybrid control model, or DG control is a function of voltage or a smart battery reported SOC, this restriction may not apply. However, It must be acknowledged that such a connection will not account for the battery charging performed by solar.

Location 3 – Priority Load Bus:

Similar to location 1, with the additional consideration that the solar shelf cannot charge the battery when the battery LVD is open.

Location 4 - Low Priority Load Bus:

Similar to location 3, with the additional consideration that solar is isolated to one load branch when the load LVD is open.

5.9 Solar Input Connections

Local regulations may require the solar wires/cables pass through a protection box before entry into a cabinet, shelter, and/or building that houses the NetSure Solar Converter Shelf. One good feature that is dominant with these boxes is a disconnect.

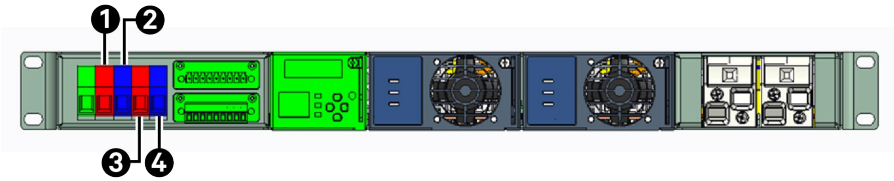
Acknowledging solar connectors are not rated for a live connection, the following procedure is written the inclusion of a solar protection box with a disconnect. If a disconnect is not available, final connection should be made at night.

Procedure

1. At day, with the sun well above the horizon and there is no shade on the array, verify and record the solar array input voltage. This voltage should be between 70 VDC to 400 VDC.
2. With the solar array disconnected (breaker) open, connect the wires/cables from the solar array to the designated terminal blocks provided in the system. Terminate the +ve and -ve wires/cables from the solar array on the +ve and –ve terminal blocks (ensure correct polarity). See Figure 5.13.

WARNING! High voltage precautions should be followed.

Figure 5.13 DC Input Connection



Item	Description
1	Input Terminal Block for PV1+ (Solar Array 1 Positive)
2	Input Terminal Block for PV1- (Solar Array 1 Negative)
3	Input Terminal Block for PV2+ (Solar Array 2 Positive)
4	Input Terminal Block for PV2- (Solar Array 2 Negative)

MC4 Red-Black solar input wires/cables from Vertiv may be available as an option. These wires/cables are available in three (3) sizes (length and gauge) to ensure voltage drop (losses) will be less than 1%. See Table 5.2.

Table 5.2 Recommended Input Cable Sizes

Cable Size	Distance from Source
12 AWG (4 mm^2)	15 m (49 feet) ± 0.1 m (0.32 feet)
10 AWG (6 mm^2)	25 m (82 feet) ± 0.1 m (0.32 feet)
8 AWG (10 mm^2)	35 m (115 feet) ± 0.1 m (0.32 feet)

6 Installing the Solar Converter Module

Refer to the Solar Converter User Manual (UM1S484300E4) to install the solar converter module.

7 Initially Starting, Configuring, and Checking System Operation

WARNING! The unit is to be installed by authorized personnel only. Vertiv assumes no responsibility if the unit is installed by untrained personnel. It is the customer's responsibility to ensure that technicians are adequately trained for installation.

7.1 Initial Startup Preparation

CAUTION! Interconnection to a host system as outlined in this procedure may lead to a service interruption and/or the extension of alarms in the host system. Notify any appropriate personnel before starting these procedures. Also, notify personnel when these procedures are completed.

7.2 Powering up

NOTE! *If connecting the Solar Expansion Shelf to an existing NetSure Controller, the original controller may need to be updated.*

1. Once all ground (earth), data, and power connections are securely made (tight), the unit is ready for power up.
2. Take a reference measurement of the input host voltage. Technician must also determine maximum voltage drop from the Solar Converter Shelves to the host system.
3. Determine if under normal operations, if the voltage of the host system will fluctuate and the range of fluctuation. For example, responding to Battery Temperature compensation.
4. Connect (switch on) each solar array connected to the Solar Add-On and Expansion shelves.
5. With the solar array under sunlight, the controller will recognize each solar converter module (S48-4300E4).
6. Login to the webpage
   a) For the Solar Add-On, see “Using the Solar Add-On M831 Web Interface” on page 26 and in accordance with company policies, update the language, password, date and time, and site name. Identify any alarms and address.
   b) For Solar Expansion connected to a Vertiv NetSure host system M830, refer to “Using the Host M830 Web Interface” on page 34.
7. After initial login and set up (for the Solar Add-On Shelf, the user can modify the NCU configuration as per the site requirements), observe the status of the indicators located on the controller and solar modules. If the system is operating normally, only the green LED will be illuminated. Any active alarms should be identified and resolved. Refer the NCU User Manual (UM1M831ANA or UM831A7.2.71) for the status and alarm indicators of the controller. Refer to the Solar Converter User Manual (UM1S484300E4) for the status and alarm indicators of the solar converter module.
8. Acknowledging voltage drop, set the solar converter voltage higher than the host system's voltage. Refer to “Settings > Voltage under Battery Charge and Temperature” on page 29 for the Solar Add-On and “Verify Voltage Settings” on page 36 for a M830.
9. In accordance with site design, enable Solar Off.
   a) Solar Off functionality is enable on the Solar Add-On and some M830 NCU releases.
10. Switch on the MCB on the solar shelf (push in front top bottom) and the host system. Confirm that the solar panel is "lit" up and that the current is being delivered to the host system/load.

8 Using the Solar Add-On M831 Web Interface

Refer to the NCU User Manual (UM1M831ANA or UM1M831A7.2.71) for additional information.

8.1 Solar Add-On Login

To login to the web interface of NCU, enter the default username and password as mentioned below:

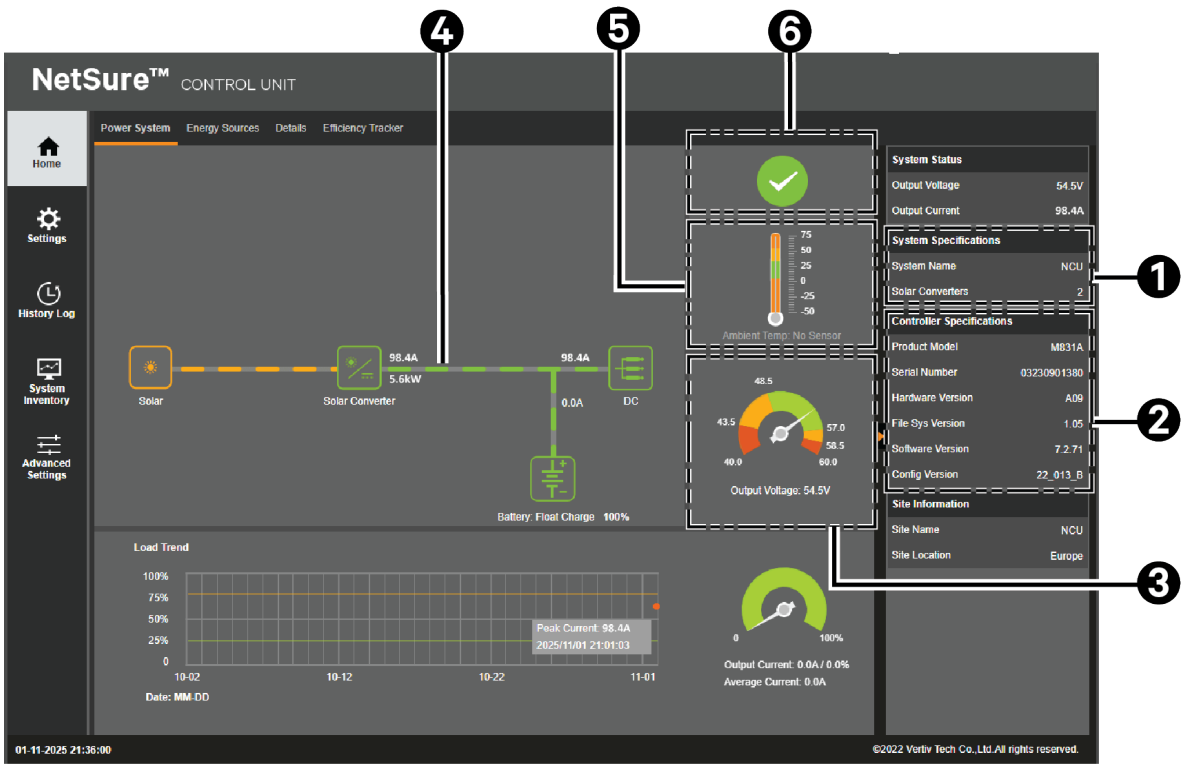
- Default User Name: Admin
- Default Password: 12345678

User can change the password. Support special characters, include: ~ `!@/$#%^&*()\-+={}[]|:;"'<>,.?

NOTE! *In the event the password has been forgotten and recovery is required, refer to the NCU Manual (UM1M831A7.2.71) (search for "reset") or contact your regional Vertiv Technical Support at https://www.vertiv.com/support/*

After entering a valid User Name and Password and clicking LOGIN, the "Homepage" window opens. See Figure 8.1.

Figure 8.1 Homepage



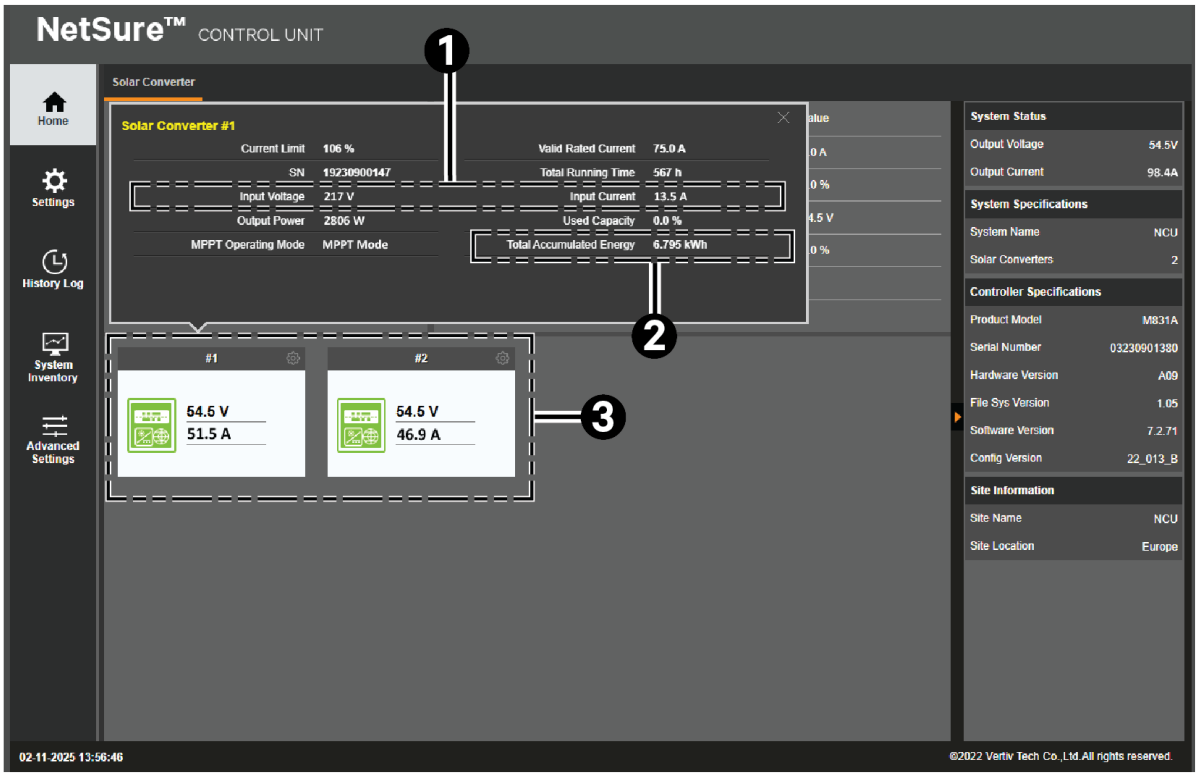
Item	Description
1	Number of S48-4300E4 solar converters recognized. Example: 2
2	Software and configuration version information. Example: 7.2.71 and 22_013B
3	The voltage at which the solar converters are delivering power. Example: 54.5 VDC
4	The current and power being provided. Example: 98.4 A and 5.6 kW.
5	Ambient temperature, if a sensor is connected.
6	Alarm status, as illustrated there are no active alarms.

NOTE! *There is no battery shunt measurement in this system, so the battery icon should be ignored. Similarly in the load trend graph, the green-orange boundary lines are not relevant and can be ignored.*

8.2 Solar Converters

To view each solar converter, click on the solar converter icon from the homepage screen. Then select the individual converter. See Figure 8.2.

Figure 8.2 Solar Converters



Item	Description
1	Converter 1: Solar array input voltage and current. Example: 217 V and 13.5 A.
2	Converter 1: Energy Provided in Lifetime. Example: 6.795 kWh
3	Converter 1: Output voltage and current. Example: 54.5 V and 51.5 A Converter 2: Output voltage and current. Example: 54.5 V and 46.9 A

NOTE! *The rated current limit of the S48-4300E4 is 81.5A. The displayed current value of 75A (as of November 1, 2025) is derived from supporting an old standard, where the current is defined by maximum power of the rectifier-converter divided by a common lead battery's equalization voltage (4320W/57.6VDC=75A).*

Similarly, capacity is calculated against this rated current.

8.3 Settings > Solar Tab

In "Solar Tab" under "Settings", there are several controls to be considered that deal with the unique properties of solar being an intermittent power energy source and provides low to no power, including the solar converter will not generate power at night. In support of this natural condition, solar alarms are generated after days (user defined, with the factory default of 3 (three) days) of no power.

Another attribute of a solar supplemental power solution – whether it is in the morning, evening, under heavy shade or heavy cloud, the solar converters will provide low power and starve the load. Without support from another power source, such as the grid or battery, the typical response is that the load will shutdown. Similarly, as the NetSure Solar Converter Shelves are provided as solar supplemental solutions to reduce the cost of operating from an AC source, where the solar power output is expected to be equal or less than the load, and thus it should not be expected that solar will support the load by itself.

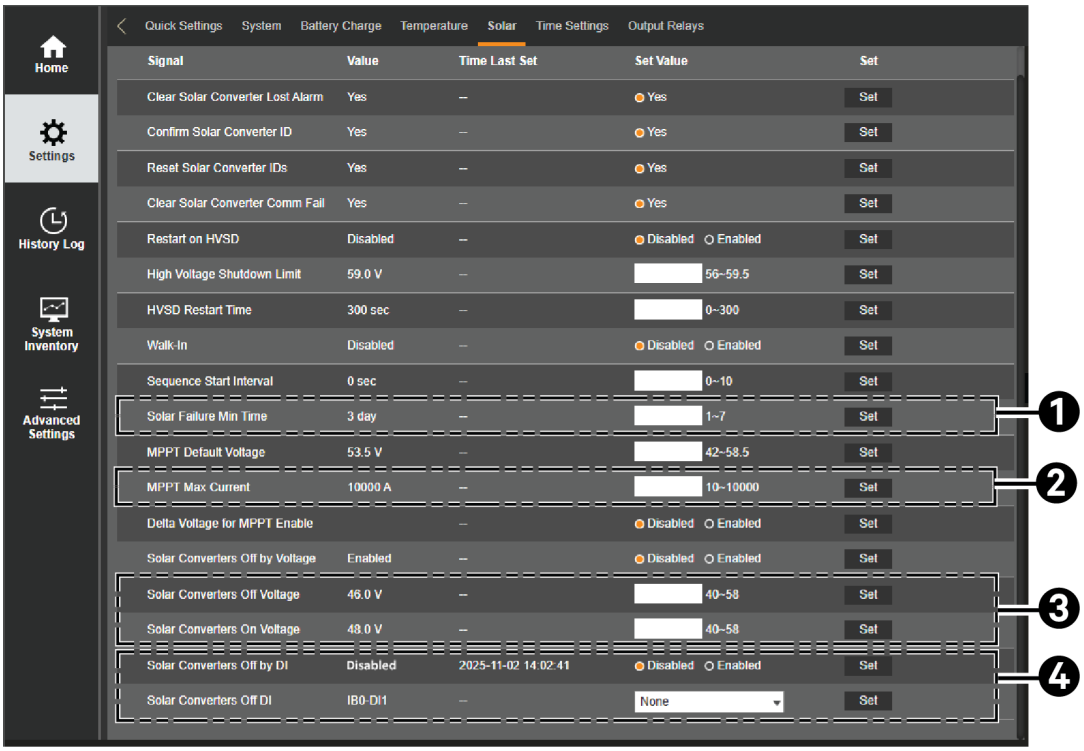
This attribute where load demands exceed solar power can lead to what is known as the "YoYo", where a load frequently-repeatability startups and shutdowns, when AC power is not available and the battery is effectively “empty”. As repeated YoYo can accelerate battery aging and may harm some components, such as LVD starter coils, it is best to shutdown solar after AC is lost and before the battery is exhausted.

To halt this YoYo phenomenon, there are two strategies available:

- Using an external controller or relay to turn off or disconnect solar, when it senses the lose of an AC feed or response to another alarm-signal on the NCU’s relay IB0-DI0. Refer to “Solar Add-On DI – Solar Switch Off CONN2” on page 18 for more information.
- Set the system controller to turn off solar when it senses a low voltage.

NOTE! *The Solar Add-On solution is supplemental power to support the load and should not be used to replace the battery recharge of the host system.*

Figure 8.3 Solar Settings



Item	Description
1	A night without solar is normal and no reason to be alarm, but two or more days and nights is an indicator a fault needs to be addressed. The default setting is three days without any solar power, will generate an alarm.
2	The system can limit the current of all MPPTs combined. The maximum current of any S48-4300E4 MPPT is 81.5 ADC, which is dependent on a solar array generating more than 4300 W of power into the solar converter with an input voltage above 200 VDC. For more information on current limiting and default voltage, refer to the NCU Manual or contact Vertiv.
3	To eliminate the probability of a ‘YoYo’ on recovery, turn off the solar converter when it detects the bus voltage is low. As an alternative, use “Solar Converter off by DI”.
4	As an alternative to "Solar Converters Off by Voltage" as described above to reduce the probability of a YoYo on recovery, turn off the solar converter using an external relay or the host controller into the controller’s DI. By default, this option is disabled when the system ships.

8.4 Settings > Voltage under Battery Charge and Temperature

NOTE! *The voltage output of the S48-4300E4 is defined under the Settings Tabs of Battery Charge and Temperature.*

The delivery of solar power is based on the principle of voltage dominance. The load and battery will take power first from the power source with the highest potential. In the event, the supplemental source is insufficient to power the load, the load and battery will make up for the short-fall from the second source (rectifiers), and one will see main bus voltage will also drop.

To assert voltage dominance, the delivered voltage from the solar converter should be higher than the voltage on the host system busbar accounting for voltage drop, typically 0.3 VDC to 0.5 VDC. In the case of long runs, where separation from the converters to the host system, resulting in a large voltage drop, it is recommended that junction boxes with large wire be used to reduce voltage drop, and/or consider increasing the voltage differential to 1 VDC or greater.

WARNING! Ensure the differential is not excessive, as this may result in battery damage by the solar converter under fault conditions.

Once Float Voltage (Solar) is set, all other settings on the Battery Charge tab should reflect the installed battery and battery manual.

If the optional temperature sensor has been installed, go to the Temperature tab and complete the setup. Refer to the NCU User Manual (UM1M831ANA or UM1M831A7.2.71) for additional information on temperature sensor setup.

Figure 8.4 Solar Converter Voltage Settings

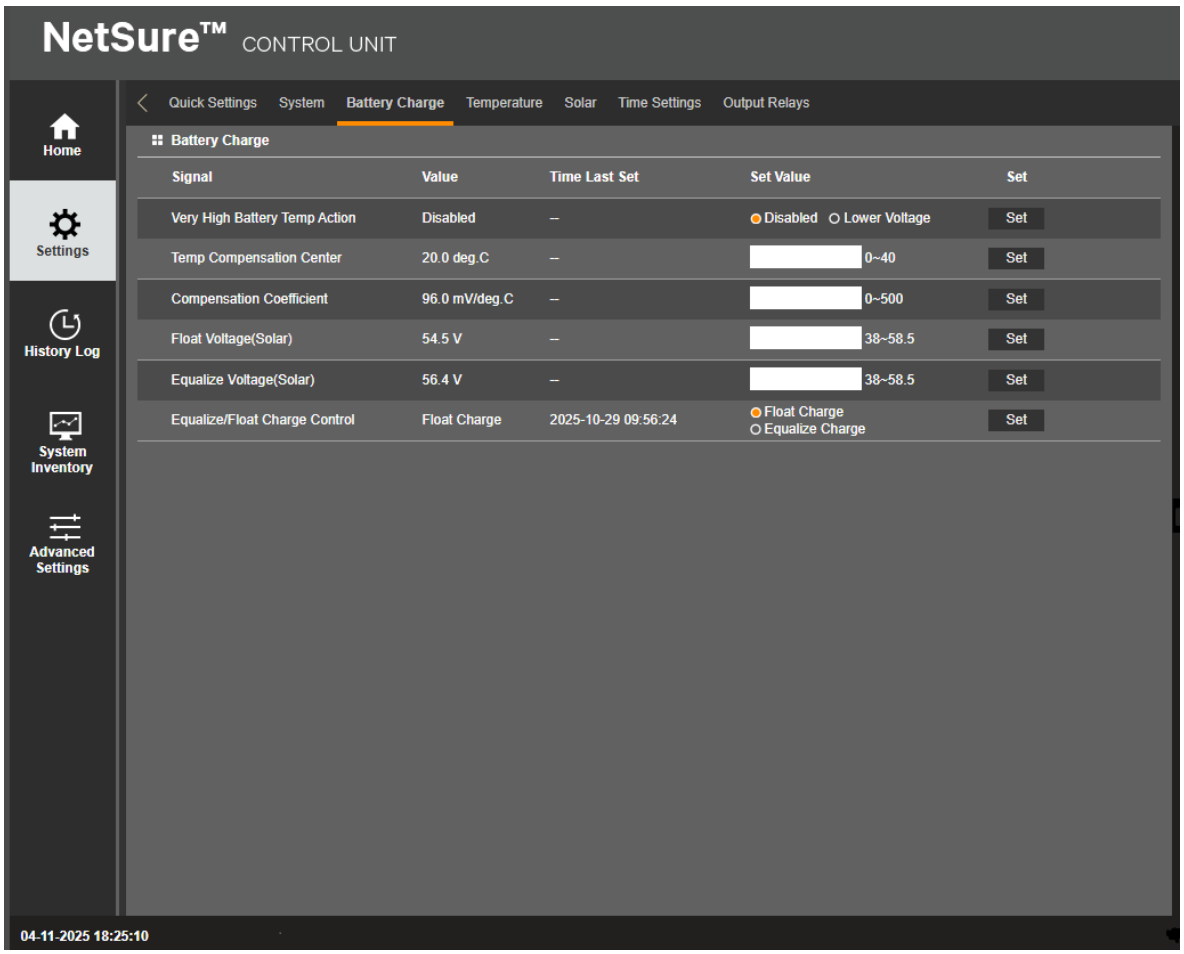
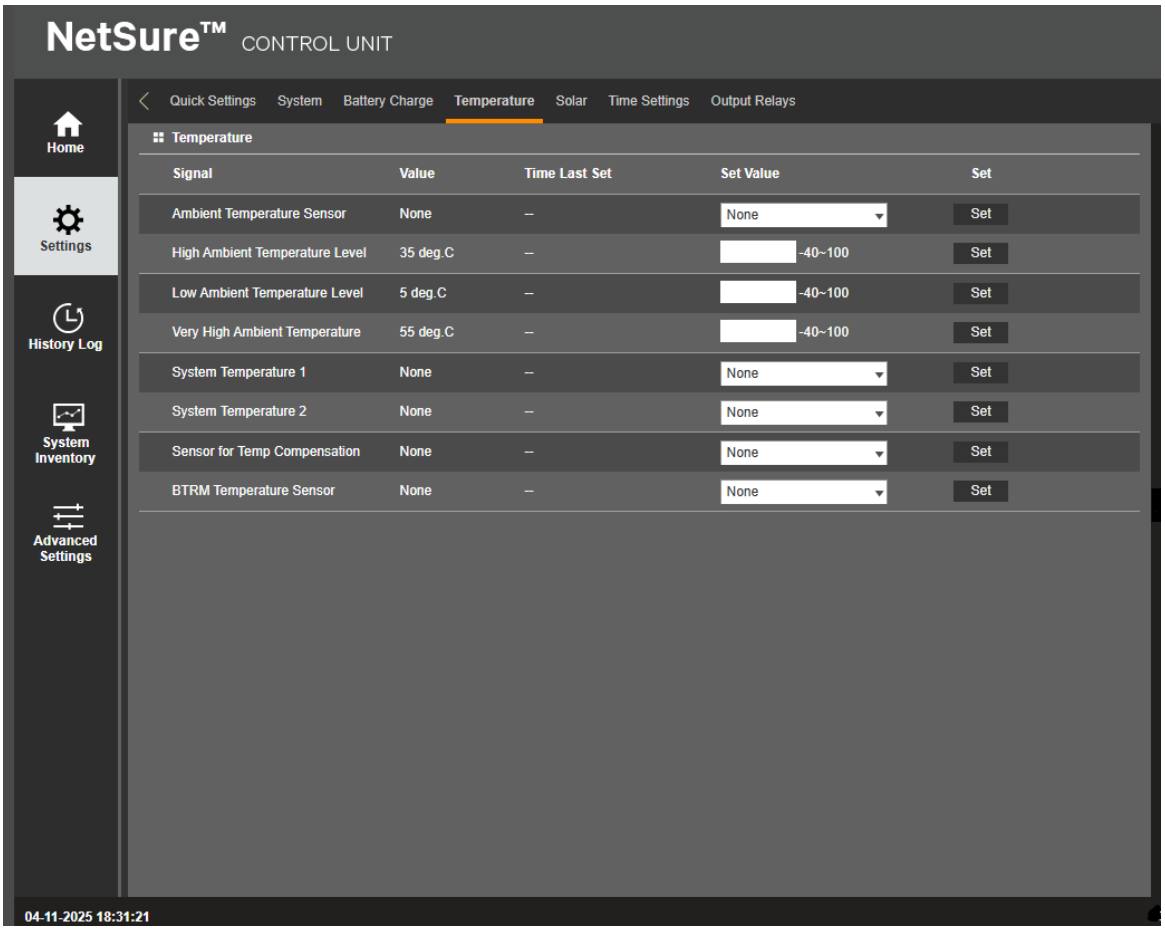


Figure 8.5 Temperature Sensor Setup



Example 1:

1. If the lithium battery's recommended float voltage is -54.0 VDC and the solar array peak power is greater than the typical load, set the

   - Solar float converter to -54.0 VDC
   - Host system's rectifier voltage to -53.5 VDC.

   At night, during the early morning and late afternoon, when the solar power available exceeds the load demand, the voltage to the load and battery will be -53.5 VDC. As the sun rises and delivers more power than the load requires, the voltage will rise to
   -54.0 VDC.

   It should be noted that lithium batteries perform well and operate more efficiently at lower battery voltages. Other batteries with inline bi-directional such as sodium Ion are tolerant of this split voltage regime.

Example 2:

2. If the lead battery's recommended float voltage is -54.0 VDC plus temperature compensation and the solar array peak power is less than the typical load, set the

   - Host system's rectifier voltage to -54.0 VDC, with temperature compensation as per the battery manual.
   - Solar float converter to -54.5 VDC, with temperature compensation as per the battery manual.

- Note that the host system's temperature compensation may have different data entry - variables and may look different than the NetSure Solar Converter Shelf; but the requirement is to allow the solar converter to replicate the same changes to voltage as the host system.

  Although the solar converter has higher voltage, it does not have sufficient power to fulfill the load and battery requirements, so the voltage available for the load and battery is the same as that provided by the host system.

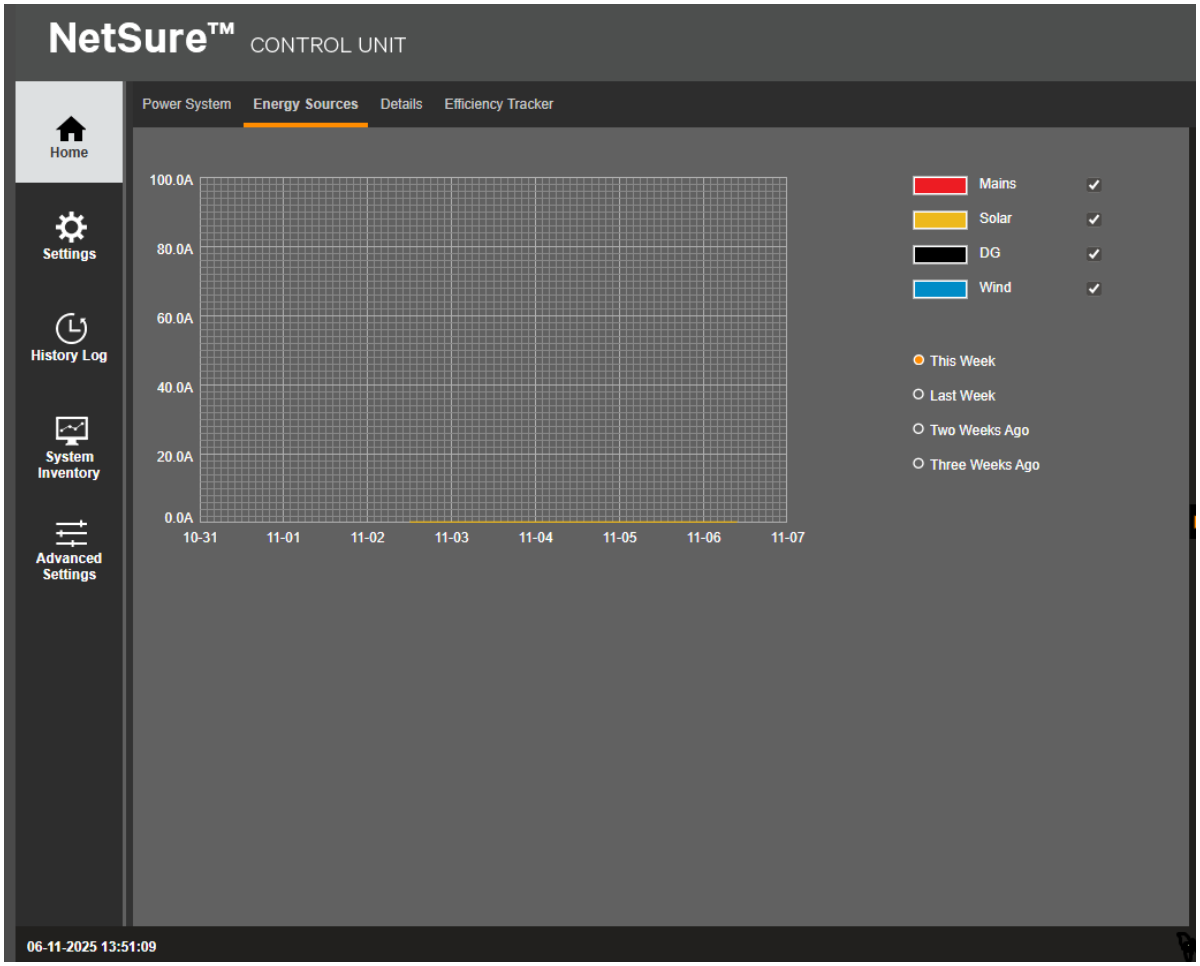
8.5 Other Solar-Add-On Tabs

Additional supporting notes that are specific to the NetSure Solar Add-On M831.

8.5.1 Home > Energy Sources

Figure 8.6 provides a graphical view of the energy sources.

Figure 8.6 Details - Energy Sources



8.5.2 Details, Annual Energy Savings

Available to track energy delivered with annual summary for the previous 5 years. After year 5, data is pushed down and out with the oldest data being removed.

Figure 8.7 Details – Annual Energy Savings Summation

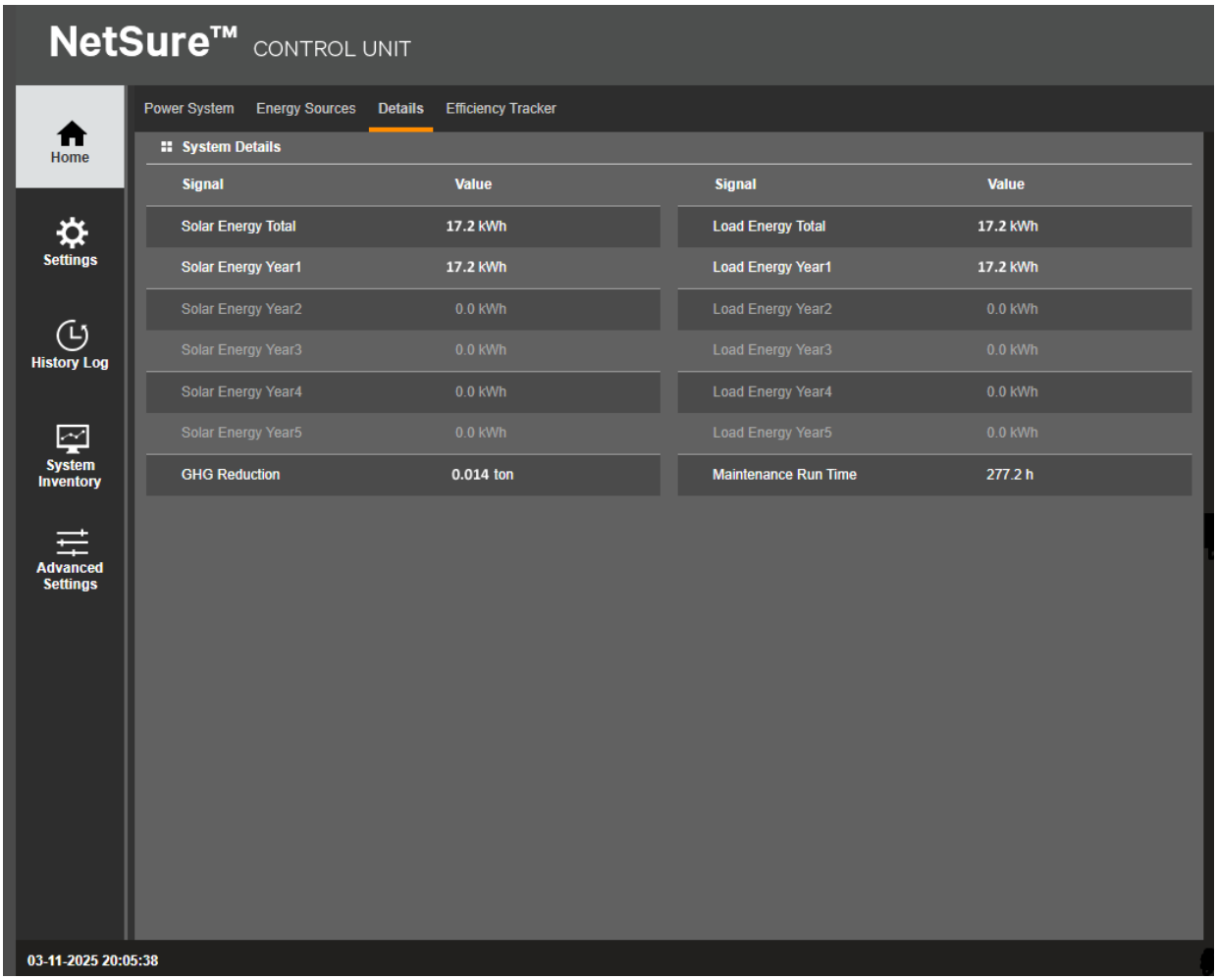
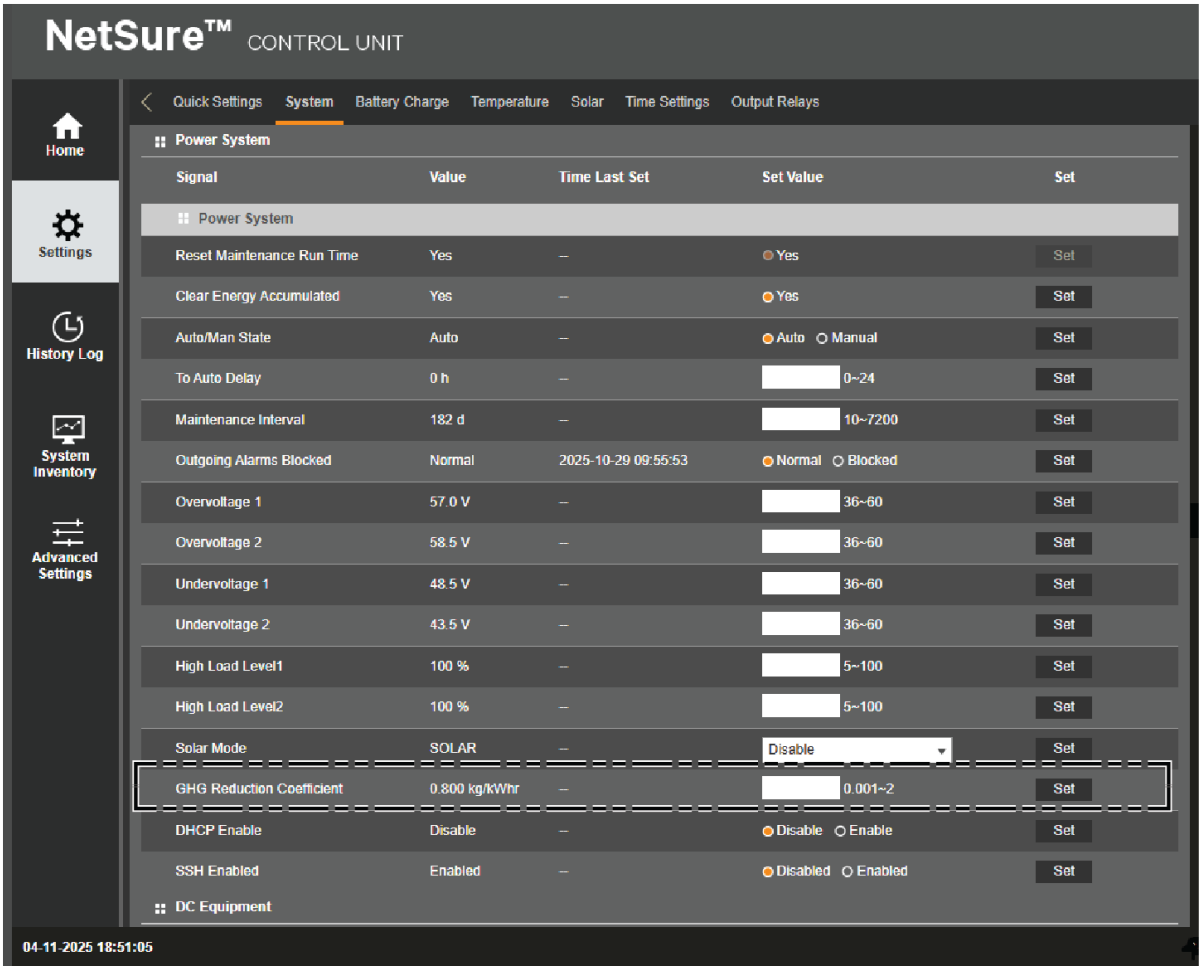


Figure 8.8 GHG Data Values



To enable a GHG summation, enter the projected GHG cost of using the grid or generator, per kWh in the Systems Tab, under Power System.

The actual value should be determined by the customer's ESG group, but as a reference the following estimates have been provided.

Table 8.1 Example of GHG Costs

AC Energy Source	GHG Reduction
Biogas	0.011
Biomass	0.025
Coal	0.960
Diesel	0.778
Geothermal	0.038
Heavy Oil	0.778
Hydroelectric - River	0.013
Hydroelectric – Tidal	0.010
Natural Gas	0.443
Nuclear	0.066
Solar PV	0.032
Wind	0.010

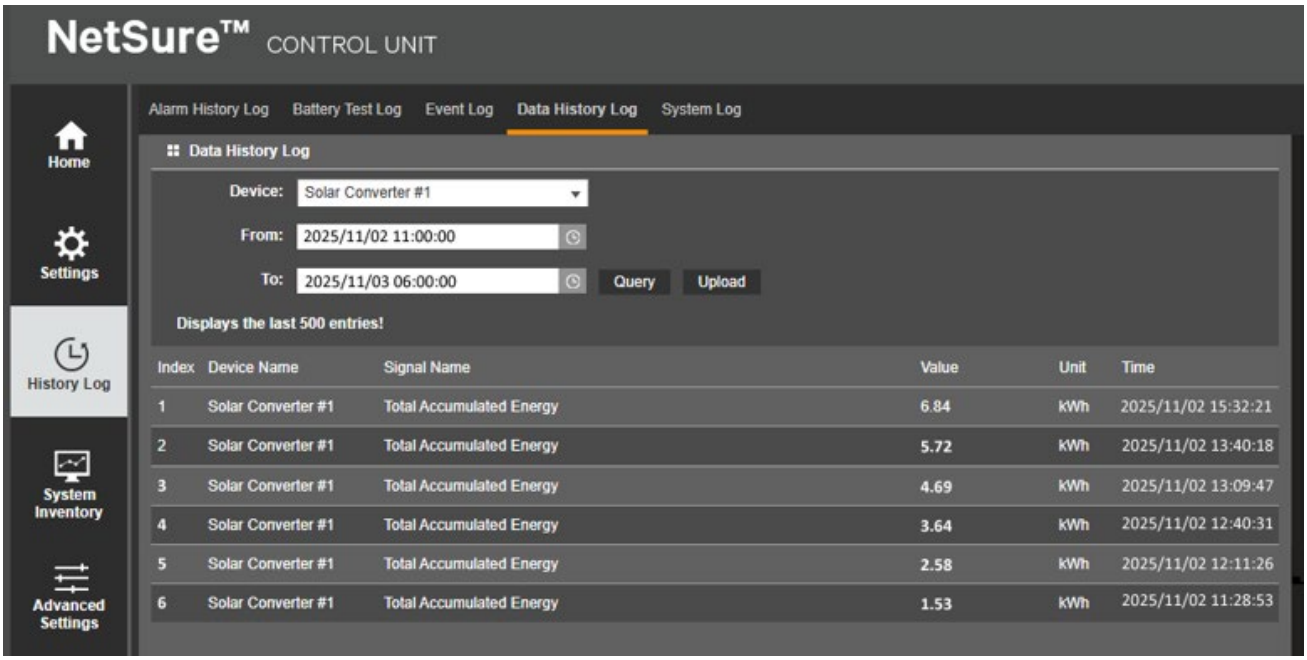
8.5.3 Home > Efficiency Tracker

Though displayed, information is not relevant, as it pertains to rectifiers.

8.5.4 Log > System Log to collect Energy Delivered

The Data History Log for each individual solar converter will record every incremental kWh. Refer to the Controller Manual or contact Vertiv on methods to pull data from the controller.

Figure 8.9 Data History Log



8.6 SNMP

Contact your regional Vertiv Technical Support, if you require an SNMP MIB, starting at https://www.vertiv.com/support/.

9 Using the Host M830 Web Interface

Refer to the NCU User Manual linked to the host system (such as UM1M831ANA or UM1831A7.2.71) as your primary document. The following section is to assist on topics specific to adding a Solar Expansion to an existing operational NetSure M830.

NOTE! An NCU software update may be necessary, refer to “Introduction” on page 1.

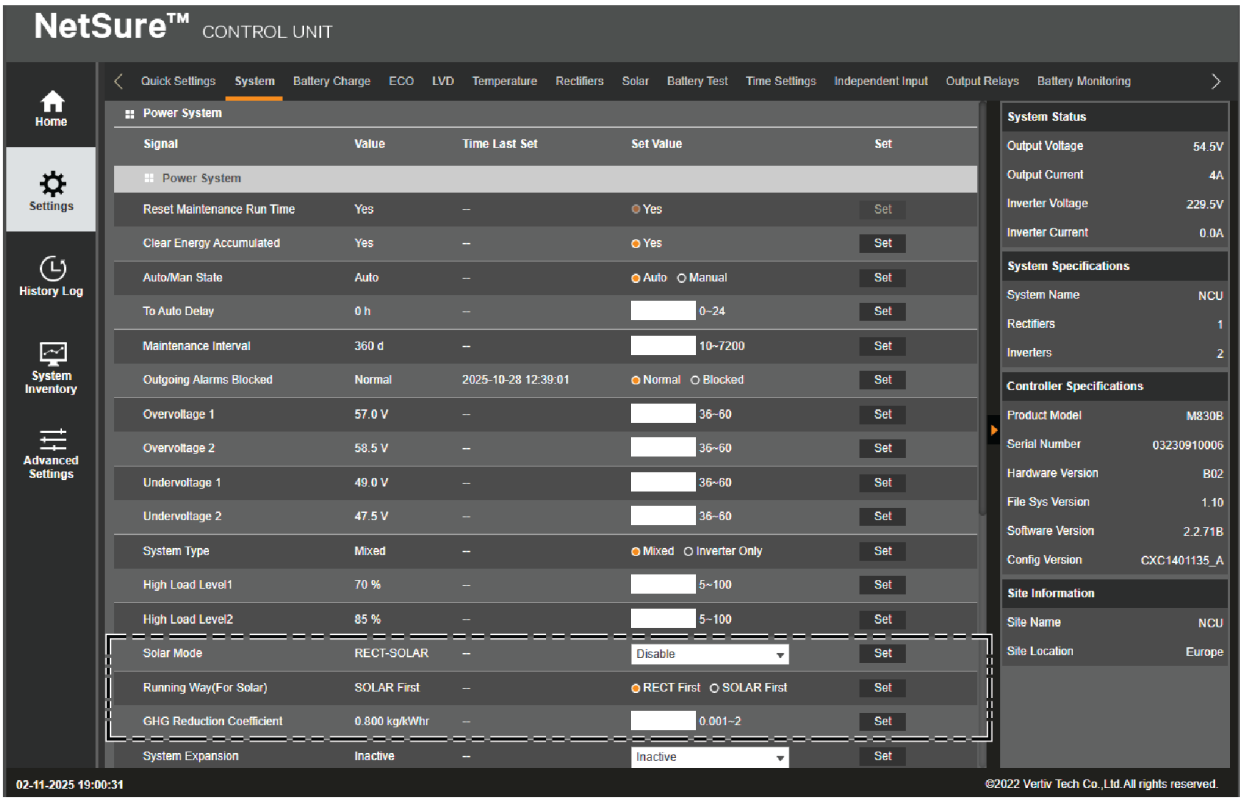
9.1 Host recognizing Solar

Though the Solar Expansion may be under power, the NCU will not recognize the S48-4300E4 until the “Mode” has been defined, acknowledging the system is using both rectifiers and solar.

As you change Solar Mode to “RECT-Solar”, consider which device shall have priority, typically Solar, and whether you want to adjust the default GHG coefficient (Refer to “Details, Annual Energy Savings” on page 32 and Table 8.1 on page 33)

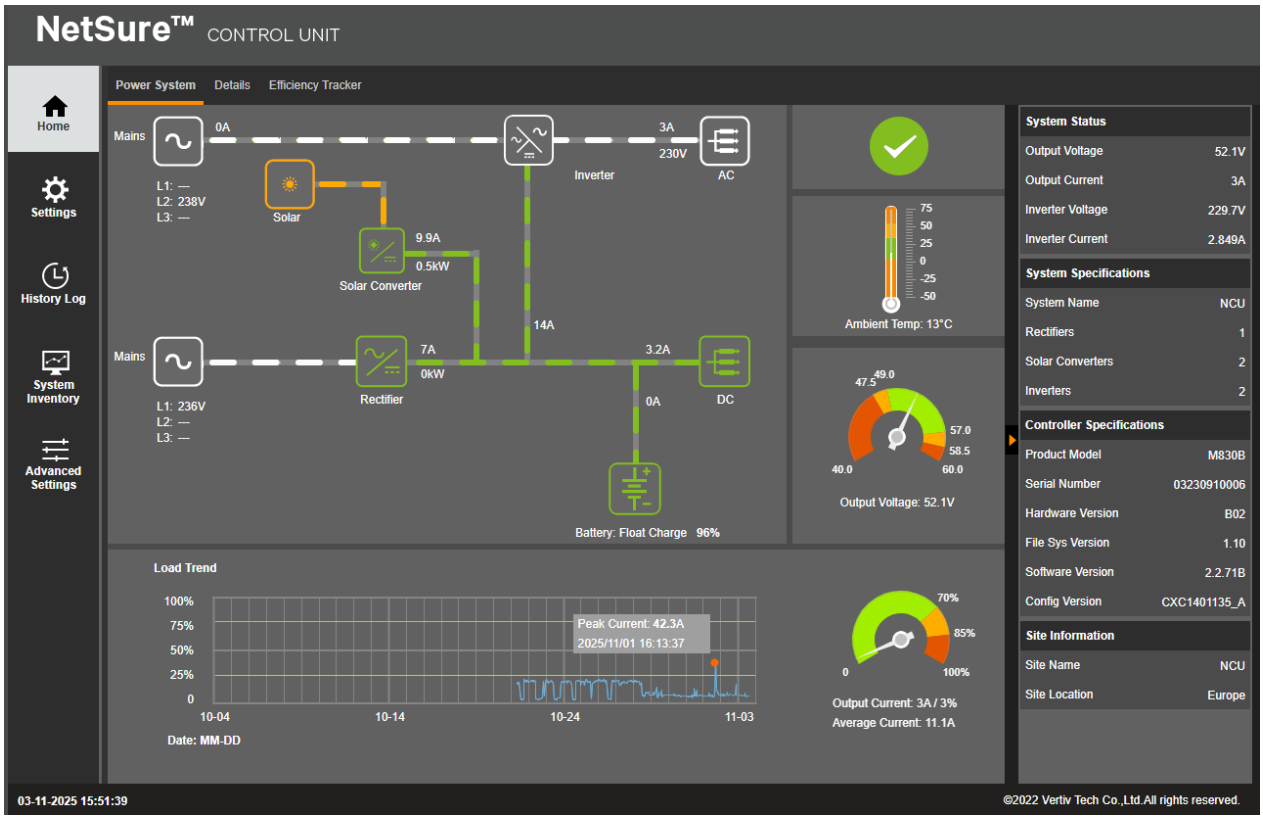
NOTE! RECTifier First is rarely used and typically used for Off-Grid installations with large solar arrays and where generators are used to infrequently recharge the battery. Thus, during the infrequent recharge, the generator is keep under “full” planned load and eliminates any risk of “wet stacking” (carbon build-up) of the generator.

Figure 9.1 Set Solar Mode



Once the Mode is changed to “RECT-SOLAR”, the NCU will recognize the S48-4300E4. Go back to the homepage, and you should see the Solar Converters.

Figure 9.2 Homepage



9.2 Verify Voltage Settings

Go to the Battery Tab, and if necessary, update the following settings.

- Curr Limit Mode: Voltage
- Max Diff Voltage of Solar and RECT: 2.9 V
- Min Diff Voltage of Solar and RECT: 0.5 V

Figure 9.3 Verify Voltage Settings – Battery Current Limit Mode

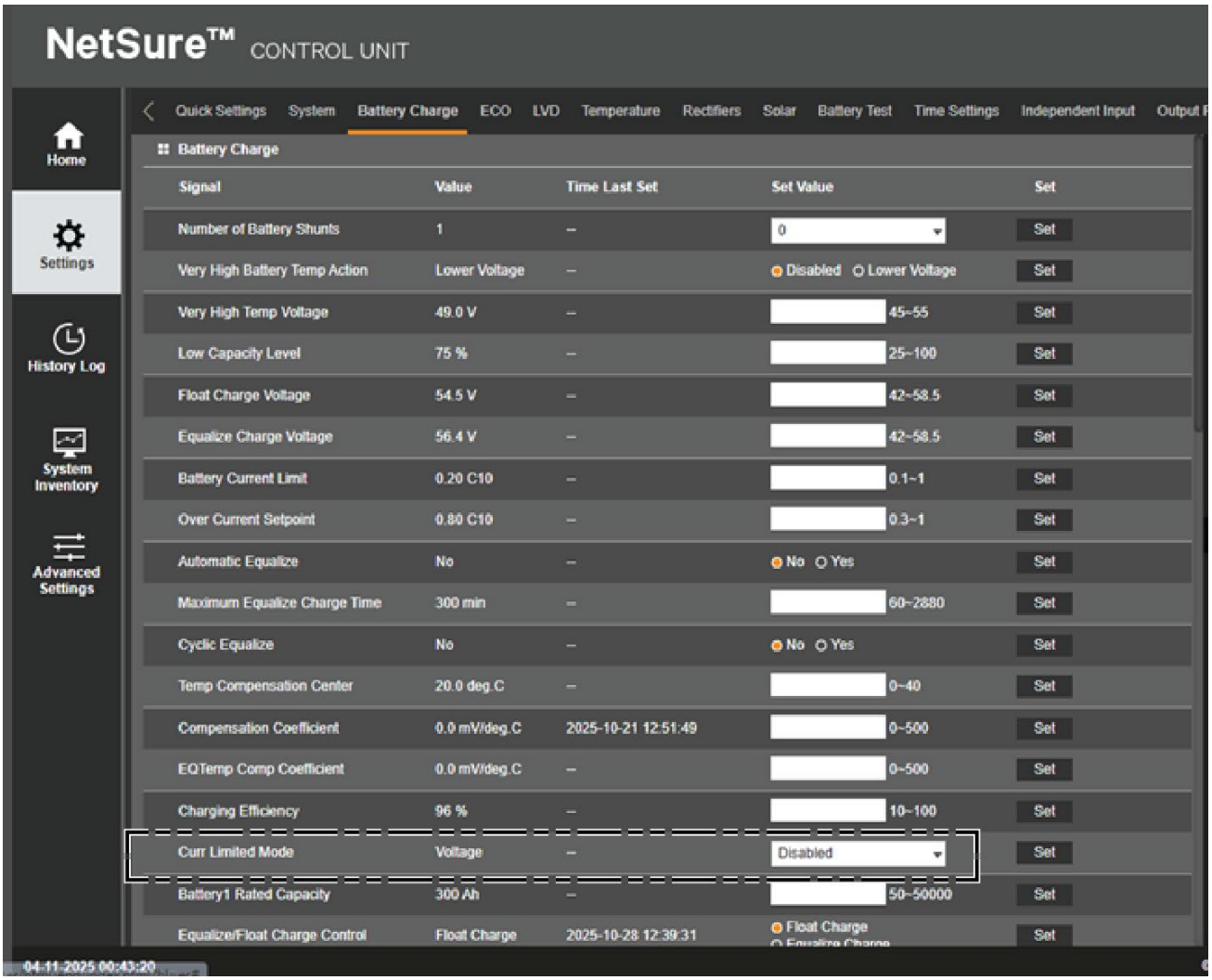
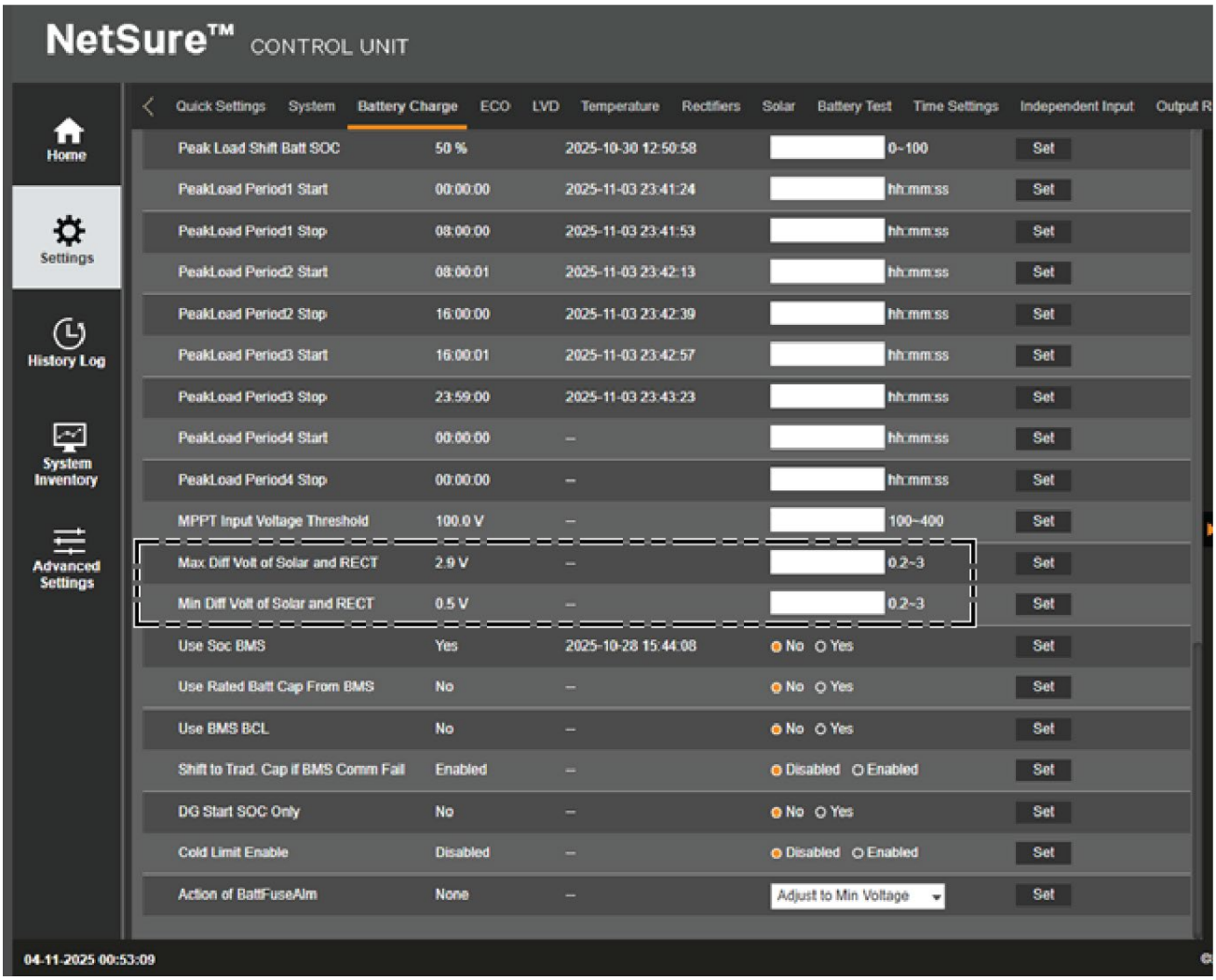


Figure 9.4 Verify Voltage Settings – Solar Differential



10 Technical Parameters of Solar Converter Module

Refer to the Solar Converter User Manual (UM1S484300E4) for the information of the technical parameters of solar converter module.

11 Maintenance

This chapter describes the routine maintenance, alarm and fault handling, and preventive maintenance.

NOTE! *The maintenance of solar shelf must be conducted in compliance with relevant safety rules. Only the trained personnel with adequate knowledge about the solar, solar array, and the solar converter shelf shall work on the internal parts of the system.*

11.1 Routine Maintenance

ALERT! Lack of maintenance is likely to cause system malfunction and reduced life of system components and will void warranty.

There is no general “recipe” for maintenance intervals, as they are affected by the climate (temperature, humidity), site’s local conditions (such as dust, sand, smoke, fumes, pollution, and salt), and application (such as on-grid, off-grid, depth of discharge, rate of recharge, and load). We recommend scheduling a maintenance check once a quarter.

In cooler and very clean environments, the frequency of maintenance can be as low as twice a year. However, at elevated ambient temperatures and with high pollutant content in the air, the maintenance frequency dramatically increases and can be as often as twice a month (site specific environmental conditions).

In the event of sand/dust storms or heavy rains, immediate maintenance can be required for solar panels mounted near the ground. Quick action is necessary to address potential issues such as debris accumulation on the array and potential splash back from heavy rainfall.

Conduct routine maintenance during the mid-day. The routine maintenance items are listed in Table 11.1.

Table 11.1 Routine Maintenance Items

Maintenance Item	Frequency	Inspection Method/Tools	Actions
All switchgear is operational.	Once a quarter	Visual and mechanical inspection	Verify all wiring is secure, and all switches, breakers, fuses and accessible SPDs are operational.
Solar power is being delivered.	Once a quarter	Measure with Clamp Meter	During mid-day, when the sun is on the solar array, read the current being delivered by each solar converter as reported (NCU).
Indicator of each module is normal.	Once a quarter	Visual inspection	Log into NCU, verify all converters are visible and address any alarms
The solar array is clean and undamaged, including panels, cables, frames, protections, and grounding.	Once a quarter or if the solar array is constantly heavily covered in debris, sand, dirt or water spotting, increase the frequency of cleaning.	Visual inspection	Clean the solar array, and if any damage is detected, schedule a repair.

11.2 Handling Alarms and Fault

Handling of the Fault of Solar Module

Refer to the Solar Converter User Manual (UM1S484300E4) for the information on handling of the fault of solar module.

Handling Alarms of Monitoring Unit

Maintain a log of reading that includes date, weather, time, voltage, current and accumulated energy. This will assist in determining systematic operation.

Refer to the NCU User Manual (UM1M831ANA) for the handling alarms of monitoring unit. The handling methods of normal alarms about solar power shelf are given in Table 11.2.

Table 11.2 Handling Methods of Normal Alarms

No.	Name of Alarm	Handling Method
1	DC Over Volt Alarm	1. Check the DC output voltage and the DC Over Voltage Limits of the monitoring unit. If the DC Over Voltage Limits are inappropriate, change them. 2. Locate the solar converter module that is causing the over voltage alarm. Ensure that the batteries (if connected) can operate normally. Switch off the input to the shelf. Then connect the inputs and switch on the modules one by one. The module that generated the high voltage alarm is the faulty one. Replace this module.
2	DC Under Volt Alarm	1. Check the DC output voltage and the DC Under Voltage alarm setting value of the monitoring unit. If the DC Under Voltage Limits are inappropriate, change them. 2. Check if the DC input is within the range of operation of the solar module. If not, disconnect certain loads to prolong the operation of the solar power supply system. 3. Check if the solar converter modules are exiting operations (no output current). If yes, replace the unit. 4. Check the load total current. If the load total current in floating charge exceeds the total output current, then it needs to remove part load, or increase the solar modules, to make the total current of the solar module exceed 120% of the total load current, and there should be at least one redundancy backup of solar unit.
3	The Load Branch Disconnected	Check if the branch MCB is open (check the position of the MCB handle). If yes, locate and remove the fault. If not, the alarm loop is faulty; contact Vertiv.
4	Module Fault	The red LED in the module panel is lightened. Cut off the input of this module and restart it after some time. If it still alarms, replace the module.
5	Solar Module Protect	Check if the solar input voltage is outside the range of 70 V to 400 V (between the under-voltage point and the over-voltage point). If the solar module is often in an over/under-voltage state, contact the maintenance personnel to improve it.
6	Module Fan Fault	Check whether the solar module fan is still working. If the fan stands still, check whether the fan is blocked or not. If yes, clean it. However, if the fan still does not move, replace it.
7	Module Comm Failure	Check if the communication connection between the module and the monitoring module is normal. If it is normal, then restart the module. If the alarm continues, then replace the module.
8	High Battery Temperature Alarm	Check if this is caused by an internal battery fault. If yes, replace the faulty battery. Check if the temperature in the battery room is too high. If yes, reduce the temperature in the battery room.
9	DC SPD Fault	Check the DC SPD status. If the DC SPD is damaged, replace it.

12 Troubleshooting and Repair

12.1 Controller and Solar Converter Module

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

- NCU User Manual (UM1M831ANA)
- Solar Converter User Manual (UM1S484300E4)

User Replaceable Components

User replaceable part numbers are as follows.

Item	Model Number
Solar Module	S48-4300E4
Controller	M831A (must have a software configuration file matching that of the original being replaced)

12.2 Controller Configuration

If any controller configuration settings were changed, refer to the NCU User Manual (UM1M831ANA) and save a copy of the configuration file. This file can be used to restore the controller settings, if required, at a later date.

12.3 Replacement Procedures

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

12.3.1 Replacing the SPD (if installed)

Replacement procedure for the SPD 1 is shown below. Follow the same procedure for replacement of the SPD 2.

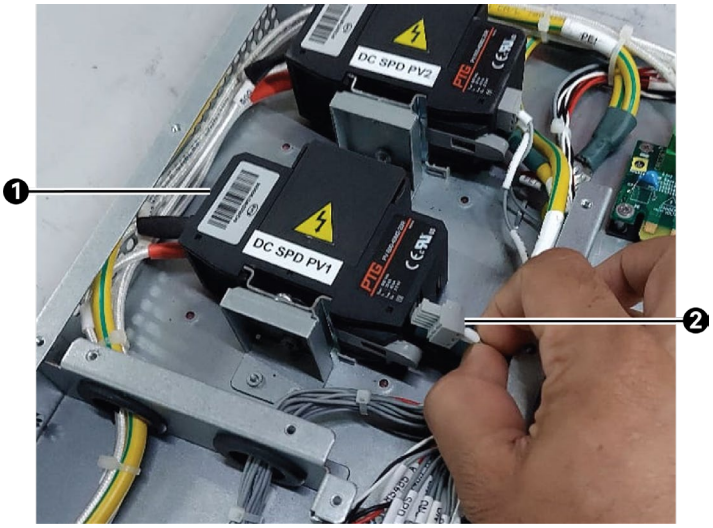
DANGER! Adhere to the “Important Safety Instructions” presented at the front of this document.

DANGER! Disconnect the DC input and output power from the shelf before performing this procedure.

Procedure

1. Remove the top cover of the unit.
2. Remove the signal cable connector from the SPD. See Figure 12.1.

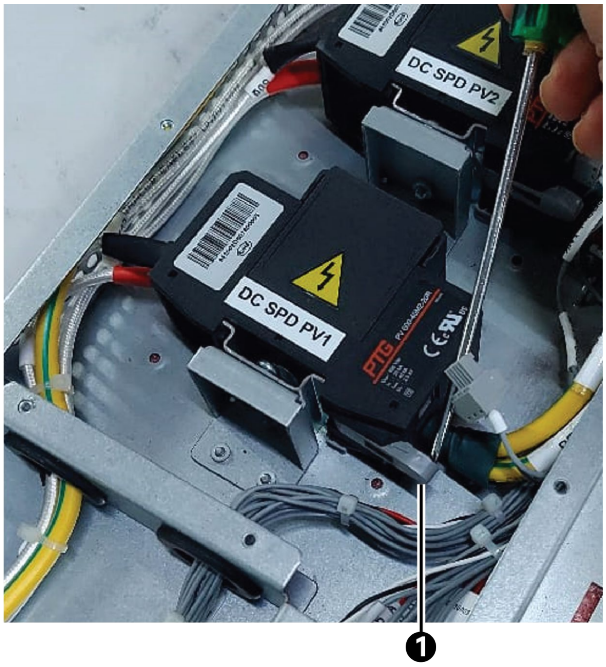
Figure 12.1 Removing the Signal Cable Connector



Item	Description
1	SPD
2	Signal Cable Connector

3. Push the latch downward by using a screwdriver to unlock the SPD from the DIN rail. See Figure 12.2.

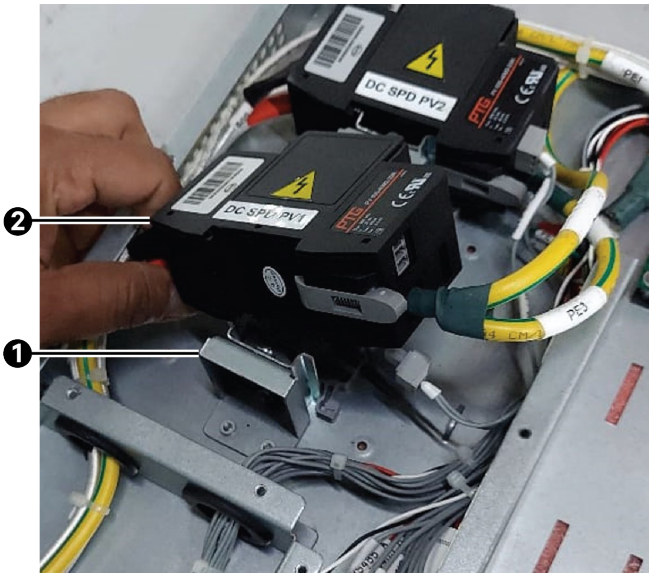
Figure 12.2 Unlocking the SPD



Item	Description
1	Latch

4. Slide the SPD upwards and remove it from the DIN rail. Figure 12.3

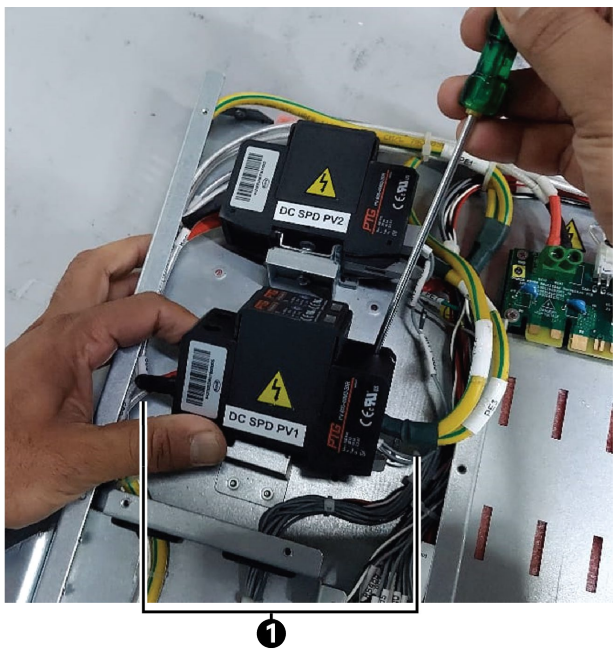
Figure 12.3 Removing the SPD



Item	Description
1	DIN Rail
2	SPD

5. Remove the wires/cables connected to the SPD by using a screwdriver. Note the location of these wires/cables on the SPD. See Figure 12.4.

Figure 12.4 Removing the Wires/Cables



Item	Description
1	Wires/Cables

6. Connect the wires/cables that were removed in above step on the new SPD at the same locations.
7. Slide the SPD downward until it locks on the DIN rail. Ensure that the SPD is fixed on the DIN rail.
8. Connect the signal cable connector to the new SPD at the same location.
9. Verify there are no SPD related alarms being generated by the system.
10. Install the top cover.

13 Part Lists

Figure 13.1 Part Numbers for EMEA Region (including options and spare parts)

Part Number	Description
1S484300E4	Vertiv™ eSure™ 4.3 kW Solar Converter
BMK2257103-002	Vertiv™ NetSure™ 8.6 kW Solar Converter Add-On Shelf with SPD (883500086000)
BMK2257103-004	Vertiv™ NetSure™ 8.6 kW Solar Converter Expansion Shelf with SPD (883500086001)
SXA1100035/1	Blank (Solar Converter) Slot Cover, fits in shelves built in 2026 or later
KET10306/3	Temperature Sensor, 10 m
BMY201457-4	MC4 Red-Black 4 mm^2 Power Cables, 5 m
BMY201457-5	MC4 Red-Black 4 mm^2 Power Cables, 10 m
BMY201457/2	MC4 Red-Black 6 mm^2 Power Cables, 20 m
RAV501230-1	AC Voltage Monitoring Relay
BMG908423-21	IP65 Solar Protection Box, w CB and SPD for 1 S48
BMG908423-22	IP65 Solar Protection Box, w CB and SPD for 2 S48
BMG908423-23	IP65 Solar Protection Box, w CB and SPD for 3 S48
BMY2257103-1S	NCU to Expansion Shelf CAN bus Kit, 3 m
BMY2257103-3S	CAN bus Extension Shelf Kit, 7 cm
BMY2257103-4S	CAN bus Terminator Kit
BMY1100004-8S	DC Cabinet Mounting Kit
BMP903110/1	Replacement: M831 Mini-NCU Controller
NFS854114-125	Replacement: 125A UL-1077 Output Breaker
NGC60122/2	Replacement: Class II SPD
NGC60122/1	Replacement: Class I+II SPD (field upgrade)

Figure 13.2 Part Numbers for North America Region (including options and spare parts)

Part Number	Description
1S484300E4	Vertiv™ eSure™ 4.3 kW Solar Converter
744900180006	Vertiv™ NetSure™ 8.6 kW Solar Converter Add-On Shelf (without internal SPD)
744900180007	Vertiv™ NetSure™ 8.6 kW Solar Converter Expansion Shelf (without internal SPD) *
SXA1100035/1	Blank (Solar Converter) Slot Cover, fits in shelves built in 2026 or later
556155	10' Temperature Sensor
552992	33' Temperature Sensor
283033100000	AC Relay for Solar Off
562868	33' CAN bus Cable for All Systems Except NetSure 7100 Compact Systems (582137100101 through 582137100106) *
559932	25' CAN bus Cable for NetSure 7100 Compact Systems (582137100101 through 582137100106) *
1M831ANA10207933	Replacement: M831 Mini-NCU Controller
280401252110	Replacement: 125A UL-1077 Output Breaker
* One (1) CAN bus cable must be ordered for each and every Expansion Shelf.	

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