VERTIV.

Trinergy™

User and Installation Manual

1.5/1.6/2/2.1 MW CE, 1.5/2/2.5 MW UL

The information contained in this document is subject to change without notice and may not be suitable for all applications. While every precaution has been taken to ensure the accuracy and completeness of this document, Vertiv assumes no responsibility and disclaims all liability for damages result from use of this information or for any errors or omissions.

Refer to local regulations and building codes relating to the application, installation, and operation of this product. The consulting engineer, installer, and/or end user is responsible for compliance with all applicable laws and regulations relation to the application, installation, and operation of this product.

The products covered by this instruction manual are manufactured and/or sold by Vertiv. This document is the property of Vertiv and contains confidential and proprietary information owned by Vertiv. Any copying, use, or disclosure of it without the written permission of Vertiv is strictly prohibited.

Names of companies and products are trademarks or registered trademarks of the respective companies. Any questions regarding usage of trademark names should be directed to the original manufacturer.

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.

TABLE OF CONTENTS

1 Important Safety Instructions **3**
2 Introduction **7**
2.1 Notes to the Conformity 7
2.1.1 European Directives and UK Regulations 7
2.1.2 Conformity Standards 7
2.2 Notice to European Union Customers: Disposal of Old Appliances 8
3 Mechanical Installation **9**
3.1 Pre-Installation Planning 9
3.2 Environmental Considerations 9
3.2.1 UPS Room 9
3.2.2 Storing the UPS and Batteries for Delayed Installation 10
3.2.3 Installation Altitude 10
3.3 Delivery and Handling 11
3.3.1 Handling with Package 11
3.3.2 Positioning and Clearances 13
3.3.3 Raised-Floor Installations 13
3.3.4 Unpacking and Unloading the Cabinet from the Pallet 13
3.4 Installation 15
3.4.1 Mechanical Installation 15
3.4.2 Signal Connections 38
3.4.3 Floor Anchors - Optional 43
3.4.4 Kickplate Installation - Standard 43
3.4.5 Special Considerations for 1+N Parallel Systems 44
3.5 Power Cable Busbars 45
4 Electrical Installation **47**
4.1 Power Cables 47
4.2 External Protective Devices 48
4.2.1 Ground Fault Detection (Use of differential protection devices) 48
4.2.2 Sizing the Input Breaker that Feeds the UPS 49
4.2.3 Automatic Transfer Switches 50
4.2.4 Backfeed Protection 50
4.3 Input Power Cable Connection 51
4.3.1 Equipment Ground 51
4.3.2 Cable Connection 51
4.3.3 BMS Supply - Optional 52
4.4 DC Power Connections 54
4.5 Configuring Ground Connections 54
4.5.1 Recommended Grounding Configuration, Battery Systems 55
4.6 Distributed Static Switch (1+N) System Cabling Layouts 55
4.7 Control Cable and Communication 55
4.7.1 Slots for Vertiv™ Liebert® IntelliSlot™ Cards – SLOT2 and SLOT3 57
4.7.2 Slot for Vertiv™ LIFE™ Services Products – SLOT1 58
4.7.3 Environmental Sensor - AP63-XP6 58

4.7.4 Connector for REPO (Input and Status) and Backfeed Status – AP63-X70 58
4.7.5 Customizable Output Dry Contacts - AP65-XP12 and AP66-XP12 59
4.7.6 Customizable Input Dry Contacts - AP65-XP11 and AP66-XP11 60
4.7.7 Connector for Parallel UPS Connection - AP63-X16, AP63-X20, AP63-X19 and AP63-X15 62
4.7.8 Multiple Bus Synchronization Module (MBSM) - AP63-X18 62
4.7.9 Battery Interface Cards - AP71-X2, AP72-X2, AP73-X2, AP74-X2 and AP75-X2 62
4.7.10 Ethernet Switch Power Supply - AP70-XP15 62
4.7.11 Serviceability Board Panel 63
4.8 Top/Bottom Entry Low-Voltage 64
5 Normal and Safe Operation 65
5.1 Function 65
5.1.1 On-line Principle 65
5.1.2 Battery Management 65
5.1.3 Bypass-line Principal and Overload Management 65
5.1.4 Communication 66
5.2 Product Features 66
5.2.1 Safe and Reliable Operation 66
5.2.2 Easy Installation and Operation 66
5.2.3 Battery Management 66
5.2.4 Environment, EMC 66
5.2.5 Modern Technology 66
5.3 Block Diagram 67
5.3.1 Components 67
5.4 Operating Modes 67
5.4.1 On-line Operation 67
5.4.2 Battery Operation 68
5.4.3 Dynamic Online Operation 68
5.4.4 Bypass Operation 68
5.4.5 Battery Shield 69
5.4.6 Power Smoothing 69
5.5 Placement into Service 70
5.5.1 Forming 70
5.5.2 Switch on the UPS 70
5.5.3 Connect the Batteries 70
5.5.4 Switch to On-line Operation 71
5.6 UPS Switching Procedures 71
5.6.1 Procedure 1: UPS TURN-ON PROCEDURE 71
5.6.2 Procedure 2: UPS TURN-OFF PROCEDURE 71
5.6.3 Procedure 3: TRANSFER FROM NORMAL MODE TO MAINTENANCE BYPASS MODE 71
5.6.4 Procedure 4: TRANSFER FROM MAINTENANCE BYPASS MODE TO NORMAL MODE 72
5.7 Inverter START /STOP Procedures 72
5.7.1 Single UPS - Start Inverter 72
5.7.2 Single UPS - Stop Inverter 72
5.8 Manual Operations—1+N Systems 72
5.8.1 Startup—1+N Module System 72
5.8.2 Load Transfer-1+N System: Transfer System Inverter to Bypass 74

5.8.3 Load Transfer-1+N System: Transfer System from Bypass to Inverter 74
5.8.4 Maintenance Bypass Load Transfers—1+N Module System 74
5.8.5 Shutdown-1+N System Shutdown 76
6 Optional Equipment 77
6.1 Options 77
6.2 Multi-Module System Options and Accessories 77
6.2.1 Paralleling Cable Kit 78
7 Maintenance 79
7.1 Limited Life Components 79
7.2 Disposal of Batteries 79
7.3 Decommissioning 80
7.3.1 Taking out of Service 80
8 Technical Data 81
Appendices 91
Appendix A: Technical Support and Contacts 91
Appendix B: Submittal Drawings 93

This page intentionally left blank

Contacting Vertiv for support

To contact Vertiv Services for information or repair service in the United States, call 800-543-2378. Vertiv Services offers a complete range of start-up services, repair services, preventive maintenance plans and service contracts.

For repair or maintenance service outside the 48 contiguous United States, contact Vertiv Services, if available in your area. For areas not covered by Vertiv Services, the authorized distributor is responsible for providing qualified, factory-authorized service.

For Vertiv Services to assist you promptly, have the following information available:

Part numbers: _____

Serial numbers: _____

Rating: _____

Date purchased: _____

Date installed: _____

Location: _____

Input voltage/frequency: _____

Output voltage/frequency: _____

DC source reserve time: _____

Product Warranty Registration

To register for warranty protection, visit the Service and Support section of our Web site at:

www.vertiv.com

Click on Product Registration and fill out the form.

This page intentionally left blank

1 Important Safety Instructions

SAVE THESE INSTRUCTIONS

This manual contains important instructions that should be followed during installation of your Vertiv™ Trinergy™ Uninterruptible Power System (UPS). Read this manual thoroughly, paying special attention to the sections that apply to your installation, before working with the UPS. Retain this manual for use by installing personnel.

WARNING! only electrically skilled person (service personnel) with proper authorization can operate with UPS. An electrically skilled person is a person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create.

WARNING! Risk of electrical shock. Can cause personal injury or death. This UPS has several circuits that are energized with high DC as well as AC voltages. Check for voltage with both AC and DC voltmeters before working within the UPS. Check for voltage with both AC and DC voltmeters before making contact. Only properly trained and qualified personnel wearing appropriate safety headgear, gloves, shoes and glasses should be involved in installing the UPS or preparing the UPS for installation. When performing maintenance on any part of the equipment under power, service personnel and test equipment should be standing on rubber mats. In case of fire involving electrical equipment, use only carbon dioxide fire extinguishers or those approved for use in fighting electrical fires.

WARNING! Extreme caution is required when performing installation and maintenance. Special safety precautions are required for procedures involving handling, installation and maintenance of the UPS system. Observe all safety precautions in this manual before handling or installing the UPS system. Observe all these precautions before as well as during performance of all maintenance procedures. Observe all DC safety precautions before working on or near the DC system.

WARNING! Risk of heavy unit falling over. Improper handling can cause equipment damage, injury or death. Exercise extreme care when handling UPS cabinets to avoid equipment damage or injury to personnel. Locate the center of gravity symbols and determine the unit's weight before handling each cabinet. Test lift and balance the cabinets before transporting them. Maintain minimum tilt from vertical at all times. Slots at the base of the module cabinets are intended for forklift use. Base slots will support the unit only if the forks are completely beneath the unit. Read all of the following instructions before attempting to move, lift or remove packaging from the unit, or to prepare the unit for installation. The UPS module weighs up to 5700 kg (12600 lb). Refer to Technical Data on page 81 for details.

WARNING! Risk of electrical shock and fire. Can cause equipment damage, personal injury or death. Only normal safety precautions are necessary under typical operation and with all UPS doors closed. The area around the UPS system should be kept free of puddles of water, excess moisture and debris. Only test equipment that is designed for troubleshooting should be used. This is particularly true for oscilloscopes. Always check with an AC and DC voltmeter to ensure safety before making contact with the UPS or using tools to work on any UPS component. Dangerously high potential electric charges may exist at the capacitor banks and at the DC connections even when input power is turned Off. All wiring must be installed by a properly trained and qualified electrician. All power and control wiring must comply with all applicable national, state and local codes. One person should never work alone, even if all power is disconnected from the equipment. A second person should be standing nearby to assist and to summon help in case of an accident.

WARNING! HIGH LEAKAGE CURRENT: the minimum size of the PE conductor shall comply with the local safety regulations for high PE conductor current equipment, when the customer IO is provided by a third party a warning symbol ISO 7010- W001 (2011-06) shall be present.

The UL9540 ESS system requires an upstream input circuit breaker (feeder breaker) which is a customer-supplied responsibility for field installation with means of an accessible manual disconnect. The customer must ensure that all lockout/tagout (LOTO) devices are rated in line with a specific manufacturer kilo ampere interrupting capacity (kAIC) specification as required by NFPA70E and CSA Z462, as per table 12. Before starting any electrical installation or maintenance of the ESS system, ensure that the correct LOTO procedure is followed for all upstream feeder breakers and downstream output breakers directly connected to the UPS, and any DC breakers for the battery circuit to properly isolate power. The correct LOTO procedure will be determined by the manufacturer for all applicable equipment. The size and type of the LOTO device will depend on the manufacturer and size of disconnect device used. Refer to the manufacturer-supplied user information for all applicable equipment.

Arc Flash Ratings should be determined as part of a customer site arc flash coordination study. Ground fault detection is required per NFPA 70E and CSA Z462. For compliance with UL 9540 ESS system requirements related to LOTO procedures for DC energy sources, refer to the applicable manufacturer documentation for the installed battery system:

- SL-71251_Vertiv™ EnergyCore Lithium 5 Battery Cabinet User Manual.
- SL-71369_Vertiv™ EnergyCore Lithium 7 Battery Cabinet User Manual.
- U6A4_250520_Samsung Gen 2 Battery Cabinet User Manual

NOTICE

ONLY FOR UL MARKET.

When the unit is equipped with the FCC optional kit it complies with the limits for a Class A digital device, pursuant to Part 15 Subpart J of FCC rules. These limits provide reasonable protection against harmful interference in a commercial environment. This unit generates radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. Operation of this unit in a residential area may cause harmful interference that the user must correct at his own expense.

NOTE: Materials sold hereunder cannot be used in the patient vicinity (e.g., use where UL, cUL or IEC 60601-1 is required). Medical applications such as invasive procedures and electrical life support equipment are subject to additional terms and conditions.

Battery Cabinet Precautions

The following warning applies to all battery cabinets supplied with UPS systems. Additional warnings and cautions applicable to battery cabinets may be found in Important Safety Instructions on the previous page.

WARNING! Internal battery strapping must be verified by manufacturer prior to moving a battery cabinet (after initial installation).

Battery cabinets contain non-spillable batteries

Keep units upright

Do not stack

Do not tilt

Failure to heed this warning could result in smoke, fire or electric hazard.
Contact Technical Support before moving battery cabinets (after initial installation).
For systems using DC sources other than batteries, refer to the manufacturer's recommendations for handling and care.

L'arrimage des batteries internes doit être vérifié par le fabricant avant de déplacer une armoire de batteries (après l'installation initiale).

Les armoires de batteries contiennent des batteries étanches

Maintenir les systèmes à la verticale

Ne pas empiler

Ne pas incliner

Le non-respect de ces consignes comporte des risques liés à la fumée, au feu ou à l'électricité.
Composez le Vertiv™ avant de déplacer des armoires de batteries (après l'installation initiale).
Reportez-vous aux recommandations du fabricant relatives à la manipulation et à l'entretien pour les systèmes qui utilisent d'autres sources d'alimentation c.c. que les batteries.

This page intentionally left blank

2 Introduction

This Installation Manual contains information on the installation, operation and use of the Vertiv™ Trinergy™ UPS. We recommend reading this document before installing the equipment, which must be operated only by qualified personnel. Afterwards, the manual must be kept and referred to whenever work must be done on the UPS.

2.1 Notes to the Conformity

2.1.1 European Directives and UK Regulations

This product conforms to the following European directives and UK Regulations:

2014/35/EU Low Voltage Directive (LVD)

Directive of the council for adapting the legal regulations of member states on electrical equipment for use within specific voltage limits.

Electrical Equipment (Safety) Regulations: 2016

Regulations implemented according to EU Directive (2014/35/EU) on electrical equipment designed for use within specific voltage limits approved on the GB market.

2014/30/EU Electromagnetic Compatibility (EMC) Directive

Directive of the council for adapting the legal regulations of member states on electromagnetic compatibility.

Electromagnetic Compatibility Regulations: 2016

Regulations concerning the aspects on electromagnetic compatibility approved on the GB market.

2011/65/EU RoHS2 Directive

Directive of the council for adapting the legal regulations of member states on the restriction of the use of certain hazardous substances that can be used in the manufacture of electrical and electronic equipment.

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012.

The restriction of the use of certain hazardous substances that can be used in the manufacture of electrical and electronic equipment approved on the GB market.

2.1.2 Conformity Standards

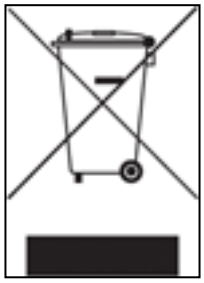
Conformity is established through compliance with the following standards:

- UL 1778, Uninterruptible Power Systems, Edition 5, Revision Date 04/03/2024
- CSA C22.2 No. 107.3, Uninterruptible Power Systems, Edition 3, Revision Date 04/28/2023
- IEC 62040-1, UNINTERRUPTIBLE POWER SYSTEMS (UPS) - PART 1: GENERAL AND SAFETY REQUIREMENTS FOR UPS, Edition 2, Issue Date 07/12/2017
- IEC 62040-2, UNINTERRUPTIBLE POWER SYSTEMS (UPS) - PART 2: ELECTROMAGNETIC COMPATIBILITY (EMC) REQUIREMENTS, Edition 3, Issue Date 25/11/2016
- IEC 62040-3, UNINTERRUPTIBLE POWER SYSTEMS (UPS) - PART 3: METHOD OF SPECIFYING THE PERFORMANCE AND TEST REQUIREMENTS, Edition 3, Issue Date 21/04/2021

Additional information regarding adherence to these directives and regulations is included in the appendices NSR and EMC to the Declarations of Conformity. If needed, the Declarations of Conformity can be requested to Vertiv.

2.2 Notice to European Union Customers: Disposal of Old Appliances

This product has been supplied from an environmentally responsible manufacturer that complies with the Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/CE. The crossed-out wheelie bin symbol on the right is placed on this product to encourage you to recycle wherever possible. Please be environmentally responsible and recycle this product at your local recycling facility at its end of life. Do not dispose of this product as unsorted municipal waste. Follow local municipal waste ordinances for proper disposal provisions to reduce the environmental impact of waste electrical and electronic equipment (WEEE). For information regarding the scrapping of this equipment please contact your closest Vertiv Representative.



3 Mechanical Installation

3.1 Pre-Installation Planning

This section describes the requirements that must be taken into account when planning the positioning and cabling of the Vertiv™ Trinergy™ UPS and related equipment.

Installing personnel should observe these general procedures and practices. The particular conditions of each site will determine the applicability of such procedures.

WARNING! Risk of electrical shock. Can cause injury or death. Special care must be taken when working with the batteries associated with this equipment. When the batteries are connected together, the battery-terminal voltage will exceed 400VDC and is potentially lethal.

NOTE: All equipment not referred to in this manual is shipped with details of its own mechanical and electrical installation.

NOTICE

Risk of incorrect input power connection. Can cause equipment damage.

Refer to Technical Data on page 81 for details.

NOTE: Do not apply electrical power to the UPS equipment before the arrival of the authorized personnel. Connecting power before the authorized personnel determines the system is properly installed may void the warranty.

3.2 Environmental Considerations

3.2.1 UPS Room

The Vertiv Trinergy UPS should be installed vertically, on a level and even concrete or other non-combustible surface, and in an area protected from extremes of temperature and humidity. Refer to Technical Data on page 81 for details.

The Vertiv Trinergy UPS is intended for indoor installation and should be located in a cool, dry, clean-air environment with adequate ventilation to keep the ambient temperature within the specified operating range (refer to Technical Data on page 81 for details).

NOTE: Vertiv will not accept liability or pay costs, fees, or damages arising from storing or operating the UPS outside of the specified environmental, performance, or operating ranges and conditions as set forth herein or in other product documentation. Contact Vertiv Technical Support for more information.

The UPS is cooled with the aid of internal fans. Do not cover the ventilation openings. Cooling air must enter and exit the cabinets freely to prevent overheating or malfunctioning.

The UPS is equipped with air filters behind the front doors. A schedule for inspection of the air filters is required. The period between inspections will depend upon environmental conditions.

When using bottom-entry cabling, the conduit plate must be installed.

NOTICE

Foreign material inside or in the vicinity of the UPS module presents a potential risk to the operational integrity of an installed UPS system.

This risk is especially high if any conductive material finds its way inside the UPS module.

The risk potentially involves damage to the installed UPS equipment and subsequent degradation or loss of power to the connected critical site load.

Vertiv applies the highest safety standards in equipment design to ensure that no live parts are exposed to external contact, and also to ensure that the equipment is protected against the introduction of foreign bodies during operation. However, it is not possible for Vertiv to ensure that foreign bodies will not be introduced during on-site installation, or when the UPS doors and covers are open and the electrical terminals are exposed to allow power line connections to be made by the electrical contractor/installer.

To prevent major disruption to site operations and risk to property and personnel, including the possibility of a fatality, each site's facility manager or construction manager must prevent foreign bodies from being introduced into the UPS module.

All UPS modules are thoroughly inspected by Vertiv engineers before being placed into service and testing on-site. However, the person responsible for the site must ensure that the UPS module and the immediate surroundings are kept clean and free from any possible conductive material such as metal foil, food wrappers, cable shields, washers and other hardware, scrap metal and dust.

If the UPS system is shut down after placement into service and testing is completed, the UPS room must be kept clean to avoid the possibility (during restart) of the considerable volume of airflow produced by UPS operation to dislodge and/or drag any foreign bodies into the equipment, which can result in system failure and possible supply interruption to the critical site load, and several hours of downtime resulting from the damage typically associated with such events.

If the UPS is left running/operational after placement into service and testing, the room must be kept clean to prevent foreign bodies from entering the UPS module via its forced-air flow.

NOTE: Ensure that the top of the UPS is protected from any metal shavings and debris by using the temporary external filter material. The installer is responsible for ensuring that no conductive material enters the unit. The installer will be billed at Vertiv's prevailing labor wage for any cleaning or unit or component failure as a result of debris entering the unit.

3.2.2 Storing the UPS and Batteries for Delayed Installation

WARNING! Do not remove the external packaging until Vertiv Trinergy UPS is ready to be assembled in a safe & clean environment.

If the UPS system will not be installed immediately, store it indoors in a clean, dry and cool location (refer to Technical Data on page 81 for details). If the system includes a battery cabinet, the batteries' requirements dictate the storage conditions. Unpack, install, and charge batteries as soon as possible after delivery.

NOTICE

Risk of failure to properly charge the batteries can cause permanent damage to the batteries and void the warranty.

Batteries will discharge during storage. Batteries must be recharged as recommended by the battery manufacturer. A notice of **Charge Before Date** is affixed to each cabinet that has batteries inside. The **Charge Before Date** is calculated based on storing the batteries at 25 °C (77 °F). Storage at a higher temperature will increase the rate of self-discharge, which requires earlier recharging. Consult the battery manufacturer on how to determine when the batteries need to be recharged.

The DC capacitors in one or more Power Modules (PMs) and Booster Modules (BMs) require formation if they are out of service for more than 18 months. This requirement includes, but is not limited to, the following conditions:

- PMs and BMs in storage for more than 18 months
- A UPS system that is not in operation for more than 18 months

3.2.3 Installation Altitude

The maximum operating altitude of the UPS, without derating, is 1000 m (3300 ft). At higher altitudes the load must be reduced according to **Table 3.1** on the facing page.

Table 3.1 Altitude Derating

Altitude, m (ft)	Derating Factor
1000 (3281)	1.000
1200 (3937)	0.990
1500 (4922)	0.975
2000 (6566)	0.950
2500 (8203)	0.925
3000 (9843)	0.900
3500 (11,483)	0.875
3600 (11,811)	0.870
4000 (13,124)	0.850
4200 (13,780)	0.840
4500 (14,764)	0.825
5000 (16,405)	0.800

3.3 Delivery and Handling

Handling the unit with straps is not authorized.

Before installing the UPS, carry out the following preliminary checks:

- Before you start to unpack and unload the UPS, check the ShockWatch and TiltWatch indicators located on the exterior packaging surface. If the equipment has been correctly transported in the upright position, the indicators should be intact. If the ShockWatch indicator turns red or the TiltWatch shows an inclination greater than the angle specified on the TiltWatch label, contact the appropriate parties to report inappropriate transportation. Document with photographs (ShockWatch/TiltWatch indicators, all sides of packaging, any visible damage).
- Visually examine the UPS equipment for transit damage, both internally and externally.

CAUTION: Report any damage, if present, to the shipper and to your Vertiv representative immediately.

- Verify that the correct equipment is being delivered. The equipment supplied has an identification tag on the interior of the doors stating the type, size, and main-calibration characteristics of the UPS.
- Verify that the UPS room satisfies the environmental conditions stipulated in the equipment specification, paying particular attention to the ambient temperature and air exchange system.

WARNING! Improper operations can cause product damage, injury or death. Verify that all the lifting and moving equipment is rated for the weight of the unit before attempting to move, lift, remove packaging from or prepare the unit for installation. Make reference to the local safety regulations about lifting and handling heavy loads. When moving the equipment, secure it against tilting more than 10 degrees from vertical.

3.3.1 Handling with Package

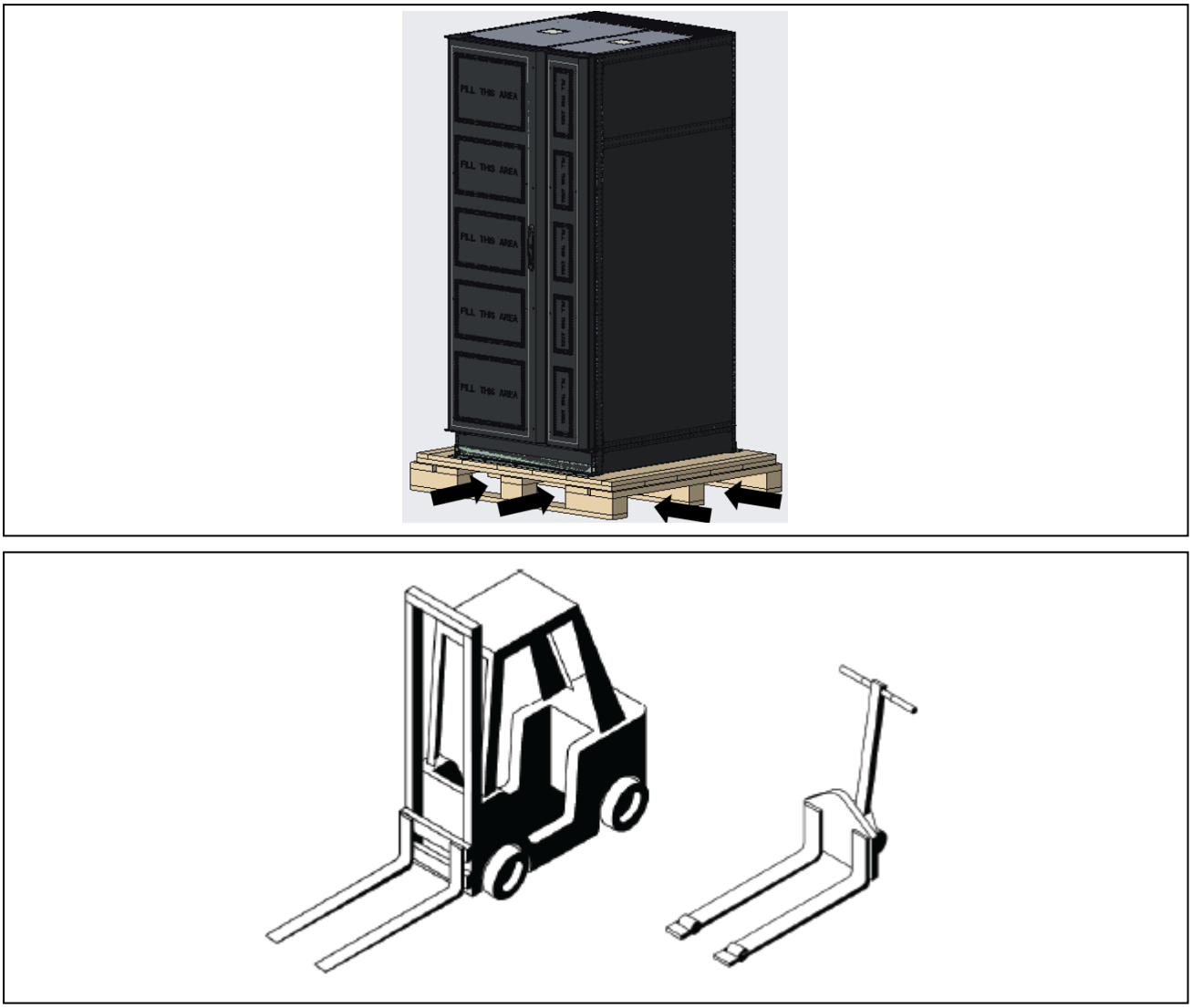
Plan the travel route between the point of arrival and the unit's position to make sure that all passages are wide enough for the unit and that floors are capable of supporting its weight. For instance, check that doorways, lifts, ramps and so on are adequate and that there are no impassable corners or changes in the level of corridors that would prevent passage.

Ensure that the UPS weight is within the designated surface weight loading (kg/cm^2) of any handling equipment. For weight details, see Technical Data on page 81.

- Make reference to the local safety regulations about lifting and handling heavy loads.

- Make sure that the fork length and distance is suitable for the unit length and to ensure the unit stability.
- Spread the forks to the widest allowable distance to still fit under the pallet.
- Lift the unit from one of the four sides.

Figure 3.1 Lifting the Unit from One of the Four Sides Using a Fork Lift or a Pallet Jack



The cabinet is structurally designed to permit lifting from the base with a forklift, pallet jack or similar equipment.

Move the UPS with a forklift or similar equipment to ease the relocation and to reduce unit vibration. The bottom structure of the UPS will support the unit only if the forks are completely beneath the unit. The optional battery cabinets also should be moved with a forklift or similar equipment.

Ensure that any equipment used in moving the UPS cabinet has sufficient lifting capacity to transport the unit. Care must be taken to protect the panels. Do not tilt the UPS or other system cabinet more than 10 degrees.

Handling with straps is not authorized.

WARNING! Risk of heavy unit falling over. Improper handling can cause equipment damage, injury or death. Because the weight distribution in the cabinet is uneven, use extreme care while handling and transporting. Pay attention to overhead obstacles, for example doorways. Take extreme care when handling UPS cabinets to avoid equipment damage or injury to personnel. Locate the center of gravity symbols and determine the unit's weight before handling each cabinet. Test lift and balance the cabinets before transporting them. Maintain the minimum tilt from vertical at all times. The UPS module weighs up to 5700 kg (12600 lb). Refer to Technical Data on page 81 for details.

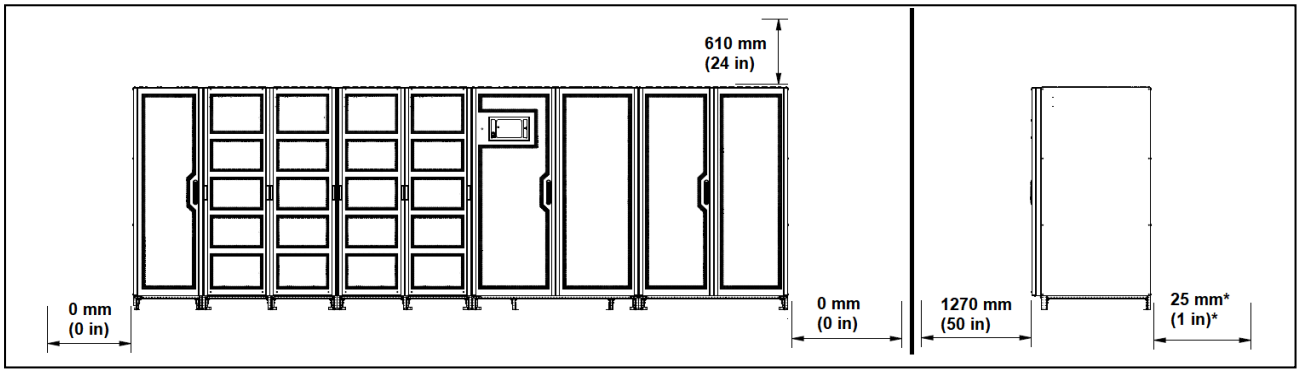
3.3.2 Positioning and Clearances

Access to the power terminals, auxiliary terminal blocks and power switches is from the front and top.

The doors and top low-voltage cover can be opened for access to the power connection bars, auxiliary terminal blocks and power isolators. The front door can be opened 90 degrees for more flexibility in installations.

The UPS has no ventilation grilles at either side or at the rear. Leave a distance of 610 mm (24 in) between the top of the UPS and any overhead obstacles for service and adequate circulation of air from the unit. Clearance around the front of the equipment should be sufficient to enable free passage of personnel with the doors fully opened, up to 127 cm (50 in). In the rare instance of module replacement, 127 cm (50 in) of clearance is required for the Service team to perform module replacement. 127 cm (50 in) allows adequate clearance for both the module and the heavy duty lift used by the Service team to remove and replace the modules. If 127 cm (50 in) is not available, then the Service team will instead replace components and subassemblies in the modules as part of their repair process. In any case, minimum front clearance must be 915 mm (36 in).

Figure 3.2 Clearances—Front and Left Side Views



NOTE: Required only for correct positioning of the STS during installation; not necessary for UPS final operation.

The rear of the machine can be positioned against a wall; in this case the unit must be assembled and then moved to the wall using two or more pallet trucks, see installation procedure for details.

For further details, refer to Submittal Drawings on page 93.

3.3.3 Raised-Floor Installations

If the equipment will be installed on a raised floor, mount the UPS on a pedestal suitably designed to accept the equipment point-loading. Refer to the base view to design this pedestal (refer to Submittal Drawings on page 93).

3.3.4 Unpacking and Unloading the Cabinet from the Pallet

WARNING! Do not remove the external packaging until Vertiv™ Trinergy™ UPS is ready to be assembled in a safe and clean environment.

Take the utmost care when removing the packaging to prevent damage to the equipment. Check all packaging materials to ensure that no important items are discarded.

Once unpacking, remove the front doors and then take the UPS off the pallet by removing all the retaining screws and the bracket L-shaped securing it. Refer to Figure 3.3 on the next page to identify them.

Core 2x and core 3x units: The side L-shaped brackets have a different configuration. These brackets must be removed and then repositioned as shown in Figure 3.4 on the next page. This provides structural reinforcement to the units during subsequent handling and movement after removal from the pallet.

IMPORTANT! The side L-shaped brackets must be removed when coupling the core unit with other units.

Once the front doors, retaining screws, and L-shaped brackets are removed (and the side brackets are repositioned for core 2x and core 3x units), lift the unit off the pallet using a forklift.

Once the front doors, the retaining screws and the brackets L-shaped are removed, lift the unit off with a forklift.

Figure 3.3 Screws, Brackets L-shaped, and Front Doors to be Removed—Front and Rear View

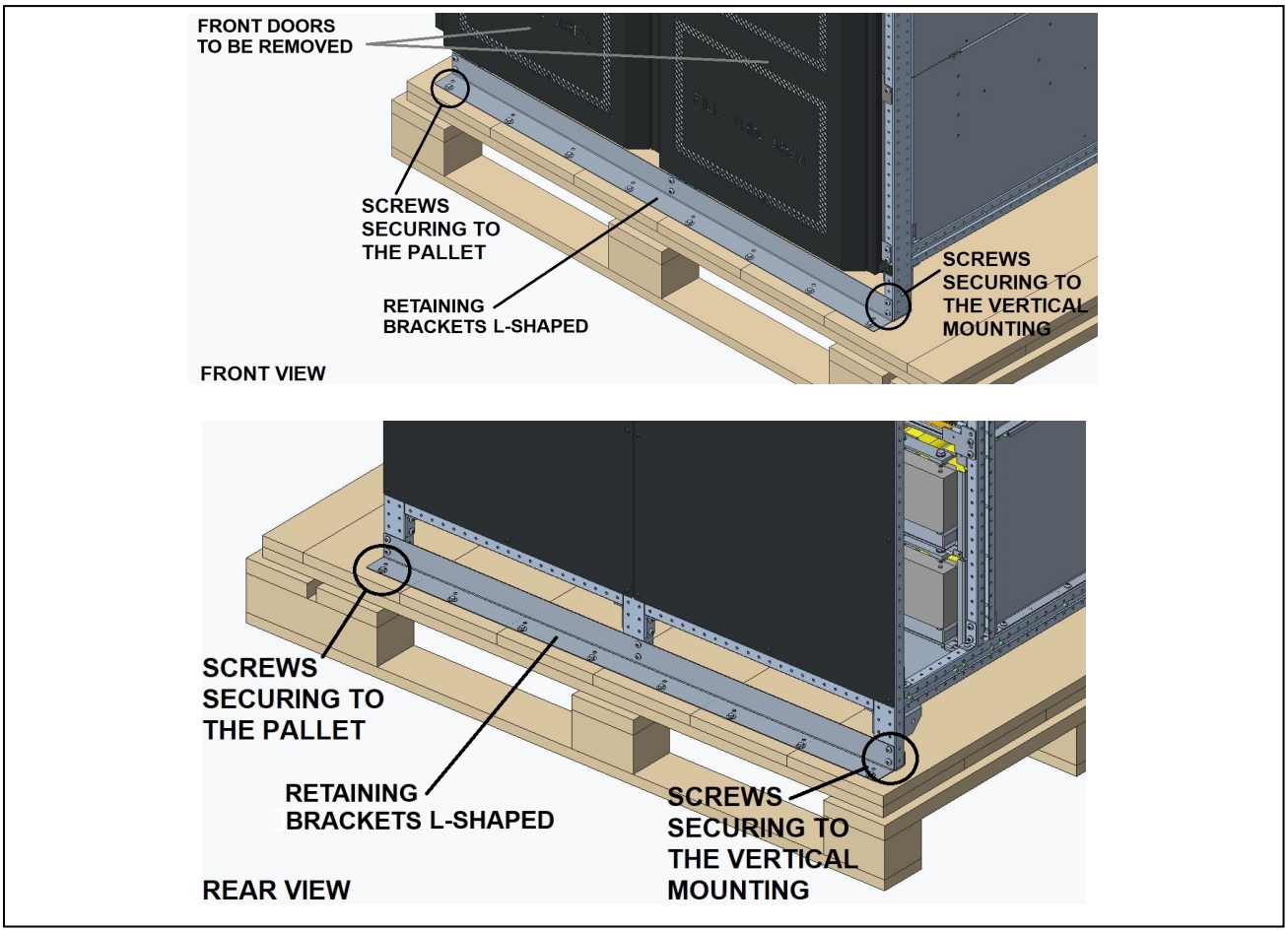
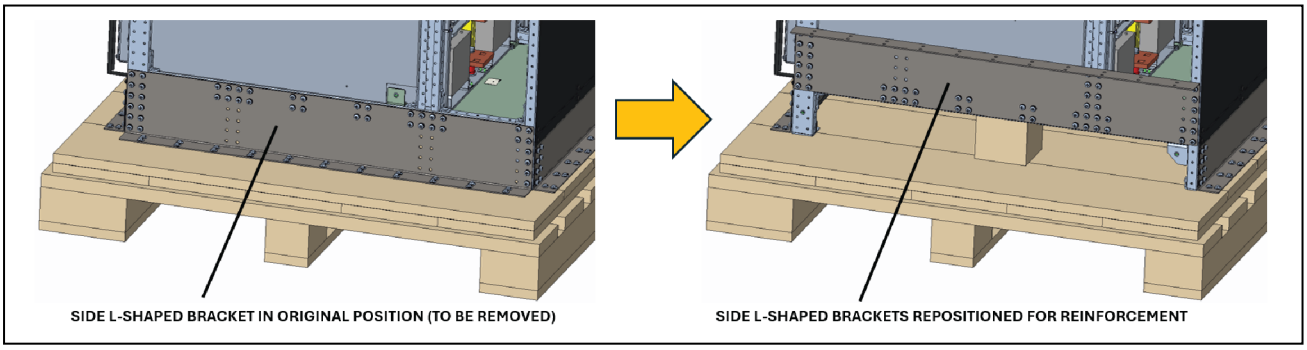


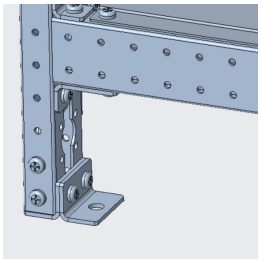
Figure 3.4 Side L-SHAPED Brackets configuration for core 2x/3x units



For handling details, refer to Submittal Drawings on page 93.

Do not remove the brackets L-shaped similar to the one in **Figure 3.5** below because they must be used to secure the equipment to the building floor before operation.

Figure 3.5 Bracket L-shaped to Secure the Equipment to the Building Floor



3.4 Installation

3.4.1 Mechanical Installation

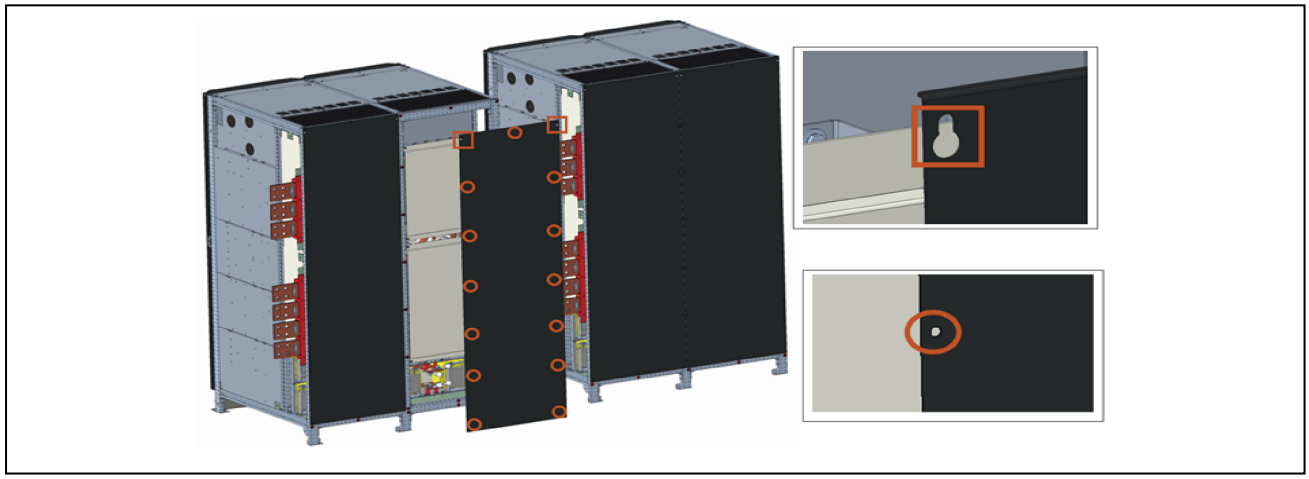
Mechanical assembly of the cores

The following procedure describes the step-by-step process for connecting two core 2x cubicles, each rated at 1000 kW:

NOTE: The same procedure applies when coupling a core 2x unit with a core 3x unit.

1. Unpack the cores following the instructions in Unpacking and Unloading the Cabinet from the Pallet on page 13.
2. Remove the side L-shaped brackets that were previously repositioned as shown in Figure 3.4 on the previous page from both core 2x units.
3. Place the 2 cubicles of Core 2x close to each other. The core that has the back copper busbars junction kit, to connect together the busbars of 4 cores inputs and 4 cores output, must be placed on the right, while the core without this kit must be placed on the left. Dismount both the painted back panels of the core with the union busbars, removing the hexagonal socket button head screws with their washers.

Figure 3.6 Rear View, Painted Back Panel Removed



WARNING! Do not place immediately the Cores close to the wall. It is mandatory to check that all the electrical connections, both AC and DC, are all properly connected, before placing the back of the system close to the wall. Electrical connections require access from the rear side.

4. On the core with back copper busbars junction kit, on the back right side, remove the M6x15 screws supporting the back lexan panel. This will allow the complete removal of the lexan panels.

Figure 3.7 Rear View, Lexan Screws Removal

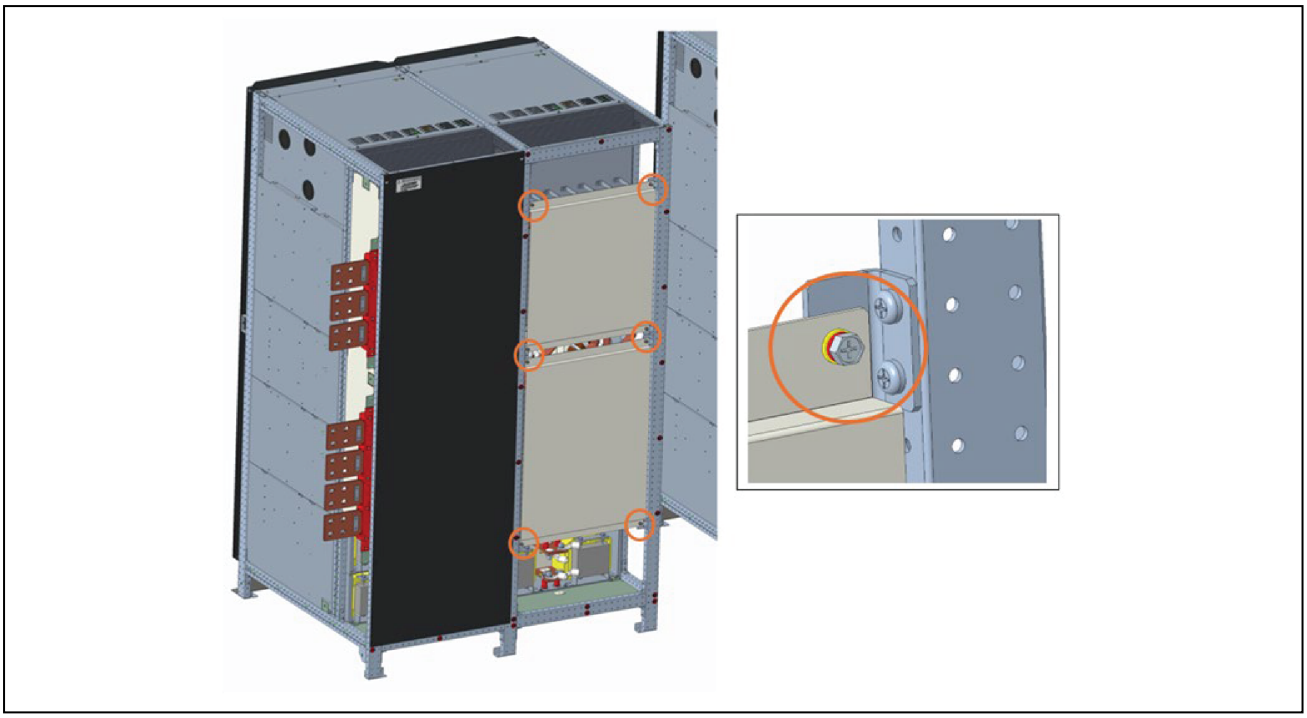
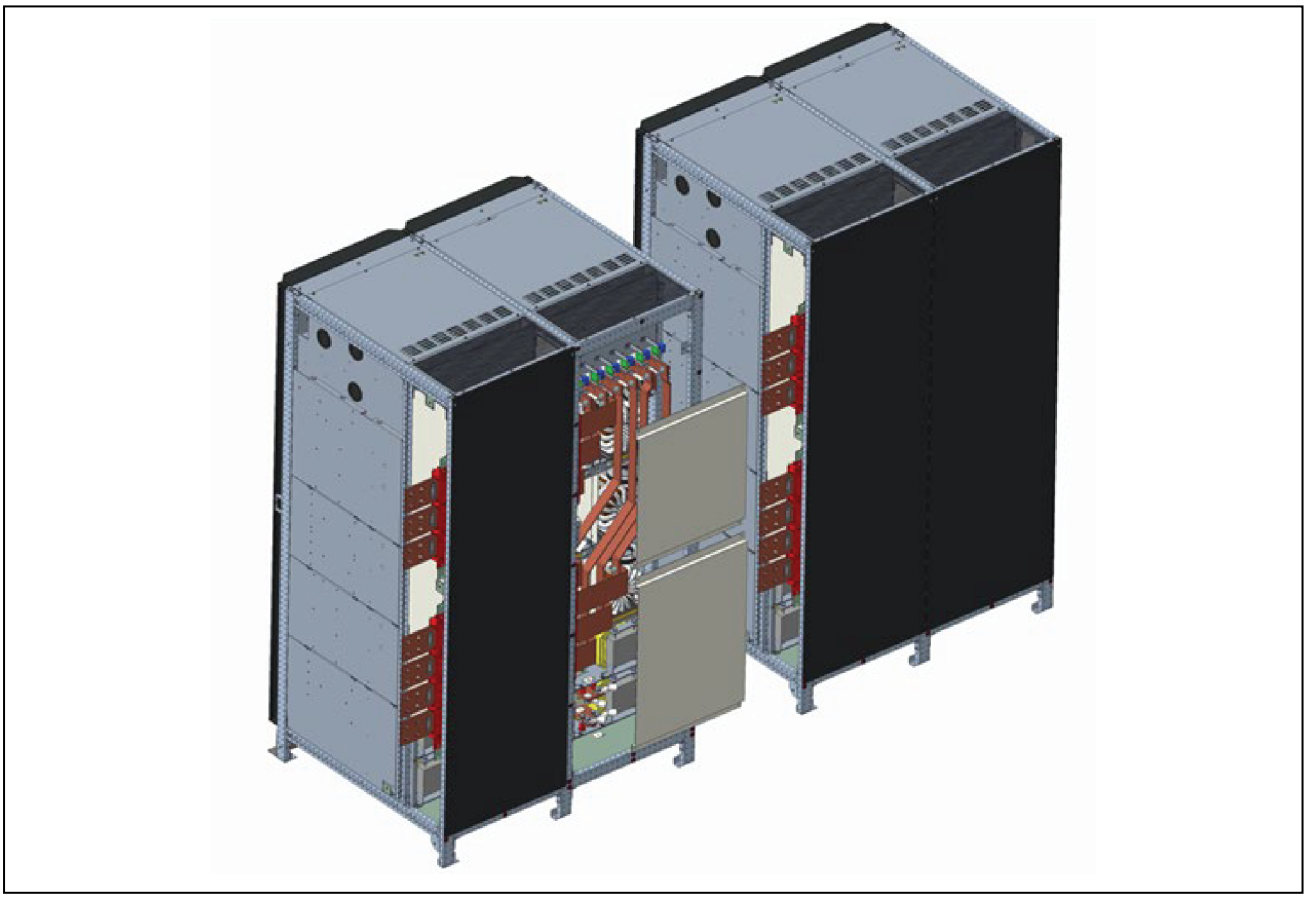


Figure 3.8 Rear View, Rear Lexans Removal



5. On the core with back copper busbars junction kit, on the front, disassemble the front-left painted panel, removing the M6x10 black hexagon socked button head screws as shown in the **Figure 3.9** on the facing page. Frontal panel-side covers can be removed too, as per **Figure 3.10** on the facing page.

Figure 3.9 Front View, Front Painted Panel Removal

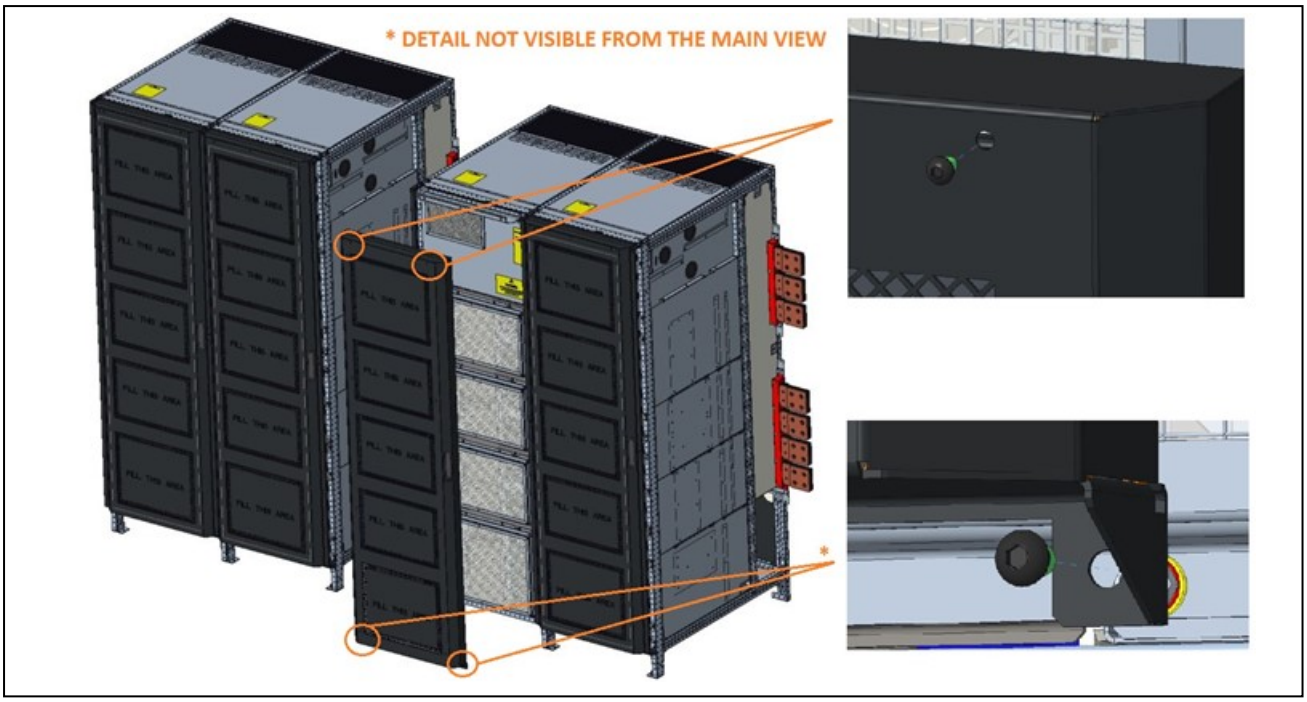
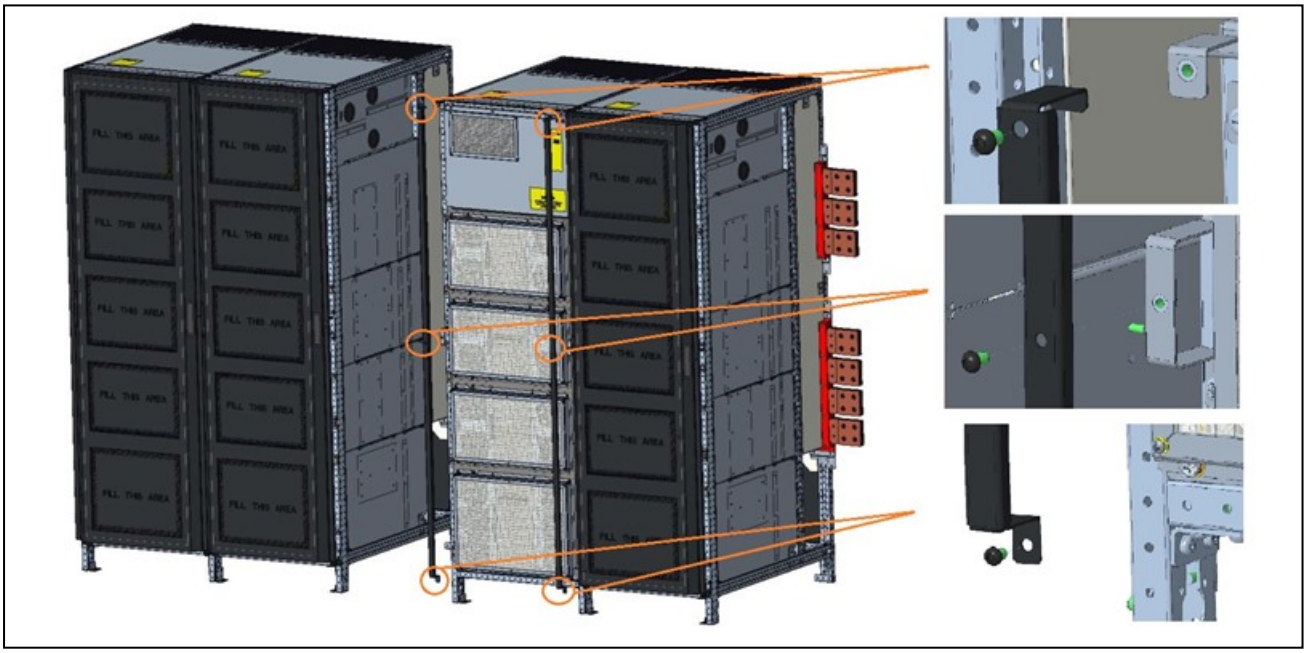
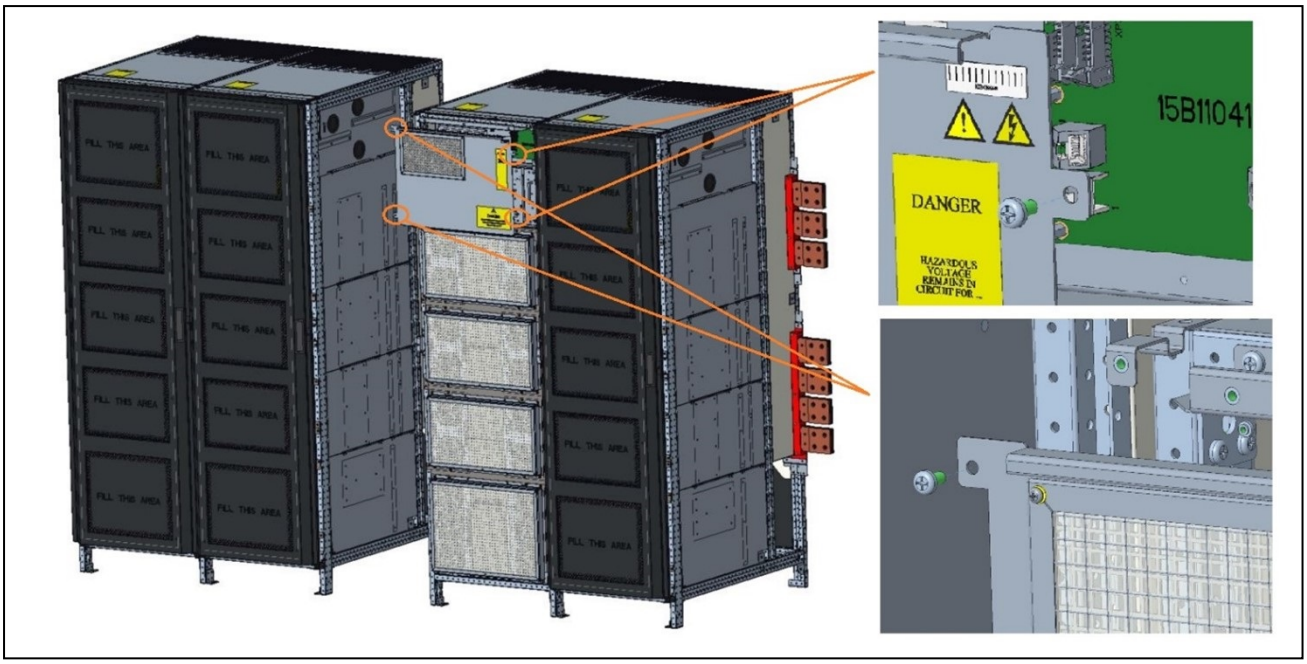


Figure 3.10 Front view, Front Painted Closures Removal



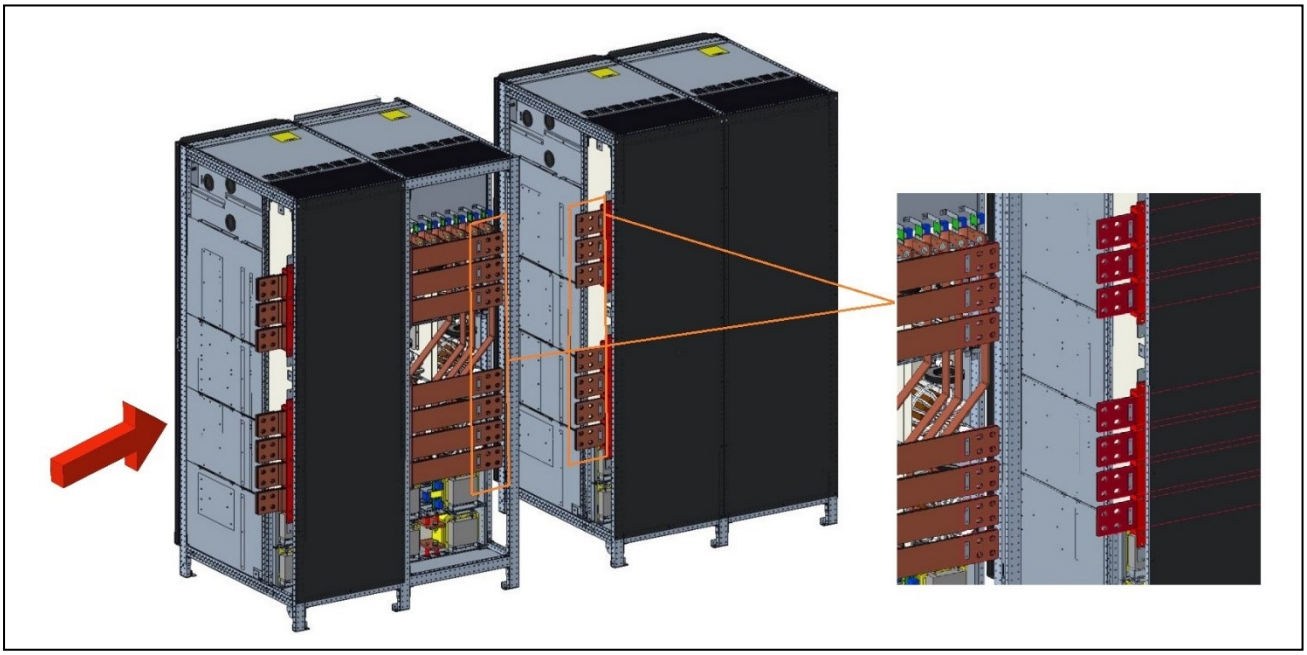
6. On the same core, where the painted door was removed, disassemble the top second access panel, removing the screws fixing it to the cubicle, as showed in Figure 3.11 on the next page.

Figure 3.11 Front View, Top Second Access Panel Removed



7. Align the left lateral side of the cubicle of the core with back copper busbars junction kit to the right lateral side of the other cubicle 2x cores. Pay attention to have the copper busbars on the back properly aligned and matching (**Figure 3.12** below). Ensure to apply contact grease on the surfaces of the union busbars and distribution busbars that must be fixed together for the electrical connection (detail in **Figure 3.12** below).

Figure 3.12 Rear View, Cores Side Alignment



8. Thanks to the previous steps already completed, the mechanical fixing points that allow the mechanical mounting of the cores together is now possible. Secure mechanically the 2 cubicles of the cores: on the front, bolt the cubicles together using n.2 M8x20 hexagonal head screws with flat and grower washers (**Figure 3.13** on the facing page). On the rear side, bolt the cubicles together using n.3 M8x20 hexagonal head screws with flat and grower washers (**Figure 3.14** on the facing page).

Figure 3.13 Front View, Mechanical Front Securing System of the 2-core Cubicles Together

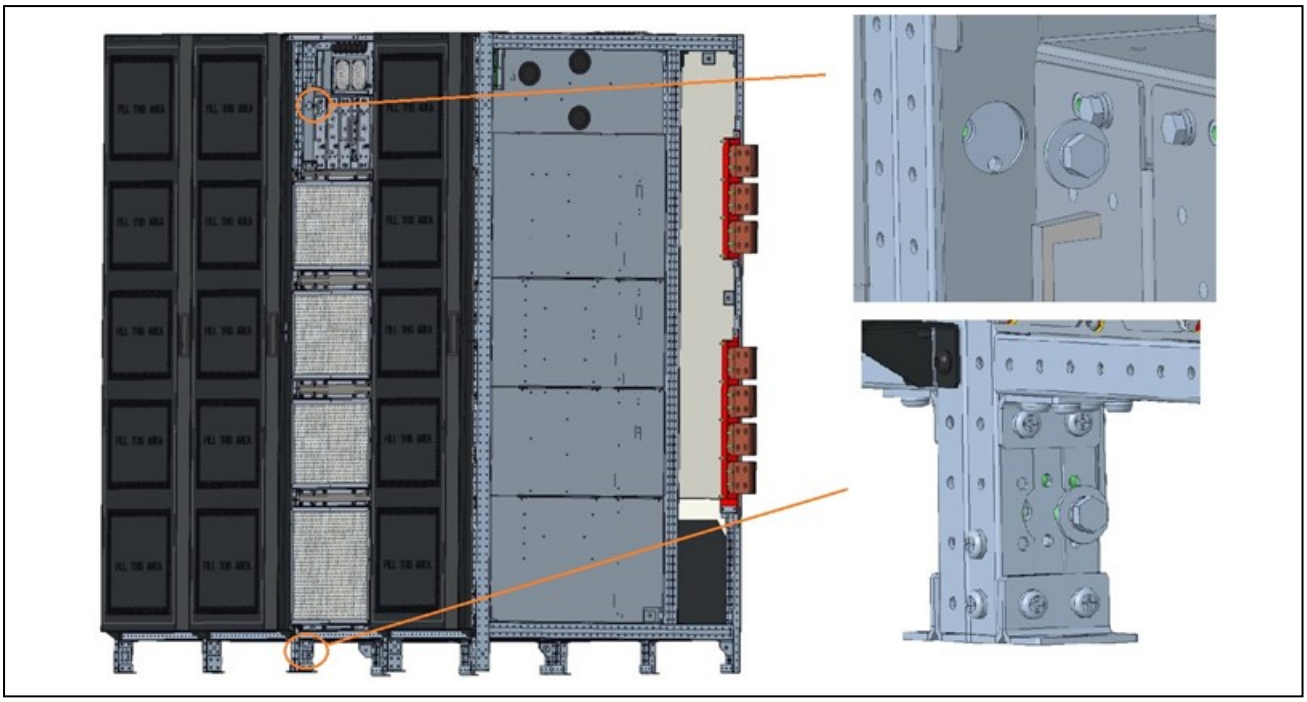
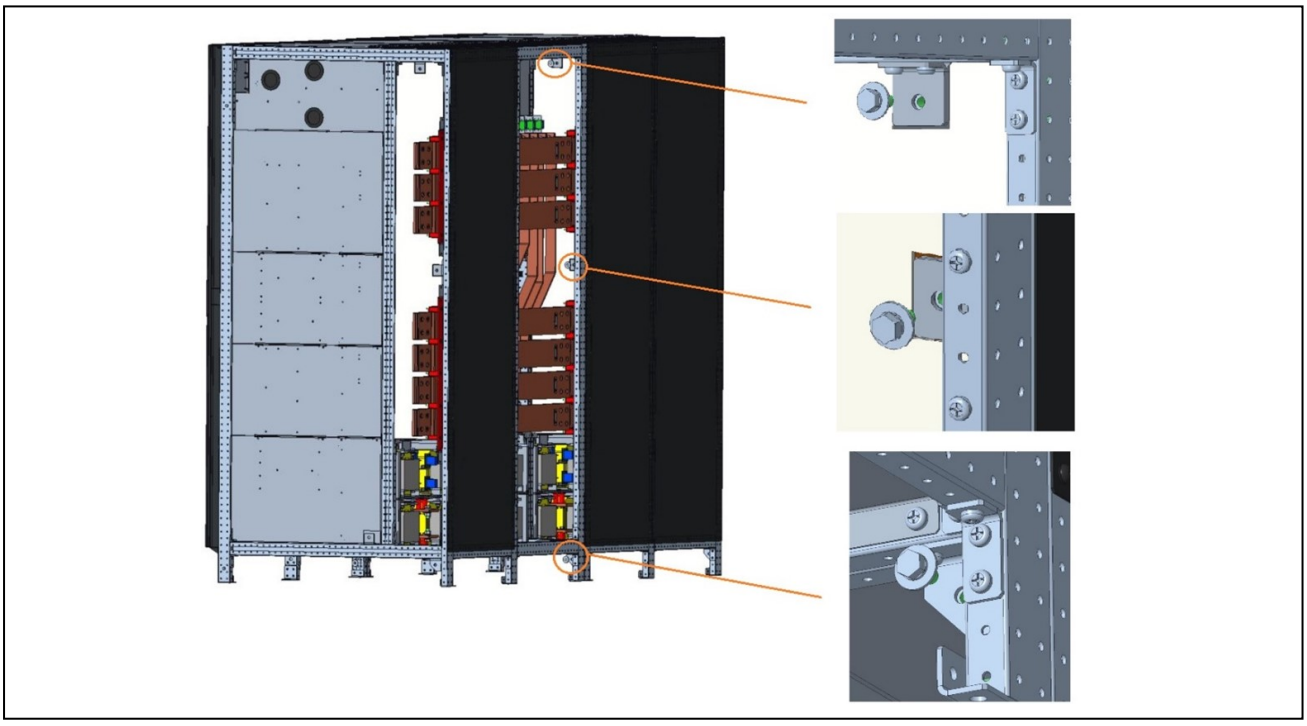
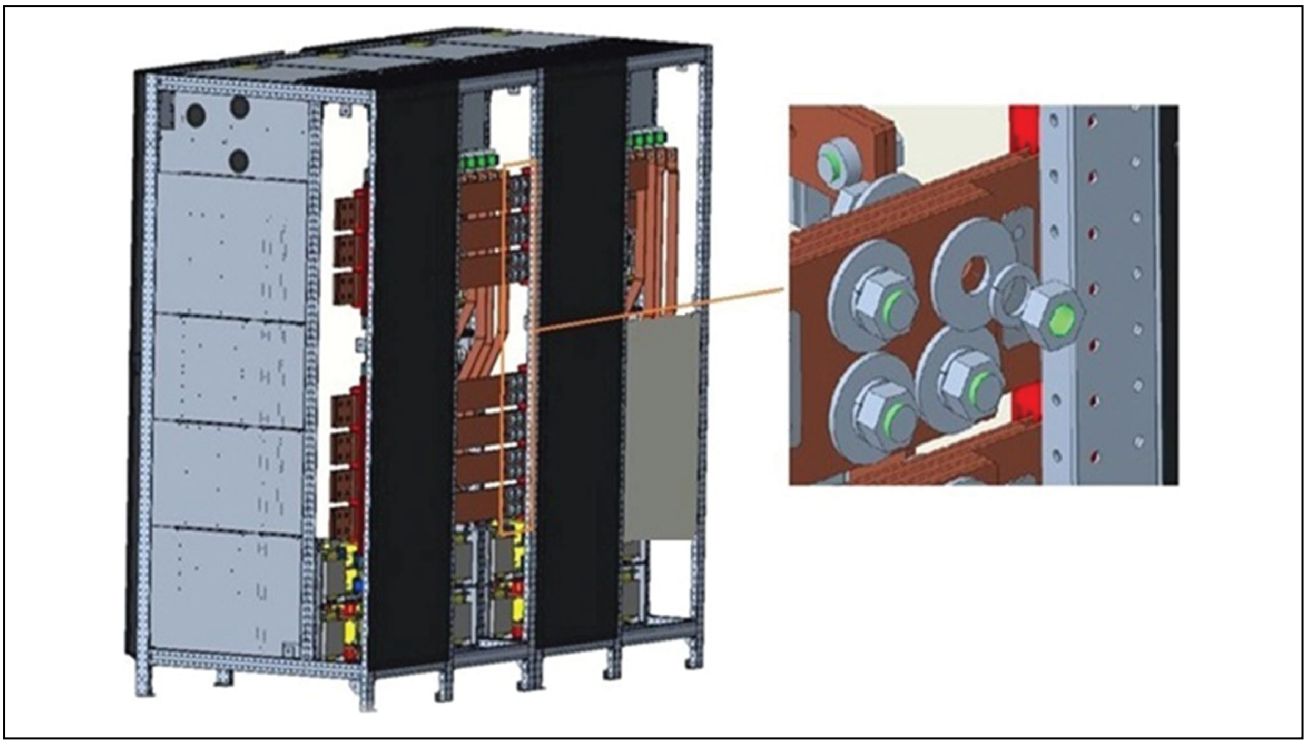


Figure 3.14 Rear View, Mechanical Rear Securing System of the 2-core Cubicles together



9. Mount and electrically connect the 2 cores cubicles together, bolting the copper busbars. Use n. 28 full bolts M16x55 made of hexagonal head screws with flat wide washers, split washers and nuts. It is mandatory requested to follow the assembly of the bolts with the nut on the external back side of the Cores and the screws inserted from the inside of Cores to the external side (**Figure 3.15** on the next page).

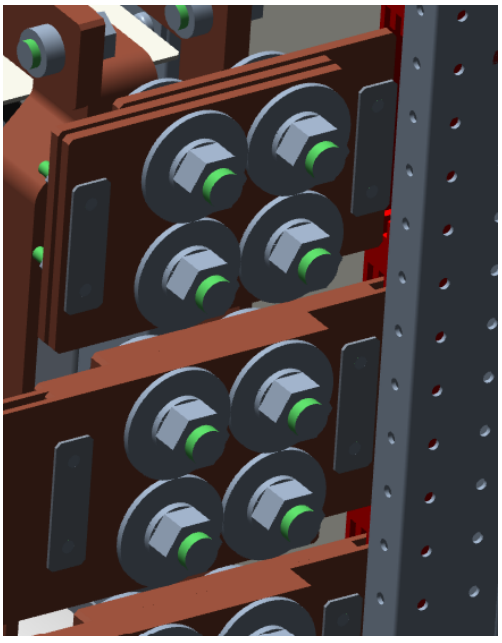
Figure 3.15 Rear View, Electrical Connection of the Copper Busbars on the Back of the 2-core Cubicles



Note that between the busbars crossing the unit and connecting a cubicle to the other, it is fundamental and mandatory to install spacers to cover the gaps and have proper electrical installation.

Spacers must be put in quantity = 1 between the 2 busbars coming from the Core cubicle close to DC Cabinet, and must be added in quantity = 2 in the other Core cubicle busbar distribution, to allow the most correct busbar placement and electrical connection. Refer to (Figure 3.16 below) for evidence and clarity; on the top of the figure only the spacers are shown, on the bottom of the figure the spacers are installed between the busbars used for the electrical distribution in the Cores. This is valid for mains input, output, and neutral connections.

Figure 3.16 Evidence and Detail of Installation of the Spacers



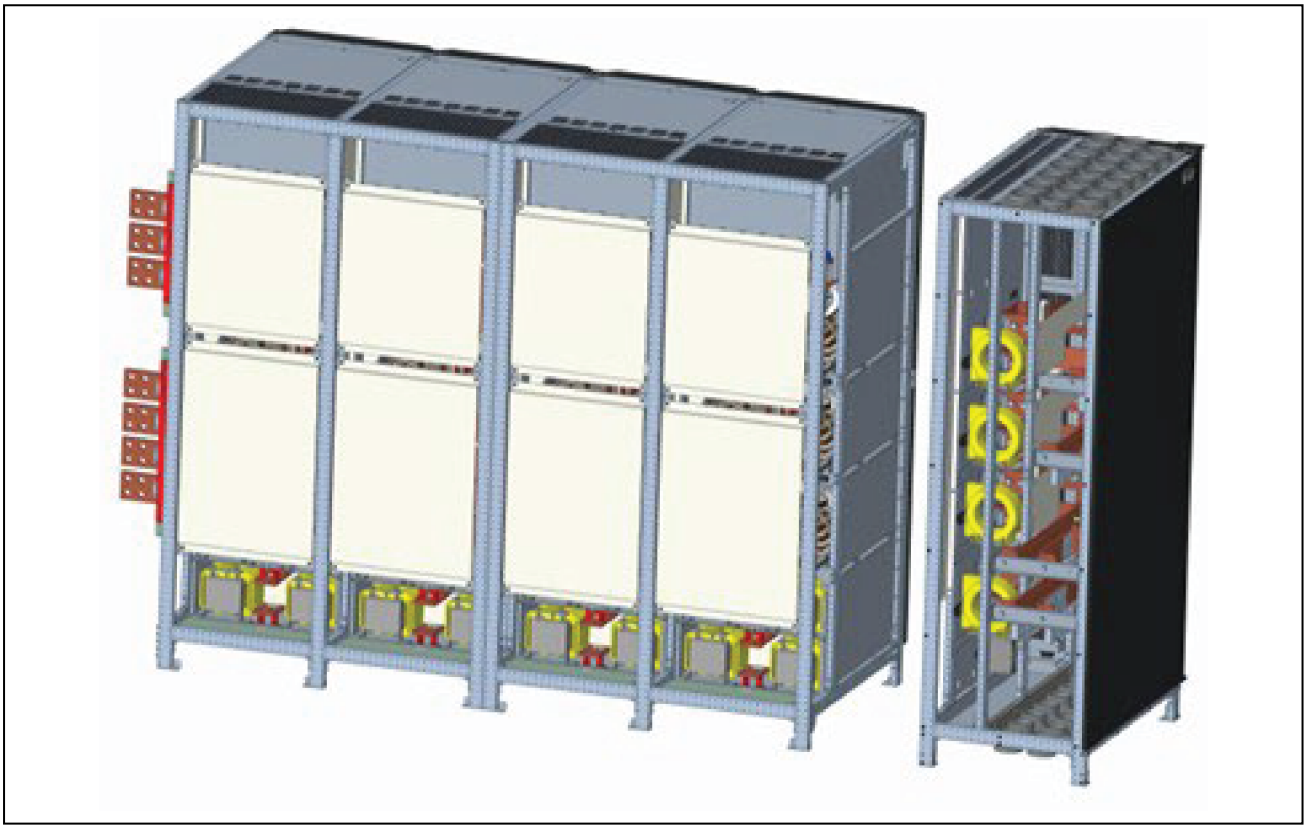
10. Reinstall lexan panels on the back of the Cores. Do not install the rear painted panels until the entire DC Cabinet installation and check is not yet completed. On the front, removed second access panels and painted panels can be reinstalled following the opposite procedure of what described in the previous steps.

Mechanical assembly of DC cabinet to the cores

The following notes explain the procedure to connect the DC cabinet to the Core cubicles. If the DC Cabinet is provided already assembled to the leftmost core cubicle, these notes can be discarded. If the DC Cabinet is supplied loose, not assembled to leftmost core cubicle, then this instruction must be carefully read and followed.

1. Unpack the DC cabinet following the instructions in Unpacking and Unloading the Cabinet from the Pallet on page 13.
2. Seeing the system from the front, the DC Cabinet must always be placed on the very left of the system that is equivalent, seeing the system from the back, as placing the DC cabinet on the right of the cores. Remove the rear painted panels from the DC cabinet and all the cores that do not yet have the panels removed. Follow the same procedure described at step 3 in Mechanical assembly of the cores on page 15.
3. In case there is a Core 5x, the DC Cabinet must always be connected to Core 2x.

Figure 3.17 Rear View, Back Panels of DC Cabinet and Cores Removed



4. Secure mechanically, both on the front and on the back, the DC Cabinet cubicle to the Core cubicle. To secure the cubicle on the back, use n.3 M8x20 hexagonal head screws with grower and flat wide washers (**Figure 3.18** on the next page). To secure the cubicles on the front, use 2 M8x20 hexagonal head screws with grower and flat wide washers (**Figure 3.19** on the next page).

Figure 3.18 Rear View, Mechanically Securing the DC Cabinet to the Core Cubicle

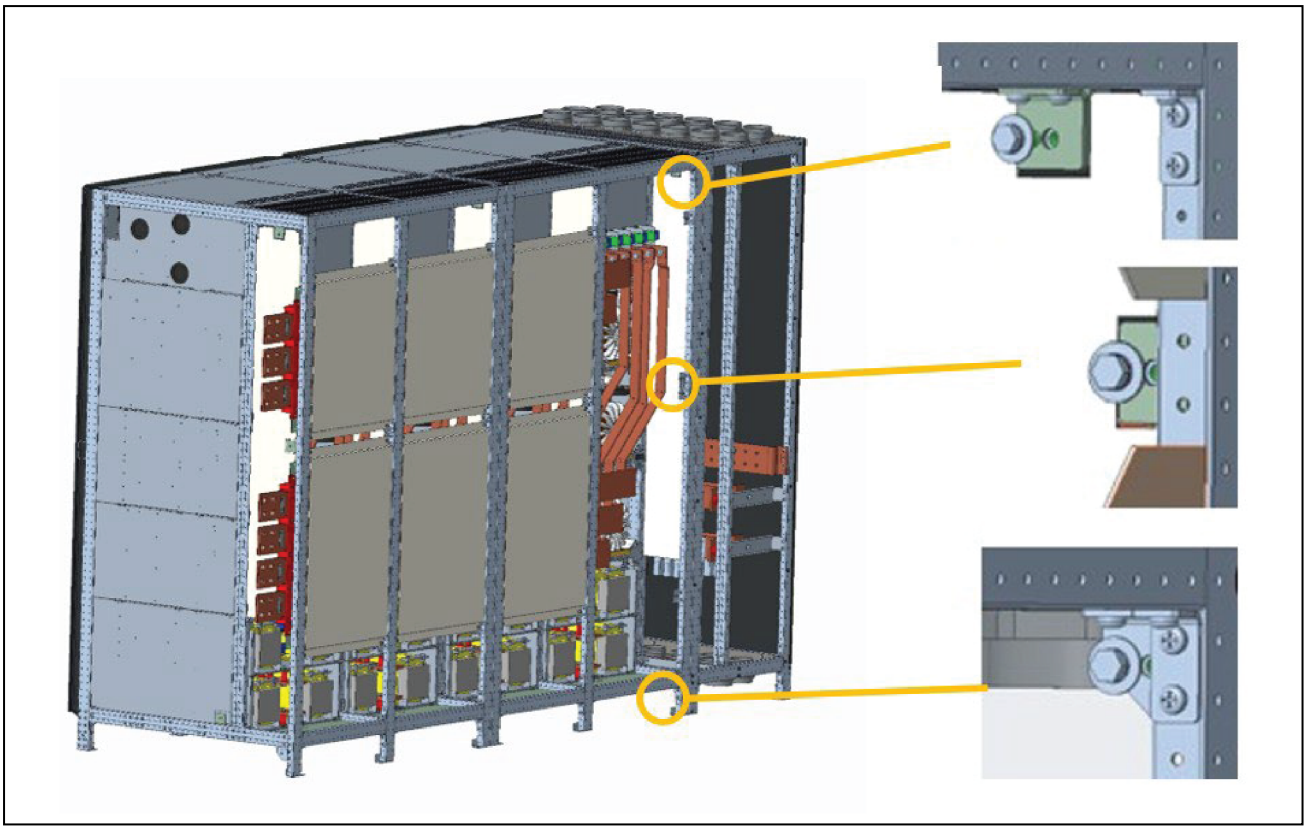
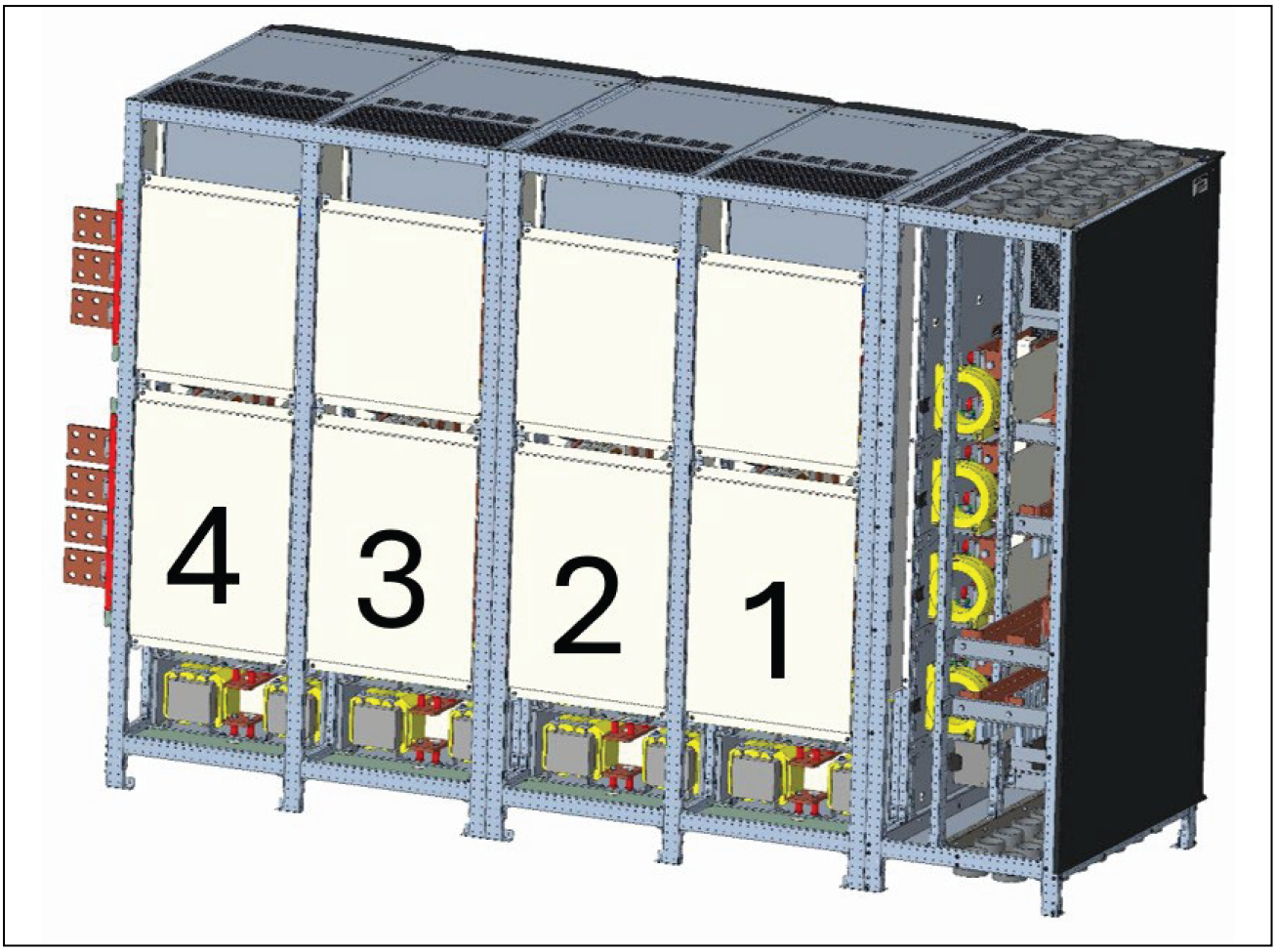


Figure 3.19 Front View, Mechanically Securing the DC Cabinet to the Core Cubicle

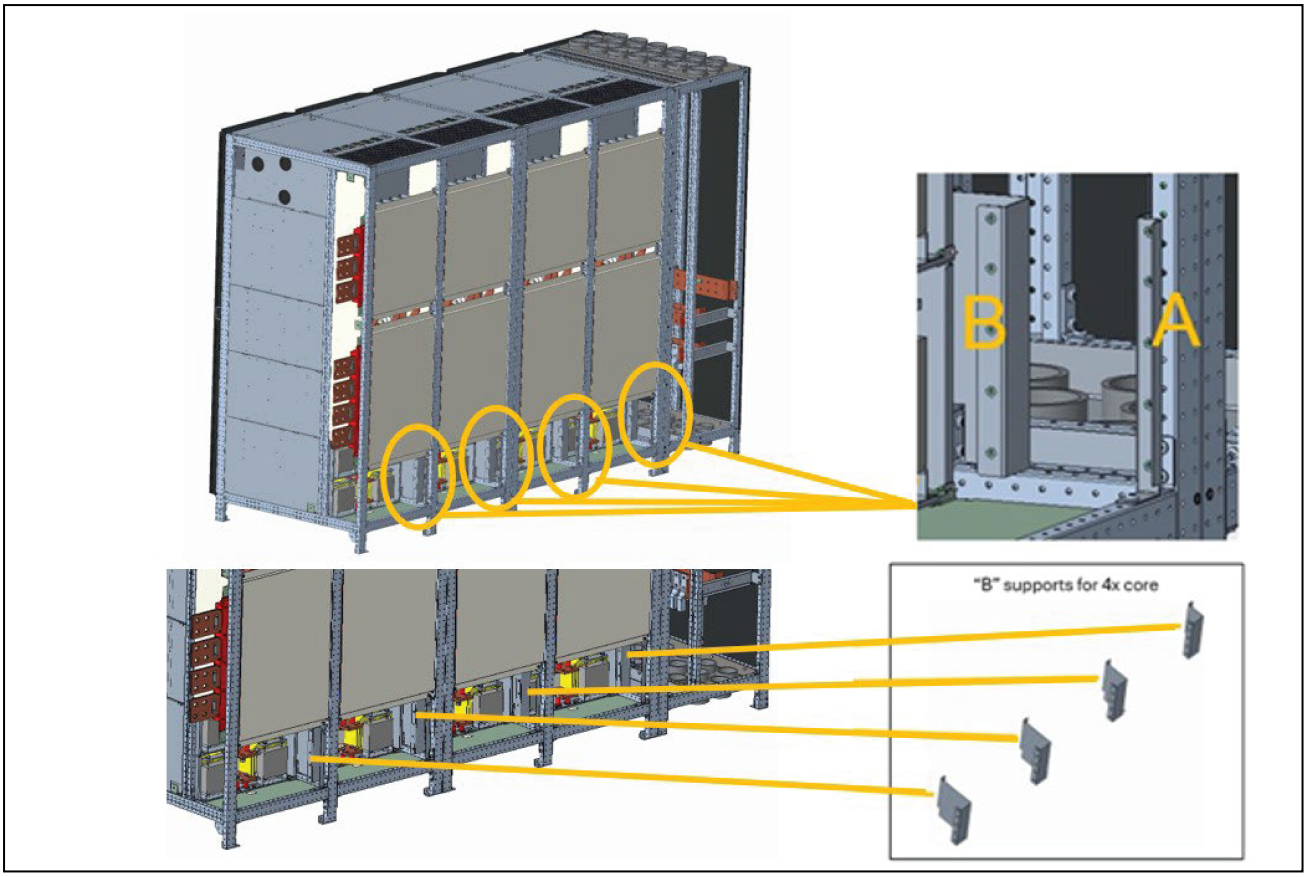
5. All the booster cells placed on the bottom of each single core must be connected to a specific couple of fuses and customer connection for the battery in the DC cabinet. Using as reference a 2MW-4Core system, the correspondence must be done as per following identification.

Figure 3.20 Rear View, Cores Identification



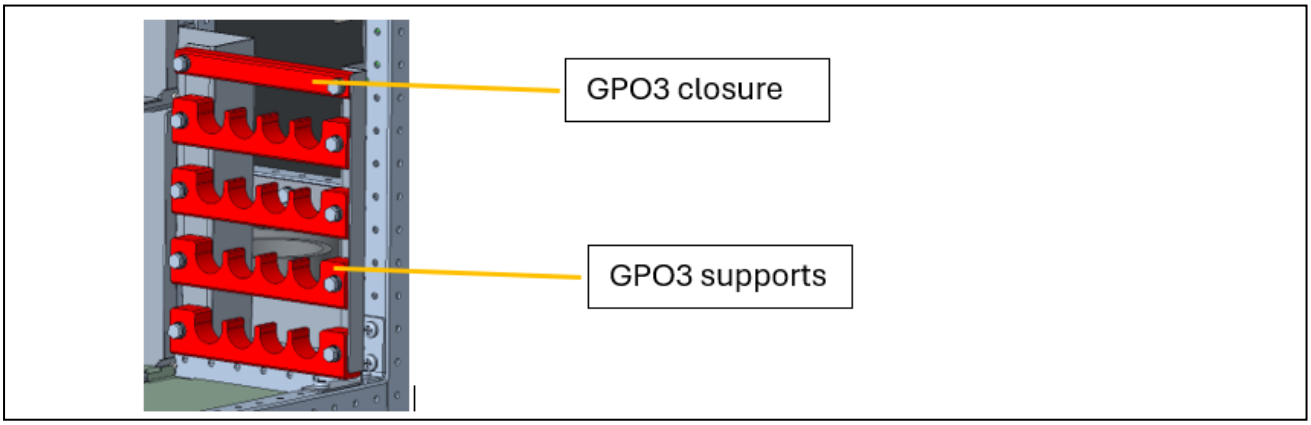
6. The power cables must be fixed to the internal bars of the DC Cabinet, as per factory pre-installation. On the core side, to support and guide the power cables, install the first metal support (A as shown in Figure 3.21 on the next page), using 3 self-tapping screws M6x12 for each. Then install the second support (B as shown in Figure 3.21 on the next page) using 4 self-tapping screws M6x12. The A supports are identical for all cores while to identify the correct B metal support for each core, the shortest support must be installed on core 1. From core 2 up to the last core furthest from the AC cabinet, install supports with progressively increasing lengths.

Figure 3.21 Rear View, Placement of the First Metallic Support for the Power Cables



7. After installing all metal supports, proceed with mounting the GPO3 supports. On each core, it is necessary to mount n.4 GPO3 supports and n.1 GPO3 closure as shown in Figure 3.22 below. To identify the correct GPO3 support for each core, the widest one must be mounted on core 1. For cores 2 through the furthest core from the AC cabinet, install supports with gradually decreasing width.

Figure 3.22 Example of GPO3 Support Installation for Core 1(for 4x Cores Unit)



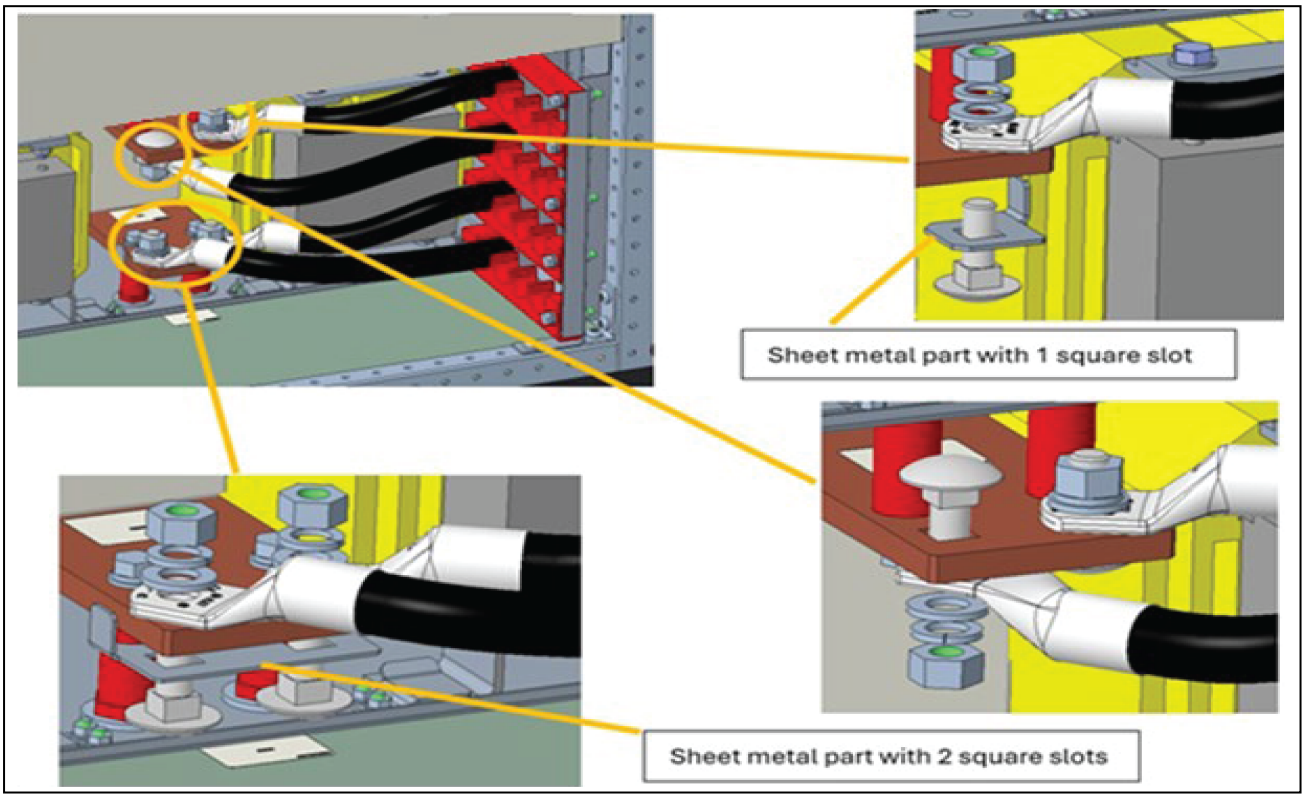
8. Connect the power cables from the DC Cabinet to the specific Core DC busbars, passing through the specific GPO3-vetronite support. as shown in the Figure 3.23 on the facing page.

WARNING! Ensure the proper cable connection. Check the electrical connection to warranty the connection and continuity between positive and negative connections from the DC booster of the core to the DC Customer connection on the DC Cabinet.

Secure the power cables to the DC Boost busbar connections using n.4 M12x35 Round Head Sq Neck bolts with flat washer, grower and nut. As shown Figure 3.23 below, mount the two sheet metal parts. These two metal sheet components serve as rotation end stops for the cable lug to maintain safe clearance between the cable lugs and other live parts. Pay attention to their orientation. For the correct screw insertion direction, refer to what is shown in the Figure 3.23 below.

Always verify and ensure that positive cables are connected to the positive connection bar and negative cables to the negative connection bar. Do not bend cables excessively. Apply correct tightening torque when securing cables to bars.

Figure 3.23 Rear View of Core 1, Power Cables Routing



9. Route the 4 cables to be connected to core 2 straight through the GPO3 supports of core 1 and core 2. See Figure 3.24 below for reference. Connect the cables to the copper bars following the same procedure used for core 1. Repeat the installation procedure for the remaining Cores.

WARNING! Consider all requirements and warning notes mentioned in the previous points

Figure 3.24 Rear View, Core 2 Connection

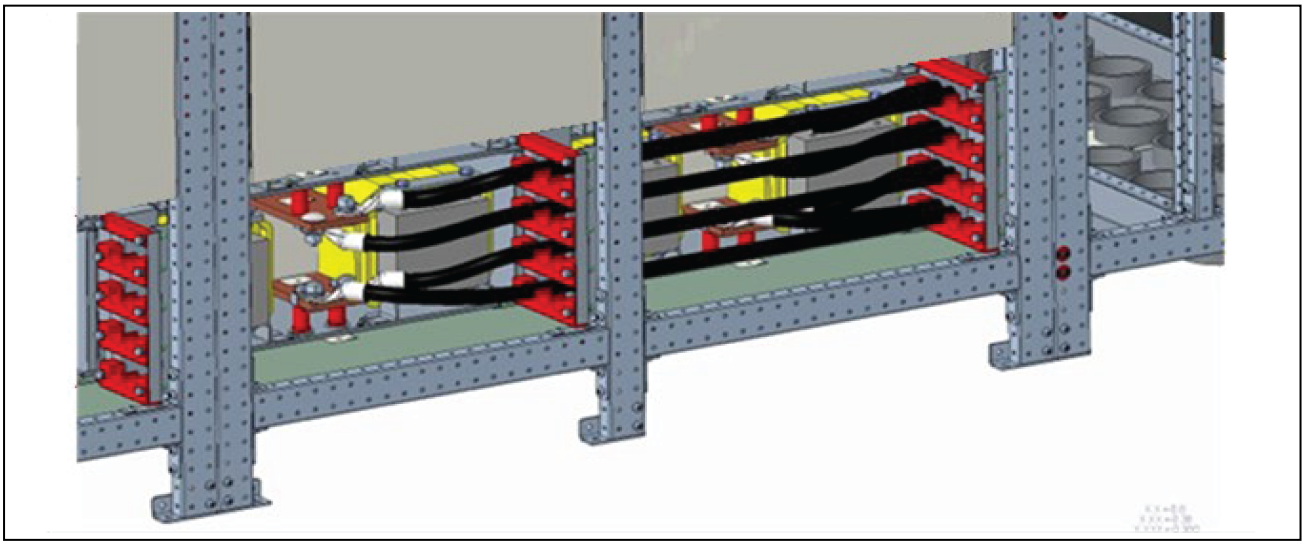
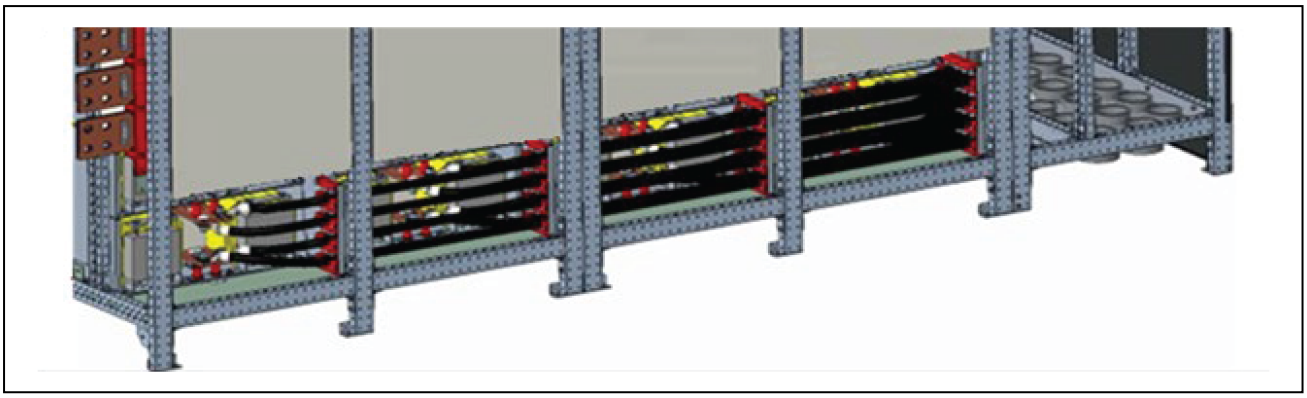


Figure 3.25 Rear View, Final Layout DC Cable Connection to Cores



10. When the entire cable assembly is completed, install the Core Lexan panels if removed (reverse process of step 3). After the installation of Lexan covers, the painted external back panels can be mounted and secured to the cubicle using the provided screws and washers.

Mechanical assembly of static switch cabinet to the cores

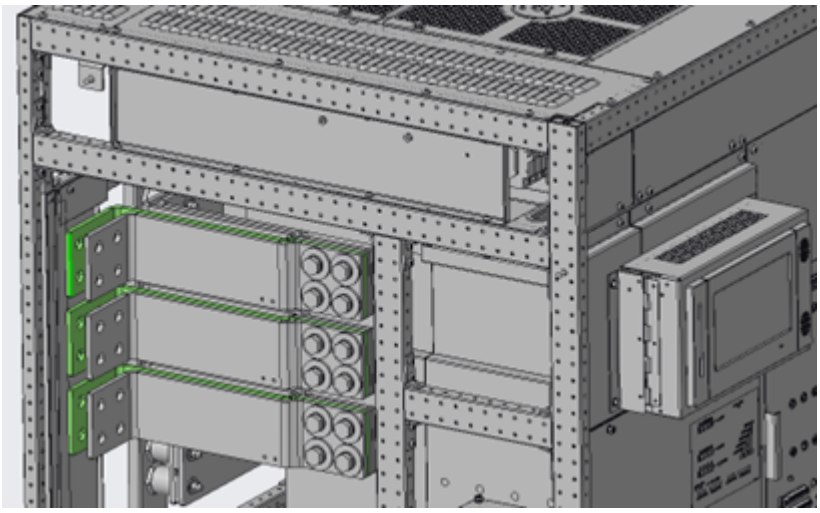
1. Unpack the Static Switch Unit cabinet following the instructions in Unpacking and Unloading the Cabinet from the Pallet on page 13.
2. Together with the Static Switch unit, there are copper busbars provided loose, or provided not firmly secured to the STS unit, but connected on the busbars to be matched to the cores.

   Identify the busbars as per following details:

   a. 3x busbars with captive nuts and long protrusion to the front must be mounted on the back of the top 3 phases busbars connections. These 3 busbars are identical and have a little Z-bend on the front of the long side.

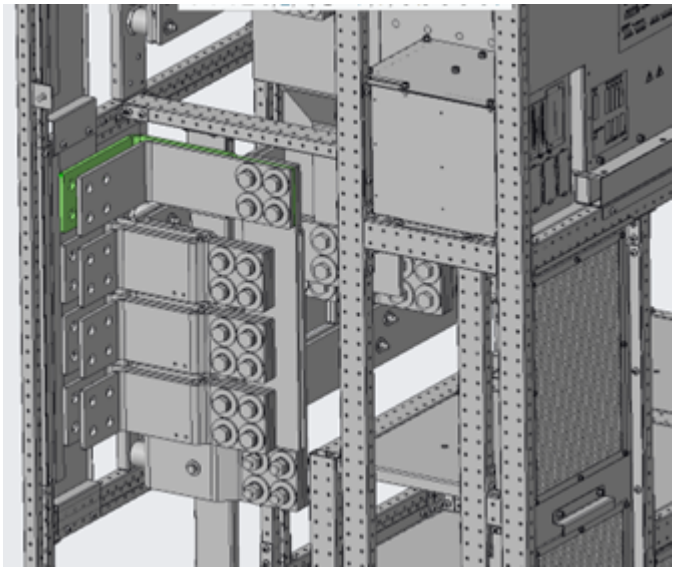
      3x busbars with similar shape, but without captive nuts, must be mounted on the front of the core busbars, on the same 3 phases.

Figure 3.26 Left-front Side View of the STS; Identification of the Busbars to be Removed and Assembled to Cores



   b. One single busbar with captive nut, L-shaped with long protrusion to the front must be mounted on the back of the top-lower busbar connection. One single busbar with similar shape, but without captive nuts, must be mounted on the front of the core busbar, on the same copper connection.

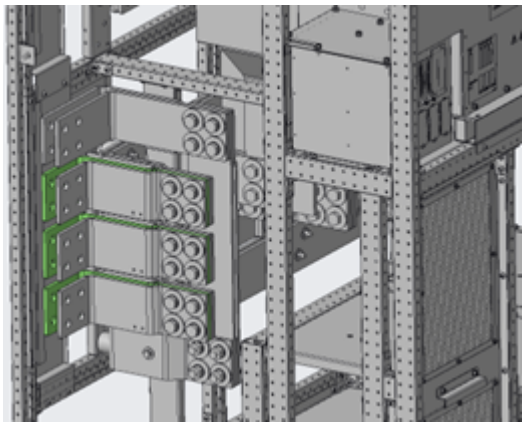
Figure 3.27 Left-front Side View of the STS; Identification of the Busbars to be Removed and Assembled to Cores



c. 3x busbars with captive nuts and short protrusion to the front must be mounted on the back of the bottom 3 phases busbars connections. These 3 busbars are identical and have a little Z-bend on the front of the long side.

   3x busbars with similar shape, but without captive nuts, must be mounted on the front of the core busbars, on the same 3 phases.

Figure 3.28 Left-front Side View of the STS; Identification of the Busbars to be Removed and Assembled to Cores



Use M16x65 hexagonal head screws with grower and flat wide washers to secure the entire busbar assemblies (Figure 3.29 on the next page).

Figure 3.29 Front Side View, Final Installation of Copper Bars from STS to Cores

Note that between the busbars connecting the Core cubicle to the STS there are gaps necessary for the correct distribution on the back of the Cores. When these are connected to the STS, these gaps must be closed sing spacers, and it is fundamental and mandatory to install them to cover the gaps and have proper electrical installation.

On the Core to be connected to the STS, the spacers must be installed in accordance with the provided Copper kit to be used to link and electrically connect the Core to the STS. This configuration may vary in accordance with the number of installed Cores and the rating of the STS.

Figure 3.30 Rear-right Detail of the Assembly Core 3x to be Installed to STS. One Small, Squared Spacer to be Put on the Back

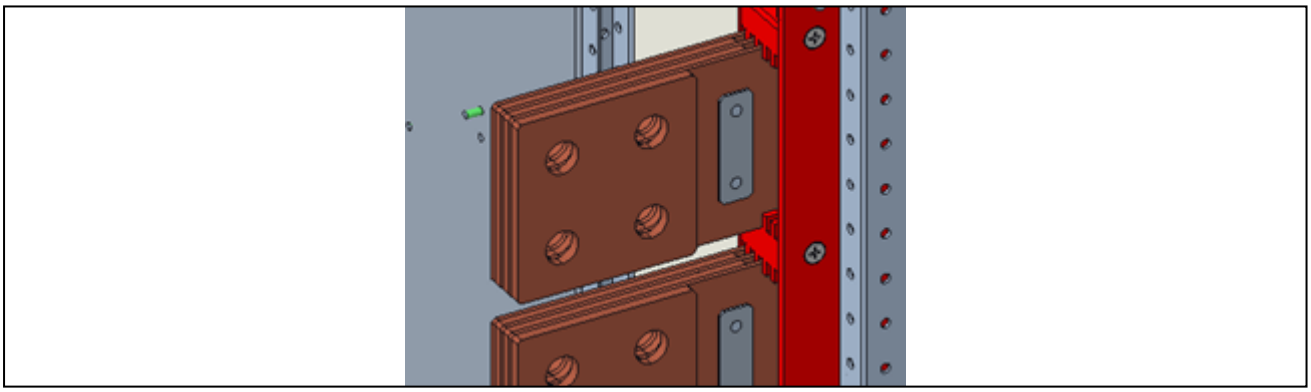
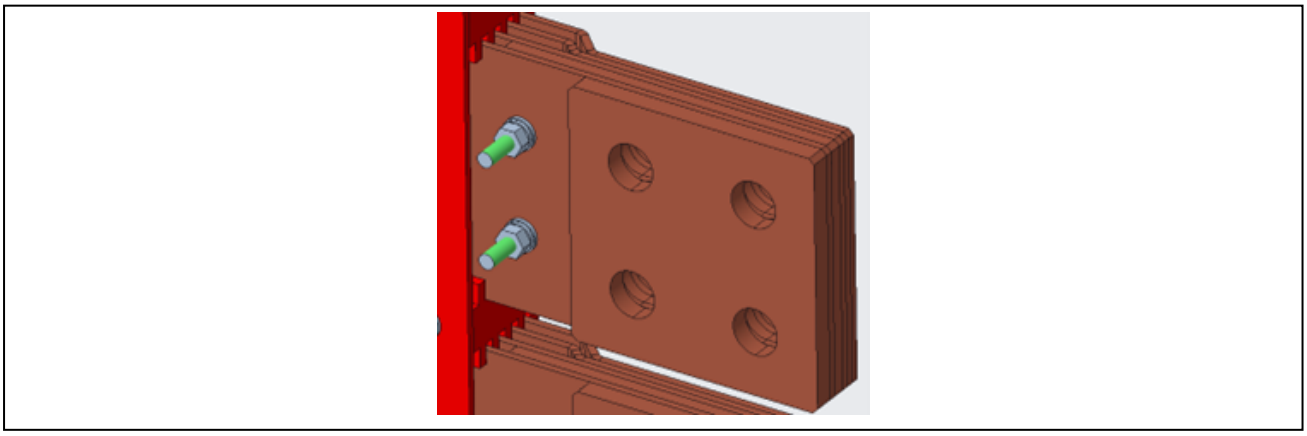
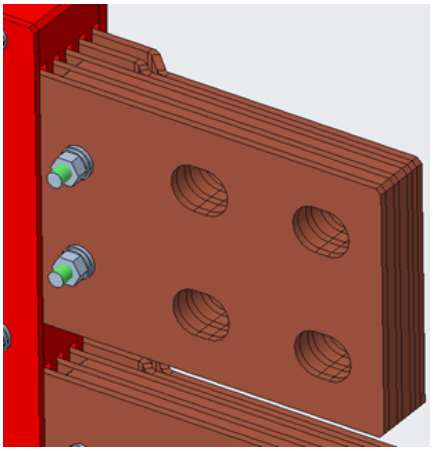


Figure 3.31 Front-Right Detail of Two Core 2x Units Assembled for Installation to the Static Transfer Switch



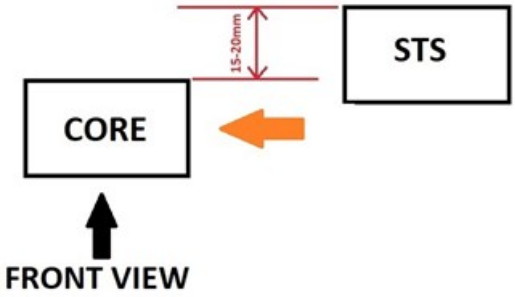
NOTE: Install one small, squared spacer on the front busbar connection and one longer spacer between the busbars.

Figure 3.32 Front-Right Detail of Core 2x and Core 3x Units Assembled for Installation to the Static Transfer Switch

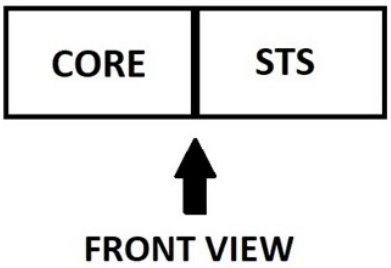


NOTE: Install two long spacers between the busbars to cover the gaps.

3. To secure and connect the STS unit to the core, move the STS unit as close to the core as possible, paying attention to align it to the cores, moving it from right to left (orange arrow in the figure below), keeping an offset between 15 mm and 20 mm between the back panels of cores and STS unit.

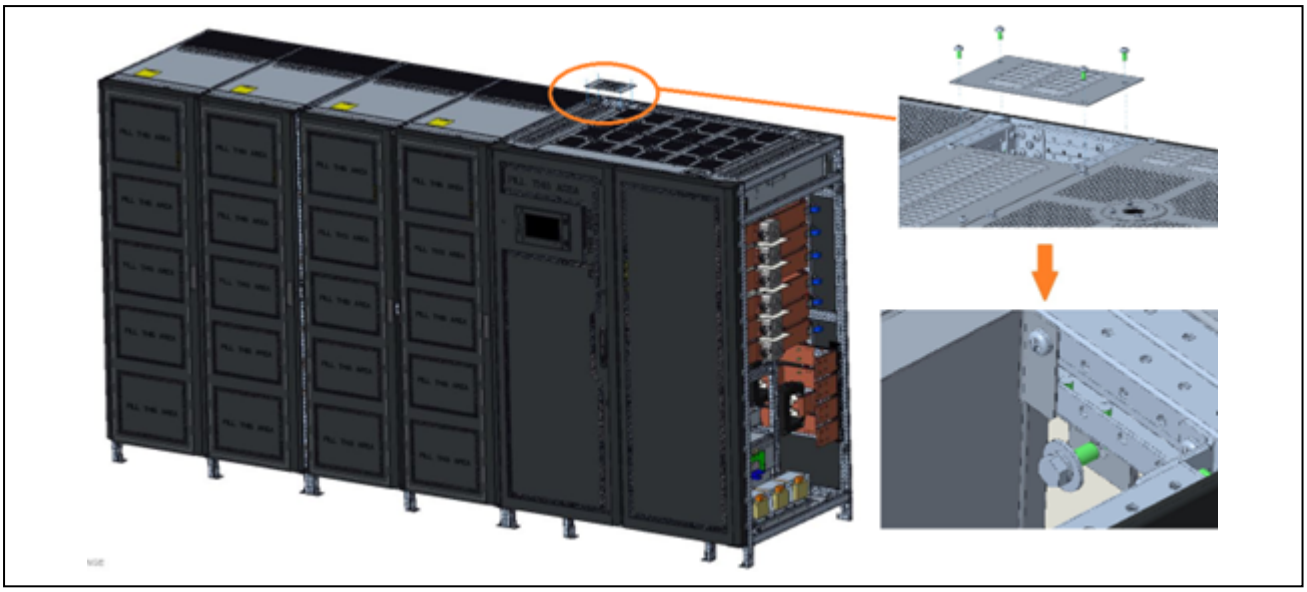


When the left side of the Core cubicle is matched with the right side of the STS cubicle, then align the front side of the STS to the front side of the Cores. Handling should be done moving the STS towards the front; this allows the STS cabinet being aligned in all the directions to the Cores, and in having the most correct and properly matching of all the internal busbars in any direction.



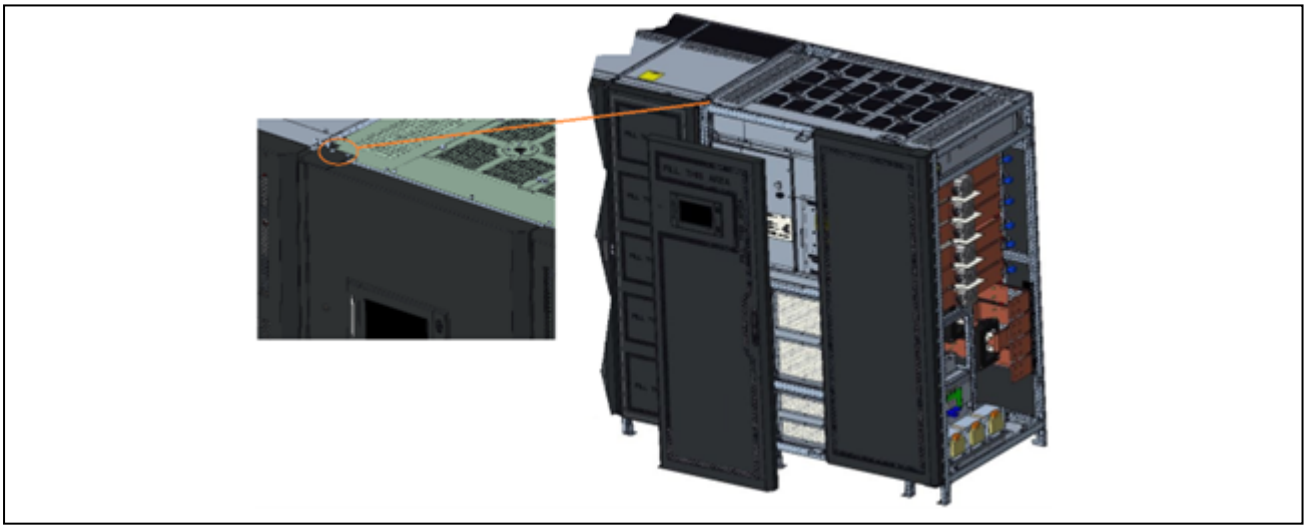
4. To secure mechanically the STS unit to the core cubicles, 5 mechanical connections should be done between the 2 units. The very first to be done is suggested to be the one on the top-back of the STS unit cubicle. Remove the top rear closure panel from the STS unit, unscrewing it from the cubicle. On the lateral side, between STS and Core cubicles, there is a specific flange to be used to secure together the cubicles using M8x20 hexagonal head screw with grower and flat wide washers.

Figure 3.33 Front Isometric View, Top Rear Panel Removal and Mechanical Connection of the Cubicles



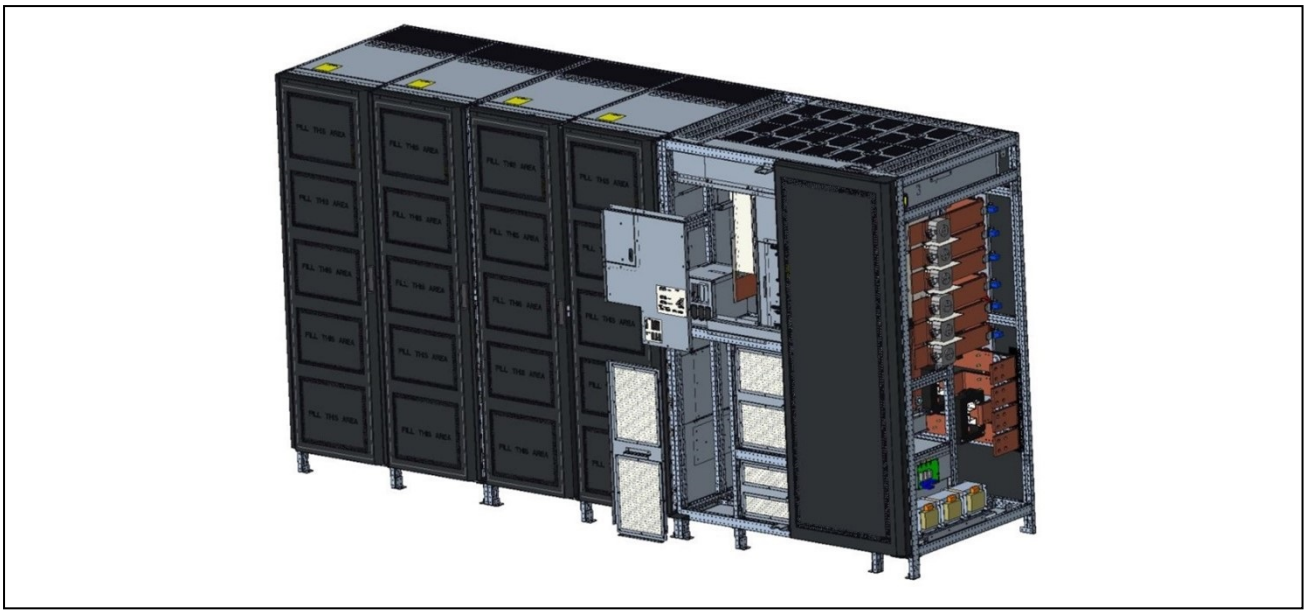
5. To complete the other 4 mechanical connections, remove the left-front painted door. To do this action it is not necessary to remove the top hinge securing the painted door to the cubicle. It is simply enough to make the 3 screws that are securing the hinge getting a little loose and not properly tightened, to let the door be removed from the top-hinge pin blocking the door to the structure.

Figure 3.34 Front Isometric View, Left Painted Door of STS Removed



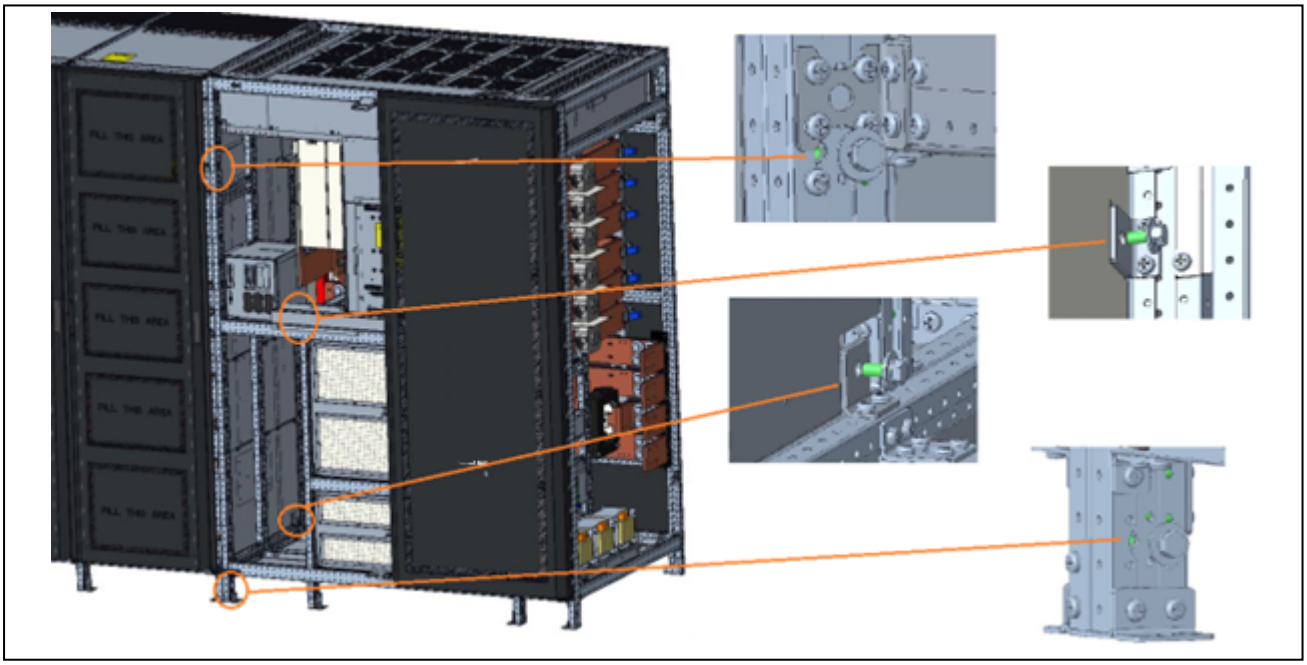
6. Remove the very left STS cubicle second access panels, removing the screws securing the to the mounting cubicle and to the rest of the structure. Panels to be removed are highlighted in below figure.

Figure 3.35 Front Isometric View, Left-sided STS Second Access Panels Removed



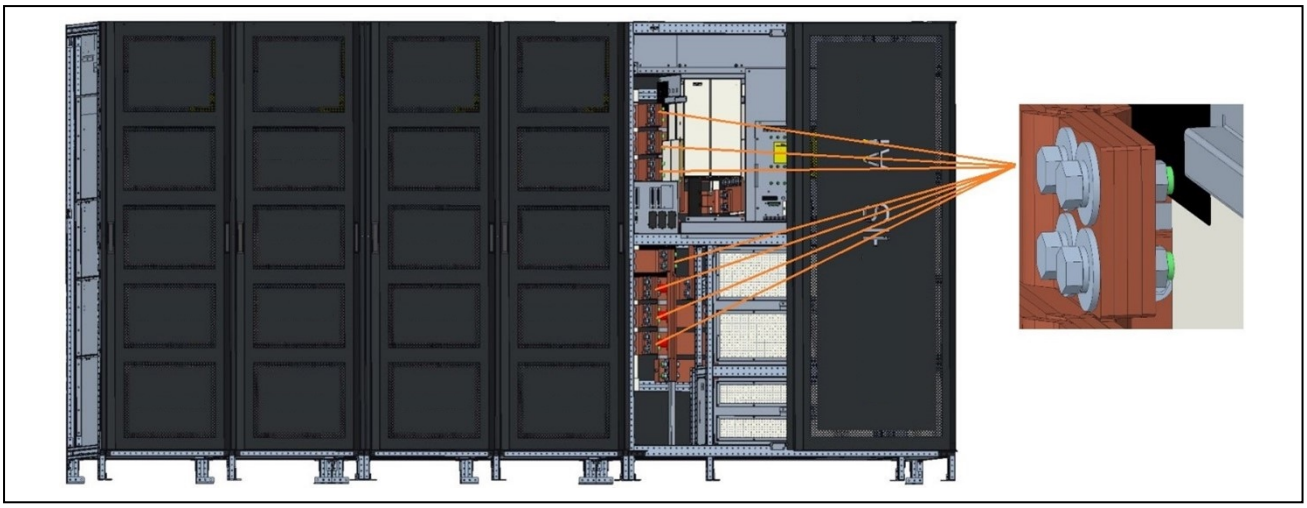
7. Secure the STS cubicle to the Cores cubicle in the other 4 mounting points, that are now accessible on the internal left side of the STS, using M8x20 hexagonal head screws with grower and flat wide washers. Two fastening points are on the front mounting, one on the top at eyes height, and one on the very bottom, at feet height. The other two fastening points are on the back-left of the unit, one close to the bottom closure panel, and one at the middle height of the unit.

Figure 3.36 Front Isometric View, Mechanical Fastening Points Accessible from the Front



8. The electrical connection between the STS and the Core units is done bolting together the busbars that were required to be properly assembled and aligned in the previous steps. With the same front access used to fasten the cubicles, install on the copper busbars the M16x55 hexagonal head screws with grower and flat wide washers, 4 bolts for each copper busbar connection.

Figure 3.37 Front Isometric View Electrical Connections between STS and Cores



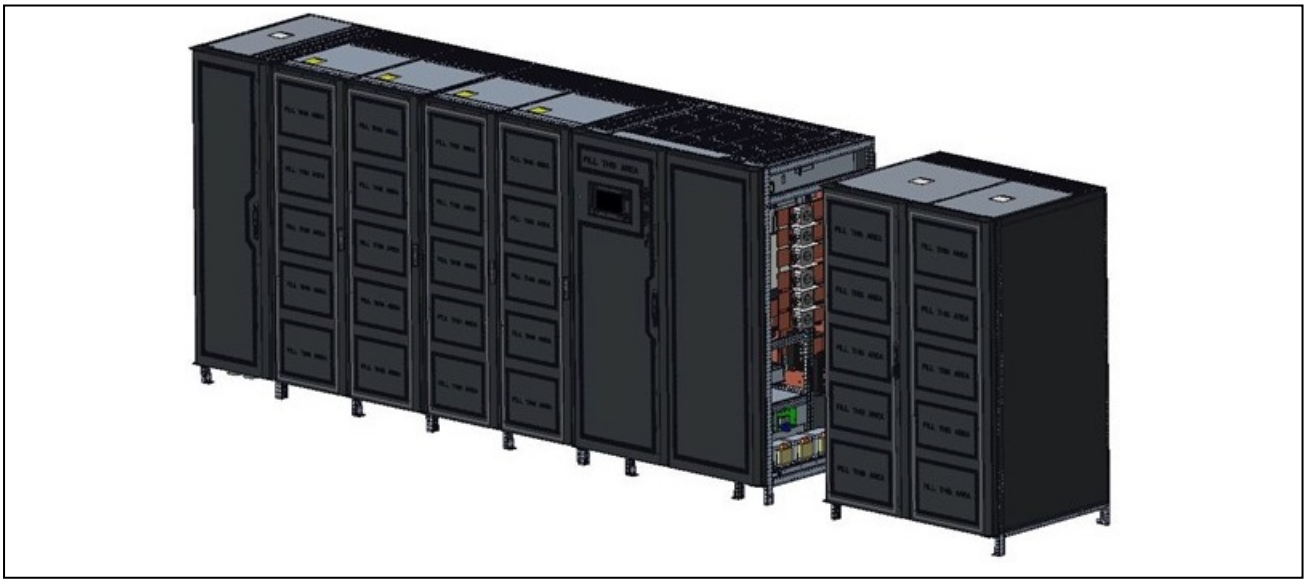
9. Reinstall the top cover closure panel, all the second access panels, and the front-left painted door to ensure the unit is correctly restored to its required conditions.

Mechanical assembly of AC Input/Output (AC IO) cabinet to the STS unit

The unit may be provided with an AC cabinet dedicated to the customer power connections for 3-phase mains input, 3-phase bypass input, 3-phase output, grounding, and eventually neutral connection, basing on the relevant destination market requirements.

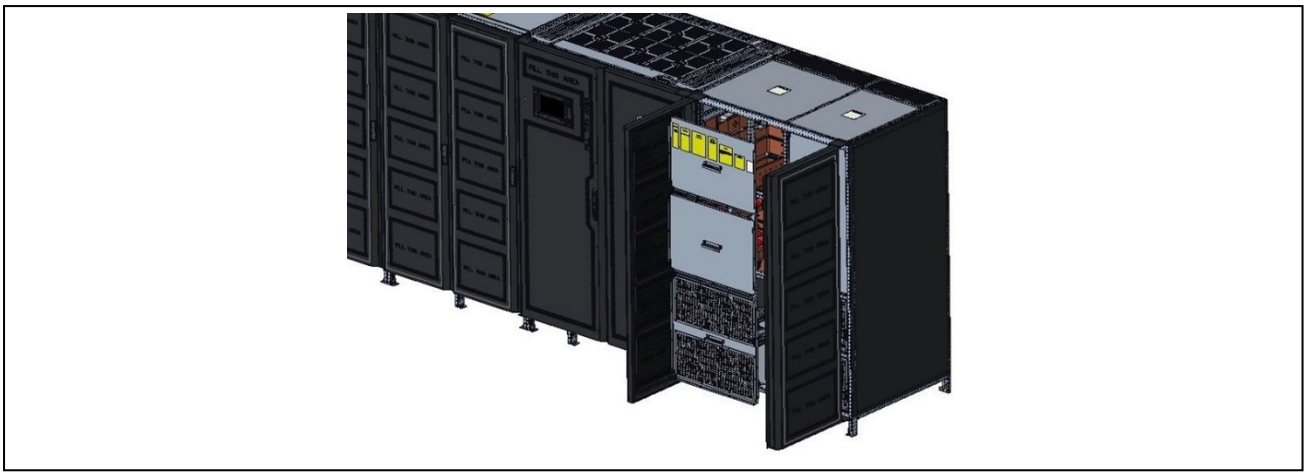
1. Unpack the Static Switch Unit cabinet following the instructions in Unpacking and Unloading the Cabinet from the Pallet on page 13.
2. Place it close to the STS unit, aligning it both on the lateral side and to the front.

Figure 3.38 Front View, AC Cabinet Handling



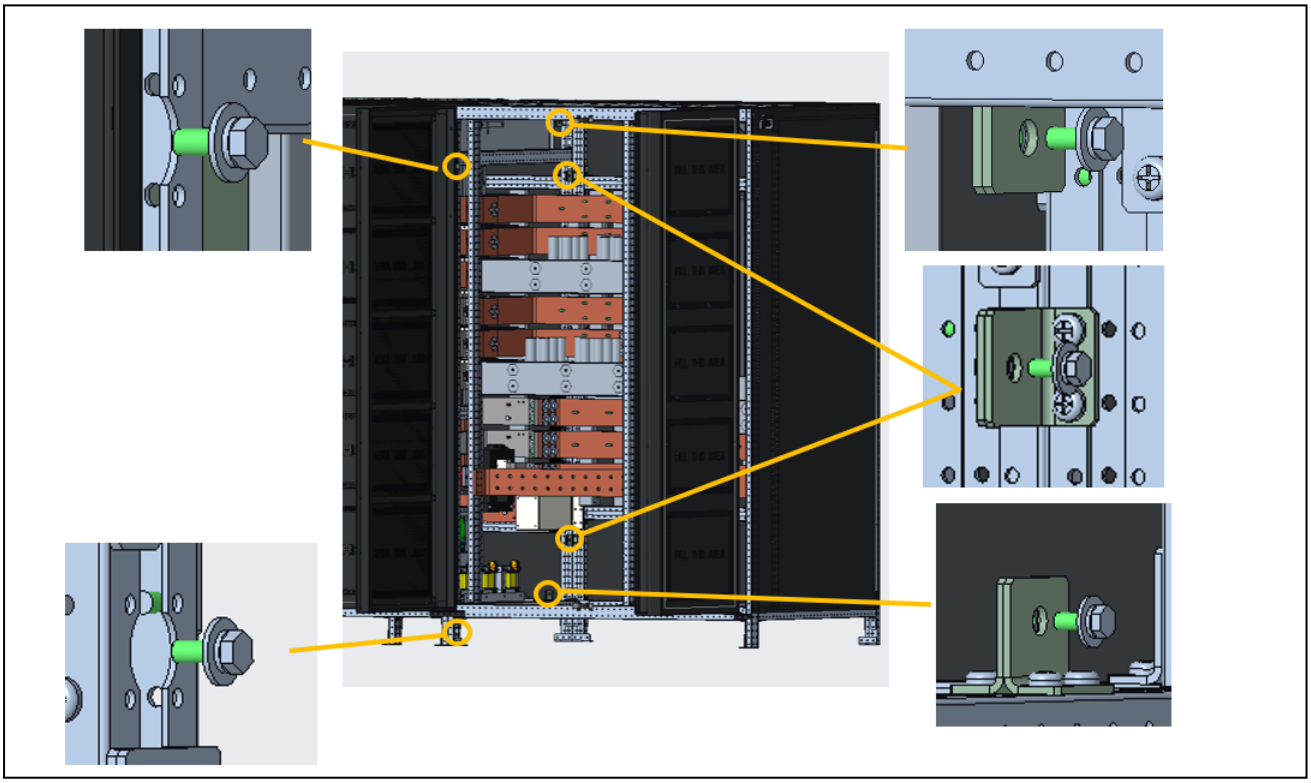
3. Open the doors and keep them open, or, otherwise, remove the left side painted door as per previous step 25. Remove the second access panels present on the left of the cubicle.

Figure 3.39 Removing AC Cabinet Second Access Panels



4. Secure the AC IO cubicle to the STS cubicle using the 6x available mounting points, using M8x20 hexagonal head screws with grower and flat wide washers. Two fastening points are on the front mounting, one on the top at eyes height, and one on the very bottom, at feet height. Other four fastening points are on the back of the unit, one close to the bottom closure panel, and one at the middle height of the unit. The last two fastening points are located close to the top and bottom closure panels, close to the back of the unit.

Figure 3.40 Front View, Mechanical Fastening of the AC IO to the STS



5. The electrical input connection between the AC cabinet and the STS unit is made by securing the 3 main power busbar connections and the 3 bypass busbar connections to the fuses in the STS unit. Before proceeding with the tightening, it is necessary to verify that the copper busbars perfectly match with the STS fuses. If the alignment is correct (as shown in Figure 3.41 on the next page) proceed with tightening using M10 captive screws/threaded grub screws with related hardware, applying the correct tightening torque without straining the fuses. If the copper busbars and fuses are not aligned (as shown in picture Figure 3.42 on the next page) it is possible to correct the position of the copper busbars. By loosening the screws and nuts that secure the AC cabinet busbar to be adjusted (Figure 3.43 on the next page shows an example of the screws to be loosened for a single phase), adjustment can be made. As shown in Figure 3.44 on page 35, which provides an illustrative example, the connecting busbars are equipped with slots that allow horizontal translation, thus enabling the correct coupling with the fuses. If the busbars need to be translated, the screw on the Sheetmetal support (marked in red in Figure 3.43 on the next page) must be removed and should not be reinstalled.

Figure 3.41 Detail of the Correct Alignment between Fuses and Copper Busbars

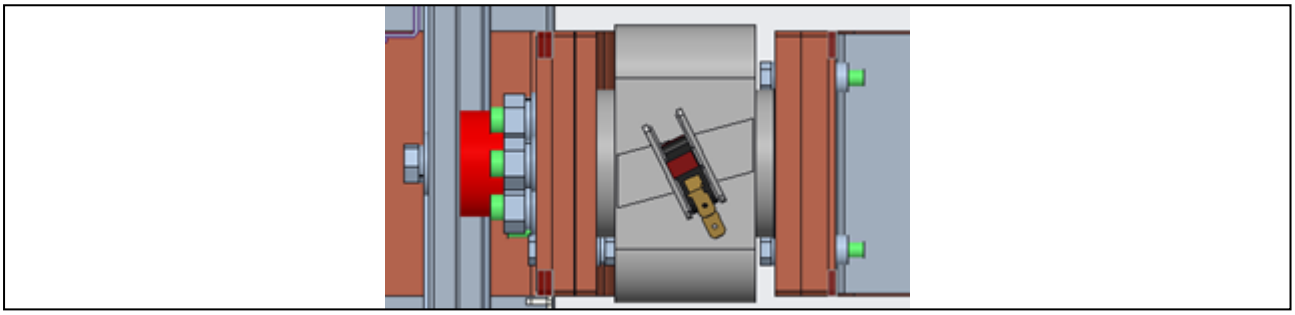


Figure 3.42 Detail of the Incorrect Alignment between Fuses and Copper Busbars

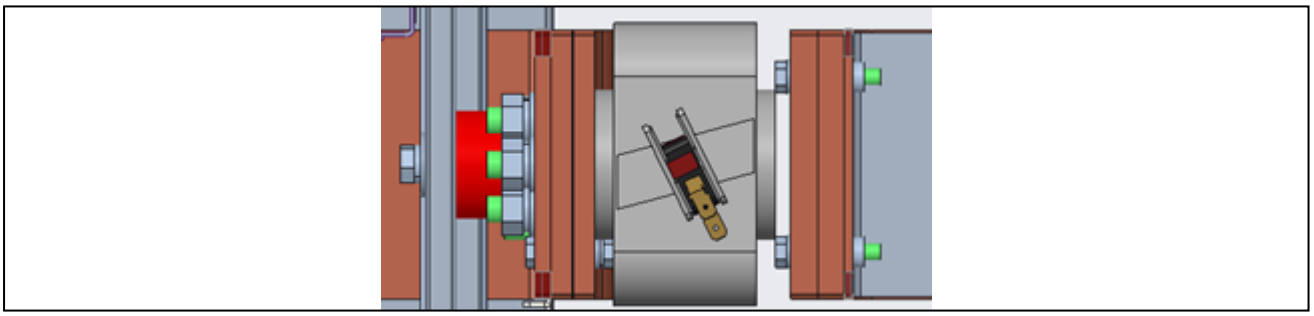


Figure 3.43 Example of Screws to be Loosened to Allow Busbar Translation

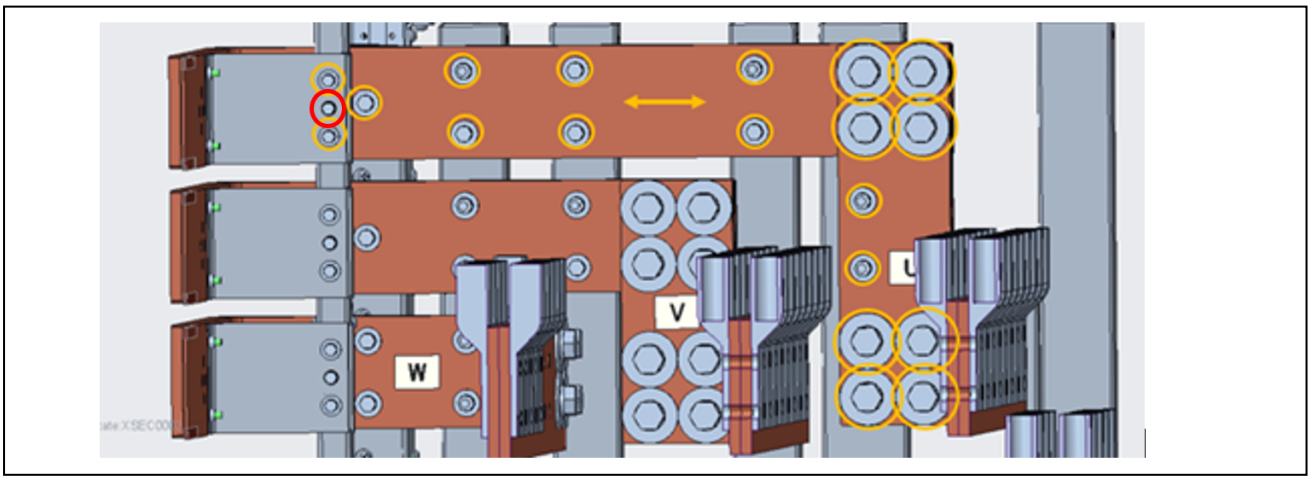
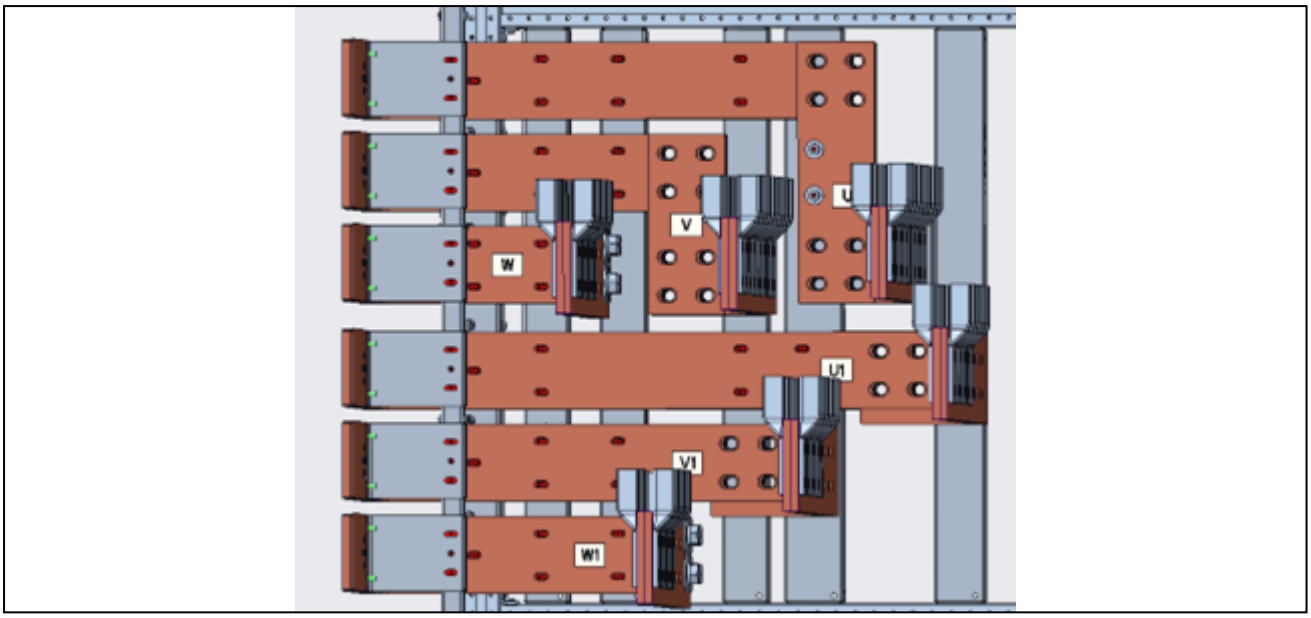
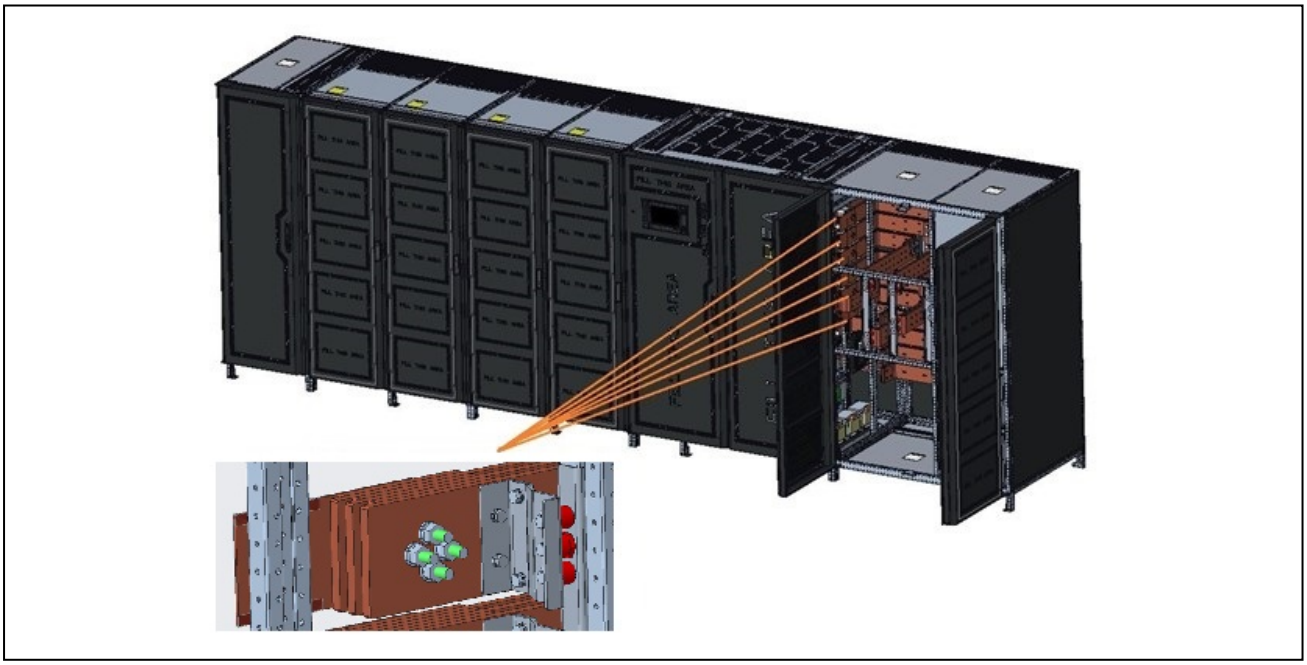


Figure 3.44 Showing Slots for the Input Busbar Translation



WARNING! Specific correct tightening torque determined by fuses manufacturer MUST be respected. Check fuse manufacturer specification and always be compliant with their requirements. E.g.: for Eaton fuse 170M7085, the set/grub screws must be tightened carefully applying a torque of 5-8 Nm. Secure the connection with M10 nut, flat and split washers. Torque must be 40 Nm, ungreased, in accordance with Bussmann specification. As a rule, the torque on the nuts relates to the threaded hole dimension in the fuse contact. A calibrated torque wrench with a tolerance of maximum ±4 percent is recommended.

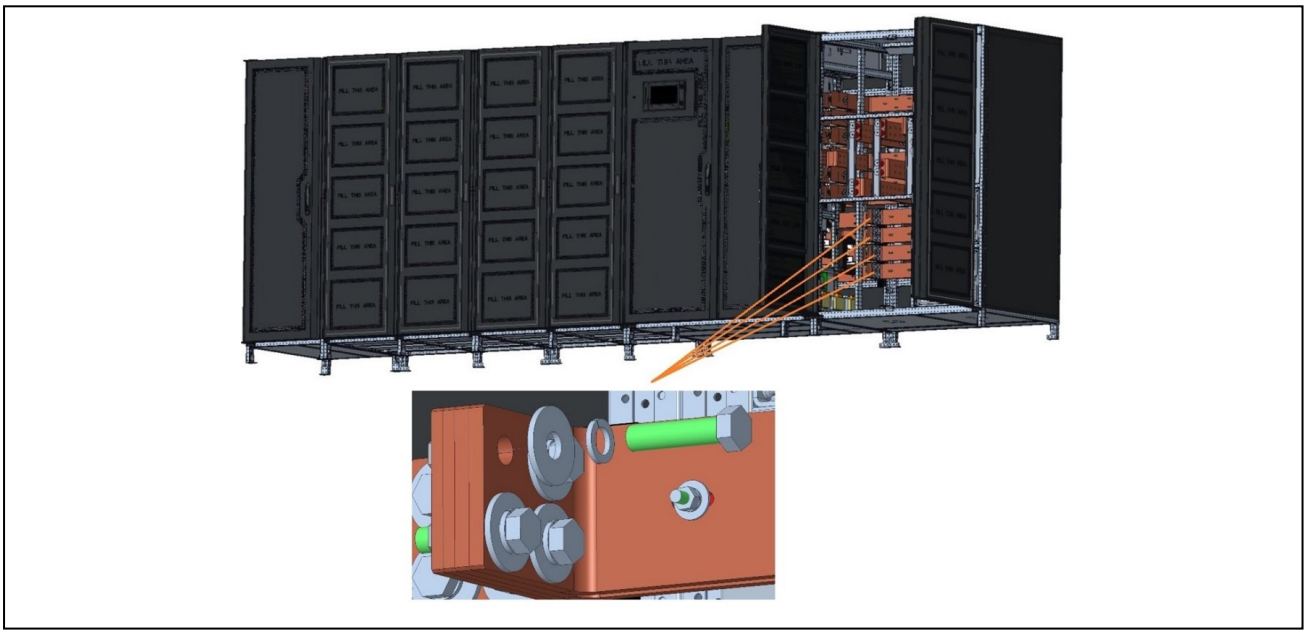
Figure 3.45 Front View, Mains and Bypass Copper Busbars Connections from AC Cabinet to the STS Fuses



6. The electrical output connection between the AC cabinet and the STS unit is made by securing the 3 output busbar connections to their corresponding busbars in the STS unit. Similar to the previous point, if the AC cabinet output busbars and the STS unit are not correctly aligned, it is possible to loosen the screws and nuts to allow horizontal translation of the AC Cabinet copper busbars (as shown in Figure 3.46 on the next page) using the available slots to achieve the correct coupling with the STS busbars. If present, the neutral electrical connection is secured by bolting together the STS busbar with its corresponding connection in the AC cabinet. Secure the copper busbars using M16 hexagonal head screws with grower and wide flat washers.

Figure 3.46 Showing Slots for the Output Busbar Translation

Figure 3.47 Front View, Mains and Bypass Copper Busbars Connections from AC Cabinet to the STS



7. Reinstall all the second access panels, and the eventually removed painted doors to ensure the unit is correctly restored to its required conditions.

Mechanical assembly of a switchgear to the STS unit

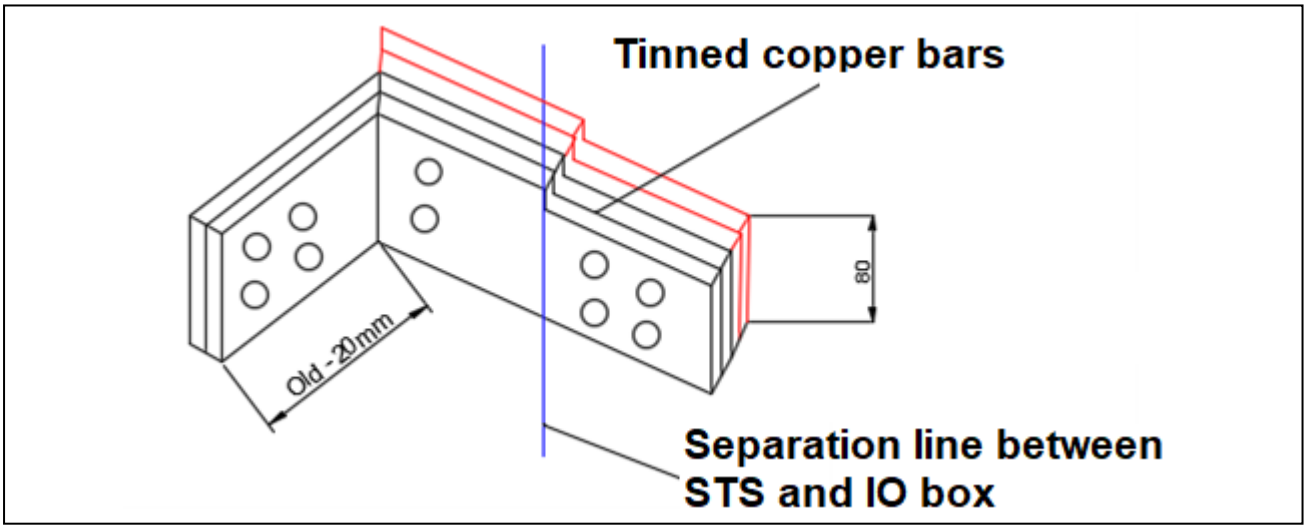
The unit may be provided without an AC cabinet (close coupling version) in case there is the need to connect it to a third party switchgear. In this case, the connection must be done directly to the mains input, bypass input fuses, to the output and neutral (only 3W+N distribution) busbars. These fuses and busbars are the ones present in the STS cubicle and must be used for any switchgear connection.

CAUTION: Specific correct tightening torque determined by fuses manufacturer MUST be respected. Check fuse manufacturer specification and always be compliant with their requirements. (e.g.: for Eaton fuse 170M7085, for ungreased surface, 4xM10 threaded connections, use 40Nm ±4% tolerance maximum at the moment of printing this manual).

Figure 3.48 Front View, Mains and Bypass Copper Busbars Connections from AC Cabinet to the STS

Available connections are:
Mains and bypass input: on each fuse, 4 connection points for M10 thread hole, 40 Nm torque as suggested by fuse manufacturer.
Output and neutral connection: on each busbar, 4 connection points with already present M16 captive nuts.

Figure 3.49 STS with Close-coupled Integration Busbars



The minimum bus bar size is 2x (10x100mm) on the fuse connection, refer to Table 8.3 on page 86 thorough Table 8.6 on page 86 for current ratings, it is recommended to size the link with 4x(80x100mm) busbars.

Coupling and PE between switchgear and UPS is guaranteed when a minimum number of screws are mounted to secure the IO frame to the STS cubicle frame. Please refer to the Switchgear manual for details. The units need to be closed when assembled and IP20 guaranteed.

The switchgear cabinet shall be marked according to the rating in Table 8.3 on page 86 thorough Table 8.6 on page 86.

The following warning shall be applied on the switchgear panel during the field installation.

Contact Vertiv Technical Support for more information.

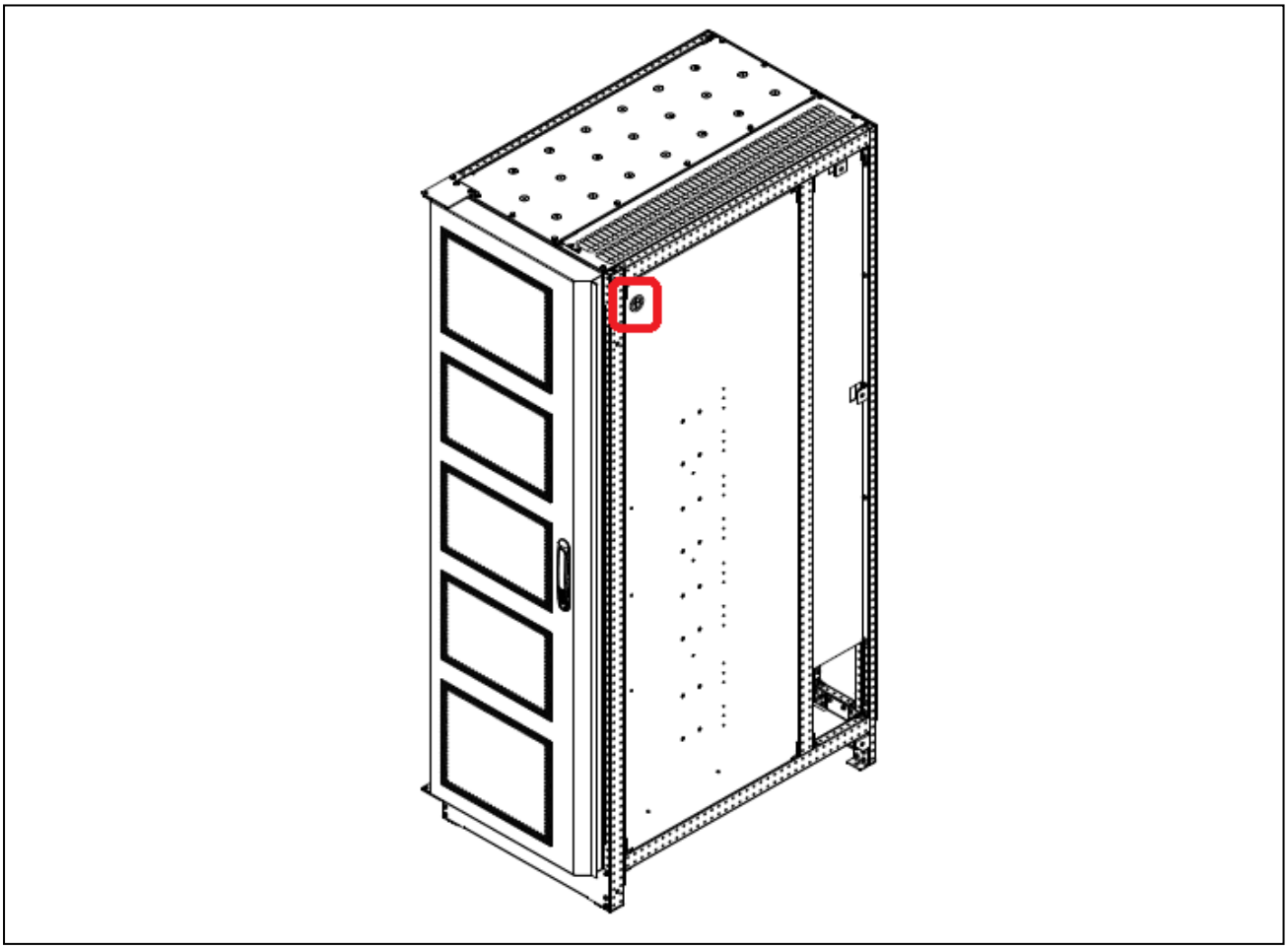
UL	IEC
WARNING HIGH LEAKAGE CURRENT Earth connection essential before connecting supply.	WARNING HIGH LEAKAGE CURRENT Earth connection essential before connecting supply.
WARNING HIGH VOLTAGE Battery circuit is not isolated from AC input. Hazardous voltage is present for five minutes after turning all power off. Wait at least five minutes as capacitors discharge and verify there is no voltage present on DC bus before working on electronics.	DANGER Hazardous voltage remains in circuit for 5 minutes after removing main power supply: see operating instruction.
WARNING ELECTRICAL SHOCK HAZARD Multiple "High Voltage" sources may be present. Disconnect from all AC and DC sources prior to servicing. See Installation Manual for wiring precautions. Failure to do so causes risk of death or serious injury.	DANGER Equipment powered by multiple power sources. Isolate UPS by switching off external disconnect devices of: mains input, bypass input and output (AC source) and all battery cabinets (DC source). DANGER Equipment powered by more than one source components live even when equipment is switched to maintenance by-pass.
BEFORE WORKING ON THIS CIRCUIT Isolate Uninterruptible Power System (UPS). Then check for hazardous voltage between all terminals including the protective earth. Risk of voltage backfeed .	BEFORE WORKING ON THIS CIRCUIT Isolate Uninterruptible Power System (UPS). Then check for hazardous voltage between all terminals including the protective earth. Risk of voltage backfeed .

3.4.2 Signal Connections

Signal connection of the DC cabinet to the system

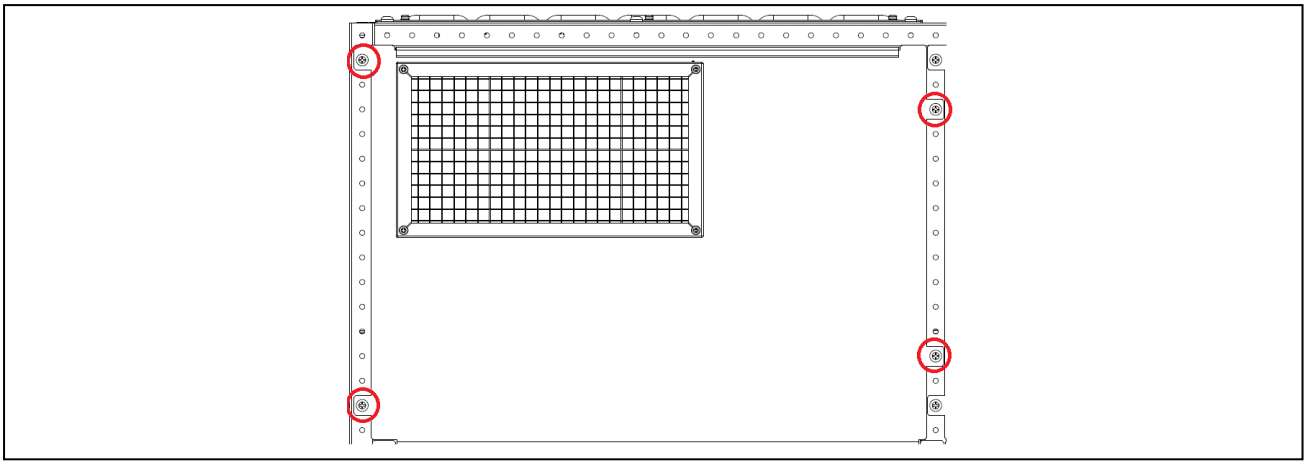
Two plugs, X30A and X50A, exit from the cable gland positioned at the top-right side of the DC Cabinet, and must be connected to the cables provided in the installation kit, having same name, X30A and X50A.

Figure 3.50 DC Cabinet Cable Gland Position



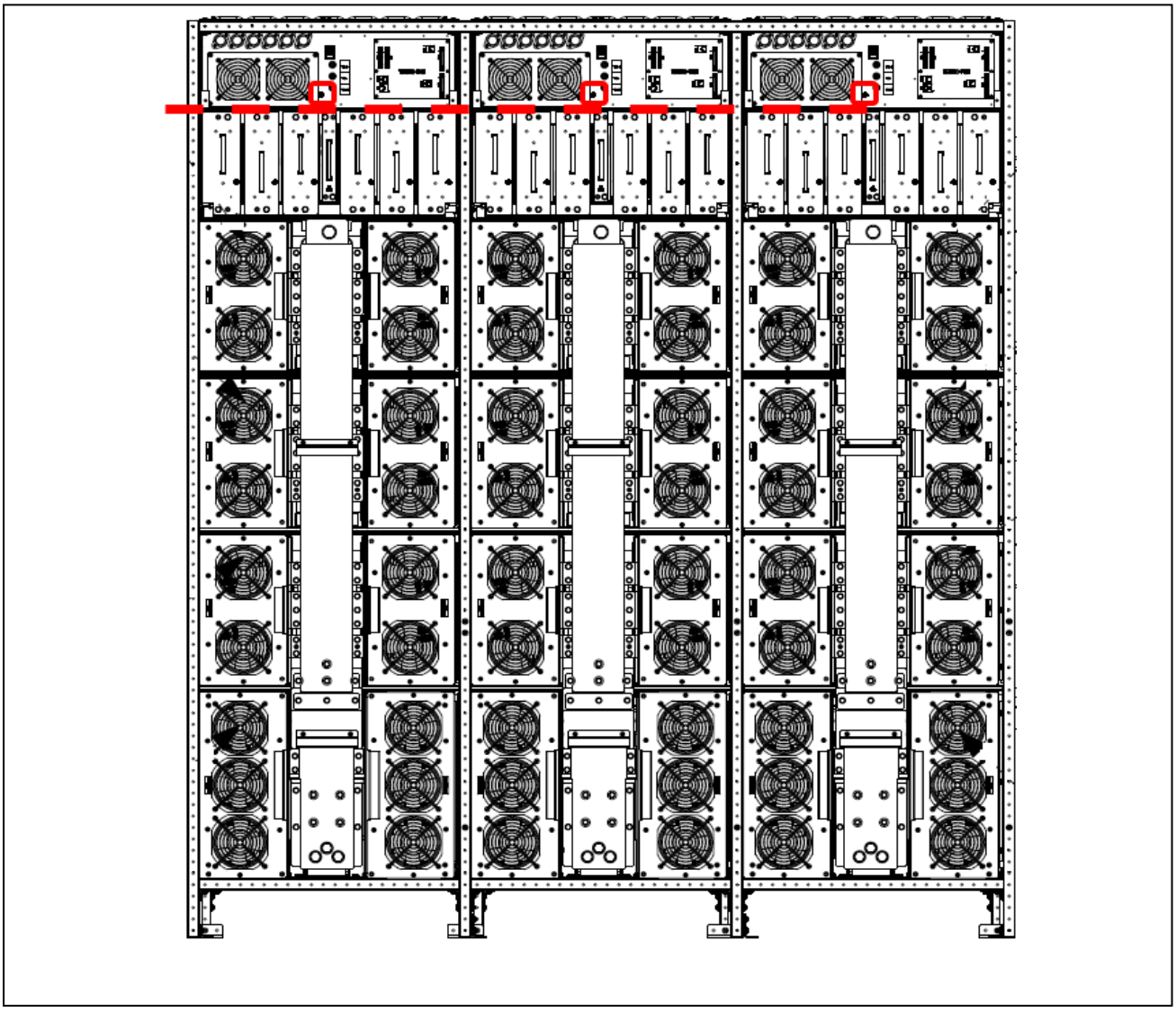
Remove the 2° access panels of all the Cores giving access to the fans/signal fuses/ PIB board area which serves as conduit where these cables must be placed.

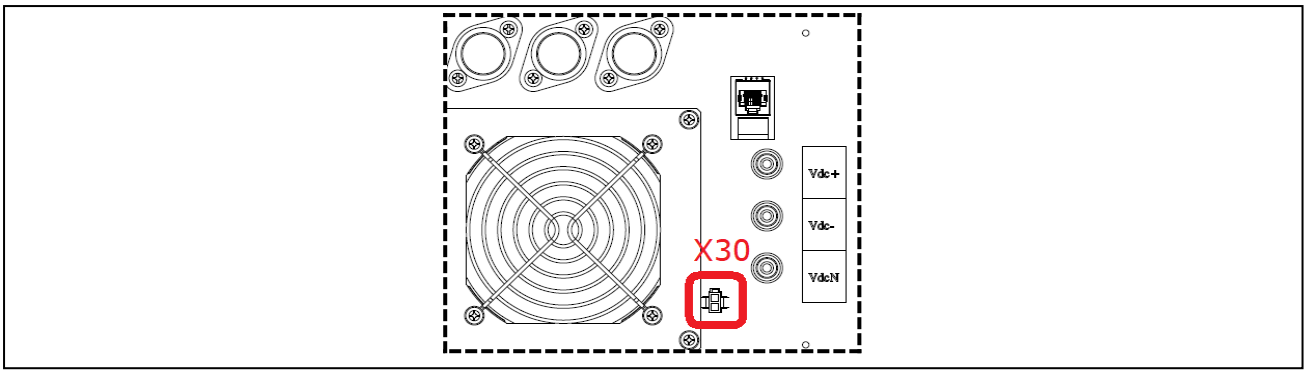
Figure 3.51 2° Access Panels to be Removed



On the other side of X30A the cable has as many X30 2-way connectors as cores that are all connected to the respective X30 plug in the Cores (the core closest to the DC Cabinet is identified as CORE1 while the furthest one is identified as COREn). The cable routing is shown below.

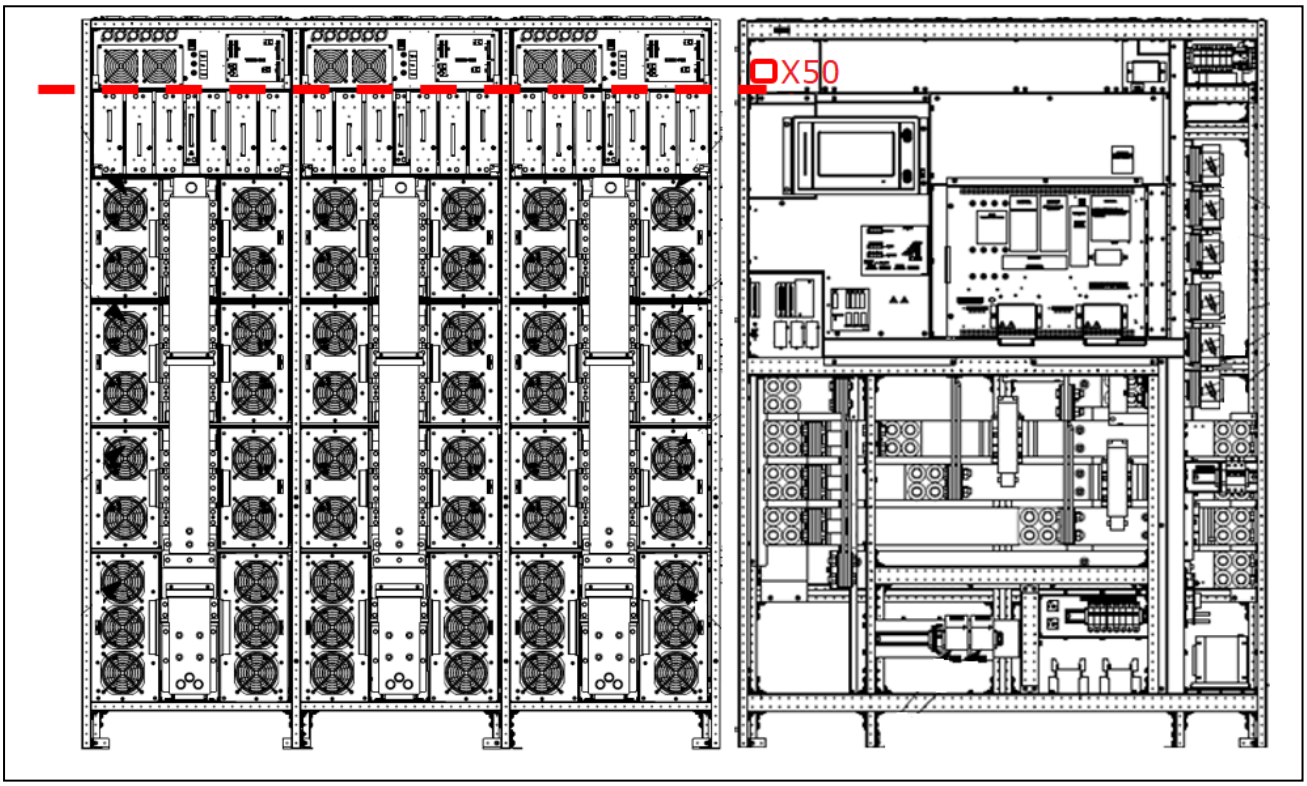
Figure 3.52 Core Cable Routing and Connector Detail





The other cable, from X50A, has a 6-ways connector (X50) that is connected to the STS. The X50 connector is placed loose in the internal conduit above the display area. The cable routing is shown below.

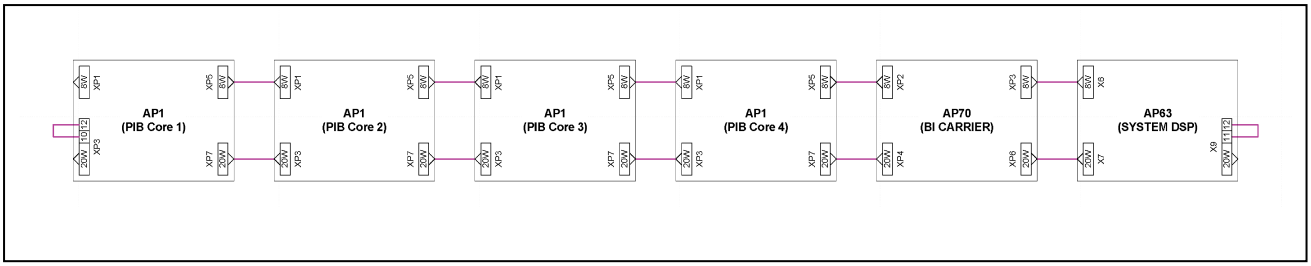
Figure 3.53 STS Cable Routing



System signal connection

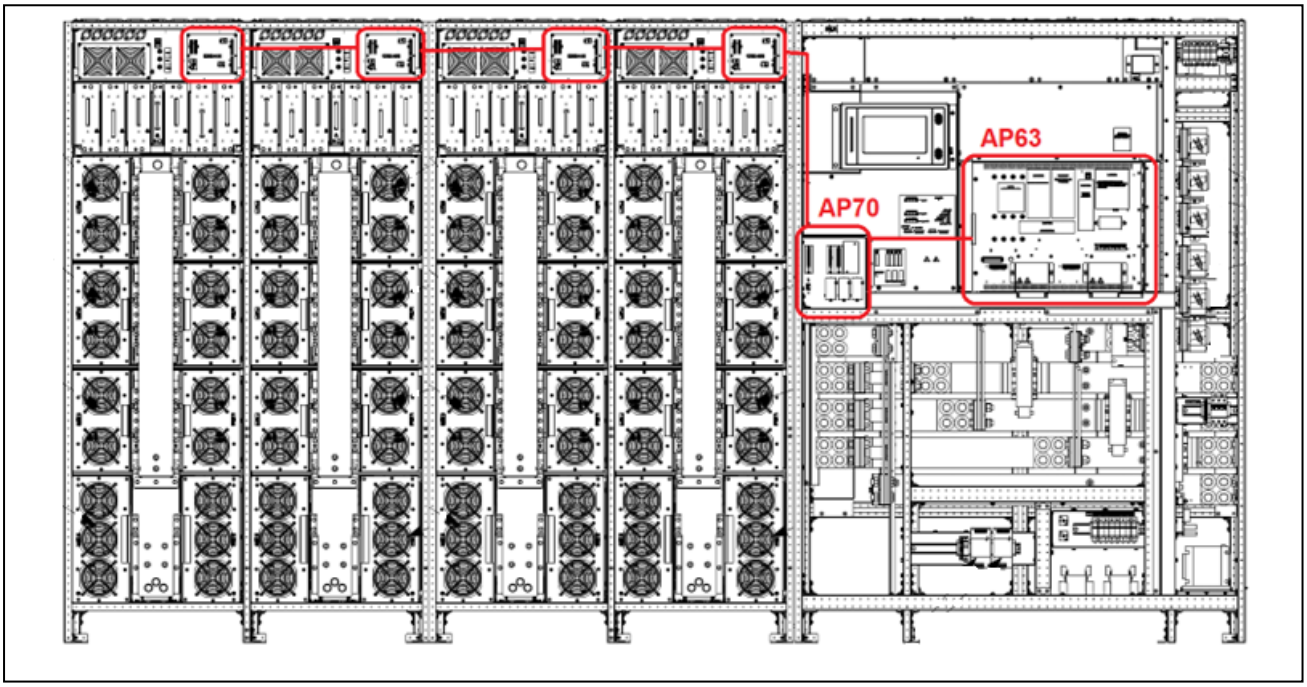
About the system signal connection, refer to the below schematic, to be used as reference for a 4-CORES system. Other systems with lower or higher amount of Cores are anyway represented by the below schematic, adding or removing AP1 (PIB) boards between the first and last represented core.

Figure 3.54 SYSTEM Schematic



The cable routing is shown below. On the STS, the cable routing between PIB connected to the core closest to STS and internal to the STS itself is already factory installed. In field it is necessary to install the cables connecting the AP1 (PIB) on each core to its closest cores. On core 1 ensure that the termination connector is installed in XP3 PCBA connector.

Figure 3.55 SYSTEM Cable Routing



For the PIB board placed on the core, here below the evidence of the connectors to be used to assembly the cable chain.

The provided cable kit also includes the jumper to be positioned only on XP3 of core 1.

On the PIB board there is a switch that must be properly set basing on the placement and identification of each core.
Over core 1, the setting of the switch must be on ON on all the positions.
Over all the other COREs, the setting of the switch must be on OFF on all the positions.

Figure 3.56 Terminals on the Switches on the STS DSP

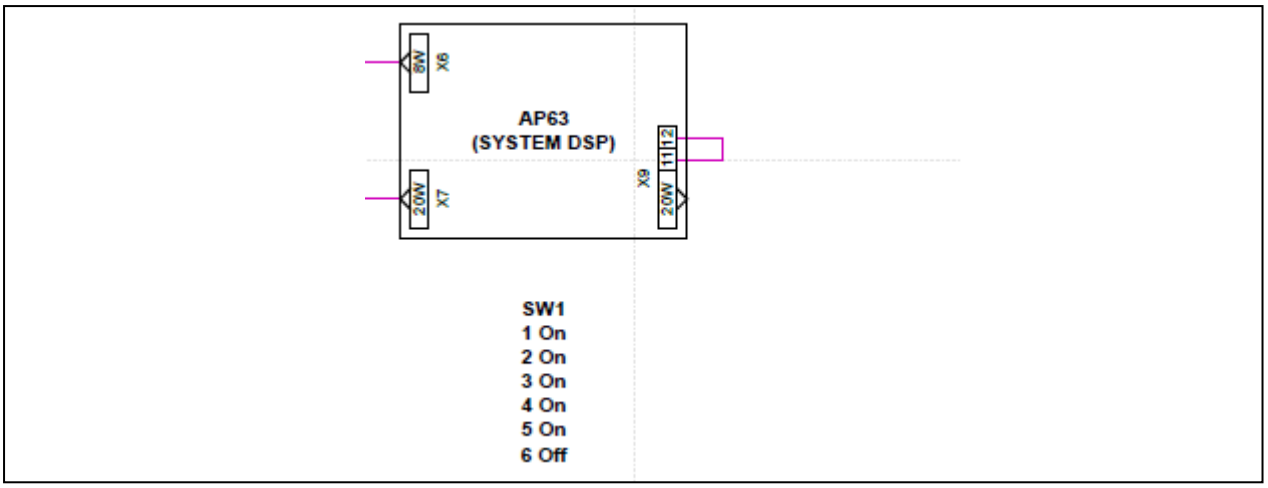
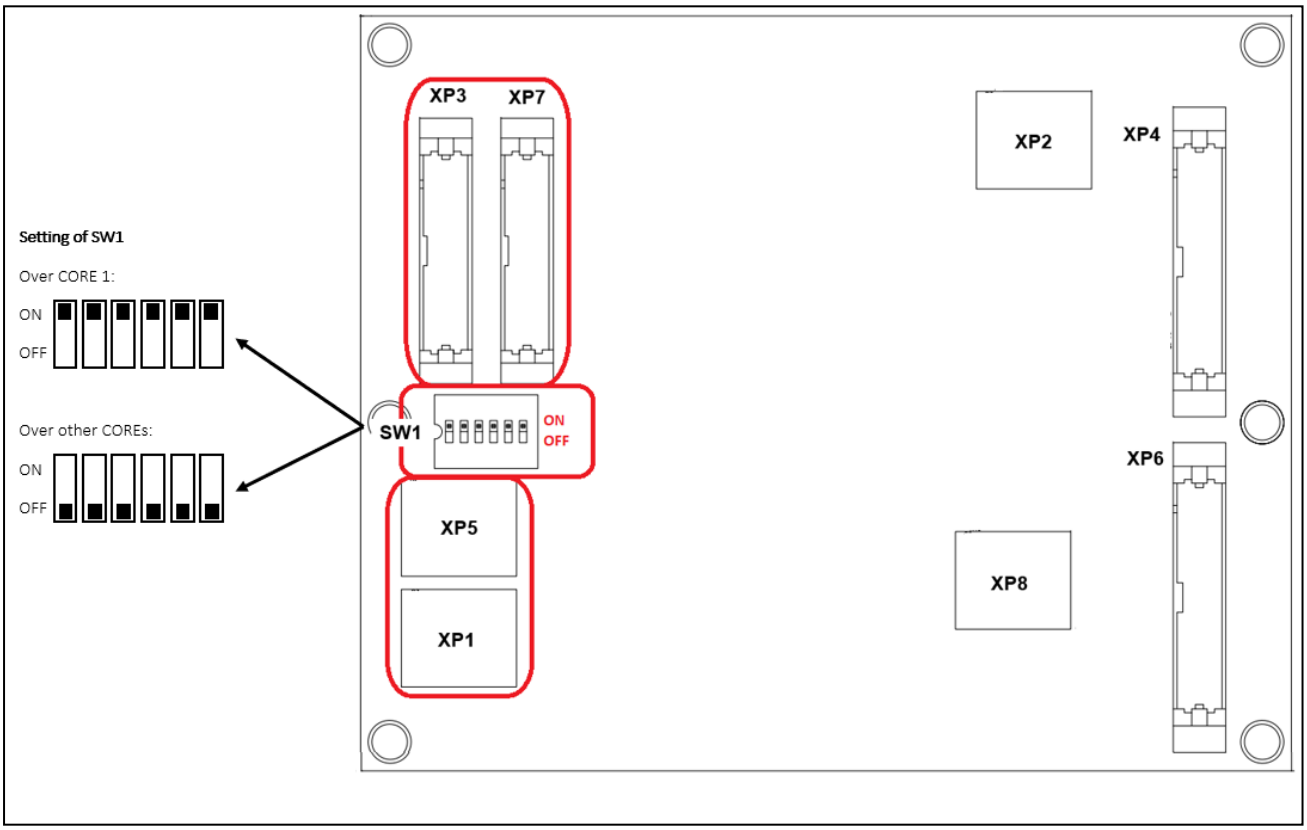


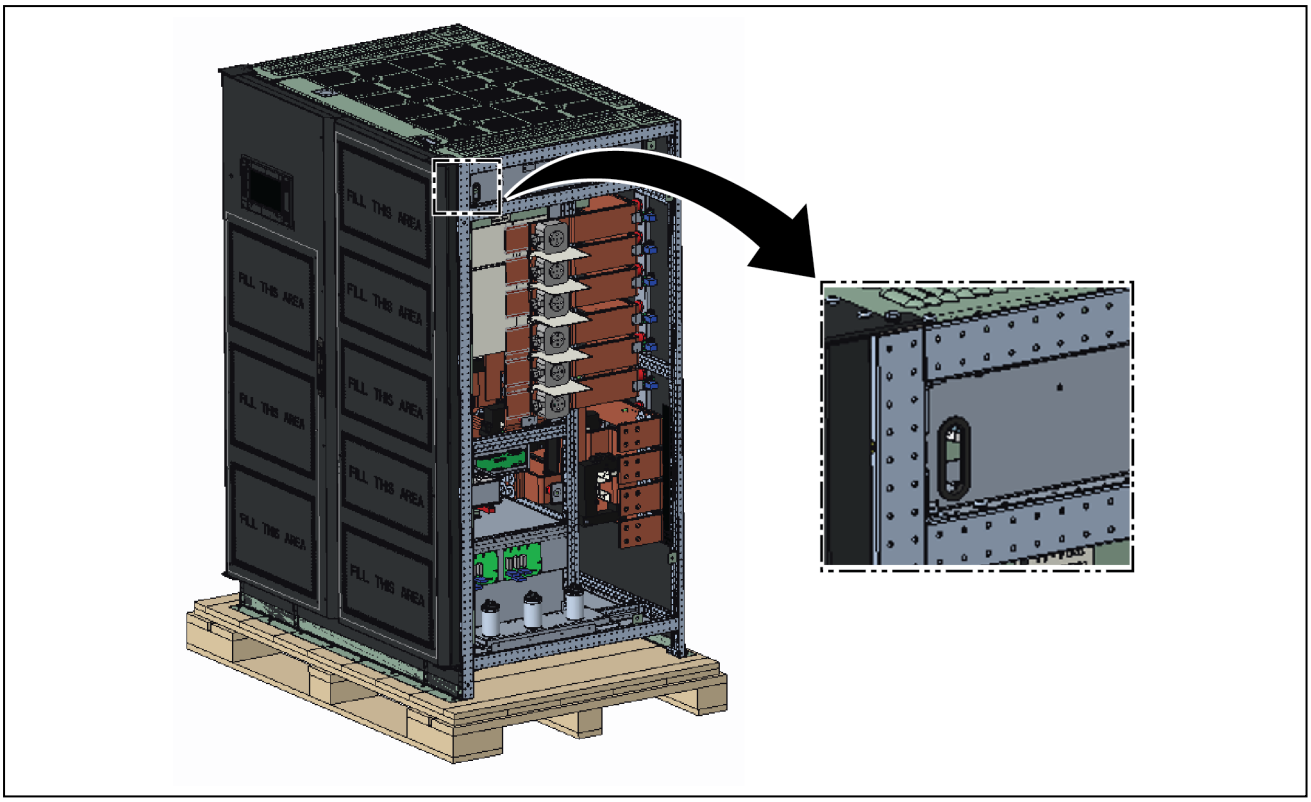
Figure 3.57 PIB Connectors and PIB Switch SW1



Internal signal cables routing from the AC CABINET/Switchgear to the STS

For signal wiring coming from the AC Cabinet/Switchgear to the STS, cables can be routed through the passage shown in the Figure 3.58 on the facing page.

Figure 3.58 Internal Signal Cable Routing



IMPORTANT! This cable routing path is intended for internal machine wiring only. It represents an internal passage within the UPS system boundaries and should not be used for external cable routing.

3.4.3 Floor Anchors - Optional

For seismic-resistant installations, special floor anchors must be used for the UPS and matching battery cabinets; see Technical Data on page 81.

3.4.4 Kickplate Installation - Standard

Kick plates must be installed. If the unit will be installed in a position that does not permit access to rear of the UPS, if possible, install the kick plates before the unit is placed in its final position.

Install the kickplates to all the cabinets, installing hexagonal socket button head screws and their washers, provided together with the units, and to be divided as following:

- 17 pcs for the DC cabinet 4x
- 17 pcs for each core 2x
- 16 pcs for the STS box
- 22 pcs for the AC cabinet

The number of screws and washers may differ basing on the system to be assembled, for reference only.

Side kickplates must be mounted only on DC cabinet (left kickplate) and AC cabinet (right kickplate).

Figure 3.59 Kickplates installed, front view

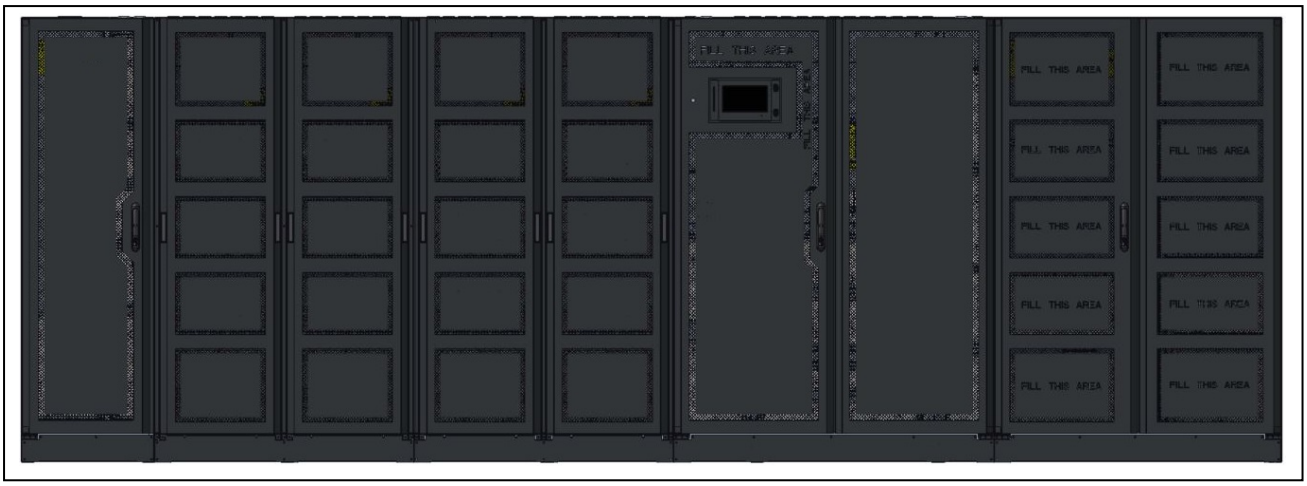
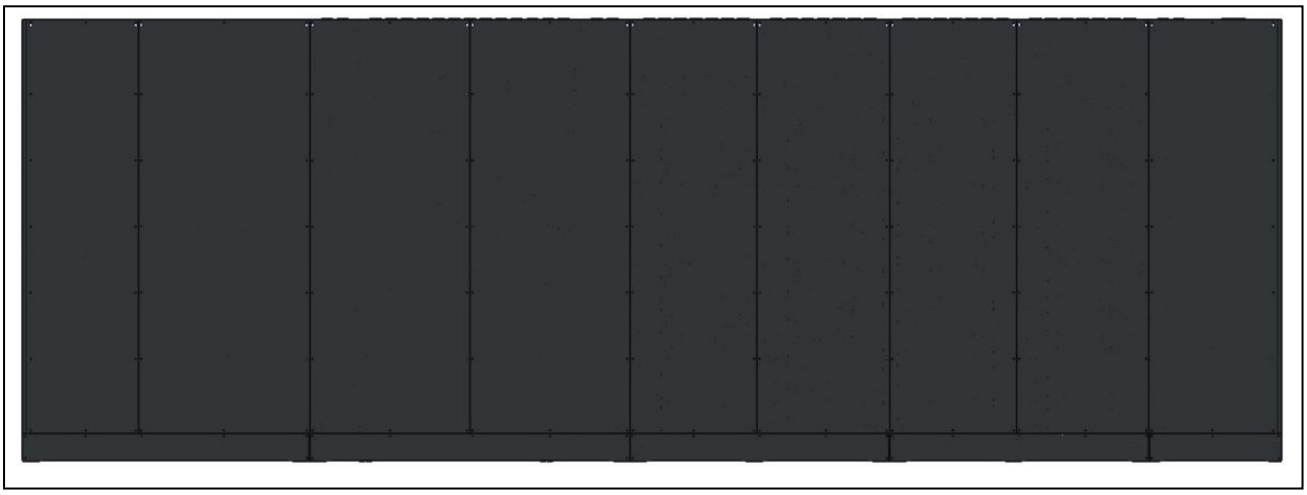


Figure 3.60 Kickplates installed, rear view



3.4.5 Special Considerations for 1+N Parallel Systems

Consider the grounding configuration of your system before finalizing module placement; see Configuring Ground Connections on page 54.

The cabling impedance must be closely matched to ensure proper load-sharing. Mismatched impedance may cause an overload on one module in a 1+N system, triggering a shutdown and loss of power to the connected load. Mismatched cable impedance is amplified when a 1+N system is operating on bypass because the power on the bypass path is not controlled. We recommend matching the impedance in the bypass path of parallel systems as closely as possible to ensure good bypass current sharing.

The impedance mismatch can also be minimized by controlling the wiring length of each unit. The design and the layout of the UPS system and associated panels and cabling should be examined closely to ensure that cable lengths and impedance are closely matched.

For Vertiv Trinergy UPS systems, the total combined cable length of the bypass feeder cables and the module output cables for each module must be within 5% from maximum to minimum. The combined cable length is the sum of the length from the common source feeding all the modules to the common output switchboard.

If the cabling impedance must be greater than 5% or the total, planned system load exceeds more than 90% per module, contact your Vertiv representative to calculate whether the system will result in an overload condition when operating on bypass.

When bringing a 1+N system online for the first time or after removing one unit, we recommend checking the bypass current mismatch. To check the bypass current mismatch:

1. Place a load on the bypass of each UPS module.
2. View the output current of each unit.

The accuracy of the currents displayed on the UPS module is sufficient for this check. If the mismatch is greater than 5%, the bypass impedance must be balanced or the load must be limited to less than the maximum rating.

The output switchboard for any 1+N system must be configured with one Module Output Circuit Breaker (MOB) for each UPS module that is to be connected to that switchboard.

The breaker must be equipped with auxiliary contacts that will be monitored by the UPS for interlocks to function properly and for the HMI to indicate the bypassed status of the module.

We recommend selecting breakers that work at current levels that may occur when switching a module onto the active bus. Breakers with adjustable instantaneous settings should be adequate to achieve this.

3.5 Power Cable Busbars

Cables can enter the UPS cabinet from bottom or top into the input/output (I/O) section of the unit.

The detailed cabling and connection for your UPS system is described in the installation drawings. In addition to the following instructions, refer to the appropriate illustrations for your unit included in Submittal Drawings on page 93.

Input power, from utility power , connects to the UPS through an input/output cabinet. DC system connects to the UPS through an DC cabinet.

This page intentionally left blank

4 Electrical Installation

These guidelines are for qualified installers who must have knowledge of local wiring practices pertaining to the equipment to be installed.

WARNING! Risk of electrical shock. Can cause injury or death. The UPS contains high DC as well as AC voltages. Check for voltage with both DC and AC voltmeters before working within the UPS. Only properly trained and qualified personnel wearing appropriate safety headgear, gloves, shoes and glasses should be involved in installing the UPS or preparing the UPS for installation.

4.1 Power Cables

The UPS requires both power and control cabling. All control cables, whether shielded or not, should be run separately from the power cables in metal conduits or metal ducts that are electrically bonded to the metalwork of the cabinets to which they are connected.

The cable design must comply with the voltages and currents in Technical Data on page 81, follow local wiring practices and take into consideration the environmental conditions (temperature and physical support media), room temperature and conditions of installation of the cable and system's overload capacity (see Technical Data on page 81).

WARNING! Risk of electrical shock. Can cause injury or death. Before cabling the UPS, ensure that you are aware of the location and operation of the external isolators that connect the UPS input/bypass supply to the power distribution panel. Check that these supplies are electrically isolated and post any necessary warning signs to prevent them from being connected to the UPS or other system cabinets.
Follow Lock Out Tag Out (LOTO) procedure for safety and local regulations.

Risque de décharge électrique pouvant causer des blessures graves, voire mortelles. Avant de procéder au câblage du système ASC, assurez-vous que vous êtes au courant de l'emplacement et du fonctionnement des isolateurs externes qui raccordent l'alimentation d'entrée ou de dérivation au panneau de distribution électrique. Vérifiez que ces raccords sont isolés électriquement et installez tous les panneaux d'avertissement nécessaires pour empêcher leur utilisation accidentelle.
Respecter la procédure de Verrouillage et étiquetage (LOTO) pour la sécurité et les réglementations locales.

When sizing battery cables, a maximum volt drop of 2VDC is permissible at the current ratings given in Technical Data on page 81.

The following are guidelines only and are superseded by local regulations and codes of practice where applicable:

- The grounding conductor should be sized according to the fault rating, cable lengths, type of protection, etc. The grounding cable connecting the UPS to the main ground system must follow the most direct route possible.
- Using smaller, paralleled cables for heavy currents can ease installation.
- AC and DC cables must be run in conduits according to local codes, national codes and standard best practices. This will prevent creation of excess EMI fields.

4.2 External Protective Devices

For safety, it is necessary to install circuit breakers in the input AC supply and external battery system. Given that every installation has its own characteristics, this section provides guidelines for qualified installation personnel with knowledge of operating practices, regulatory standards and the equipment to be installed.

Figure 4.1 External Circuit Breakers in a Typical System

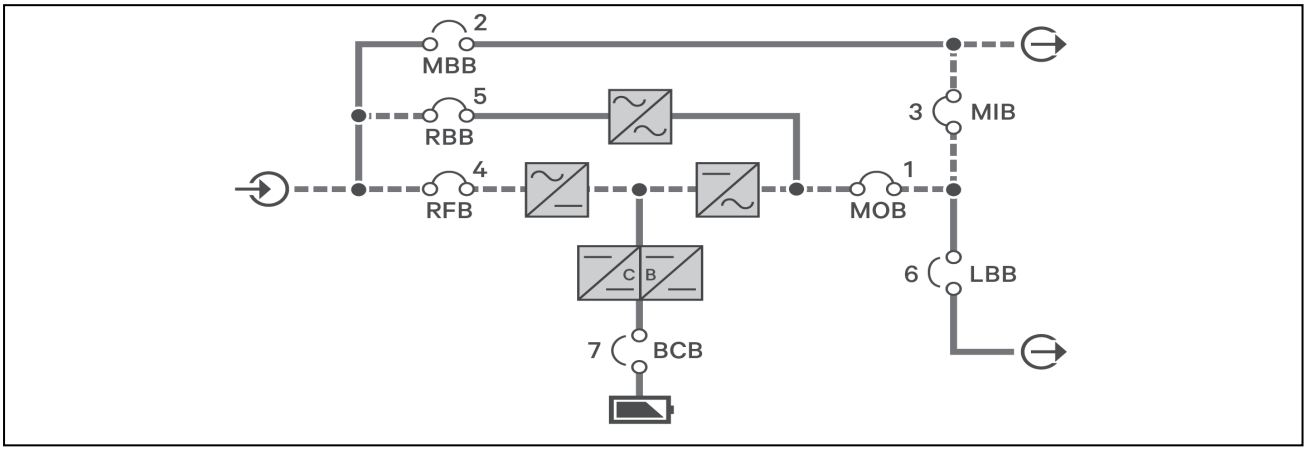


Table 4.1 Programmable Input Contacts for External Circuit Breakers

Item	Circuit Breakers	Description
1	Module Output Breaker (MOB)	The MOB isolates the output of the UPS from the critical load or collective bus of a parallel UPS system. It is typically located in a system paralleling cabinet, system control cabinet, switchgear, or switchboard.
2	Maintenance Bypass Breaker (MBB)	The MBB isolates an alternate source from the critical load. It is typically located in a maintenance bypass cabinet, system paralleling cabinet, system control cabinet, switchgear, switchboard, or panel board.
3	Maintenance Isolation Breaker (MIB)	The MIB isolates the UPS system from the critical load. It is typically located in a maintenance bypass cabinet, system paralleling cabinet, system control cabinet, switchgear, switchboard, or panel board.
4	Rectifier Feed Breaker (RFB)	The RFB isolates the UPS rectifier input. It is typically located in switchgear, a switchboard, or a panel board.
5	Remote Back-Feed Breaker (RBB)	The RBB isolates the UPS static bypass switch input. It is typically located in switchgear, a switchboard, or a panel board.
6	Load Bank Breaker (LBB)	The LBB connects the output of the UPS or the critical load to a load bank for testing. It is typically located in switchgear, a switchboard, or a panel board.
7	Battery Circuit Breaker (BCB)	The BCB isolates the DC/DC converter of the UPS from the battery system. The BCB is typically co-located with the battery system.

4.2.1 Ground Fault Detection (Use of differential protection devices)

IMPORTANT! Single-phase loads must not be directly connected to the output of a three-wire UPS configuration.

NOTICE - Differential Current Breakers

- The UPS does not require differential protection devices connected ahead of it. However, when these devices are installed in compliance with local regulations, note that separate DCBs in the line power and bypass line power circuits may trip unexpectedly, thus interrupting the power supply to the unit. Therefore, if a DCB must be installed, only one should be used for both primary and bypass inputs.
- In parallel distributed systems, only one common differential protection device should be installed ahead of the point where the line divides into the UPS primary and bypass line power circuits. If separate DCBs are installed in different configurations, they may trip unexpectedly.

- In order to guarantee correct distribution in the neutral cables, installation personnel shall make sure that the lengths of the cables are as equal as possible. However, if the bypass lines lead from sources that are electrically isolated from each other, a differential protection device may be installed on each line. In this case, and in cases when the load is supplied from the Bypass via the Static Bypass Switch, the isolated sources are connected in parallel. A case-by-case analysis should be made as to whether any resulting imbalance between the currents on the Bypass lines is compatible with the respective protection devices.

A differential device installed on the primary and bypass inputs supply senses the sum of all ground leakage currents in both the UPS and the load it supplies. To avoid spurious operation, the following must be taken into consideration when selecting differential protection devices for installation on input lines:

1. The nominal value of ID must take into account the ground leakage current of the UPS and the load under normal operating conditions: ID = ID_{UPS} + load leakage current.
2. Be of a delayed operation type (greater than 300mS);
3. The type of differential switch used must conform to product regulation IEC/EN/BS 62040-1:2019/A11:2021. PECS itself can cause smooth DC current when an RCD is used this is a RCD type B.

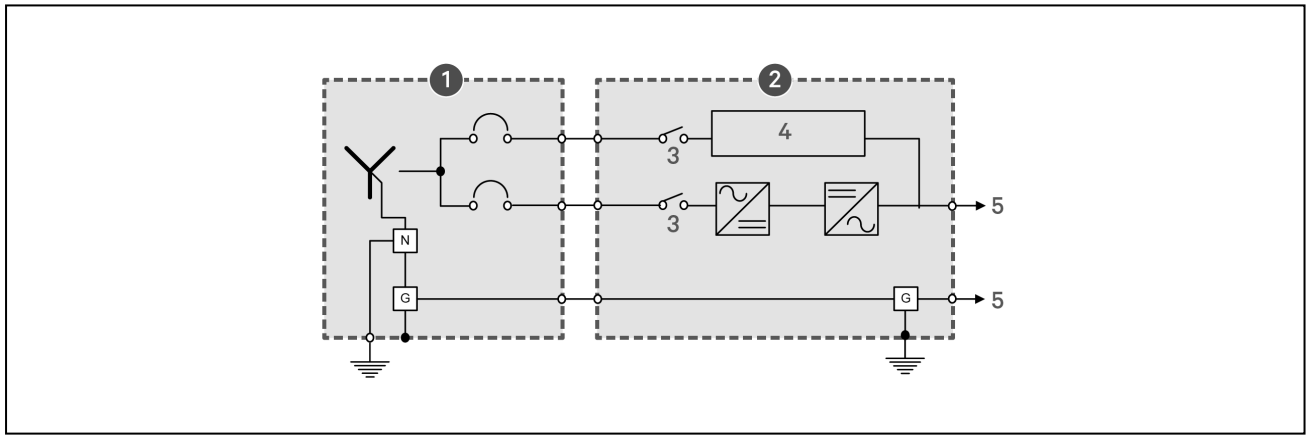
The Vertiv™ Trinergy™ UPS units are compatible with High-Resistance Ground (HRG) applications. Contact the factory for HRG compatibility.

NOTICE

Risk of improper installation. Can cause equipment damage.

Failure to set the ground-fault interrupters properly could cause loss of power to the critical load.

Figure 4.2 Grounding Diagram-Three-Wire Single-Module Systems



Item	Description
1	Source
2	UPS
3	Optional back-feed disconnect
4	BPSS
5	To connected equipment

4.2.2 Sizing the Input Breaker that Feeds the UPS

External overcurrent protection must be provided. See Technical Data on page 81 for overload capacity.

Nominal input current (considered continuous) is based on full-rated output load. Maximum current includes nominal input current and maximum battery recharge current (considered noncontinuous).

Continuous and noncontinuous current are defined in the national and local electrical codes.

Maximum input current is controlled by the current limit setting, which is adjustable. Values shown are for maximum current limit. The input current limit should not be set less than 120% of the current needed to support the inverter at full load for normal operation.

This results in sufficient power to recharge the battery in a reasonable time and to operate over the published input voltage range.

Power class	kAIC (up to)	Specification	General specification	Comments	Input Current Rating	Output/Bypass Current Rating
1.5MW UL w/ AC cabinet	150 kA	UL-Listed 489 (Molded Case Circuit Breaker) or UL 1066 (Low Voltage AC Power Circuit Breaker), which are required for use in UL-listed switchgear or switchboards. The circuit breaker must have a short-time rating at a maximum voltage of 480V for three cycles	The remote breaker must be equipped with UVR/shunt trip and auxiliary contacts for proper operation with the UPS	UPS internal fuse protection exists on rectifier and bypass input	2500A	2000A
1.5MW UL w/o AC cabinet	200 kA				2500A	2000A
2MW UL w/ AC cabinet 480V	150 kA				3000A	2500A
2MW UL w/o AC cabinet 480V	200 kA				3000A	2500A
2MW UL w/ AC cabinet 415V	150 kA				4000A	3000A
2MW UL w/o AC cabinet 415V	200 kA				4000A	3000A
2.5MW UL	150 kA				4000A	4000A
1.5MW CE w/ AC cabinet	150 kA	IEC listed IEC 60947-2 Circuit Breaker The circuit breaker must have a short-time withstand current rated for three cycles			3000A	2500A
1.6MW CE w/ AC cabinet	150 kA				3000A	2000A
2MW UL w/o AC cabinet 415V	150 kA				3600A	3300A
2MW CE w/o AC cabinet	200 kA				3600A	3300A
The interrupting capability of the overcurrent protective device shall be equal or greater than the prospective short circuit current of the mains supply. The IEC external disconnection device shall meet disconnection times in table in IEC 60364-4-41:2005, Table 41.1						

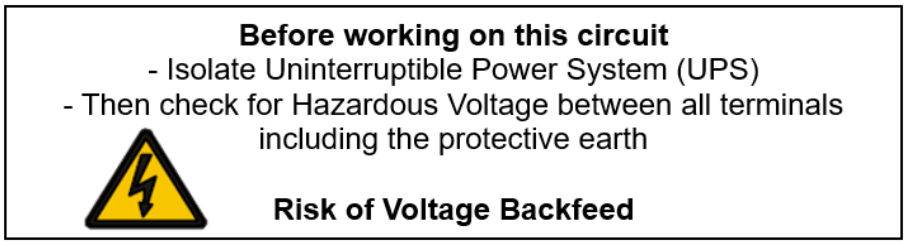
4.2.3 Automatic Transfer Switches

An automatic transfer switch feeding the UPS should apply a 100ms break-before-make delay when transferring between out-of-phase sources.

4.2.4 Backfeed Protection

To prevent electric shock hazards caused by backfeed through the Static Bypass Switch, Vertiv Trinergy UPS is equipped with an internal optional back-feed breaker or as alternative a disconnector must be installed in conformance with Product Standard IEC/EN/BS 62040-1:2019/A11:2021. The UPS generates a logic command at AP63 X70 (see tab 4.3) to ensure that the disconnector operates correctly.

When the automatic backfeed isolator is external to the UPS, the installer shall provide on all primary isolators and on external access points between such isolators and the UPS a warning label similar to this:



N.B. In case of single-line feeder, the disconnector must be installed ahead of the UPS primary and bypass inputs. When this disconnector is activated, the UPS switches to Battery Mode.

N.B. In case of dual-line feeder, the disconnector must be installed upstream of the UPS bypass input. When the disconnector is activated, the bypass line is no longer available.

N.B. The PE and N terminals must be connected in accordance with the requirements of the local line power distribution system (TN-C, TN-S, TN-C-S, TT etc.). For instance, in TN-C installations the PEN conductor from the supply transformer must be connected to the UPS PE and N terminals

4.3 Input Power Cable Connection

The rectifier input, bypass, output and battery power cables (all require lug-type terminations) are connected to busbars in the I/O sections. The terminal details and connections for your UPS system are described in the installation drawings. Refer to the appropriate illustrations for your unit included in Submittal Drawings on page 93.

NOTE: Before making any power-wiring connections, make sure that you complete all of the interconnections for your system. The interconnects are very hard to access after the power wiring is complete. To make the interconnections, see connections the appropriate "Interconnection Details" drawing for your system, listed in Submittal Drawings on page 93.

4.3.1 Equipment Ground

The equipment ground busbar is in the I/O section, described in the appropriate illustrations for your unit, included in Submittal Drawings on page 93.

The grounding conductor must be connected to the ground busbar and bonded to each cabinet in the system.

All cabinets and cabling must be grounded in accordance with local regulations.

NOTE: In addition to safety requirements, it is important to follow grounding best practices for EMC requirements. For example, daisy-chain grounding connection between UPS modules located in different electrical rooms or floors is not recommended. Proper grounding reduces problems in systems caused by electromagnetic interference.

WARNING! Failure to follow adequate grounding procedures can result in electric shock hazard to personnel and the risk of fire, should a ground fault occur. All operations described in this section must be performed by properly trained and qualified electricians or technical personnel. If any difficulties are encountered, contact Vertiv Technical Support.

WARNING! Le non-respect des procédures de mise à la terre peut entraîner des risques d'électrocution du personnel et des risques d'incendie en cas de défectuosité de la mise à la terre. Toutes les opérations décrites dans cette section ne doivent être effectuées que par des électriciens ou des techniciens professionnels dûment formés et qualifiés . En cas de difficultés, communiquez avec Vertiv™. Pour obtenir les renseignements de contact, consultez la dernière page de ce manuel.

4.3.2 Cable Connection

Once the equipment has been positioned and secured, connect the power cables. Refer to the appropriate illustrations for your unit, included in Submittal Drawings on page 93, and complete the following steps:

1. Verify that the UPS equipment is isolated from its external power source and that all the UPS power isolators are open.
2. Check that these supplies are electrically isolated and post any necessary warning signs to prevent their inadvertent operation.
3. Open exterior and interior panels on the front of the I/O sections.
4. Connect the ground to the equipment ground busbar in the I/O sections. Always connect the Ground cable first and do not proceed if the Ground cable is not connected.
5. Make power connections and tighten the connections to the proper torque.
6. Ensure correct phase rotation.

WARNING! Risk of electrical shock. Can cause injury or death. If the load equipment will not be ready to accept power on the arrival of the commissioning engineer, ensure that the system output cables are safely isolated at their termination.

WARNING! Risque de décharge électrique pouvant causer des blessures graves, voire mortelles. Si les équipements branchés ne sont pas prêts à être alimentés à l'arrivée de l'ingénieur de mise en service, assurez-vous que les bornes des câbles de sortie du système soient isolées de façon sécuritaire.

WARNING! Risk of electrical shock. Can cause injury or death. When connecting the cables between the battery extremities to the circuit breaker, always connect the circuit breaker end of the cable first.

WARNING! Risque de décharge électrique pouvant causer des blessures graves, voire mortelles. Lors du raccordement de câbles entre des bornes de batterie et un disjoncteur, branchez toujours en premier l'extrémité du câble qui se raccorde au disjoncteur.

7. For control connection details, see Control Cable and Communication on page 55.
8. Close and secure the interior and exterior doors.
9. Attach the kick plates to the bottom of the unit.

NOTE: If the unit is to be installed in a position that does not permit access to the rear kick plates, then the kick plates must be installed before the unit is placed in its final position.

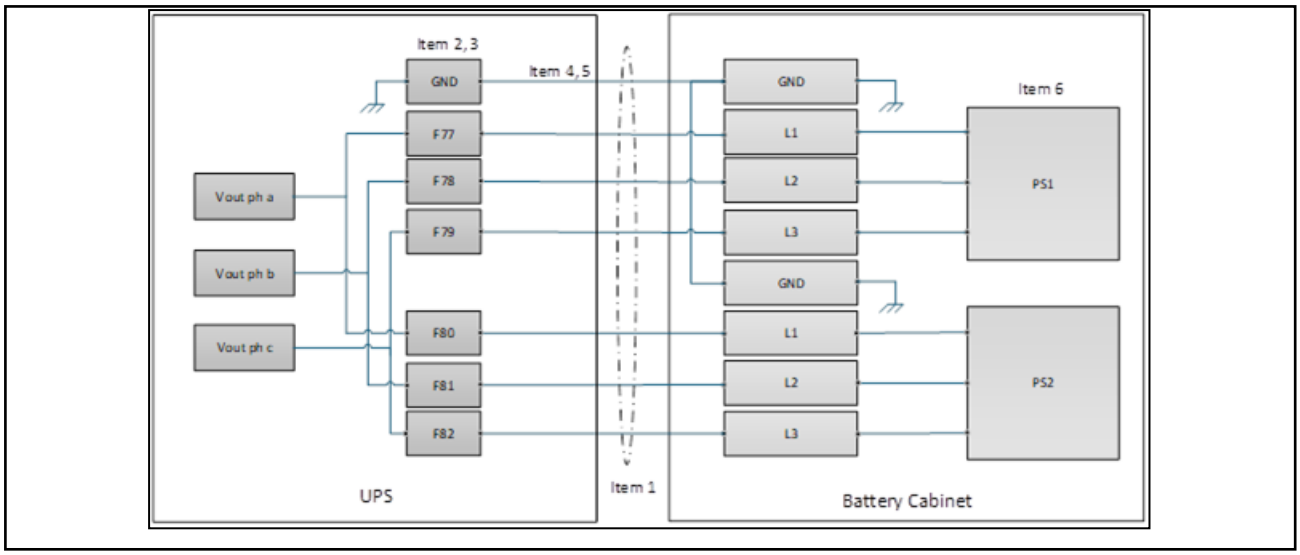
4.3.3 BMS Supply - Optional

This optional kit is used to power third parties' battery monitoring system (BMS) like the one provided inside Samsung Battery Cabinet.

It includes 6 fuses and a double redundant 3-phase cable system described in the figure below and marked within the dotted-dashed lines. It spans the distance from the Battery Cabinet to Vertiv UPS.

Notes	Specifications
Voltage	480VAC (Max)
Current	10A (Max)

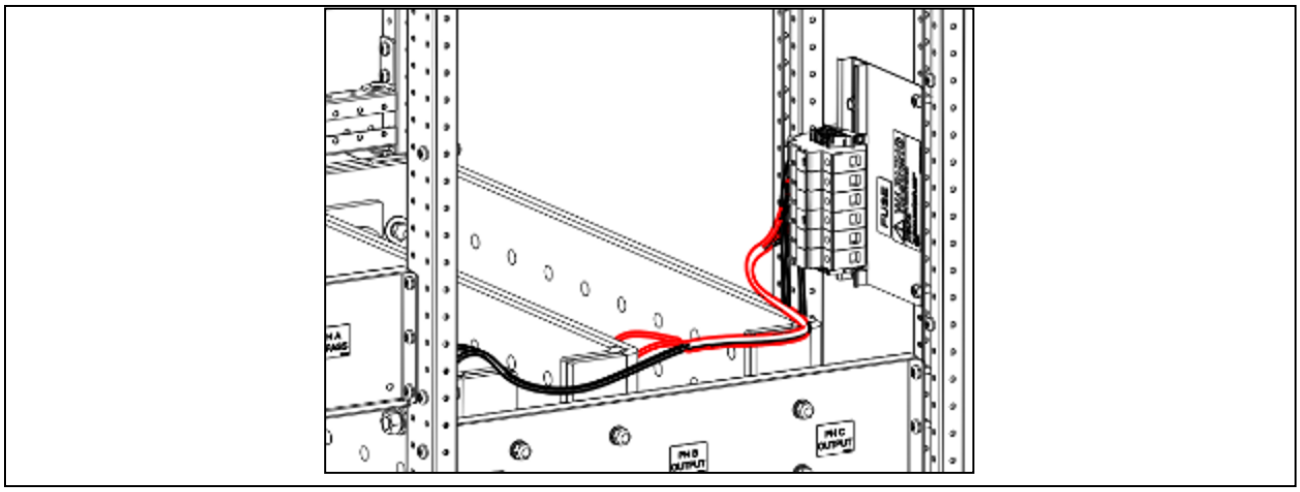
Figure 4.3 Final HV Double Redundant Wire Routing



Item	Description	Specifications
1	7 Wire Cable Harness	Customer Supplied
2	Fuses F77-F82 (Qty. 6)	7.5A (Rated) Time Delay
3	Fuse Block	Consist of 6 Fuse Holders
4	Wire 0-50 Ft	THHN-14-19
5	Wire 50-100 Ft	THHN-12-19
6	Power Supply(s)	TDR-480-48

CAUTION: UPS and Battery Cabinet ground wires must be solidly connected to the ground with appropriately sized wire conductors in line with national and local electrical codes. Each conduit or raceway containing phase conductors must also contain a ground wire for both the UPS and Battery Cabinet, which are solidly connected to the ground terminal at each termination point.

Figure 4.4 Final HV Double Redundant Wire Routing Fuse Holder



The above image shows the fuses that constitute the fuse block in the UPS Module Cabinet (mounted to the DIN rail). The output for the customer-supplied Wire Harness must be connected the right side of the fuse block network, as shown (a ground connection is required, but not shown).

4.4 DC Power Connections

WARNING! Risk of electrical shock. Can cause injury or death. The UPS contains high DC as well as AC voltages. Check for voltage with both DC and AC voltmeters before working within the UPS, the input/output cabinet or the battery cabinet. Only properly trained and qualified personnel wearing appropriate safety headgear, gloves, shoes and glasses should be involved in installing the UPS or preparing the UPS for installation.

A local battery disconnect near the battery must be installed for safe maintenance. The UPS does not include any battery disconnect, it is required to use a lock-out tag-out device in the battery room and always check for hazardous voltage before performing maintenance on the UPS.

An external battery protection device must be installed to ensure adequate protection in case of short circuit fault. This protection may consist of fuses or automatic breakers suitable for DC applications. Size the external battery protection device in accordance with the available battery short circuit current and the battery string voltage.

Notice

Batteries are able to withstand an external short circuit under specific conditions and for a specified duration. Fuses, circuit breakers and cables must be selected in accordance to the battery characteristics. Contact Vertiv Technical Support for more information.

Notice

External shorts can lead to irreversible battery damage and reduced battery service life.

WARNING! Missing or incorrect battery protection may cause extensive damage to the batteries, the UPS and ancillary equipment. Vertiv will neither accept liability nor pay damages resulting from accidents caused by missing or incorrect sizing of the battery protection device(s). Contact Vertiv Technical Support for more information.

Vertiv recommends using a proprietary battery breaker control option to remotely trip the battery breaker and safely disconnect the battery. See Submittal Drawings on page 93for details.

4.5 Configuring Ground Connections

The UPS is compatible with solidly grounded wye sources or a high-resistance ground system.

Improper grounding is the largest single cause of UPS installation and startup problems. Grounding techniques vary significantly from site to site, depending on several factors.

Proper grounding should be based on the appropriate national and local electrical codes sections, but safe and proper equipment operation requires further enhancements. The following pages detail recommendations for grounding various system configurations to ensure optimal UPS system performance.

WARNING! The UPS ground lug must be solidly connected to the service entrance ground by an appropriately sized wire conductor per national and local electrical codes (IEC 60364-5-54, etc.). Each conduit or raceway containing phase conductors must also contain a ground wire, both for UPS input and output, which are solidly connected to the ground terminal at each termination point.

WARNING! In addition to safety requirements it is important to follow grounding best practices for EMC requirements. For example, daisy-chain grounding connection between UPS modules located in different electrical rooms or floors is not recommended.

CAUTION: The UPS ground lug must be solidly connected to the service entrance ground by an appropriately sized wire conductor per the national and local electrical codes. Each conduit or raceway containing phase conductors must also contain a ground wire, both for UPS input and output, which are solidly connected to the ground terminal at each termination point. Conduit-based grounding systems tend to degrade over time. Therefore, using conduit as a grounding conductor for UPS applications may degrade UPS performance and cause improper UPS operation.

4.5.1 Recommended Grounding Configuration, Battery Systems

Battery cabinet systems must be connected as floating (ungrounded) systems.

Center-tapped or grounded battery systems are not possible with battery cabinet systems.

Whether the battery system is open-rack or cabinet, the metal rack parts or cabinet must be grounded to the UPS module ground bus.

4.6 Distributed Static Switch (1+N) System Cabling Layouts

The output switchboard must be fitted with module output breakers (MOB) equipped with auxiliary contacts to communicate breaker status. The MOB must function properly with current levels that may occur when switching a module onto the active bus. Breakers with adjustable instantaneous settings should be adequate to achieve this.

NOTE: Before making any power-wiring connections, make sure that you complete all of the interconnections for your system. The interconnects are very hard to access after the power wiring is complete. To make the interconnections, see connections the appropriate “Interconnection Details” drawing for your system, listed in Submittal Drawings on page 93.

The distributed static switch cabling for your UPS system is described in the installation drawings. Refer to the appropriate illustrations for your unit included Submittal Drawings on page 93.

4.7 Control Cable and Communication

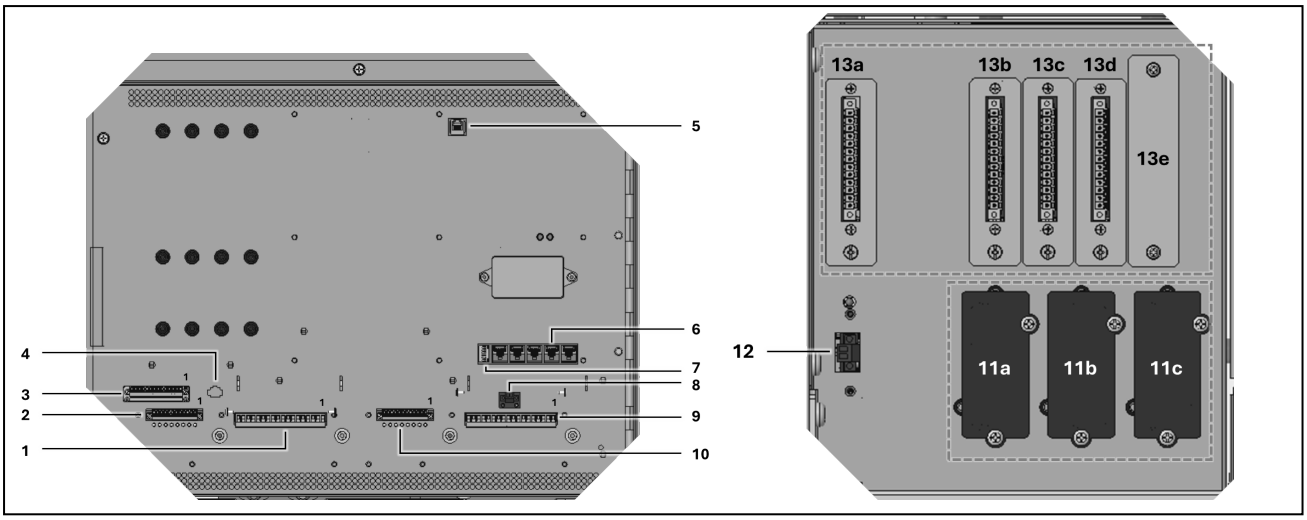
WARNING! The installer needs to make sure to connect only DVC A circuits on DVC A input/output on the unit.

NOTE: The low-voltage conduit plate must be removed prior to punching holes for landing conduit. Failure to do so may result in equipment damage due to metal debris.

Based on a site’s specific needs, the UPS may require auxiliary connections to manage the battery system (external battery circuit breaker), communicate with a building management system or provide alarm signaling to external devices, or for Remote Emergency Power Off (REPO). The connections for the interfaces below are in the low-voltage customer connections in the front of the UPS, see Figure 4.5 on the next page.

Table 4.2 on the next page, describes the interfaces.

Figure 4.5 Customer-Connection Locations in All Models



Refer to **Figure 4.11** on page 64 for the conduit cable routing.

Table 4.2 Connection Interfaces

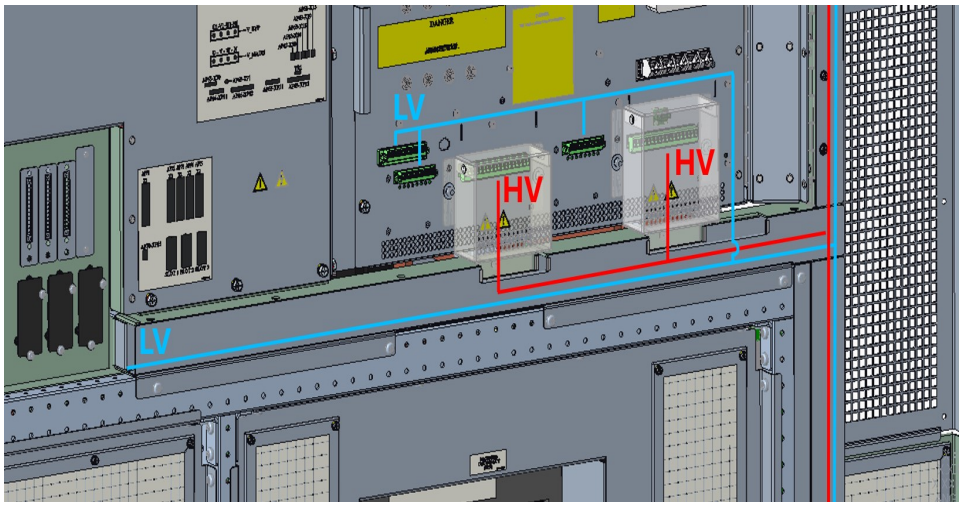
Item	Description	SELV	Max current & Voltage
1	AP66–XP12 - Selectable output dry contacts, 6 Form C contacts	NO	1A@250Vac
2	AP66-XP11 - Selectable input dry contacts, 8 Form A/B contacts or 4 Form C contacts	YES	10mA
3	AP63-X70 - EPO inputs, EPO output, Backfeed output	YES	1A@36Vdc
4	AP63-X71 - EPO door input	YES	20mA
6	AP63-X16, AP63-X20, AP63-X19, AP63-X15 - Parallel UPS communication Bus	YES	CAN physical layer standards
7	AP63-X18 - Multiple Bus Synchronization Module (MBSM)	YES	5Vdc@30mA
8	RBB option – TB1 – shunt trip coil supply	NO	3A - 120 Vac
9	AP65-XP12 - Selectable output dry contacts, 6 Form C contacts	NO	1A@250Vac
10	AP65-XP11 - Selectable input dry contacts, 8 Form A/B contacts or 4 form C contacts	YES	10mA
11a	SLOT 1 for Vertiv™ Liebert® IntelliSlot™ Communication Cards. Interface for Vertiv™ LIFE™ Services.	YES	#
11b	SLOT 2 for Vertiv Liebert IntelliSlot Communication Cards.	YES	#
11c	SLOT 3 for Vertiv Liebert IntelliSlot Communication Cards.	YES	#
12	AP70-XP15 – Ethernet Switch power supply 24 V DC – 15 W	YES	0.5A@24Vdc
13a	AP71-X2 Battery Interface Cards for CORE 1 **NOTE: The number of available connectors depends on the system size**	YES	#
13b	AP72-X2 Battery Interface Cards for CORE 2 **NOTE: The number of available connectors depends on the system size**	YES	#
13c	AP73-X2 Battery Interface Cards for CORE 3 **NOTE: The number of available connectors depends on the system size**	YES	#
13d	AP74-X2 Battery Interface Cards for CORE 4 **NOTE: The number of available connectors depends on the system size**	YES	#
13e	AP75-X2 Battery Interface Cards for CORE 5 **NOTE: The number of available connectors depends on the system size**	YES	#

Table 4.3 Internal Connections

Item	Description	SELV	Max current & Voltage
5	AP63-XP6 – 1-Wire interface for Vertiv Temp/Humidity sensor	#	#

CAUTION: Please make sure that final HV and LV wiring routing is respected in the field installation and that SELV (DVC A) circuits are connected to SELV DCV A UPS ports.

Figure 4.6 Final HV and LV wiring routing



4.7.1 Slots for Vertiv™ Liebert® IntelliSlot™ Cards – SLOT2 and SLOT3

These slots permit installing network communication cards. This adapter provides an independent external network interface for communication with network monitoring and building management systems.

The Vertiv Liebert IntelliSlot platform includes the Vertiv™ Liebert® IntelliSlot™ RDU120 and Vertiv™ Liebert® IntelliSlot™ IS-485 EXI cards. The platform communicates with Vertiv software tools and services, including Vertiv™ SiteScan™ Web.

The Vertiv Liebert IntelliSlot RDU120 card supports up to two third-party protocols along with HTTP/S (Web), Vertiv Protocol, SMTP and SMS.

Third-party protocols available on the Vertiv Liebert IntelliSlot RDU120 card are:

- BACnet IP-BACnet over Internet Protocol
- BACnet MSTP-BACnet Master-Slave/Token-Passing (MSTP) communications protocol over an RS-485 serial network (also known as BACnet MSTP RS-485)
- Modbus RTU
- Modbus TCP
- SNMP versions 1, 2c and 3

When determining the protocols, consider the following:

- No more than two protocols may be enabled on one card.
- Only one version of BACnet may be selected, either BACnet IP or BACnet MSTP.
- Only one version of Modbus may be selected, either Modbus TCP or Modbus RTU.
- Only one of the protocols can use the 485 port; choosing two 485 protocols will cause conflicts.

The Vertiv Liebert IntelliSlot IS-485 EXI Card connects to a SiteLink-E, allowing Vertiv SiteScan Web 4.0 monitoring and control.

4.7.2 Slot for Vertiv™ LIFE™ Services Products – SLOT1

This slot is the reserved interface for Vertiv LIFE by using Vertiv™ Liebert® IntelliSlot™ RDU120. This card collects the high resolution data, that are exchanged with LIFE Services station. Ask your local Vertiv representative for details on IFE Services and its benefits for your UPS system.

4.7.3 Environmental Sensor - AP63-XP6

This port is reserved to interface Vertiv™ Geist™ GTHD device, used to measure ambient temperature, humidity and dew point.

Figure 4.7 Interface Vertiv Geist GTHD device

4.7.4 Connector for REPO (Input and Status) and Backfeed Status – AP63-X70

The Remote Emergency Power Off (REPO) shuts down the UPS rectifier, inverter and static bypass. It disconnects the external battery circuit breakers, the Load from Inverter output , but it does not disconnect the input mains supply to the UPS. If required, this additional action can be performed by adding a contact to the emergency stop switch placed on an upstream breaker.

The REPO button must be connected to the UPS with a twisted/shielded cable no longer than 20 m (66 ft). The contact must be closed under normal operating conditions. When this contact opens, the load will be cut Off and a fault will appear on the display. Resuming normal operation requires resetting the REPO button to its closed position and resetting the fault on the display.

EPO is On when either EPO Input Contact 1 (AP63-X70 pin 1-2) or EPO Input Contact 2 (AP63-X70 pin 3-4) is open. The inputs contacts are independent and in OR logic but can be programmed with AND function on request.

If the EPO button is not installed, jumper leads must be connected between Pins 1 - 2 of EPO Input Contact 1 (AP63-X70) and between Pins 3 – 4 of EPO Input Contact 2. (AP63-X70).

The UPS REPO status may be monitored by connecting to the Form-C REPO Status Pins 5, 6 and 7 of AP63-X70.

The contact AP63-X70 Pins 8, 9 and 10 will provide Backfeed Protection according to IEC/EN 62040-1+A1:2013. This output can be used to trip or drive a contact in order to insulate the bypass input line when a SCR failure occurs.

See Submittal Drawings on page 93 for more details.

Table 4.4 REPO and BACKFED Connection

Connector	Pin	Signal	Description
AP63-X71	1-2 and 3-4	EPO Input door	EPO is ON when either Input 1 or Input 2 are open; the inputs are independent and in OR logic or AND logic
AP63-X70	1-2 and 3-4	EPO Input Contact #1 and #2	
AP63-X70	5	EPO Status Contact - N.C.	Form-C dry contacts
	6	EPO Status Contact - COMMON	
	7	EPO Status Contact - N.O.	
AP63-X70	8	BKF Status N.C.	Form-C dry contacts
	9	BKF Status COMMON	
	10	BKF Status N.O.	

WARNING! The external push button must be voltage-free and isolated from all sources and GND. The external REPO system must not exceed 24 Vdc.

NOTE: The external EPO switch must latch Open when activated.

4.7.5 Customizable Output Dry Contacts - AP65-XP12 and AP66-XP12

The UPS has two 18-pin screw connectors (AP65-XP12 and AP66-XP12) that allow connecting 12 Form C or Form A/B configurable output contacts. Each contact is rated for 120VAC/5A. The separation to the other low Voltage circuits shall be respected.

See Submittal Drawings on page 93 for more details.

Table 4.5 Customizable Output Contacts

PIN	User Output	Default setting
AP65 -XP12 pin 1 -2-3	1	Summary Alarm (Default)
AP65 -XP12 pin 4-5-6	2	Inverter Not On (Default)
AP65 -XP12 pin 7-8-9	3	Residual battery Autonomy is Expiring (Default)
AP65 -XP12 pin 10-11-12	4	Rectifier or Bypass Mains Failure (Default)
AP65 -XP12 pin 13-14-15	5	User Selectable
AP65 -XP12 pin 16-17-18	6	User Selectable
AP66 -XP12 pin 1-2-3	7	User Selectable
AP66 -XP12 pin 4-5-6	8	User Selectable
AP66 -XP12 pin 7-8-9	9	User Selectable
AP66 -XP12 pin 10-11-12	10	User Selectable
AP66 -XP12 pin 13-14-15	11	User Selectable
AP66 -XP12 pin 16-17-18	12	User Selectable

The selectable contacts can be customized (by qualified technicians only) to perform the following functions:

Summary Alarm (Fault/Warning)	Inverter Off
Residual Battery Autonomy Is Expiring	Rectifier or Bypass Mains Failure
Inverter On	Maintenance Bypass Switch (MBB) Closed
Inverter Self Clock	Summary Fault
Inverter Overtemperature	Imminent Shutdown
Battery Undervoltage	Inverter Overload
Rectifier Mains Failure	Bypass Mains Failure
Battery Overtemperature	On Generator
Battery Pre-warning Level (Low Battery)	Battery Capacity Level 25%
Battery Capacity Level 50%	Battery Capacity Level 75%
Battery Capacity Level 100%	Load Level 25%
Load Level 50%	Load Level 75%
Load Level 100%	Load Level 105%
Line Fault	Summary Alarm Or Line Fault
Power Loss Pre-warning	Power Loss Warning

Load Not Supplied	Eco Mode Active
Remote Back-Feed Breaker	BCB Open
Multi-Module Operating System Detected	

4.7.6 Customizable Input Dry Contacts - AP65-XP11 and AP66-XP11

The UPS contains two 12-pin screw connectors (AP65-XP11 and AP66-XP11) that allow connecting 8 Form C or 16 Form A/B configurable output contacts.

See Submittal Drawings on page 93 for more details.

Table 4.6 Form A/B Customizable Input Contacts

Pin	User Input	Default Setting
AP65 -XP11 pin 1 - 2	1	User Selectable
AP65 -XP11 pin 2 - 3	2	User Selectable
AP65 -XP11 pin 4 – 5	3	User Selectable
AP65 -XP11 pin 5 – 6	4	User Selectable
AP65 -XP11 pin 7 – 8	5	User Selectable
AP65 -XP11 pin 8 – 9	6	User Selectable
AP65 -XP11 pin 10 – 11	7	User Selectable
AP65 -XP11 pin 11 – 12	8	User Selectable
AP66 -XP11 pin 1 - 2	9	User Selectable
AP66 -XP11 pin 2 - 3	10	User Selectable
AP66 -XP11 pin 4 – 5	11	User Selectable
AP66 -XP11 pin 5 – 6	12	User Selectable
AP66 -XP11 pin 7 – 8	13	User Selectable
AP66 -XP11 pin 8 – 9	14	User Selectable
AP66 -XP11 pin 10 – 11	15	User Selectable
AP66 -XP12 pin 11 – 12	16	User Selectable

The selectable input contacts can be customized by qualified service technicians to perform the functions below.

- On Generator
- Mirrored on Generator
- Fast Power Off
- External Maintenance Bypass CB
- Fault Acknowledge
- External Output CB (MOB)
- Maintenance Isolation Breaker (MIB)
- Disable Inverter Start
- Force Rectifier Off/On
- DC Ground Fault Detection
- Disable Bypass SS
- Disable Battery Charging
- External Remote Feed CB Status
- External Remote Back-Feed CB Status
- External Load Bank CB Status System

- External Load Bank CB Status Module
- Remote Enable
- Remote Transfer to Bypass
- Remote Transfer to Inverter

WARNING! Use no-voltage contacts to drive the inputs. Do not use voltages supplied by an external power supply.

Remote Control Using Programmable Logic Controllers (PLC)

The UPS provides an external control interface for maintenance bypass switchgear equipped with a key interlock system and to manage a battery system. The interface provides 8 Form C or 16 selectable Form A/B programmable input dry contacts (AP65/66-XP11), and 12 Form C output dry contacts (AP65/66-XP12) that can also be configured as Form A/B programmable output dry contacts. Programmable contacts can be customized to meet customer needs and to integrate with remote controls.

Figure 4.8 below illustrates the location of each breaker for a typical UPS system, and Table 4.7 below describes available programmable input contacts for external circuit breakers.

While the programmable contacts allow flexibility for integration with external controls, it is important to note that any UPS input contact programmed to reflect the status of a breaker must be supplied by an auxiliary contact of that breaker. The status of a breaker should not be supplied to the UPS input contacts by PLC logic-driven output contacts.

Each UPS input contact can be programmed to reflect the state of a single breaker only and should not receive multiple breaker status signals (that is, no piggybacking signals).

Failure to adhere to these guidelines may result in unintended operation, damage to the equipment, or even a critical load loss. Any customers planning Vertiv™ Trinergy™ UPS installations that incorporate PLC remote control should contact Vertiv Applications Engineering for guidance.

Figure 4.8 External Circuit Breakers in a Typical System

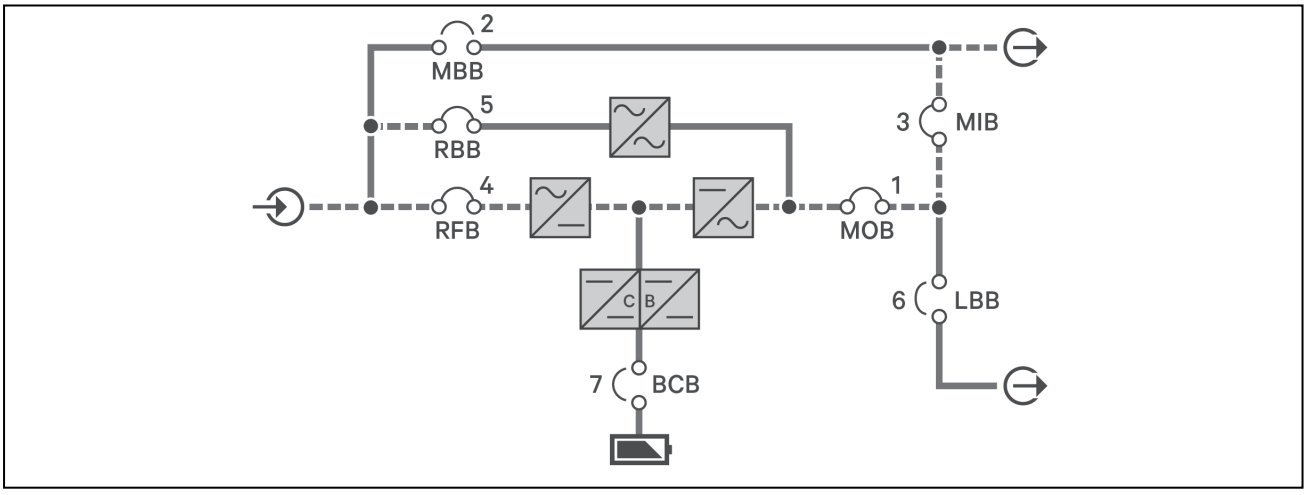


Table 4.7 Programmable Input Contacts for External Circuit Breakers

Item	Circuit Breakers	Description
1	Module Output Breaker (MOB)	The MOB isolates the output of the UPS from the critical load or collective bus of a parallel UPS system. It is typically located in a system paralleling cabinet, system control cabinet, switchgear, or switchboard.
2	Maintenance Bypass Breaker (MBB)	The MBB isolates an alternate source from the critical load. It is typically located in a maintenance bypass cabinet, system paralleling cabinet, system control cabinet, switchgear, switchboard, or panel board.
3	Maintenance Isolation Breaker (MIB)	MIB isolates the UPS system from the critical load. It is typically located in a maintenance bypass cabinet, system paralleling cabinet, system control cabinet, switchgear, switchboard, or panel board.

Table 4.7 Programmable Input Contacts for External Circuit Breakers (continued)

Item	Circuit Breakers	Description
4	Rectifier Feed Breaker (RFB)	The RFB isolates the UPS rectifier input. It is typically located in switchgear, a switchboard, or a panel board.
5	Remote Back-Feed Breaker (RBB)	The RBB isolates the UPS static bypass switch input. It is typically located in switchgear, a switchboard, or a panel board.
6	Load Bank Breaker (LBB)	The LBB connects the output of the UPS or the critical load to a load bank for testing. It is typically located in switchgear, a switchboard, or a panel board.
7	Battery Circuit Breaker (BCB)	The BCB isolates the DC/DC converter of the UPS from the battery system. The BCB is typically co-located with the battery system.

4.7.7 Connector for Parallel UPS Connection - AP63-X16, AP63-X20, AP63-X19 and AP63-X15

This interface is used for paralleling two or more UPS's with each other.

See Submittal Drawings on page 93 for more details.

4.7.8 Multiple Bus Synchronization Module (MBSM) - AP63-X18

This interface is used to communicate with an external synchronization device, such as Load Bus Sync Module (for two modules only) or the Multibus Sync Module (for up to 11 modules). See the manuals related to these options for more details.

The interface can be used to synchronize the outputs of multiple UPS devices, even when they do not have a common output. This enables an external static switching device to communicate between UPS outputs in the event of a malfunction, without creating synchronization problems.

See Submittal Drawings on page 93 for more details.

4.7.9 Battery Interface Cards - AP71-X2, AP72-X2, AP73-X2, AP74-X2 and AP75-X2

These boards are used to communicate between the UPS module and battery cabinets or Module Battery Disconnects.

AP71-X2 Interface for CORE 1
AP72-X2 Interface for CORE 2
AP73-X2 Interface for CORE 3
AP74-X2 Interface for CORE 4
AP75-X2 Interface for CORE 5

See Submittal Drawings on page 93 for more details.

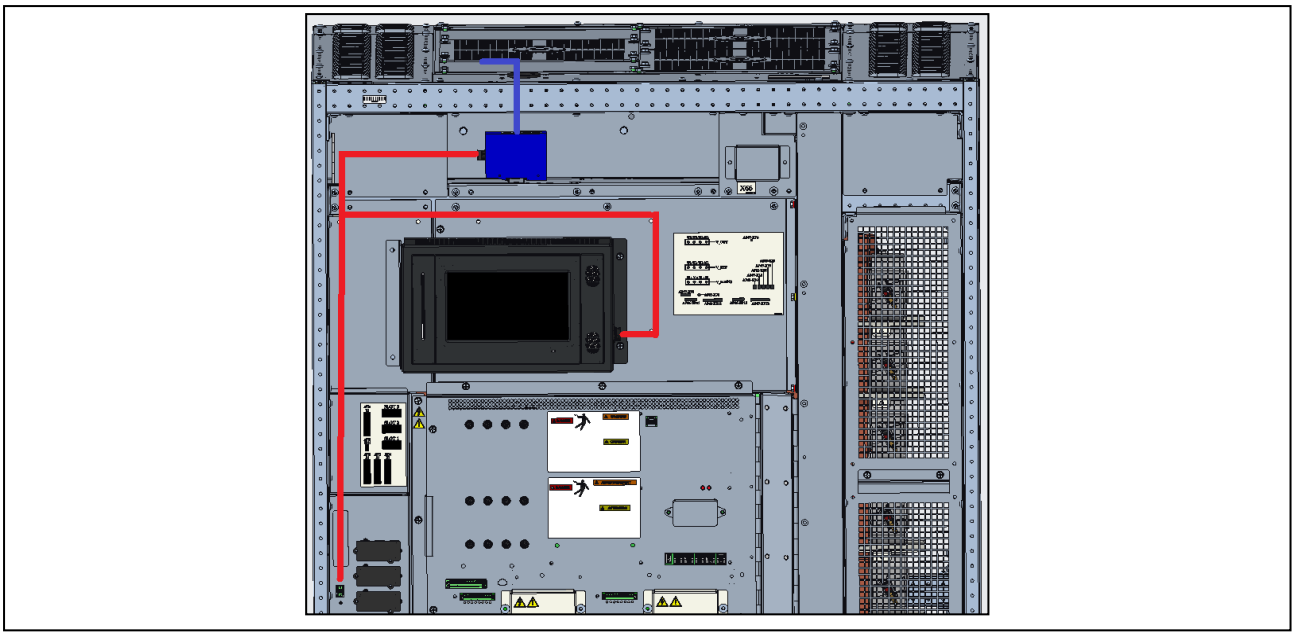
4.7.10 Ethernet Switch Power Supply - AP70-XP15

This connector to supply an optional Ethernet Switch that will be connected to GHMI through J25. Through this option will be possible establish a MODBUS connection with battery BMSs .

The ethernet cables, connected to BMS, will be routed on the UPS top and connected to the switch by removing the screwed plate as shown in **Figure 4.9** on the facing page.

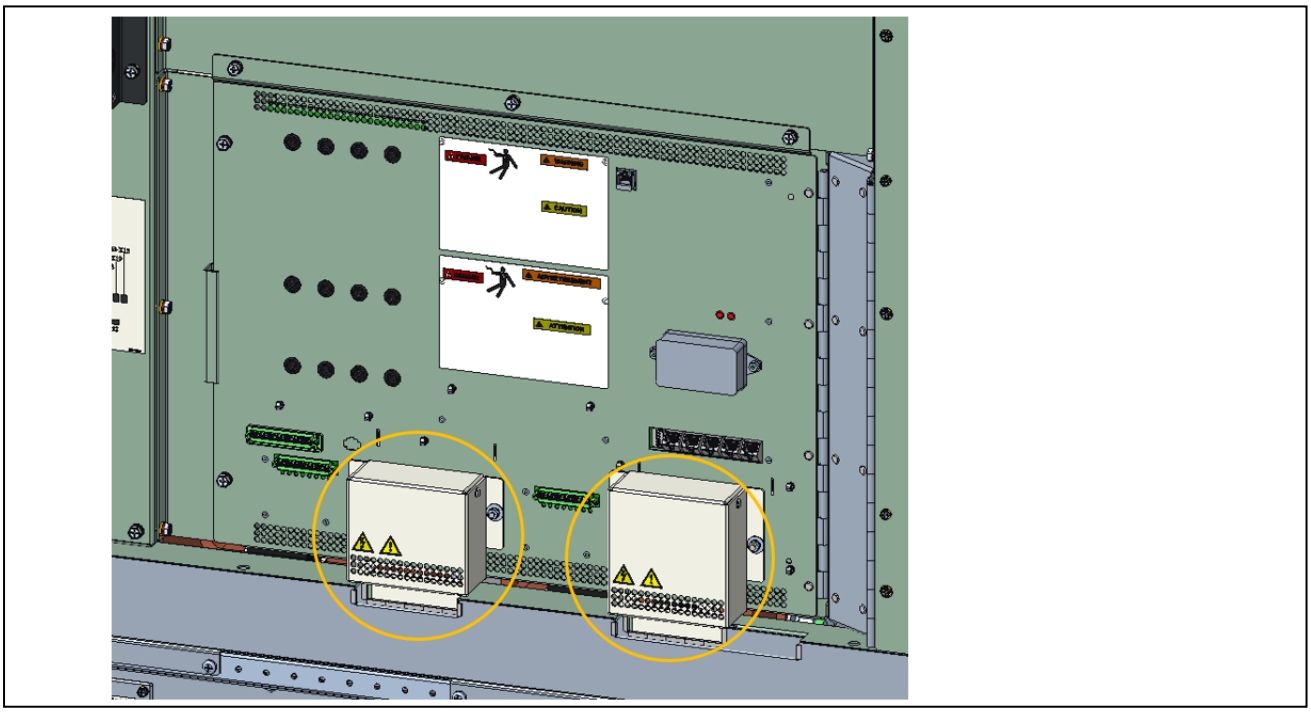
See Submittal Drawings on page 93 for more details.

Figure 4.9 Ethernet cables routing



4.7.11 Serviceability Board Panel

Figure 4.10 Lexan to remove on the Board Panel



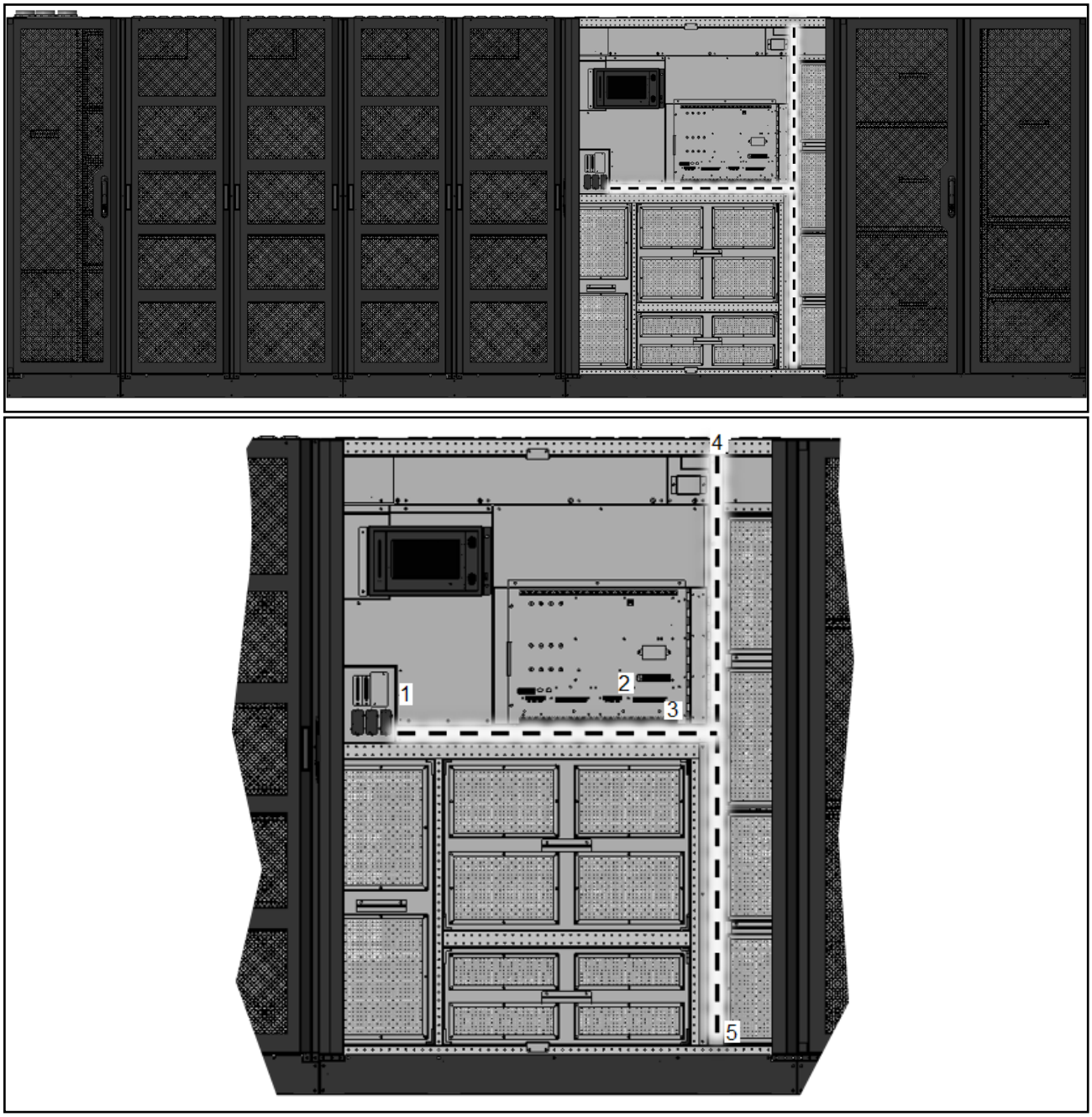
Before opening the door, remove the Lexan and disconnect the cables.

WARNING! It's important to strictly follow the procedure for safety reasons and because of a potential risk of damaging the cables.

4.8 Top/Bottom Entry Low-Voltage

Before making any power wiring connections, make sure that you complete all of the interconnections for your system. To make the interconnections, see the appropriate **Interconnection Details** drawing for your system, listed in Submittal Drawings on page 93. Figure 4.11 below is an example of the wiring route.

Figure 4.11 Low-Voltage Cable Routing Example



5 Normal and Safe Operation

5.1 Function

The uninterruptible power supply (UPS) is connected between line power and electrical load. It protects the load from line power interruptions and power failures.

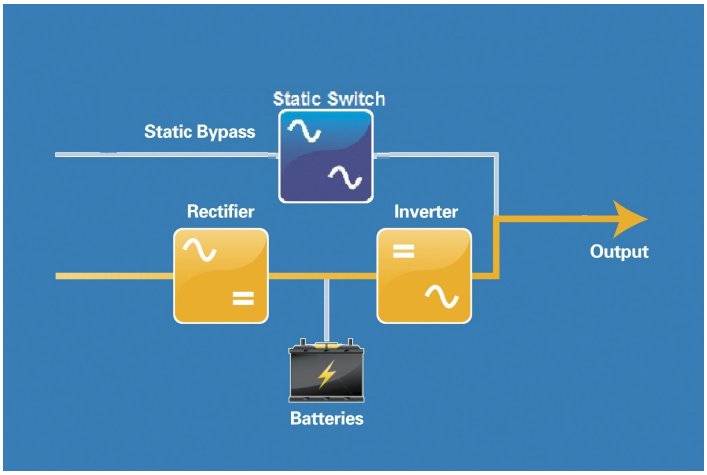
WARNING! To avoid overheating inside the UPS, do not operate the unit for extended periods with the rectifier running, the Inverter switched off and the Bypass switch open.

5.1.1 On-line Principle

In on-line operation, the alternating voltage of the line power is converted into direct voltage. This DC voltage is used simultaneously to charge the battery and supply the inverter. The inverter converts the direct voltage into interference-free alternating voltage at a fixed frequency and amplitude, which supplies the connected loads. This protects the load from line power disturbances and provides a secure supply for electrical loads (PCs, network servers, multi-console systems).

In case of a line power failure, the batteries provide uninterrupted power to the loads for a given period, depending on battery capacity and connected load.

Figure 5.1 UPS in on-line operation



5.1.2 Battery Management

The battery is charged and discharged, as well as monitored, using a dedicated microprocessor control. This ensures maximum battery life. For details, see Product Features on the next page.

5.1.3 Bypass-line Principal and Overload Management

In the event of an overload (e.g. > 150% of nominal load), if the Bypass line is available, the load is immediately transferred to bypass, otherwise the load is supplied by the inverter for a limited time (see Technical Data on page 81 inverter output section) after which the supply to the load will be interrupted. A corresponding fault message is displayed on the touch screen. To restore the initial conditions, the output load must first be reduced, and then a manual reset must be carried out to clear the fault message from the touch screen. Contact customer service for more information. In the event of an inverter fault, the supply for the load is transferred immediately to the Bypass line. The touch screen displays the corresponding fault message. Before carrying out a manual reset to restore initial conditions, it is necessary to remove the root cause of the fault. It is strongly recommended you contact customer support for more information.

5.1.4 Communication

The UPS offers several interfaces for communication with computers.

5.2 Product Features

5.2.1 Safe and Reliable Operation

- Continuous-duty booster
- High withstand rating
- Dynamic Line Support Feature to increase performances on clearing output short circuits.
- Self isolating cores
- Waveform Capture
- Distributed batteries
- Humidity management
- High operating temperature

5.2.2 Easy Installation and Operation

- Guided procedures for installation
- GHMI provides indication of status, load and battery quality
- Event memory for fault analysis
- Fault display and audible signal
- Enhanced Data Log with more data and insights

5.2.3 Battery Management

- Battery monitoring with Dry Contacts, Modbus or BIB (Battery Interface Boards)
- Automatic battery circuit test
- Temperature-dependent charging

5.2.4 Environment, EMC

- EMC limits values to comply with European regulations and standards
- Energy savings due to high efficiency
- Low noise level
- Special EMC filter for higher demands (optional FCC)

5.2.5 Modern Technology

- IGBT power transistors
- Highly integrated digital electronics (ASICs)
- Especially well suited for computer loads

The UPS can also be used as a frequency converter for 50/60Hz or vice versa.

5.3 Block Diagram

The UPS does not include any internal switch; external switches must be installed and monitored by the UPS through dedicated input contacts

KEY TO SWITCHES:

- RFB = RECTIFIER INPUT BREAKER
- RBB = BYPASS INPUT BREAKER
- MBB = MAINTENANCE BYPASS BREAKER
- MOB = MODULE OUTPUT BREAKER
- BCB = BATTERY CIRCUIT BREAKER

5.3.1 Components

The UPS consists of the following components:

- Rectifier - Provides regulated DC voltage to inverter and booster/charger.
- Inverter - Provides controlled AC output voltage to the critical load
- Battery converter - Charges the battery when line power is present. Supplies the inverter from the battery when line power is not present.
- Static Bypass Switch
- Maintenance Bypass - Not supplied with the unit

5.4 Operating Modes

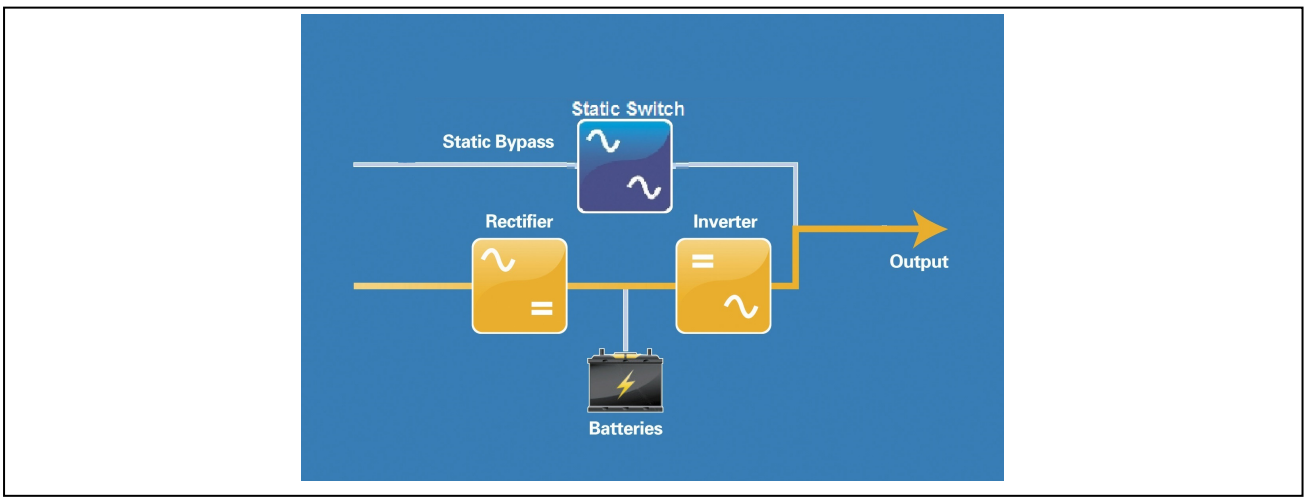
The UPS has 5 different operating modes. These are described below.

5.4.1 On-line Operation

Normal UPS operating mode. The connected loads are supplied from line power via the Inverter. The batteries are charged as necessary. The inverter reliably filters line power disturbances and provides a stable, interference-free supply to the load. The Normal state is displayed.

In this operating mode, the UPS switches to battery operation if a line power failure occurs. If an overload or short circuit occurs on the UPS output, or if there is a fault in the inverter, the UPS switches to Bypass operation.

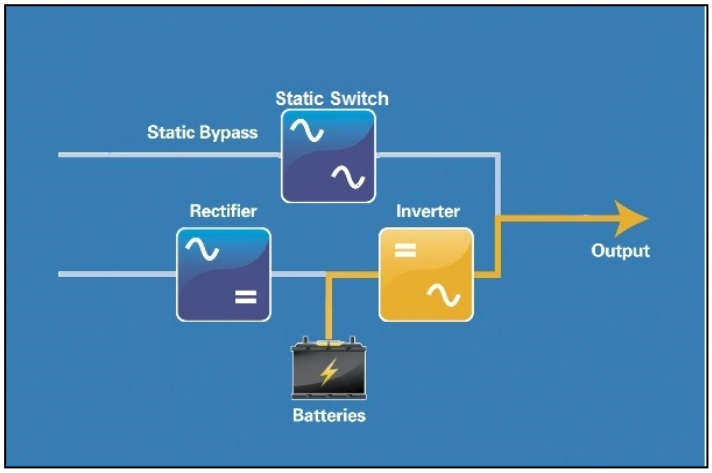
Figure 5.2 Power flow in on-line operation



5.4.2 Battery Operation

In this operating mode, the connected load is supplied from the batteries via the inverter. In the event of power failure, battery operation is automatically activated and supplies the loads without interruption. If the power failure lasts longer than 30s, the UPS signals a fault condition. The battery's operating condition is displayed. From this operating mode, the UPS automatically reverts to on-line operation within the backup time after the line power returns. If the duration of the power failure is longer than battery capacity under current load, the UPS provides the relative information via its interfaces. Computers can be automatically powered down with additional software (optional).

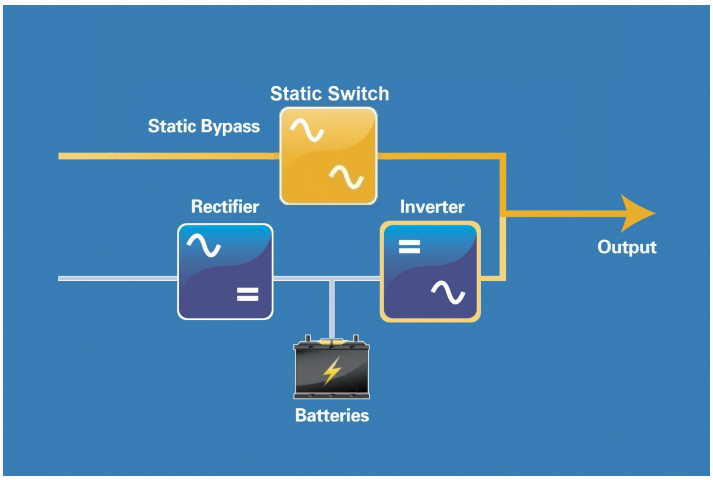
Figure 5.3 Power flow during battery operation



5.4.3 Dynamic Online Operation

This operating mode is available as option and compensates for output load THDi, output load PF. It reduces line power disturbances such as sags and swells. The load is fed by the bypass line, and the inverter works as an active filter, which compensates for the reactive power required by the load. In a typical condition, this mode offers 96.5 - 98.5% efficiency, depending on the type of load (e.g. nonlinear or linear) and the condition of input line power.

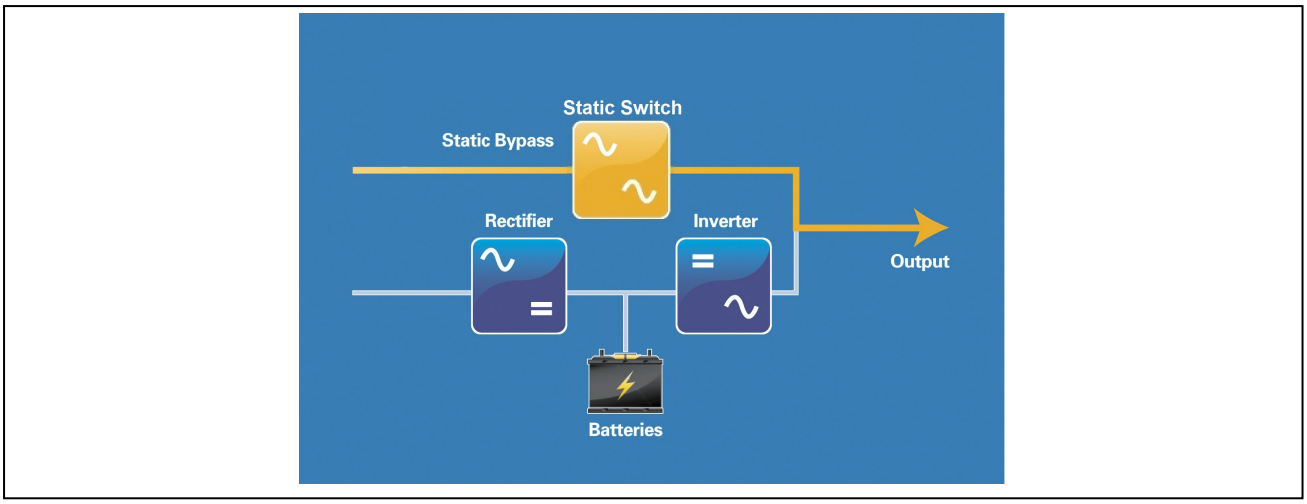
Figure 5.4 Power flow in Dynamic online operation



5.4.4 Bypass Operation

In this operating mode, the connected loads are supplied from line power via the Static Bypass Switch. The Static Bypass Switch is used to provide power to the loads. If an overload or short-circuit on UPS output occurs, the Static Bypass Switch is automatically activated to provide uninterrupted power to the loads. The Bypass operating condition is displayed. From this operating mode, the UPS automatically reverts to on-line operation after the fault is corrected. Bypass operation can also be specifically selected from the control panel using the push button.

Figure 5.5 Power flow in Bypass operation



5.4.5 Battery Shield

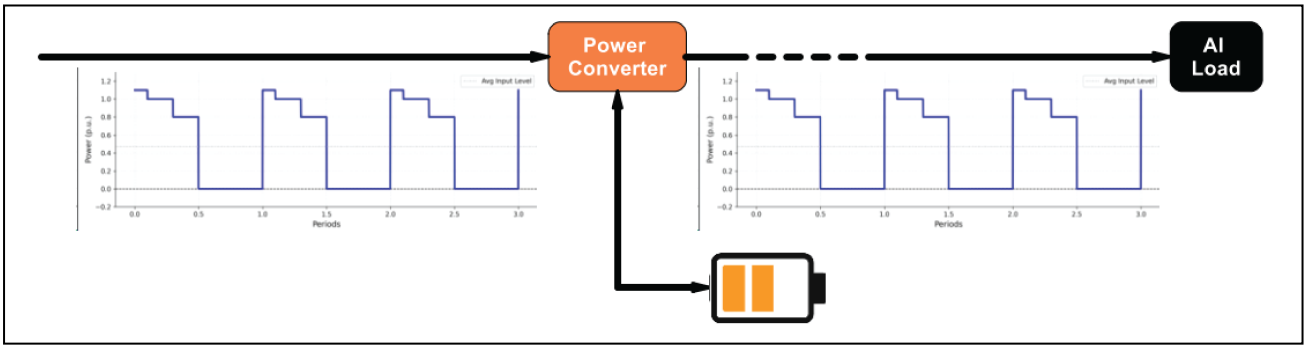
In this operating mode, the battery is protected from unnecessary micro-cycling during fast transients, preserving charge for use during critical conditions, such as emergency events.

During large and recurring load steps, power variations are smoothly transferred from the IT load to the DC link and then to the input source, with minimal deviation.

The Vertiv converter firmware prevents the battery from participating in repeated upward load steps, which could otherwise result in gradual discharge over time. This approach improves battery utilization and efficiency.

As a result, the battery is not subjected to abnormal stress, thereby extending its service life and maintaining reliable performance.

Figure 5.6 Power Transfer with Battery Shield Mode during Load Transients



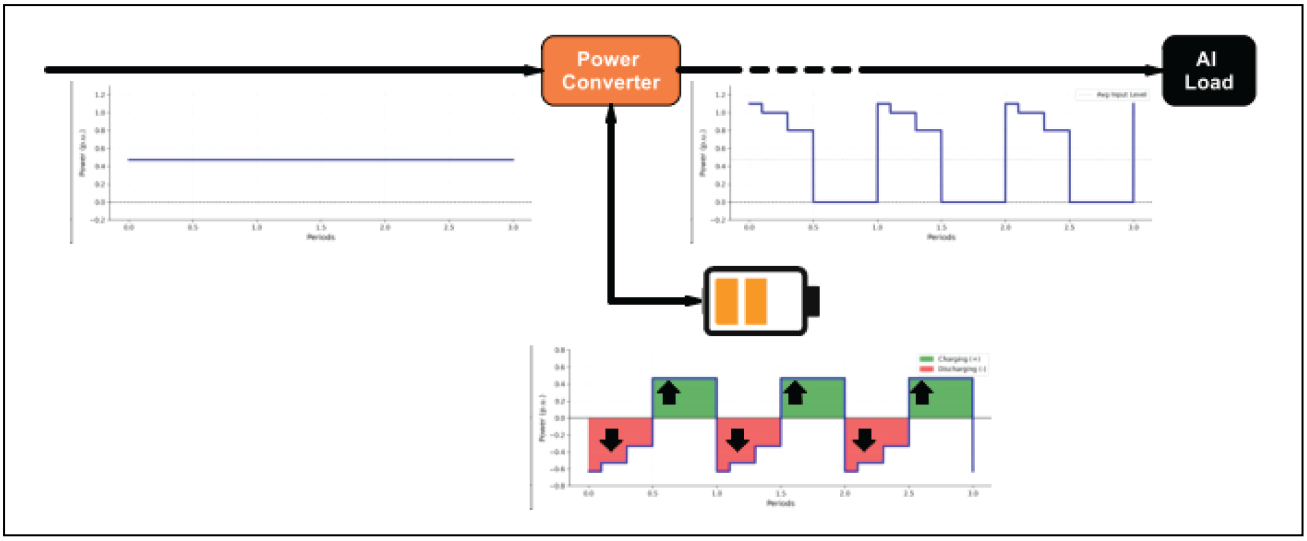
5.4.6 Power Smoothing

In this operating mode, the converter actively charges and discharges the battery (or capacitor bank) to compensate for deviations of the load power from its average value, ensuring a stable power supply. However, this continuous cycling introduces additional stress on the battery due to frequent charge and discharge events, which can lead to increased operating temperatures over time.

To minimize sudden impacts on the input source, excess power is directed to the battery when the instantaneous output is below the average value, and additional power is drawn from the battery when it exceeds the average. The system continuously calculates the average UPS output power over each full load cycle to manage this process effectively.

A target state of charge (SOC) is maintained to keep the battery within optimal operating conditions. Additionally, input power variations are controlled using a ramp rate, typically up to 1% kW per second, to ensure gradual and stable power transitions.

Figure 5.7 Battery Charge/Discharge for Power Smoothing and Input Stabilization



5.5 Placement into Service

5.5.1 Forming

If the UPS devices have not been used for one year or more, the intermediate circuit capacitors must be reformed. If the UPS devices are placed into service within one year after delivery (check nameplate), this action is not necessary.

- Contact customer service if the intermediate circuit capacitors must be reformed.
- Carry out placement into service as follows:

5.5.2 Switch on the UPS

- Check that the UPS is connected according to Installation on page 15.
- Make sure the ventilation grilles are unobstructed
- Make sure the ground connection is in place
- Make sure that any external switches are in the OFF (0) position and that the UPS is completely de-energized
- Make sure that any external batteries are disconnected

WARNING! Do not connect any devices that may overload the UPS or draw direct current from it.

WARNING! If these instructions are not observed correctly, problems may occur with the supply of power.

5.5.3 Connect the Batteries

Before the system starts, make sure that UPS battery connection polarity is correct. Wrong connections can damage the system and endanger operator safety.

WARNING! This operation must be carried out by qualified personnel. To prevent damage to the system, before closing battery breaker, use a suitable instrument to make sure that the polarity of the battery voltage measured on the external side of battery breaker matches the polarity indicated in Submittal Drawings on page 93.

WARNING! Close battery breaker only after battery polarity has been carefully checked and when required in the procedures in UPS Switching Procedures on the facing page.

5.5.4 Switch to On-line Operation

- Set the UPS to On-line Operation (see UPS Switching Procedures below).

5.6 UPS Switching Procedures

The following procedures refer to Block Diagram on page 67.

5.6.1 Procedure 1: UPS TURN-ON PROCEDURE

Starting with the UPS completely deenergized, this procedure explains how to switch on the UPS and set it to Normal Operating Mode.

Step	Action	Status
1	Switch RFB to the ON position	Rectifier start up
2	Switch RBB to the ON position (wait for the Static Bypass Switch to switch on)	Static Bypass Switch ON and fans ON
3	Check the charger is on then close external battery switches[1]	
4	Switch MOB to the ON position IMPORTANT: when MOB is closed, the output of the UPS and all the loads connected to it will be energized.	System in Bypass Mode - Output voltage present
5	Touch “Inverter On” on the touch screen.	Normal Mode

[1] Before closing the battery breaker check DC voltages across the circuit breaker to ensure voltage level is consistent with the battery configuration

5.6.2 Procedure 2: UPS TURN-OFF PROCEDURE

Starting with the UPS in the Normal Mode, this procedure explains how to switch off the UPS. When this procedure is followed, the output voltage is completely turned off and any load connected to UPS output is shut down.

Step	Action	Status
1	Touch “Inverter Off” on the touch screen	System in Bypass Mode
2	Switch external battery breaker to the OFF position	
3	Switch MOB to the OFF position	Load not supplied
4	Switch RBB to the OFF position	
5	Switch RFB to the OFF position	

5.6.3 Procedure 3: TRANSFER FROM NORMAL MODE TO MAINTENANCE BYPASS MODE

Starting with the UPS in the Normal Mode, this procedure explains how to transfer the load to Maintenance Bypass and shut down the UPS.

Step	Action	Status
1	Touch “Inverter Off” on the touch screen	System in Bypass Mode
2	Switch battery breaker to the OFF position	Battery disconnector
3	Switch MBB to the ON position	
4	Switch MOB to the OFF position	Service Mode
5	Switch RFB and RBB to the OFF position	Maintenance Bypass Mode - UPS completely de-energized

5.6.4 Procedure 4: TRANSFER FROM MAINTENANCE BYPASS MODE TO NORMAL MODE

Starting with the UPS in the Maintenance Bypass mode, this procedure explains how transfer the load to Normal Mode and start the UPS.

Step	Action	Status
1	Switch RFB to the ON position	Rectifier start up
2	Switch RBB to the ON position (wait for Static Bypass Switch to turn on)	Static Bypass Switch ON and fans ON
3	Switch external battery to the ON position	
4	Switch MOB to the ON position	System in Bypass Mode - Output voltage present
5	Switch MBB to the OFF position	
6	Touch “Inverter On” on the touch screen	Normal Mode

5.7 Inverter START /STOP Procedures

5.7.1 Single UPS - Start Inverter

UPS in Bypass mode: To start the inverter and transfer the load to the inverter touch ‘Inverter On’ on the touch screen.

5.7.2 Single UPS - Stop Inverter

UPS in normal mode: To stop the inverter and transfer the load to the Bypass line touch ‘Inverter Off’ on the touch screen.

5.8 Manual Operations—1+N Systems

5.8.1 Startup—1+N Module System

WARNING! Risk of electrical shock can cause equipment damage, personal injury and death. The following procedure provides power to the critical load distribution system. Verify that the critical load distribution is ready to accept power. Make sure that personnel and equipment are ready for the critical load distribution system to be energized.

ADVERTISSEMENT! Risque de décharge électrique pouvant entraîner des dommages matériels, des blessures et même la mort. La procédure suivante fournit de l’énergie au système de distribution de la charge critique. Vérifiez que ce système est prêt à être alimenté. Assurez-vous que le personnel et les équipements sont préparés pour la mise sous tension du système de distribution de la charge critique.

If the installation includes a Maintenance Bypass, power may already be supplied to the critical load equipment through the Maintenance Bypass. If there is no power to the critical load, apply power through the UPS bypass line per the following procedure.

During startup, power is supplied to the critical load through the UPS (internal) bypass line while the UPS system is being energized. Depending on the reason for the UPS system shutdown, power may be present in the bypass line. To determine this, check the Touchscreen Control Panel screen after control power is available.

NOTE: If the system was shut down in response to an Emergency Off, there may be alarm messages on the touchscreen that describe system conditions before (or at the time of) the shutdown. Some or all the alarm conditions may have been resolved. Contact Vertiv Technical Support for assistance in clearing any remaining alarm messages.

WARNING! WARNING! Risk of electrical shock and high short circuit current. Can cause equipment damage, personal injury and death. If the UPS has been shut down for maintenance, verify that all of the UPS doors are closed and latched. All test equipment must be removed from the system. All electrical connections must be secure.

ADVERTISSEMENT! Risque de décharge électrique et de présence de courant de court-circuit élevé pouvant entraîner des dommages matériels, des blessures et même la mort. Si l'alimentation sans coupure a été interrompue à des fins d'entretien, assurez-vous que toutes les portes du système ASC sont fermées et verrouillées. Tous les appareils de test doivent être retirés du système. Tous les branchements électriques doivent être serrés.

WARNING! WARNING! The following procedure must be performed exactly as described. Deviating from the procedure can result in electric shock hazard to personnel and the risk of fire.

ADVERTISSEMENT! La procédure suivante doit être suivie à la lettre. Dévier de cette procédure peut entraîner des risqué d'électrocution à la personne ainsi que des risques d'incendie.

This section lists typical step-by-step instructions to start a 1+N Module System with and without remote breakers. The Touchscreen Control Panel will list all steps required for the process, based on the unit's operational status and other factors.

- Startup—Including initial startup, recovering from input power failure, recovering from DC source shutdown and recovering from shutdowns for emergencies or maintenance.
- Load Transfers—Including transfers from UPS to bypass and re-transfers from bypass to the UPS system.
- Maintenance Bypass Load Transfers—Including transfers from internal bypass to maintenance bypass and transfers from maintenance bypass to internal bypass.
- Shutdowns—Including module shut down for maintenance and emergency shutdown.

NOTE: The following procedure assumes that the UPS installation, inspection, and initial startup have been performed by a Vertiv authorized technician, in accordance with applicable UL and CE requirements. A Vertiv authorized representative must perform the initial system startup and ensure that all UPS units are operating with the approved firmware version specified for the system and that all configuration parameters are correctly set to meet the intended application and regulatory compliance.

1. Verify that all parallel cables are properly connected to the UPS modules of the system.
2. Before applying power to the UPS modules, determine the location and position of the following circuit breakers and switches. External/Remote breakers will be in the appropriate switchgear.

- Input Circuit Breaker
  - Verify that these breakers are in the open position.
  - External Remote Back-feed Breaker (RBB) for single input/feed applications
  - External Rectifier Feed Breaker (RFB) for dual input/feed applications
- Module Battery Disconnect (MBD)—Verify that this external breaker is open or tripped. If DC source cabinets are used, verify that breakers on all the cabinets are open.
- Bypass Circuit Breaker
  - Verify that these breakers are in the open position.
  - External Remote Back-Feed Breaker (RBB) for single input/feed applications
  - (Optional) Internal Back-Feed Disconnect (BFD)
- Maintenance Isolation Breaker (MIB)—Verify that this breaker is in the open position, if installed.
- Module Output Breakers (MOB)—Verify that these breakers are in the open position.

3. Close the external rectifier feeder breaker for each UPS module in the system that will be added to the collective bus.

NOTE: Any UPS module that will not be added to the collective bus must remain de-energized or be in Maintenance Service Mode (this operation may only be performed by Vertiv Service personnel).

- External Remote Back-Feed Breaker (RBB) for single input/feed applications
- External Rectifier Feed Breaker (RFB) for dual input/feed applications

NOTE: The rectifier on each UPS will start at this time. Do not proceed until the Touchscreen Control Panel is fully operational on each UPS.

4. Verify that the rectifier has started on each UPS that will be added to the collective bus. The rectifier icon on the Touchscreen Control Panel should be green. If it is not, the issue must be corrected before proceeding.
5. Close the external Remote Back-Feed Breaker (RBB) and optional internal Back-Feed Disconnect (BFD) on each UPS that will be added to the collective bus, if installed.
6. Verify that the Bypass Static Switch (BPSS) has started on each UPS that will be added to the collective bus. The BPSS icon on the Touchscreen Control Panel should be green. The UPS module output should be on Bypass. If it is not, the issue must be corrected before proceeding.
7. Close the external Module Battery Disconnect(s) (MBD) for each UPS that will be added to the collective bus.
8. Verify that the MBD contact icon on the Touchscreen Control Panel is closed and that the Battery icon is green on each UPS that will be added to the collective bus. If it is not, the issue must be corrected before proceeding.
9. Close the external Module Output Breaker (MOB) on each UPS.
10. Close the external MIB if used. If a maintenance bypass interlocking scheme is available, then proceed with the operation of the interlock until the MIB is closed and the MBB is opened.
11. The critical load should be on the UPS bypass.
12. From the Touchscreen Control Panel of one of the energized UPS modules, touch OPERATE > UNIT OPERATIONS > Inverter On > System.
13. Verify that each energized UPS module automatically transfers to Inverter. The critical load should be on the UPS Inverter.

5.8.2 Load Transfer-1+N System: Transfer System Inverter to Bypass

This section lists typical step-by-step instructions to transfer the UPS system from Inverter Mode to Bypass Mode. The critical load should be on the UPS Inverter.

1. From the Touchscreen Control Panel of any UPS module in the system, touch OPERATE > UNIT OPERATIONS > Inverter Off > System.
2. Verify that each UPS automatically transferred to Bypass.

NOTE: The load will now be on static bypass in each UPS.

5.8.3 Load Transfer-1+N System: Transfer System from Bypass to Inverter

This section lists typical step-by-step instructions to transfer the UPS system from Bypass to Inverter mode of operation. The critical load should be on the UPS Bypass.

1. From the Touchscreen Control Panel of any UPS module in the system, touch OPERATE > UNIT OPERATIONS > Inverter On > System.
2. Verify that each UPS automatically transferred to Inverter.

5.8.4 Maintenance Bypass Load Transfers—1+N Module System

Follow these instructions to manually transfer the load between Maintenance Bypass and the UPS bypass line. Do not transfer the load between Maintenance Bypass and the UPS module inverter output. Use the Touchscreen Control Panel screen to verify that the UPS bypass line is available.

RISK OF IMPROPER OPERATING SEQUENCE. CAN CAUSE EQUIPMENT DAMAGE. FAILING TO FOLLOW THE PROPER SEQUENCE WHEN OPERATING ANY CIRCUIT BREAKER MAY CAUSE DAMAGE TO THE CONNECTED EQUIPMENT. OPERATING A MAINTENANCE BYPASS CIRCUIT BREAKER OUT OF SEQUENCE COULD CUT OFF POWER TO THE CRITICAL LOAD.

RISK OF IMPROPER LOAD TRANSFER. CAN CAUSE EQUIPMENT DAMAGE. THE UPS MUST BE ON INTERNAL BYPASS BEFORE PERFORMING THE FOLLOWING PROCEDURES AND OPERATING THE MIB OR THE MBB, OR DAMAGE TO THE UPS MAY OCCUR AND THE CRITICAL LOAD MAY BE LOST.

Maintenance Bypass Load Transfers-1+N Module System: If Load is on UPS Bypass

This section lists typical step-by-step instructions to transfer the UPS system from Bypass to Maintenance Bypass.

1. Transfer the UPS system to bypass (see Load Transfer-1+N System: Transfer System Inverter to Bypass on the previous page: Transfer System Inverter to Bypass). The OK to transfer lamp on the key-release unit will light.

NOTE: If the maintenance bypass cabinet or switchboard has any other type of custom interlock, follow the instructions for that interlock systems to remove the key.

2. If using a key interlock system:
   a. Press the key-release unit push button.
   b. Turn the key and remove it from key-release unit.

NOTE: The UPS is now locked in bypass and cannot be re-transferred to the inverter until the key is reinserted.

3. If using a key interlock system, insert the key into the lock for the Maintenance Bypass Breaker (MBB); retract the bolt.
4. Close the MBB.

RISK OF IMPROPER OPERATION SEQUENCE. MAY CAUSE EQUIPMENT DAMAGE. FAILURE TO CLOSE THE MBB WILL INTERRUPT POWER TO THE LOAD.

5. Open the Maintenance Isolation Breaker (MIB). The UPS system is now isolated from the critical load and the load is now on Maintenance Bypass.
6. If using a key interlock system, remove the key from the lock for the MIB.
7. If the maintenance bypass cabinet or switchboard has an optional, two-key interlock system, insert the key into the solenoid.
8. If UPS bypass shutdown is required, follow the instruction in Shutdown-1+N System Shutdown on page 1.

Maintenance Bypass Load Transfers—1+N Module System: If Load is on Maintenance Bypass

This section lists typical step-by-step instructions to transfer the UPS system from Maintenance Bypass to Bypass.

1. If the UPS modules are Off, start the system. Refer to Startup—1+N Module System on page 72.
2. Place all the UPS units in the system in Bypass Mode. Refer : Load Transfer-1+N System: Transfer System Inverter to Bypass on the previous page.
3. If using a key interlock system:
   a. Press the key-release unit push button.
   b. Turn the key and remove it from the key-release unit.

NOTE: The UPS is now locked in bypass and cannot be re-transferred to the inverter until the key is reinserted.

4. If using a key interlock system, insert the key into the lock for the Maintenance Isolation Breaker (MIB); retract the bolt.
5. Close the MIB.

WARNING! Risk of improper operation sequence. May cause equipment damage. Failure to close the MIB will interrupt power to the load.

6. Open the Maintenance Bypass Breaker (MBB). The load is now on UPS internal bypass.

7. If using a key interlock system, remove the key from the lock for the MBB to lock it open.
8. If the maintenance bypass cabinet or switchboard has an optional two-key interlock system, insert the key into the solenoid.

The UPS system can now be transferred from bypass to UPS, see Load Transfer-1+N System: Transfer System from Bypass to Inverter on page 1.

5.8.5 Shutdown-1+N System Shutdown

Perform a system shutdown procedure to remove power from the entire UPS system.

NOTE: Service and maintenance must be performed only by properly trained and qualified personnel and in accordance with applicable regulations as well as with manufacturer's specifications.

1. If the UPS system is operating in Inverter Mode, transfer the UPS system to bypass (see Load Transfer-1+N System: Transfer System Inverter to Bypass on page 74: Transfer System Inverter to Bypass). The OK to Transfer lamp on the key-release unit will light.
2. If an external, wraparound bypass is installed, perform the following steps; otherwise skip to 3.

If using a key interlock system:

   a. Press the key-release unit push button.
   b. Turn the key and remove it from the key-release unit.

NOTE: The UPS system is now locked in bypass and cannot be transferred until the key is returned.

   c. If using a key interlock system, insert the key into the lock for the MBB; retract the bolt.
   d. Close the MBB.

NOTE: Failure to close the Maintenance Bypass Breaker (MBB) will interrupt power to the load.

   e. Open the MIB. The UPS system is now isolated from the critical load, and the load is now on Maintenance Bypass.
   f. If using a key interlock system, remove the key from the lock for the MIB.
   g. If the maintenance bypass cabinet or switchboard has an optional, two-key interlock system, insert the key into the solenoid.
3. Open the external Module Output Breaker (MOB) on each UPS.
4. Open the external Module Battery Disconnect(s) (MBD) for each UPS module.
5. Open the external Remote Back-Feed Breaker (RBB) and optional internal Back-Feed Disconnect (BFD) on each UPS, if installed.
6. Open the external Rectifier Feeder Breaker for each UPS in the system.
   - External Remote Back-Feed Breaker (RBB) for single-input/feed applications
   - External Rectifier Feed Breaker (RFB) for dual-input/feed applications

NOTE: The Rectifier will shut down on each UPS at this time. Once shutdown is complete, the Touchscreen Control Panel will turn Off.

6 Optional Equipment

6.1 Options

NOTE: Although not required, Vertiv recommends that all UPS installations incorporate a solenoid key release unit (SKRU) as part of the maintenance bypass cabinet or switch board. Improper load transfers between the UPS Inverter and Maintenance Bypass may result in equipment damage and loss of load.

A number of options are available for Vertiv™ Trinergy™ UPS. Some options are not available for all ratings. Below are the most frequently provided. Contact your Vertiv representative for more information.

- DC (Battery) Ground Fault - Enables the detection and annunciation of battery DC ground faults in order to facilitate proactive resolution of such ground faults. The UPS can be configured to allow the circuit breaker to open or remain closed upon detection of a ground fault.
- Vertiv™ Liebert® IntelliSlot™ Cards (3 Ports) - Provides web, embedded Vertiv™ LIFE™ Technology, Vertiv Protocol, SNMP, BACnet IP/MSTP, Modbus TCP/RTU, SMTP, SMS and telnet communication and control capabilities in one, unified communication platform.
- Internal Backfeed Breaker - The internal Back-Feed Disconnect (BFD) breaker automatically disconnect the static switch input from Bypass line in case of static switch failure.
- EPO Button - Provides a push button mounted in the external door of the STS cabinet of Vertiv Trinergy UPS. If the button is pushed an EPO signal will be sent to stop the UPS.
- Load Bus Synchronization (LBS) / Multiple Bus Sync Module (MBSM) - Allows synchronizing the outputs of two or more modules when the source for one of more modules supplied by a separate non-synchronized source. See manuals 10H92873 and 10H52160PUMC for more details.
- Seismic Bracing - A separate kit for tying down the UPS module allows the unit to meet International Building Code (IBC) regulations, as per IEC 60068-2, IEC 60068-3, IEEE-693, Telcordia-GR-63-CORE and IEC ES AC156.
- Battery Cabinets and Racks - The batteries provide power in the event of a power outage. The Vertiv Trinergy UPS can use a variety of battery types, e.g. Lithium Ion, NiZn, VRLA, provided that the energy storage devices are compatible with UPS DC voltage range and the load requirements of the application.
- Battery Interface Board - A Battery Interface Box (BIB) is available to support the UPS and third-party battery cabinets or rack-mounted batteries. A BIB is required for each MBD (stand-alone or inside the third-party battery cabinet). A BIB is optional with each Battery Isolation Switch. A BIB is required for each temperature sensor. For more details refer to the BIB User Manual SL-25515.
- Power Supply Unit – External PSU kit for supplying multiple BIB or multiple dry contacts assembly
- Dry Contacts Assembly – Assembly containing a box with dry contacts board. The board can be used for tripping an external BCB and as temperature sensor for batteries.
- Modbus Battery Monitoring – Communication between UPS and batteries through Modbus (available only with Vertiv™ EnergyCore Lithium 5 and Vertiv™EnergyCore Lithium 7 batteries).
- FCC Filters – Filters reducing electrical noise and disturbances generated by the UPS, preventing interference with nearby electronic equipment and communication systems as per UL compliance.
- RBB (Remote Backfeed Breaker) – safety device to control an external breaker to prevent unintended backfeed of electrical power from the UPS during maintenance or power outages.
- BMS supply - This optional kit is used to power the battery monitoring system for the Samsung Battery Cabinet or any other BMS requiring power from UPS.

6.2 Multi-Module System Options and Accessories

The accessories and options for single-module systems may be applied to the individual modules in a multi-module (1+N) system.

6.2.1 Paralleling Cable Kit

Module-to-module communication cables are required for 1+N parallel systems. A kit with RJ-45 connectors ships with each multimodule Vertiv™ Trinergy™ UPS. At least one kit is required for each added UPS module; the number of kits required is one fewer than the number of UPS modules in the 1+N system (for example, six UPS modules would require five kits).

NOTE: Verify appropriate strain relief for all parallel communication cables to ensure that there is no tension or pressure on the RJ-45 to AP63-X16, AP63-X20, AP63-X19, AP63-X15 connections.

Parallel communication cables must be selected at least CAT6 rating and compatible with the RJ-45 connector on the Vertiv Trinergy Part # 10181062 supplied or ordered with multi-module systems. Contact the factory for details.

7 Maintenance

Vertiv recommends that regular maintenance checks be carried out on-site by an authorized customer service.

7.1 Limited Life Components

The Vertiv™ Trinergy™ UPS has a design life well in excess of 10 years. Well-maintained units can continue to provide economic benefits for 20 years or more. Long-life components are used in the UPS wherever practical and cost-effective. However, due to the currently available component material, manufacturing technology limitations and the general function and use of the component, a few components in the UPS will have a shorter life cycle and require replacement in less than 10 years.

The following components utilized in the UPS have a limited life cycle and are specifically exempt from warranty. To prevent a wear-out failure of one of these components affecting the critical load operations, Vertiv recommends these components be periodically inspected and replaced before the expected expiration of their life cycle. The expected life of each component listed below is simply an estimate and is not a guarantee. Individual users may have site-specific requirements, maintenance and other environmental conditions that affect the length of the component's useful life cycle.

Replacement components must exactly match the original component specifications.

For assistance with specific component specifications, replacement component selection and sourcing, contact Vertiv technical support. For customers using Vertiv's preventive maintenance services, the periodic inspections of these components are included. Vertiv recommend periodical inspection and replacement to avoid unanticipated interruptions in critical load operations. Refer to the following table for inspection and replacement suggested timing.

Component	Expected life	Replace in	Inspection in
Power AC Filter Capacitors	13 years	10-13 years	Check every 3 years
Power DC Filter Capacitors	13 years	10-13 years	Check every 3 years
Low-Profile Fans	8 years	6-7 years	Check every 2 years
Air Filters	1 to 3 years	1-2 years	Check 4 Times per Year
Battery, Lithium Logic Memory Backup	10 years	8 to 9 years	Check every 3 years
Battery, Storage			
Lead-Acid Wet-Cell (User Selection)	15 to 20 years	12 to 15 years	Refer to manufacturer indication
Valve-Regulated, Lead-Acid (VRLA)	5 years	2 to 3 years	
	10 years	3 to 4 years	
	20 years	8 to 12 years	
Lithium-Ion	15 years	10 years	

Expected Life is sometimes referred to as Design Life.

7.2 Disposal of Batteries

When the useful life of the batteries has ended, they must be replaced by your Customer Service representative. Exhausted accumulator batteries are classified as "harmful toxic waste" that must be disposed of in the EU by a certified disposal specialist. Outside the EU, they must be disposed of in accordance with the applicable regulations for the given country. The Customer service centre is fully equipped to deal with such batteries in accordance with regulations and with full respect for the environment. The typical useful life of the battery is 3 to 5 years at 25 °C (77 °F) ambient temperature. However, useful life also depends on the frequency and duration of line power failures.

7.3 Decommissioning

7.3.1 Taking out of Service

N.B. Switch to Service Bypass

- Switch the UPS to Maintenance Bypass operation (see Procedure 3: TRANSFER FROM NORMAL MODE TO MAINTENANCE BYPASS MODE on page 71.

N.B. Disconnect the batteries

- Open the battery isolator or battery switch if other external batteries are used.
- Before continuing work, measure the voltage on the battery terminals and on the line power input, and wait until these have dropped to 0V; or wait at least 5 min. Failure to do so may cause severe electrical shock and possibly death.

The UPS is now in the maintenance Bypass operating mode. The only voltage present is at the line power and load terminals. Qualified personnel may now carry out maintenance work while taking the corresponding safety measures.

N.B. Disconnect line power

If the loads no longer need power, you may open the external line power separation device for the UPS.

8 Technical Data

Table 8.1 Technical Data and Standards - 1.5MW CE / 1.6MW CE / 2MW CE / 2.1 MW CE

UPS Rating	1.5 MW	1.6 MW	2 MW	2.1 MW
Output Active Power at 40 °C	1.5 MW	1.6 MW	2 MW	2132 kW
Input AC Parameters				
Nominal Input Voltage to Rectifier	400 VAC (3-Phase + Neutral)			
Nominal Input Voltage to Bypass	400 VAC (3-phase + Neutral)			
Permissible Input Voltage Range	+10 %,-15 % at 400V	+10 %,-9 % at 400V	+10 %, -15 % at 400V	+10 %,-9 % at 400V
Nominal Input Frequency	50 Hz			
Permissible Input Frequency Range	+/- 10 %			
Input Power Factor	≥ 0.99			
Input Current Distortion (THDi) at Nominal Voltage at Full Load	≤ 3.0 with Input Voltage Distortion (THDv) <1 %			
Power Walk-In	1 sec to 90 sec (default 15 sec)			
Bypass Withstand Rating	Up to 200 kA (see table on par. Sizing the Input Breaker that Feeds the UPS on page 49)			
Battery and DC Parameters				
Battery Type	Lithium-Ion, Nickel Zinc, VRLA (Valve Regulated Lead Acid)			
Permissible Battery Voltage Range	396-700 Vdc			
DC Ripple at Float Voltage	≤ 1.0 %			
Temperature Compensated Battery Charging	≤0,11 %/°C			
Output Parameters				
Load Power Factor Supported (Without Derating)	0.7 Leading to 0.4 Lagging			
Output Voltage	400 VAC, 3-Phase, 3-Wire/3Phase+Neutral, 4-Wire (Selectable 380, 415)			
Output Nominal Voltage Regulation	≤ 1.0 % (3-Phase RMS Average)			
Output Voltage Regulation (50% Unbalanced Load)	≤ 2.0 % (3-Phase RMS Average)			
Output Frequency	50, 60 Hz			
Output Frequency Regulation	± 0.1%			
Output Voltage THD at Nominal Voltage (Linear Load)	≤ 1.5 %			
Output Voltage THD at Nominal Voltage Including a 100 kVA Non-Linear Load per IEC 62040-3	≤ 5.0 %			
Efficiency AC-AC Double Conversion with DC Source Disconnected	Up to 97 %			
Efficiency AC-AC Eco Mode and Dynamic Online Mode with DC Source Disconnected	Up to 99 %			
Transient Recovery	IEC 62040 - 3 CLASS 1			

Table 8.1 Technical Data and Standards - 1.5MW CE / 1.6MW CE / 2MW CE / 2.1 MW CE (continued)

UPS Rating	1.5 MW	1.6 MW	2 MW	2.1 MW
Protective class	CLASS 1			
Voltage Displacement (Balanced Loads)	120 degrees ± 1 degree			
Voltage Displacement (50% Unbalanced Loads)	120 degrees ± 2 degrees			
Overload at Nominal Voltage and 25 °C	110 % continuously; 125 % for 10 minutes; 150 % for 60 seconds			
Physical Characteristics				
Dimensions, W x D x H	4153 x 1032 x 2008 mm		5711 x 1048 x 2013 mm	
Color	Black (RAL 7021)			
Protection Class, UPS Enclosure	NEMA 1, IP 20 (with and without front door open)			
Net Weight	Up to 5706 kg			
Environmental				
Enclosure	The UPS is housed in a NEMA-1 enclosure. The enclosure is designed for indoor use only and is not to be subjected to falling objects or precipitation			
Operating Temperature	0-40 °C ambient			
Storage Temperature Range	-20 °C to +40 °C			
Typical Battery Temperature Requirements	15 °C to 25 °C or per Manufacturer Indication			
Relative Humidity	5 to 95 % R.H. / non- condensing			
Climatic (IEC 60721-3-3)	3K3			
Pollution degree	2			
Operating Elevation	1000 m			
Storage Elevation	Sea level to 15,240 m			
Acoustical Noise at 1 m	78 dBA (72 dBA at partial load)			
AC Power distribution	TN-C, TN-S, TT, corner-Earthed supply systems is not permitted			
General and System Data				
Inverter Type	High-Efficiency, Transformer-Free IGBT, Three-Level PWM Inverter			
Rectifier Type	High-Efficiency, Transformer-Free IGBT, Three-Level PWM Inverter			
Parallel Configuration	Up to 8 units in parallel			
Access	Front and Top (no rear access required)			
Communication				
Options	3 Vertiv™ Liebert® IntelliSlot™ Bays			
Card Compatibility	Vertiv™ Liebert® IntelliSlot™ RDU101 and Vertiv™ Liebert® IntelliSlot™ RDU120			
Protocols Available	Modbus-IP, Modbus-485, BACnet-IP, BACnet-MSTP, SNMP, HTTP, LIFE™ Services			
Standards				
Transportation	ISTA Procedure 3B			
Safety	IEC 62040-1 IEC 62477-1 (Reference Standard) IEC 60529 (IP code)			

Table 8.1 Technical Data and Standards - 1.5MW CE / 1.6MW CE / 2MW CE / 2.1 MW CE (continued)

UPS Rating	1.5 MW	1.6 MW	2 MW	2.1 MW
EMC	IEC 62040-2 (Category C3) Basic Standard: IEC 61000-4-2 IEC 61000-4-4 IEC 61000-4-5 IEC 61000-4-6			
Performance and test	IEC 62040-3			
Seismic	IEC 60068-2-57: 2013, IEC 60068-3-3:2019, ICC ES AC156-2020, IEEE-693-2018, Telcordia-GR-63-CORE			
Overvoltage category	This is a OVC II UPS to meet OVC III requirement an external means (SPD type 2) to reduce overvoltage category needs to be installed external to the equipment.			

NOTE: Unit intended for a CONTROLLED ENVIRONMENT, this is an indoor, temperature-regulated location such as a computer room, office, or factory floor that is relatively free of conductive contaminants such as carbon dust and similar.

NOTE: Temperature w/o derating, altitude for insulation considerations: 3000 m.

Table 8.2 Technical Data and Standards - 1.5MW UL / 2MW UL / 2.5MW UL

UPS Rating	1.5 MW	1.6 MW	2 MW	2.5 MW
Output Active Power at 104°F	1.5 MW	1.6 MW	2 MW	2.5 MW
Input AC Parameters				
Nominal Input Voltage to Rectifier	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase)
Nominal Input Voltage to Bypass	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase)
Permissible Input Voltage Range	+10 %, -20 %			
Input Frequency	60 Hz			
Permissible Input Frequency Range	+/- 10 %			
Input Power Factor	≥ 0.99			
Input Current Distortion (THDi) at Nominal Voltage at Full Load	≤ 3.0 % with Input Voltage Distortion (THDv) <1 %			
Power Walk-In	1 sec to 90 sec (default 15 sec)			
Bypass Withstand Rating	Up to 200kA (see table on par. Sizing the Input Breaker that Feeds the UPS on page 49)			
Battery and DC Parameters				
Battery Type	Lithium-Ion, Nickel Zinc, VRLA (Valve Regulated Lead Acid)			
Permissible Battery Voltage Range	396-700Vdc			
DC Ripple at Float Voltage	≤ 1.0 %			
Temperature Compensated Battery Charging	≤0,11%/°F			
Output Parameters				
Load Power Factor Supported (Without Derating)	0.7 cto 0.4 Lagging			
Output Nominal Voltage	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase) / 415 VAC (3-Phase+N)	480 VAC (3-Phase)
Output Voltage Regulation	≤ 1.0 % (3-Phase RMS Average)			

Table 8.2 Technical Data and Standards - 1.5MW UL / 2MW UL / 2.5MW UL (continued)

UPS Rating	1.5 MW	1.6 MW	2 MW	2.5 MW
Output Voltage Regulation (50% Unbalanced Load)	≤ 2.0 % (3-Phase RMS Average)			
Output Frequency	60 Hz			
Output Frequency Regulation	± 0.1 %			
Output Voltage THD at Nominal Voltage (Linear Load)	≤ 1.5 %			
Output Voltage THD at Nominal Voltage Including a 100kVA Non-Linear Load per IEC 62040-3	≤ 5.0 %			
Efficiency AC-AC Double Conversion with DC Source Disconnected	Up to 97 %			
Efficiency AC-AC Eco Mode and Dynamic Online Mode with DC Source Disconnected	Up to 99 %			
Transient Recovery	IEC 62040 - 3 CLASS 1			
Voltage Displacement (Balanced Loads)	120 degrees ± 1 degree			
Voltage Displacement (50% Unbalanced Loads)	120 degrees ± 2 degrees			
Overload at Nominal Voltage and 77°F	110% continuously; 125% for 10 minutes; 150% for 60 seconds			
Physical Characteristics				
Dimensions, W x D x H	[152 x 41 x 79] in / [164 x 41 x 79] in	[152 x 41 x 79] in / [164 x 41 x 79] in	[192 x 41 x 79] in / [225 x 41 x 79] in	251 x 41 x 79 in
Color	Black (RAL 7021)			
Protection Class, UPS Enclosure	NEMA 1, IP 20 (with and without front door open)			
Net Weight	Up to 10500 lb	Up to 10500 lb	Up to 14500 lb	Up to 16000 lb
Environmental				
Enclosure	The UPS is housed in a NEMA-1 enclosure. The enclosure is designed for indoor use only and is not to be subjected to falling objects or precipitation			
Recommended Operating Temperature Range	32°F to 104°F ambient			
Storage Temperature Range	-4°F to 104°F			
Typical Battery Temperature Requirements	59°F to 77°F or per Manufacturer Indication			
Relative Humidity	5 to 95 % R.H. / non- condensing			
Operating Elevation	3300 ft			
Storage Elevation	Sea level to 50,000 ft			
Acoustical Noise at 39 inches	78 dBA (72 dBA at partial load)			
AC Power distribution	TN-C, TN-S, TT, corner-Earthed supply systems is not permitted			
General and System Data				
Inverter Type	High-Efficiency, Transformer-Free IGBT, Three-Level PWM Inverter			
Rectifier Type	High-Efficiency, Transformer-Free IGBT, Three-Level PWM Inverter			

Table 8.2 Technical Data and Standards - 1.5MW UL / 2MW UL / 2.5MW UL (continued)

UPS Rating	1.5 MW	1.6 MW	2 MW	2.5 MW
Parallel Configuration	Up to 8 units in parallel			
Access	Front and Top (no rear access required)			
Communication				
Options	3 Vertiv™ Liebert® IntelliSlot™ Bays			
Card Compatibility	Vertiv™ Liebert® IntelliSlot™ RDU101 and Vertiv™ Liebert® IntelliSlot™ RDU120			
Protocols Available	Modbus-IP, Modbus-485, BACnet-IP, BACnet-MSTP, SNMP, HTTP, LIFE™ Services			
Standards				
Transportation	ISTA Procedure 3B			
Safety	UL 1778 5th Edition; CSA 22.2 NO 107.3 3rd edition UL 60950-1 + CAN/CSA-C22.2 No. 60950-1-07 (Reference Document)			
EMC	IEC 62040-2, FCC Part 15 Subpart B (Class A) ANSI C63.4:2014 (Test procedure)			
Surge	ANSI C62.41, Category B3			
Electrostatic Discharge (ESD) Immunity	IEC 61000-4.2 Level 2 (4kV) contact; Level 3 (8kV) air			
Seismic	IEC 60068-2-57: 2013, IEC 60068-3-3:2019, ICC ES AC156-2020, IEEE-693-2018, Telcordia-GR-63-CORE			
UL9540	If installing per UL9540, Compliance between Vertiv™ Trinergy™ UPS and Vertiv™ EnergyCore Lithium 5 Series has been Fire Propagation Tested in accordance with UL9540A, CSA Report #80132596 on Sept 29, 2023 • The Vertiv EnergyCore Lithium 5, 16 module cabinet provides 27.6 kWh of storage with a System Max 331.2 kWh (12 cabinets). • The Vertiv EnergyCore Lithium 5, 18 module cabinet provides 31.1 kWh of storage with a System Max 373.2 kWh (12 cabinets). If installing per UL9540 "Compliance between Vertiv Trinergy UPS and EnergyCore Lithium 7 Series has been Fire propagation tested in accordance with UL9540A, CSA Report #80217568 on Sept 30, 2024: • The Vertiv™ EnergyCore Lithium 7, 16 module cabinet provides 32.6 kWh of storage with a System Max 391.2 kWh (12 cabinets). • The Vertiv EnergyCore Lithium 7, 17 module cabinet provides 34.6 kWh of storage with a System Max 415.2 kWh (12 cabinets). (Vertiv Trinergy allows for a Maximum of 3 Battery Cabinets per UPS Core, Maximum of 15 battery cabinets total.) If installing per UL9540, Compliance between Vertiv Trinergy UPS and Samsung G2 Series has been Fire propagation tested in accordance with UL9540A, CSA Report #4788881169 on June 2nd, 2021: • The Samsung G2 Series 16 module cabinet provides 32.6 kWh of storage with a System Max 391.2 kWh (12 cabinets). • The Samsung G2 Series 17 module cabinet provides 34.6 kWh of storage with a System Max 415.2 kWh (12 cabinets).			
Minimum Distance Between UPS Systems	20 mm from battery room walls			
UL9540 Seismic Rating	If you are installing per UL9540, Compliance Between Vertiv Trinergy UPS and Vertiv™ EnergyCore Lithium 5: Vertiv EnergyCore Lithium 5 with CBC 2022 and IBC 2021 Vertiv Trinergy S_{DS}= 1.2g, Z/H = 1 S_{DS} = 2.5g, Z/H = 0 I_P = 1 Vertiv™ EnergyCore S_{DS}= 1.50g, Z/H = 1 S_{DS} = 1.56g, Z/H = 0 I_P = 1.5			

NOTE: Unit intended for a CONTROLLED ENVIRONMENT, this is an indoor, temperature-regulated location such as a computer room, office, or factory floor that is relatively free of conductive contaminants such as carbon dust and the like.

NOTE: Temperature w/o derating, altitude for insulation considerations: 3000 m.

Table 8.3 Current ratings - rectifier input, bypass, output - 1.5MW CE / 1.6MW CE / 2MW CE / 2.1MW CE

UPS Rating kVA/kW	Voltage VAC Frequency Hz	Nominal Current Rectifier Input	Maximum Current Rectifier Input	Nominal Current Bypass	Nominal Current Output
1500	380/400/415 50/60	2372/2253/2171	2635	2279/2165/2086	2279/2165/2086
1600	380/400/415 50/60	2528/2402/2314	2632	2430/2309/2225	2430/2309/2225
2000	380/400/415 50/60	3162/3004/2895	3513	3039/2887/2783	3039/2887/2783
2132	380/400/415 50/60	3370/3202/3086	3509	3239/3077/2966	3239/3077/2966

Table 8.4 Current ratings - rectifier input, bypass, output - 1.5MW UL / 1.6MW UL / 2MW UL / 2.5MW UL

UPS Rating kVA/kW	Voltage, VAC Frequency, Hz	Nominal Current Rectifier Input	Maximum Current Rectifier Input	Nominal Current Bypass	Nominal Current Output
1500	480/415	1877/2171	2250/2559	1804/2087	1804/2087
1600	480/415	2001/2314	2250/2559	1924/2225	1924/2225
2000	480/415	2503/2895	3000/3412	2406/2782	2406/2782
2500	480	3129	3750	3007	3007

Table 8.5 Current ratings - battery - 1.5MW CE / 1.6MW CE / 2MW CE / 2.1MW CE

UPS Rating kVA/kW	Input Voltage VAC	Nominal VDC	Maximum Battery Current @ 396 Vdc	
1500	380/400/415	540	1313 (per CORE)	3939 (total)
1600	380/400/415	540	1399 (per CORE)	4197 (total)
2000	380/400/415	540	1313 (per CORE)	5252 (total)
2132	380/400/415	540	1399 (per CORE)	5596 (total)

Table 8.6 Current ratings - battery - 1.5MW UL / 1.6MW UL / 2MW UL / 2.5MW UL

UPS Rating kVA/kW	Input Voltage VAC	Nominal VDC	Maximum Battery Current @ 396 Vdc	
1500	480	540	1313 (per CORE)	3939 (total)
1600	480	540	1399 (per CORE)	4197 (total)
2000	480	540	1313 (per CORE)	5252 (total)
2500	480	540	1313 (per CORE)	6565 (total)

Notes for 2MW CE

1. Nominal input current, nominal bypass input current and nominal output current (all considered continuous) are based on the full rated output load
2. Maximum current includes nominal input current and maximum battery recharge current (considered non-continuous)
3. Maximum input current is controlled by the current limit setting (which is adjustable)
4. Vertiv recommends that feeder protection (by others) for the rectifier AC input and the bypass AC input be provided by separate overcurrent protection devices
5. UPS output load cables must be run in separate conduit from input cables
6. Line, neutral and grounding conductors to be sized per IEC 60364-5-54:2011 and per national wiring standards. Coefficient for oversizing neutral line conductor when non-linear load is supplied = 1
7. The maximum battery current specified in the table is based on the EOD voltage of 1.67 volts per cell (VPC)
8. Number and cross section of battery conductors can be sized for the maximum battery current and a maximum voltage drop of 2.0 Vdc at 1.67 V/cell at EOD
9. All conductors are terminated on designated bus bar(s) inside the ups

10. Overload current specified in the manual must be considered
11. RECTIFIER AC INPUT: 3PH + PE or 3PH + N + PE
    BYPASS AC INPUT: 3PH + PE or 3PH + N + PE
    AC OUTPUT TO LOAD: 3PH + N + PE (rectifier/bypass input neutral wires are terminated at output neutral bus bar)
    MODULE DC INPUT FROM BATTERY: 2-WIRE (positive and negative) + PE
12. If rectifier/bypass AC input is wired for 3ph + PE, AC output must be wired for 3ph + PE
13. Control wiring and power cables must be run in separate conduits. Control wiring must be stranded tinned conductors
14. Tinned lugs are required if aluminum cable is to be used. If aluminum cable is to be used, top and bottom cable entry may be required. Contact Vertiv technical support for more information

Notes for 1.5MW UL / 1.6MW UL / 2MW UL / 2.5MW UL

1. Nominal input current, nominal bypass input current and nominal output current (all considered continuous) are based on the full rated output load at nominal voltage
2. Maximum current includes nominal input current and maximum battery recharge current (considered non-continuous)
3. Continuous and non-continuous currents are defined in NEC100
4. Maximum input current is controlled by the current limit setting (which is adjustable)
5. Vertiv recommends that feeder protection (by others) for the rectifier AC input and the bypass AC input be provided by separate overcurrent protection devices
6. UPS output load cables must be run in separate conduit from input cables
7. Line and grounding conductors to be sized per NEC national wiring standards
8. The maximum battery current specified in the table is based on the EOD voltage of 1.67 volts per cell (VPC)
9. Number and cross section of battery conductors can be sized for the maximum battery current and a maximum voltage drop of 2.0 Vdc at 1.67 V/cell at EOD
10. All conductors are terminated on designated bus bar(s) inside the ups
11. Overload current specified in the manual must be considered
12. RECTIFIER AC INPUT: 3PH + PE
    BYPASS AC INPUT: 3PH + PE
    AC OUTPUT TO LOAD: 3PH + PE
    MODULE DC INPUT FROM BATTERY: 2-WIRE (positive and negative) + PE
13. Inputs(s) must be fed from a wye source that is solidly grounded or grounded through a HRG
14. Control wiring and power cables must be run in separate conduits. Control wiring must be stranded tinned conductors
15. Tinned lugs are required if aluminum cable is to be used. If aluminum cable is to be used, top and bottom cable entry may be required. Contact Vertiv technical support for more information

Table 8.7 Recommended conduit and cable sizes COPPER - 1.5MW CE / 1.6MW CE / 2MW CE / 2.1MW CE

UPS Rating	1.5MW CE	1.6MW CE	2MW CE	2.1MW CE
INPUT	8x240 mmq (3ph+N)	8x240 mmq (3ph+N)	10x240 mmq (3ph+N)	10x240 mmq (3ph+N)
OUTPUT	7x240 mmq (3ph+N)	7x240 mmq (3ph+N)	9x240 mmq (3ph+N)	9x240 mmq (3ph+N)
BYPASS	7x240 mmq (3ph+N)	7x240 mmq (3ph+N)	9x240 mmq (3ph+N)	9x240 mmq (3ph+N)
GND	4x240 mmq	4x240 mmq	5x240 mmq	5x240 mmq
BATTERY	5x240 mmq per each Core (pos, neg)	5x240 mmq per each Core (pos, neg)	5x240 mmq per each Core (pos, neg)	5x240 mmq per each Core (pos, neg)

1. For copper, a minimum 75 °C wiring shall be used when is possible to control the environmental temperature below 35 °C ambient. For 40 °C ambient 90 °C wiring shall be used, size to be calculated based on the maximum 75 °C ambient
2. For aluminum, a minimum 90 °C wiring shall be used and wire size to be calculated on maximum 75 °C based on the switchgear used
3. The minimum size of the PE conductor shall comply with the local safety regulations for high PE conductor current equipment
4. Refer to NEC recommendations for 40 °C (104 °F) ambient rated conductors.
5. Recommended cables and conduits are based on breaker trip setting sized for the maximum continuous rated current for the rectifier input and the nominal current for the bypass and output listed in **Table 8.3** on page 86 through **Table 8.6** on page 86.
6. Conduit size is based on RNC type conduit for bottom input and EMT-type conduit for top input.
7. Vertiv recommends that the site planner choose the appropriate cable type based on the particular installation requirements.
8. These recommendations are for use with 100% rated breakers. For 125% rated breakers, refer to the NEC recommended conduit and cable sizes.
9. Upstream and downstream non-standard recommended breaker settings have their trip adjustment behind a suitable cover in accordance with 240.6 (c) of the NEC.

Table 8.8 Recommended conduit and cable sizes COPPER - 1.5MW UL / 1.6MW UL / 2MW UL / 2.5MW UL

UPS Rating	1.5MW UL 480V (3ph)	1.5MW UL 415V (3ph+N)	1.6MW UL 480V (3ph)	1.6MW UL 415V (3ph+N)	2MW UL 480V (3ph)	2MW UL 415V (3ph+N)	2.5MW UL 480V (3ph)
INPUT	7x500 kcmil	7x600 kcmil	8x500 kcmil	7x600 kcmil	8x600 kcmil	9x750 kcmil	10x750 kcmil
OUTPUT	6x500 kcmil	6x600 kcmil	7x500 kcmil	6x600 kcmil	7x600 kcmil	7x750 kcmil	9x750 kcmil
BYPASS	6x500 kcmil	6x600 kcmil	7x500 kcmil	6x600 kcmil	7x600 kcmil	7x750 kcmil	9x750 kcmil
GND	19x350 kcmil	19x350 kcmil	22x350 kcmil	19x350 kcmil	20x500 kcmil	23x500 kcmil	28x500 kcmil
BATTERY	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)

1. For copper, a minimum 75 °C wiring shall be used when is possible to control the environmental temperature below 35 °C ambient. For 40 °C ambient 90 °C wiring shall be used, size to be calculated based on the maximum 75 °C ambient
2. For aluminum, a minimum 90 °C wiring shall be used and wire size to be calculated on maximum 75 °C based on the switchgear used
3. The minimum size of the PE conductor shall comply with the local safety regulations for high PE conductor current equipment
4. Refer to NEC recommendations for 40 °C (104 °F) ambient rated conductors.
5. Recommended cables and conduits are based on breaker trip setting sized for the maximum continuous rated current for the rectifier input and the nominal current for the bypass and output listed in **Table 8.3** on page 86 through **Table 8.6** on page 86.
6. Conduit size is based on RNC type conduit for bottom input and EMT-type conduit for top input.
7. Vertiv recommends that the site planner choose the appropriate cable type based on the particular installation requirements.
8. These recommendations are for use with 100% rated breakers. For 125% rated breakers, refer to the NEC recommended conduit and cable sizes.
9. Upstream and downstream non-standard recommended breaker settings have their trip adjustment behind a suitable cover in accordance with 240.6 (c) of the NEC.

Table 8.9 Recommended conduit and cable sizes ALUMINIUM - 1.5MW CE / 1.6MW CE / 2MW CE / 2.1MW CE

UPS Rating	1.5MW CE	1.6MW CE	2MW CE	2.1MW CE
INPUT	8x240 mmq (3ph+N)	8x240 mmq (3ph+N)	10x240 mmq (3ph+N)	10x240 mmq (3ph+N)
OUTPUT	7x240 mmq (3ph+N)	7x240 mmq (3ph+N)	9x240 mmq (3ph+N)	9x240 mmq (3ph+N)
BYPASS	7x240 mmq (3ph+N)	7x240 mmq (3ph+N)	9x240 mmq (3ph+N)	9x240 mmq (3ph+N)
GND	4x240 mmq	4x240 mmq	5x240 mmq	5x240 mmq
BATTERY	5x240 mmq per each Core (pos, neg)	5x240 mmq per each Core (pos, neg)	5x240 mmq per each Core (pos, neg)	5x240 mmq per each Core (pos, neg)

1. For copper, a minimum 75 °C wiring shall be used when is possible to control the environmental temperature below 35 °C ambient. For 40 °C ambient 90 °C wiring shall be used, size to be calculated based on the maximum 75 °C ambient
2. For aluminum, a minimum 90 °C wiring shall be used and wire size to be calculated on maximum 75 °C based on the switchgear used
3. The minimum size of the PE conductor shall comply with the local safety regulations for high PE conductor current equipment
4. Refer to NEC recommendations for 40 °C (104 °F) ambient rated conductors.
5. Recommended cables and conduits are based on breaker trip setting sized for the maximum continuous rated current for the rectifier input and the nominal current for the bypass and output listed in **Table 8.3** on page 86 through **Table 8.6** on page 86.
6. Conduit size is based on RNC type conduit for bottom input and EMT-type conduit for top input.
7. Vertiv recommends that the site planner choose the appropriate cable type based on the particular installation requirements.
8. These recommendations are for use with 100% rated breakers. For 125% rated breakers, refer to the NEC recommended conduit and cable sizes.
9. Upstream and downstream non-standard recommended breaker settings have their trip adjustment behind a suitable cover in accordance with 240.6 (c) of the NEC.

Table 8.10 Recommended conduit and cable sizes ALUMINUM - 1.5MW UL / 1.6MW UL / 2MW UL / 2.5MW UL

UPS Rating	1.5MW UL 480V (3ph)	1.5MW UL 415V (3ph+N)	1.6MW UL 480V (3ph)	1.6MW UL 415V (3ph+N)	2MW UL 480V (3ph)	2MW UL 415V (3ph+N)	2.5MW UL 480V (3ph)
INPUT	7x500 kcmil	7x600 kcmil	8x500 kcmil	7x600 kcmil	8x600 kcmil	9x750 kcmil	10x750 kcmil
OUTPUT	6x500 kcmil	6x600 kcmil	7x500 kcmil	6x600 kcmil	7x600 kcmil	7x750 kcmil	9x750 kcmil
BYPASS	6x500 kcmil	6x600 kcmil	7x500 kcmil	6x600 kcmil	7x600 kcmil	7x750 kcmil	9x750 kcmil
GND	19x350 kcmil	19x350 kcmil	22x350 kcmil	19x350 kcmil	20x500 kcmil	23x500 kcmil	28x500 kcmil
BATTERY	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)	5x500 kcmil per each Core (pos, neg)

1. For copper, a minimum 75 °C wiring shall be used when is possible to control the environmental temperature below 35 °C ambient. For 40 °C ambient 90 °C wiring shall be used, size to be calculated based on the maximum 75 °C ambient
2. For aluminum, a minimum 90 °C wiring shall be used and wire size to be calculated on maximum 75 °C based on the switchgear used
3. The minimum size of the PE conductor shall comply with the local safety regulations for high PE conductor current equipment
4. Refer to NEC recommendations for 40 °C (104 °F) ambient rated conductors.
5. Recommended cables and conduits are based on breaker trip setting sized for the maximum continuous rated current for the rectifier input and the nominal current for the bypass and output listed in **Table 8.3** on page 86 through **Table 8.6** on page 86.
6. Conduit size is based on RNC type conduit for bottom input and EMT-type conduit for top input.
7. Vertiv recommends that the site planner choose the appropriate cable type based on the particular installation requirements.
8. These recommendations are for use with 100% rated breakers. For 125% rated breakers, refer to the NEC recommended conduit and cable sizes.
9. Upstream and downstream non-standard recommended breaker settings have their trip adjustment behind a suitable cover in accordance with 240.6 (c) of the NEC.

Table 8.11 Recommended Torque Values - 1.5MW CE / 1.6MW CE / 2MW CE / 1.5MW UL / 2MW UL / 2.5MW UL

Screw size	Nm (+/- 20%)
M6	6
M8	17
M10	40
M12	50
M16	115

Table 8.12 Short circuit - 2MW CE / 1.5MW UL / 2MW UL / 2.5MW UL

UPS rating	AC inverter output	AC Bypass output	DC battery output
1500 kW CE	4050 Arms (200 ms)	69 kApeak (7,6 ms)	1560 A (53 ms) x core
1600 kW CE	4050 Arms (200 ms)	69 kApeak (7,6 ms)	1560 A (53 ms) x core
2000 kW CE	5400 Arms (200 ms)	95 kApeak (7,8 ms)	1560 A (53 ms) x core
2132 kW CE	5400 Arms (200 ms)	95 kApeak (7,8 ms)	1560 A (53 ms) x core
1500 kW UL	4050 Arms (200 ms)	95 kApeak (7,8 ms)	1560 A (53 ms) x core
1600 kW UL	4050 Arms (200 ms)	71 kApeak (8,7 ms)	1560 A (53 ms) x core
2000 kW UL	5400 Arms (200 ms)	95 kApeak (7,8 ms)	1560 A (53 ms) x core
2500 kW UL	6750 Arms (200 ms)	87 kApeak (7.6 ms)	1560 A (5 3ms) x core

Appendices

Appendix A: Technical Support and Contacts

A.1 Technical Support/Service in the United States

Vertiv Group Corporation

24x7 dispatch of technicians for all products.

1-800-543-2378

Liebert® Thermal Management Products

1-800-543-2778

Liebert® Channel Products

1-800-222-5877

Liebert® AC and DC Power Products

1-800-543-2378

A.2 Locations

United States

Vertiv Headquarters

505 N Cleveland Ave

Westerville, OH, 43082, USA

Europe

Victor-von-Bruns Strasse 21,

8212 Neuhausen am Rheinfall, Switzerland

Asia

Singapore

151 Lorong Chuan, Lobby D #05-04

New Tech Park, Singapore 556741

India

Vertiv Energy Private Limited

Plot No. C 20, Road No. 19

Wagle Industrial Estate, MIDC

Thane (West), Maharashtra 400604, India

China

Vertiv Technology Co., Limited

Floors 1–4 and 6–10,

Building B2, Nanshan I Park

No. 1001 Xueyuan Road, Nanshan District

Shenzhen, Guangdong 518055, China

Appendix B: Submittal Drawings

Submittal drawings referenced in this document are listed below and are grouped by topic/application.

Table B.1 Single Line Diagrams

Submittal Number	Description
VTT-01-S003	1.5/1.6MW CE
VTT-01-S001	2 MW CE
VTT-01-S005	2.5 MW CE
VTT-01-S004	1.5/1.6MW UL 480V 3W
VTT-01-S002	2 MW UL 480V 3W
VTT-01-S006	2.5 MW UL 480V 3W
VTT-01-S013	1.5/1.6MW UL 415V 4W
VTT-01-S014	2 MW UL 415V 4W

Table B.2 Technical Information Table

Submittal Number	Description
VTT-03-S001	TECHNICAL INFORMATION TABLE VERTIV™ TRINERGY™ 1500kW CE
VTT-03-S002	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 1600kW CE
VTT-03-S003	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 2000kW CE
VTT-03-S004	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 2132kW CE
VTT-03-S006	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 1500kW UL 480V
VTT-03-S007	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 1600kW UL 480V
VTT-03-S008	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 1600kW UL 415V
VTT-03-S009	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 2000kW UL 480V
VTT-03-S010	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 2000kW UL 415V
VTT-03-S012	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 2500kW UL 480V
VTT-03-S013	TECHNICAL INFORMATION TABLE VERTIV TRINERGY 1500kW UL 415V

Table B.3 Outline Drawings Complete Systems

Submittal Number	Description
VTT-05-S001	OUTLINE DRAWING 1500/1600KW 400/415V 4WIRE 4153MM VERTIV TRINERGY CE
VTT-05-S002	OUTLINE DRAWING 2000KW 400V CE | 415V UL 4WIRE 5703MM VERTIV TRINERGY
VTT-05-S005	OUTLINE DRAWING 1500KW 480V 3WIRE 3853MM VERTIV TRINERGY UL
VTT-05-S007	OUTLINE DRAWING 2000KW 480V 3/4WIRE 4864MM VERTIV TRINERGY UL

Table B.3 Outline Drawings Complete Systems (continued)

Submittal Number	Description
VTT-05-S009	OUTLINE DRAWING 2500KW 480V 3WIRE 6377MM VERTIV™ TRINERGY™ UL
VTT-05-S011	OUTLINE DRAWING 1500KW 480V / 1500-1600KW 415V - 4WIRE 4162MM VERTIV TRINERGY UL
VTT-05-S015	OUTLINE DRAWING 2000KW 480V 3WIRE 4401MM NO AC IO CABINET VERTIV TRINERGY UL

Table B.4 Outline Drawings Single Cabinets

Submittal Number	Description
VTT-05-S500	OUTLINE DRAWING 2000KW 480V 3WIRE 1302MM AC IO CABINET VERTIV TRINERGY UL
VTT-05-S501	OUTLINE DRAWING 2000KW 480V 3WIRE 1302MM AC IO CABINET PALLETIZED VERTIV TRINERGY UL
VTT-05-S502	TERMINAL DETAILS 2000KW 480V 3WIRE 1300MM AC IO CABINET VERTIV TRINERGY UL
VTT-05-S503	OUTLINE DRAWING 2000KW 415V 4WIRE 1302MM AC IO CABINET VERTIV TRINERGY CE
VTT-05-S504	OUTLINE DRAWING 2000KW 415V 4WIRE 1302MM AC IO CABINET PALLETIZED VERTIV TRINERGY CE-UL
VTT-05-S505	TERMINAL DETAILS 2000KW 415V 4WIRE 1300MM AC IO CABINET VERTIV TRINERGY CE-UL
VTT-05-S506	OUTLINE DRAWING 2000KW DC IO CABINET VERTIV TRINERGY CE
VTT-05-S507	OUTLINE DRAWING 2000KW 602MM DC IO CABINET PALLETIZED VERTIV TRINERGY CE
VTT-05-S508	TERMINAL DETAILS 2000KW 600MM DC IO CABINET VERTIV TRINERGY CE
VTT-05-S509	ELEVATED VIEW 2000KW DC IO CABINET VERTIV TRINERGY CE-UL
VTT-05-S510	OUTLINE DRAWING 2000KW 601MM DC IO CABINET PALLETIZED VERTIV TRINERGY UL
VTT-05-S511	TERMINAL DETAILS 2000KW 600MM DC IO CABINET VERTIV TRINERGY UL
VTT-05-S512	ELEVATED VIEW 3000A STS VERTIV TRINERGY CE-UL
VTT-05-S513	OUTLINE DRAWING 3000A 1450MM STS PALLETIZED VERTIV TRINERGY CE-UL
VTT-05-S514	OUTLINE DRAWING 3000A 1450MM STS INTERNAL VIEWS NO BFD VERTIV TRINERGY CE-UL
VTT-05-S515	OUTLINE DRAWING 3000A 1450MM STS INTERNAL VIEWS WITH BFD VERTIV TRINERGY CE-UL
VTT-05-S516	OUTLINE DRAWING 2X POWER CORE 1175MM VERTIV TRINERGY CE-UL
VTT-05-S517	OUTLINE DRAWING 2X POWER CORE 1175MM PALLETIZED VERTIV TRINERGY CE-UL
VTT-05-S518	OUTLINE DRAWING 2X POWER CORE INTERNAL VIEWS VERTIV TRINERGY CE-UL
VTT-05-S519	OUTLINE DRAWING 3X POWER CORE 1750MM VERTIV TRINERGY CE-UL
VTT-05-S520	OUTLINE DRAWING 3X POWER CORE 1750MM PALLETIZED VERTIV TRINERGY CE-UL
VTT-05-S521	INTERNAL VIEWS 3X POWER CORE 1750MM PALLETIZED VERTIV TRINERGY CE-UL
VTT-05-S522	OUTLINE DRAWING 3000A 1450MM STS CLOSE COUPLED VIEWS VERTIV TRINERGY CE-UL
VTT-05-S523	TERMINAL DETAILS 3000A 1450MM STS CLOSE COUPLED VERTIV TRINERGY CE-UL
VTT-05-S524	OUTLINE DRAWINGS EXTERNAL VIEWS DC CABINET 5X VERTIV TRINERGY CE
VTT-05-S525	OUTLINE DRAWINGS HANDLING DC CABINET 5X VERTIV TRINERGY CE
VTT-05-S526	OUTLINE DRAWINGS INTERNAL VIEWS DC CABINET 5X VERTIV TRINERGY CE

Table B.4 Outline Drawings Single Cabinets (continued)

Submittal Number	Description
VTT-05-S527	OUTLINE DRAWINGS EXTERNAL VIEWS DC CABINET 5X VERTIV™ TRINERGY™ UL
VTT-05-S528	OUTLINE DRAWINGS HANDLING DC CABINET 5X VERTIV TRINERGY UL
VTT-05-S529	OUTLINE DRAWINGS INTERNAL VIEWS DC CABINET 5X VERTIV TRINERGY UL
VTT-05-S530	OUTLINE DRAWINGS EXTERNAL VIEWS DC CABINET 3X VERTIV TRINERGY CE
VTT-05-S531	OUTLINE DRAWINGS HANDLING DC CABINET 3X VERTIV TRINERGY CE
VTT-05-S532	OUTLINE DRAWINGS INTERNAL VIEWS DC CABINET 3X VERTIV TRINERGY CE
VTT-05-S533	OUTLINE DRAWINGS EXTERNAL VIEWS DC CABINET 3X VERTIV TRINERGY UL
VTT-05-S534	OUTLINE DRAWINGS HANDLING DC CABINET 3X VERTIV TRINERGY UL
VTT-05-S535	OUTLINE DRAWINGS INTERNAL VIEWS DC CABINET 3X VERTIV TRINERGY UL
VTT-05-S536	OUTLINE DRAWING 2.5MW 415V 4WIRE 1301MM AC IO CABINET VERTIV TRINERGY UL
VTT-05-S537	OUTLINE DRAWING 2.5MW 415V 3WIRE 1301MM AC IO CABINET PALLETIZED VERTIV TRINERGY UL
VTT-05-S538	TERMINAL DETAILS 2.5MW 415V 3WIRE 1300MM AC IO CABINET VERTIV TRINERGY UL
VTT-05-S539	OUTLINE DRAWING 2MW 415V 4WIRE 1302MM AC IO CABINET VERTIV TRINERGY UL
VTT-05-S540	OUTLINE DRAWING 2MW 415V 4WIRE 1302MM AC IO CABINET PALLETIZED VERTIV TRINERGY UL
VTT-05-S541	TERMINAL DETAILS 2MW 415V 4WIRE 1300MM AC IO CABINET VERTIV TRINERGY UL
VTT-05-S542	ELEVATED VIEW 2400A STS VERTIV TRINERGY CE-UL
VTT-05-S543	CoG DRAWING 2400A STS PALLETIZED VERTIV TRINERGY CE-UL
VTT-05-S544	OUTLINE DRAWING 2400A STS INTERNAL VIEWS NO BFD VERTIV TRINERGY CE-UL
VTT-05-S545	OUTLINE DRAWING 2400A STS INTERNAL VIEWS WITH BFD VERTIV TRINERGY CE-UL
VTT-05-S546	ELEVATED VIEW AC CABINET 1.5-1.6MW CE VERTIV TRINERGY
VTT-05-S547	CoG DRAWING AC CABINET 1.5-1.6MW CE PALLETIZED VERTIV TRINERGY
VTT-05-S548	TERMINAL DETAILS AC CABINET 1.5-1.6MW CE VERTIV TRINERGY
VTT-05-S549	ELEVATED VIEW AC CABINET 1.5-1.6MW UL VERTIV TRINERGY
VTT-05-S550	CoG DRAWING AC CABINET 1.5-1.6MW UL PALLETIZED VERTIV TRINERGY
VTT-05-S551	TERMINAL DETAILS AC CABINET 1.5-1.6MW UL VERTIV TRINERGY
VTT-05-S552	CoG DRAWING 2400A STS PALLETIZED VERTIV TRINERGY CE-UL
VTT-05-S553	ELEVATED VIEW AC CABINET 1.5-1.6-2.0MW UL VERTIV TRINERGY
VTT-05-S554	CoG DRAWING AC CABINET 1.5-1.6-2.0MW UL PALLETIZED VERTIV TRINERGY
VTT-05-S555	TERMINAL DETAILS AC CABINET 1.5-1.6-2.0MW UL VERTIV TRINERGY

Table B.5 Performance Graphs

Submittal Number	Description
VTT-18-S001	Inverter Overload Curves 500kW Core
VTT-18-S002	Inverter Overload Curves 533kW Core
VTT-18-S008	DC/AC efficiency, 400V, Typical
VTT-18-S009	Input Power Factor, 400V, Typical, Vertiv™ Trinergy™
VTT-18-S010	Input Current THD, 400V, Typical, Vertiv Trinergy
VTT-18-S014	DC/AC efficiency, 480V, Typical, Vertiv Trinergy
VTT-18-S015	Input Power Factor, 480V, Typical, Vertiv Trinergy
VTT-18-S016	Input Current THD, 480V, Typical, Vertiv Trinergy
VTT-18-S022	VFI AC/AC efficiency, Typical, 400V CE, Vertiv Trinergy 2MW
VTT-18-S025	VFI AC/AC efficiency, Typical, 480V UL, Vertiv Trinergy 1.5MW
VTT-18-S027	VFI AC/AC efficiency, Typical, 480V UL, Vertiv Trinergy 2MW

Table B.6 Control Wiring

Submittal Number	Description
VTT-19-S001	CABLE LAYOUT, INDEX COMMUNICATIONS AND GENERAL CONTACTS VERTIV TRINERGY
VTT-19-S002	CONTROL WIRING, CABLE GROUP #1 VERTIV ENVIRONMENT SENSOR VERTIV TRINERGY
VTT-19-S003	CONTROL WIRING, CABLE GROUP #2 PARALLEL UPS CONNECTION VERTIV TRINERGY CABLE LAYOUT, CABLE GROUP #2 PARALLEL UPS CONNECTION VERTIV TRINERGY
VTT-19-S004	CONTROL WIRING, CABLE GROUP #3 MULTIPLE BUS SYNCHRONIZATION MODULE (MBSM)
VTT-19-S005	CONTROL WIRING, CABLE GROUP #4 EPO INPUT VERTIV TRINERGY CABLE LAYOUT, CABLE GROUP #4 EPO INPUT VERTIV TRINERGY
VTT-19-S006	CONTROL WIRING, CABLE GROUP #5 EPO STATUS VERTIV TRINERGY CABLE LAYOUT, CABLE GROUP #5 EPO STATUS VERTIV TRINERGY
VTT-19-S007	CONTROL WIRING, CABLE GROUP #6 BACKFEED STATUS VERTIV TRINERGY CABLE LAYOUT, CABLE GROUP #6 BACKFEED STATUS VERTIV TRINERGY
VTT-19-S008	CONTROL WIRING, CABLE GROUP #7 SELECTABLE INPUT DRY CONTACTS CABLE LAYOUT, CABLE GROUP #7 SELECTABLE INPUT DRY CONTACTS VERTIV TRINERGY
VTT-19-S009	CONTROL WIRING, CABLE GROUP #8 SELECTABLE OUTPUT DRY CONTACTS CABLE LAYOUT, CABLE GROUP #8 SELECTABLE OUTPUT DRY CONTACTS VERTIV TRINERGY
VTT-19-S010	CONTROL WIRING, CABLE GROUP #9 ETHERNET SWITCH POWER SUPPLY VERTIV TRINERGY
VTT-19-S011	CONTROL WIRING, CABLE GROUP #10 BATTERY INTERFACE CARDS VERTIV TRINERGY
VTT-19-S012	CONTROL WIRING, CABLE GROUP #11 SLOT FOR VERTIV™ LIFE™ SERVICES PRODUCTS VERTIV TRINERGY
VTT-19-S013	CONTROL WIRING, CABLE GROUP #12 SLOTS FOR VERTIV™ LIEBERT® INTELLISLOT™ CARDS VERTIV TRINERGY

Table B.6 Control Wiring (continued)

Submittal Number	Description
VTT-19-S014	CONTROL WIRING, CABLE GROUP #13 FROM ETHERNET SWITCH TO GHMI VERTIV™ TRINERGY™
VTT-19-S015	CONTROL WIRING, CABLE GROUP#14 BATTERY VOLTAGE SENSE VERTIV TRINERGY
VTT-19-S016	CONTROL WIRING, CABLE GROUP #15 BATTERY INTERFACE BOX TO TEMPERATURE SENSOR VERTIV TRINERGY
VTT-19-S017	CONTROL WIRING, CABLE GROUP #16 FROM BI BOARD TO BIB BOARD CONNECTIONS VERTIV TRINERGY
VTT-19-S018	CONTROL WIRING, CABLE GROUP #17 BATTERY INTERFACE BOX TO DC BREAKER COIL VERTIV TRINERGY
VTT-19-S019	CONTROL WIRING, CABLE GROUPS #18 BATTERY INTERFACE BOX TO DC BREAKER UVR/AUX CONTACTS (FBO) VERTIV TRINERGY
VTT-19-S020	CONTROL WIRING, CABLE GROUP #19 CAN BIB INTERCONNECTION VERTIV TRINERGY
VTT-19-S021	CABLE LAYOUT, DISTRIBUTED BATTEY SYSTEM, BIB MONITORING, ONE MBD per CORE , BIS MONITORED
VTT-19-S022	CABLE LAYOUT, DISTRIBUTED BATTEY SYSTEM, BIB MONITORING, ONE MBD per STRING
VTT-19-S023	CONTROL CABLE LAYOUT, SKRU
VTT-19-S024	CONTROL CABLE LAYOUT, VERTIV TRINERGY WITH VERTIV™ ENERGYCORE LI5, MODBUS & DRY CONTACTS, DISTRIBUTED BATTERIES
VTT-19-S025	CONTROL CABLE LAYOUT, VERTIV TRINERGY WITH VERTIV ENERGYCORE LI5, DRY CONTACTS MONITORING, DISTRIBUTED BATTERIES

Table B.7 Seismic Anchoring Kit

Submittal Number	Description
Various	Seismic Anchoring Assemblies available for different configurations

Please contact your Vertiv representative to obtain the required seismic anchoring kit and submittal drawings for your specific application. Due to continuous product improvement programs, specifications are subject to change without notice.

This page intentionally left blank

Connect with Vertiv on Social Media

 https://www.facebook.com/vertiv/

 https://www.instagram.com/vertiv/

 https://www.linkedin.com/company/vertiv/

 https://www.x.com/Vertiv/

Vertiv.com | Vertiv Headquarters, 505 N Cleveland Ave, Westerville, OH 43082 USA

10068023P60CE-UL_SL-80218_REVG_06-26