



Liebert[®] APM2

User Manual

300 to 600 kVA Modular UPS

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Technical Support Site

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

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

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1 Important Safety Instructions

This manual contains information about the installation and operation of the Vertiv™ Liebert® APM2 300 to 600 kVA UPS single module and parallel system.

A Vertiv authorized engineer must install and commission the UPS. Failure to do so can cause product malfunction or personal safety risk.

Read the UPS manual and safety precaution carefully, failure to do so can cause product malfunction or personal safety risk.

NOTE: The Liebert® APM2 UPS is not manufactured to support the life support equipment.



WARNING! Never dispose of the internal or external battery of the UPS in a fire.

1.1 Product Safety

1. If this product is stored or remain de-energized for a long period, it must be placed in a dry and clean environment within specified temperature range.
2. The environmental requirements must be fulfilled while operating the UPS. See [Environmental Requirement](#) on page 26.
3. The UPS is designed for application in the following conditions:
 - Where the temperature and relative humidity are not in specified range given in the [Specifications](#) on page 169.
 - Is not subjected to vibrations or shocks.
 - Where conductive dusts, corrosive gases, salts, or flammable gases are not present.
 - Away from heat sources or strong electromagnetic interferences.



WARNING! The UPS with standard configuration is a product for commercial and industrial application in the atmospheric environment (with dust, corrosion, electromagnetic interference). Installation restrictions or additional measures may be needed to prevent disturbances.

1.2 Disclaimer

Vertiv disclaims all responsibility and/or liability for any defects or malfunction caused by the following actions:

- Any use or operation outside of the product [Specifications](#) on page 169, including application ranges or operating environments.
- Any unauthorized product operations, modifications or improper installation.
- Any forceful measures used when operating the product.
- Any other product related actions not in compliance with the instructions in this document.

If you need product assistance or have additional product questions, please contact your Vertiv Technical Support representative.

CE declaration of conformity

This device complies with CE 2006/95/EU (Low Voltage Safety), 2004/108/EU (EMC) and Australia and New Zealand EMC standard (C-Tick), as well as the following UPS product standards:

- IEC62040-1 General safety requirements for UPS
- IEC62040-2-EMC
- IEC62040-3 Performance requirements and test methods
- IEC62040-4 Uninterruptible power supply systems (UPS). Part 4: Environmental factors. Requirements and reports

For details, refer to [Specifications](#) on page 169.

Continued compliance requires installation in accordance with these instructions and the use of manufacturer approved accessories only.



WARNING! High earth leakage current. Earth connection is essential before connecting input power (including power supply and battery).

- This equipment is installed with an EMC filter.
- Earth leakage current is less than 3000 mA.
- Transient and steady state earth leakage currents, which may occur when the equipment is started, should be considered in the selection of instantaneous RCCBs or RCD devices.
- RCCB which is sensitive to unidirectional DC pulse (class A) and insensitive to transient state current pulse must be selected.
- The earth leakage currents of the load will be carried by the RCCBs or RCDs.
- The equipment must be earthed in accordance with the local electrical code of practice.



WARNING! Risk of voltage backfeed. Isolate the UPS, check for hazardous voltage between all terminals including the protective earth before working on this circuit.

The UPS is fitted with a dry contact closure signal for use with an external automatic disconnect device (supplied by others) to protect against backfeeding voltage into the incoming terminal through the rectifier or bypass static switch circuit. Stick the warning labels at all external at all external incoming primary supply disconnect device to warn service personnel that the circuit is connected to a UPS.



WARNING! The upstream distribution protection equipment of the UPS shall be selected in accordance with the local electrical regulations.



WARNING! All maintenance and servicing procedures involving internal access requires the use of a tool and should be carried out only by trained personnel. There are no user serviceable parts behind the covers that need a tool or wrench for removal.



WARNING! Battery voltage exceeds 400 VDC (For service personnel)



WARNING! Battery maintenance and servicing procedures require the use of a tool or key and must only be performed by trained personnel. Pay attention when working with the batteries attached to this UPS, the voltage at the battery terminal exceeds 400 V DC and can cause death.

Battery manufacturers provide details on precautions to be taken while operating when operating or in the vicinity of a large battery. These precautions should be followed implicitly. Pay attention to the local environmental conditions and the provision of protective clothing, first aid and fire fighting facilities.



WARNING! The APM2 UPS and battery circuit breaker box/battery cabinet have high voltage inside. The risk of exposing to high voltage is reduced because the high voltage components can only be accessed when the front door is opened.

There is no risk when operating this equipment according to the general instructions and the steps recommended in this manual.



WARNING! This AMP2 UPS system receives power from more than one source. All AC source and the DC source must be disconnected before servicing.

This UPS has several circuits that are energized with high AC as well as DC voltages. Check for voltage with both AC and DC voltmeters before working within the UPS.



WARNING! When internal fuse of the UPS is damaged, it must be replaced with fuse of the same electric parameters by qualified personnel.

IMPORTANT! The communication board is sensitive to electrostatic discharge, implement ESD prevention measures when managing any communication board.



WARNING! Select an appropriate MCCB to protect against short circuit and overload for the battery. It is recommended to use the Vertiv BCB box to provide a better solution.



WARNING! The power cables must be routed in the metal cable trough in order to avoid cable damage and reduce the electromagnetic radiation.

NOTE: The AMP2 UPS meets the standard requirement of short time withstand current: (Icw) of 10 kA for 300 kVA, (Icw) of 19 kA for 600 kVA. The specified upstream fuses are required to obtain the conditional short circuit current rating, Icc at 65 kA (300/600 kVA) symmetrical rms.

Table 1.1 UPS Models

Model	Product
APM 0300kMK16FN02S00	300 kVA
APM 0600kMK16FN02S00	600 kVA

There are 3 types of cabinets for 300 kVA products.

- UPS without switch.

- UPS with maintenance switch Q3 cabinet.
- UPS with input switch Q1, bypass switch Q2, maintenance switch Q3, output switch Q5 cabinet. Both top cable access and bottom cable access are available for 300 kVA.

The 600 kVA UPS products are available as a cabinet without switch or a product with a switch cabinet.

2 Overview

This chapter describes the features, design concept, parallel system, operation mode, battery management and battery protection of the Vertiv™ Liebert® APM2 300 to 600 kVA UPS.

2.1 Features

The UPS is connected between a critical load, such as a computer, and mains power to provide high quality power for the loads.

The UPS has the following advantages:

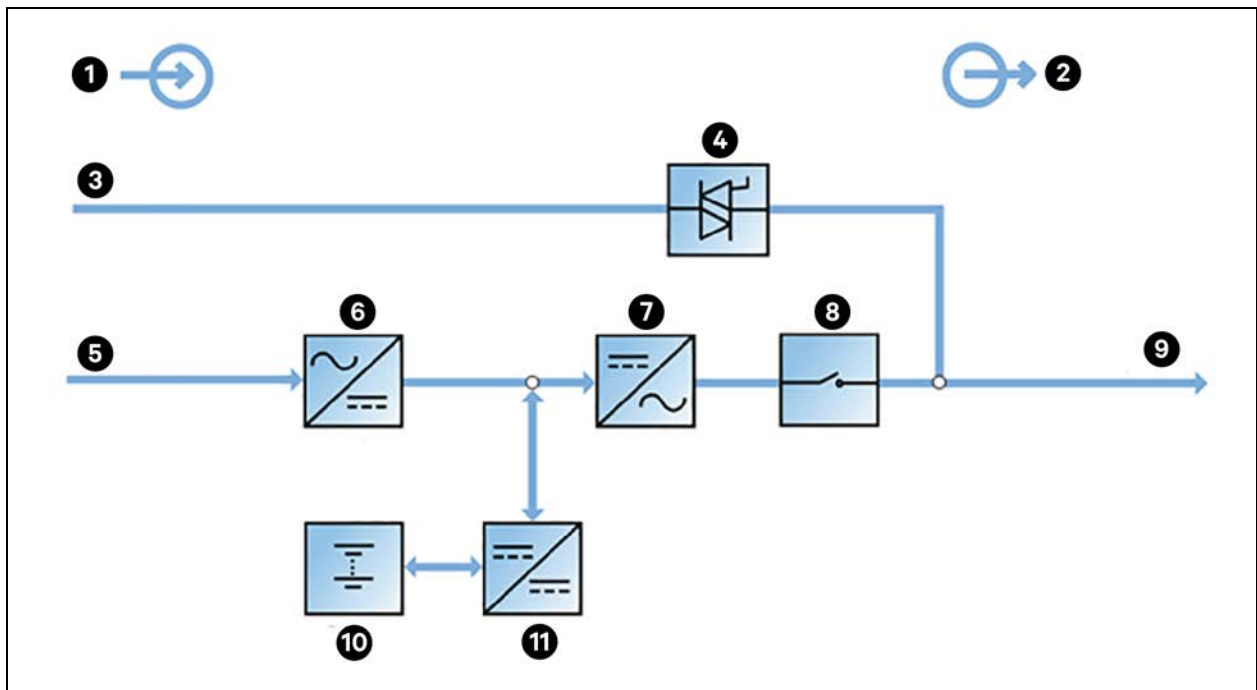
- Improves the input power quality.
- The UPS protects its output against the input power change through the intelligent controller.
- Protect the equipment in the scenario of mains direct power source failure.
- If the input power fails, the UPS will work in battery mode, and the power supply to the loads will not be interrupted.

2.2 Design Concept

2.2.1 System design

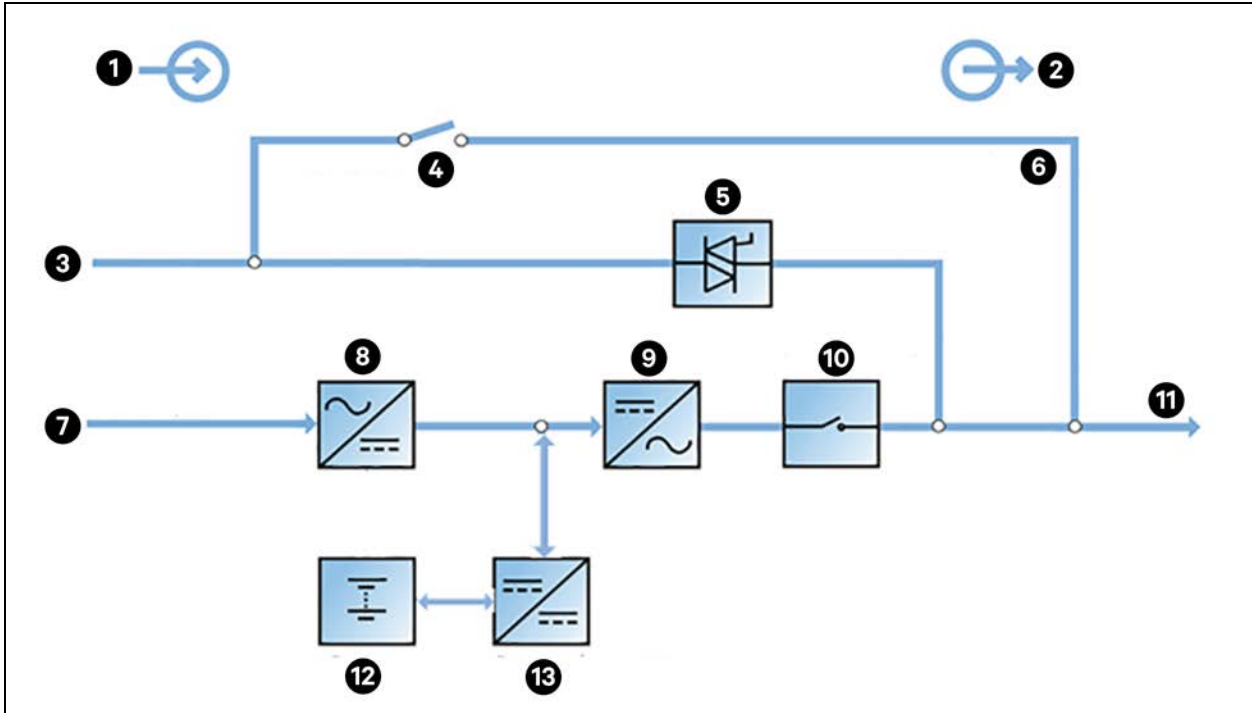
This section describes the working principle of the UPS single module. The UPS adopts AC-DC-AC converter (as shown in **Figure 2.1** below, **Figure 2.2** on the next page and **Figure 2.3** on page 7). The first stage is conversion (AC/DC) adopts three-phase high frequency rectifier to convert the three-phase input voltage into stable DC bus voltage.

Figure 2.1 Block Diagram for Working Principle of UPS Single Module of Without Switch



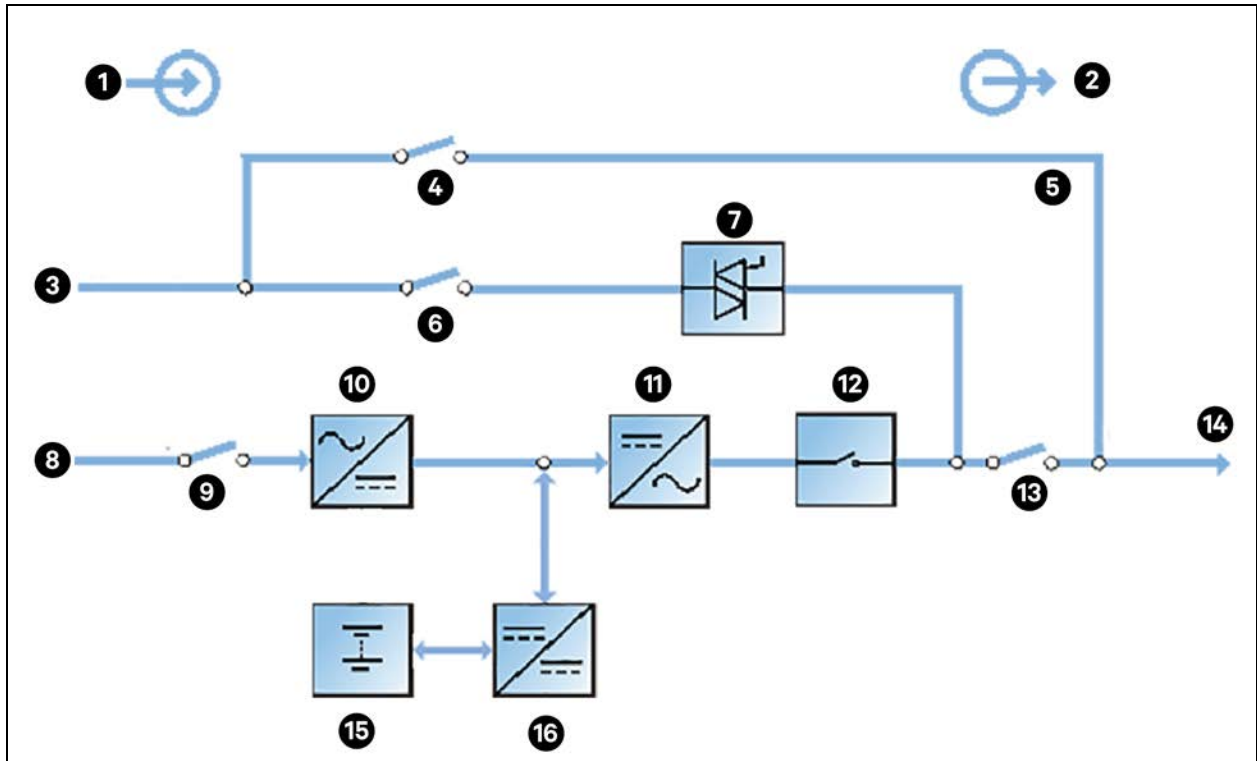
Item	Description	Item	Description
1	Input	7	Inverter
2	Output	8	Automatic inverter switch
3	Bypass input	9	UPS output
4	Static switch	10	Battery
5	Mains input	11	Charger/discharger
6	Rectifier		

Figure 2.2 Block Diagram for Working Principle of UPS Single Module of with Single Switch



Item	Description	Item	Description
1	Input	8	Rectifier
2	Output	9	Inverter
3	Bypass input	10	Automatic inverter switch
4	Maintenance bypass switch	11	UPS output
5	Static switch	12	Battery
6	Maintenance bypass	13	Charger/discharger
7	Mains input		

Figure 2.3 Block Diagram for Working Principle of UPS Single Module of with Four Switches



Item	Description	Item	Description
1	Input	9	Rectifier input switch
2	Output	10	Rectifier
3	Bypass input	11	Inverter
4	Maintenance bypass switch	12	Automatic inverter switch
5	Maintenance bypass	13	Output switch
6	Bypass input switch	14	UPS output
7	Static switch	15	Battery
8	Mains input	16	Charger/discharger

The UPS has its own battery charger and adopts advanced temperature compensation technology to effectively improve the battery service life. The inverter adopts 3 level T-type IGBT topology and uses advanced SPWM control technology to derive the stable AC voltage from the DC bus voltage.

When the mains is normal, the rectifier and inverter work together to supply the power to the load and charge the battery.

When the mains is abnormal, the rectifier stops working, and the battery supplies power to the loads through the inverter. If the battery voltage falls to end of discharge (EOD) voltage and the mains still has not been recovered, the UPS will shut down (if the system uses split bypass configuration and the bypass is normal, the system will transfer to bypass). The battery EOD voltage is preset. When the mains is abnormal, the battery maintains the UPS operation till the battery voltage is reduced to EOD voltage and the UPS shuts down, this time is called backup time. The length of backup time depends on the battery capacity and the loads.

2.2.2 Bypass

Through the intelligent control of the Static Switch module as shown in **Figure 2.1** on page 5, **Figure 2.2** on page 6 and **Figure 2.3** on the previous page). containing the controllable electronic switch, the loads can be supplied by the inverter or the bypass. In normal situation, the loads are supplied by the inverter, in which case the automatic inverter switch at inverter side is closed. In the case of overload (the overload delay time expires) or inverter failure, the automatic inverter switch is opened, and the Static Switch module with UPS logic control will automatically transfer the loads to the bypass.

In normal operating state, to get the uninterrupted transfer between inverter and bypass, the inverter output must be synchronized with the bypass.

Therefore, when the bypass frequency is within the synchronization range, the inverter control circuit will synchronize the inverter output frequency with the bypass frequency and phase.

The UPS has a manual maintenance bypass switch (model without switch excluded) for shutdown of the UPS at the time of maintenance. For maintenance, the bypass will directly supply power to the critical loads through the maintenance bypass.

NOTE: When the bypass maintenance mode supplies power to the load, the quality of the power supply may get affected.

2.2.3 System control principle

Normal operation

Normal mode

The UPS has normal input mains, the rectifier and inverter operate normally, The inverter supplied power to the load, the battery circuit breaker is closed, and the battery is in stable floating charge state.

For parallel system, as the UPS single module outputs are connected in parallel, the system checks that the inverter control circuits are perfectly synchronized with one another and with the bypass in terms of both frequency and phase, and that they have the same output voltages. Current supplied to the load is automatically divided among UPSs. A warning message appears while synchronization is in progress.

Mains abnormal

When the mains fails or is abnormal, the rectifier will stop working automatically, and the system will transfer to battery output (through inverter). The length of the operation time in battery mode depends on the load and the battery capacity. In the case of Mains abnormal, if the battery voltage falls to the EOD voltage and the mains still has not been recovered, the inverter will stop automatically, and the UPS touch screen will display alarm messages. If the system uses split bypass configuration and the bypass is normal, the system will transfer to bypass.

Mains recovery

When the main power supply resumes normal within allowable time, the rectifier will start automatically and supply the load and charge the battery again. Therefore, the power supply to the load will not be interrupted.

Disconnect battery

To disconnect the external battery from the UPS system for maintenance, use the external isolating switch. At this time, except for the battery backup function upon mains power supply failure, other functions and all the steady state performance of the UPS will not be affected.

UPS module failure

In case of inverter failure and output fuse blowout, the load will automatically transfer to the bypass, and the output power supply will not be interrupted. In this situation, contact the local Vertiv technical support.

For parallel system, In the event of a fault in a UPS module, it will automatically exit from the parallel system. If the system is still capable of providing the required load, the remaining modules will continue to supply the load with no interruption. If the remaining modules are no longer capable of fulfilling the power requirements, the load will automatically transfer to the bypass.

Overload

If the inverter is overloaded or the inverter current remains outside the [Specifications](#) on page 169 (See **Table 12.6** on page 172) longer than the specified time, the load will automatically transfer to the bypass without power interruption. If both the overload and the current are reduced to a level within the specified range, then the load will be transferred back to the inverter. In case of output short circuit, the load will be transferred to the bypass, and the inverter will shut down. Five minutes later, the inverter will start up automatically. If the short circuit is removed at this point, the load will be transferred back to the inverter. The transfer is determined by the features of the protective device of the system.

In the above two situations, the UPS screen will display alarm messages.

For parallel system, the control logic system constantly monitors load requirements and controls the power supplied by each UPS module. If an overload condition is sustained for greater than a preset time, the load will transfer to the bypass, when the number of active modules is unable to satisfy load requirements. The load returns to the inverter if the power is reduced to a value that can be sustained by the number of active modules in the system.

Maintenance bypass

The UPS has a second bypass circuit, which is maintenance bypass doesn't include non-switch model, that provides a safe working environment for the engineers to provide regular maintenance or repair to the UPS system and at the same time provide unregulated mains supply to the loads. The maintenance bypass can be manually selected through the maintenance bypass switch, and it can be disconnected by turning the switch to OFF.

NOTE: If the UPS system has 2 or more UPS modules and when the load capacity exceeds the single module capacity, do not use the internal maintenance bypass switch an external maintenance bypass breaker should be used instead.

2.2.4 UPS power supply switch configuration

The UPS equipped with single switch: maintenance bypass switch Q3.

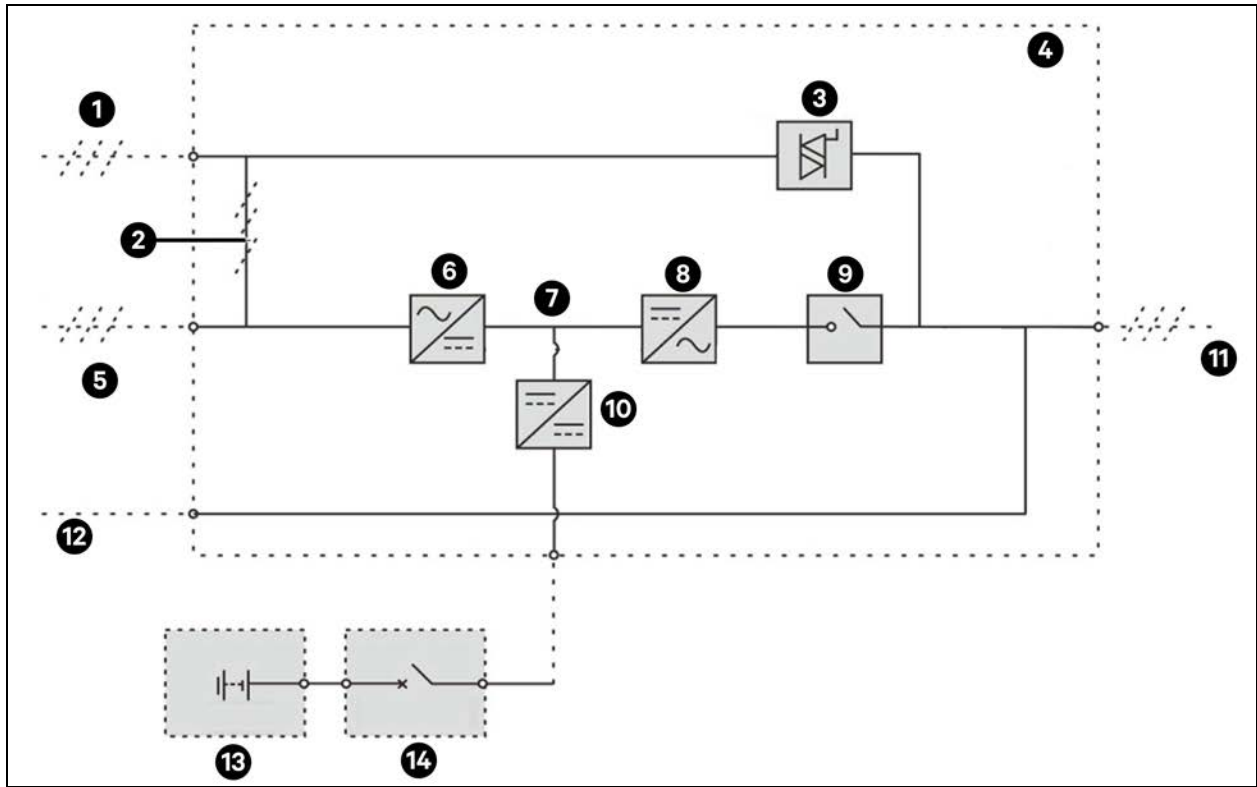
The UPS equipped with four switches:

- Rectifier input switch Q1
- Bypass input switch Q2
- Maintenance bypass switch Q3
- Output switch Q5

The block diagram of the UPS module are shown in **Figure 2.4** below, **Figure 2.5** on the facing page and **Figure 2.6** on page 12. The UPS has split bypass configuration (the bypass adopts independent mains input) and common input configuration. In split bypass configuration, the static bypass and maintenance bypass share the same independent bypass power supply. Where a separate power source is not available, the input supply connections of the bypass input switch Q2 and rectifier input switch Q1 would be linked together to make the bypass input and rectifier input use mains power of the same route.

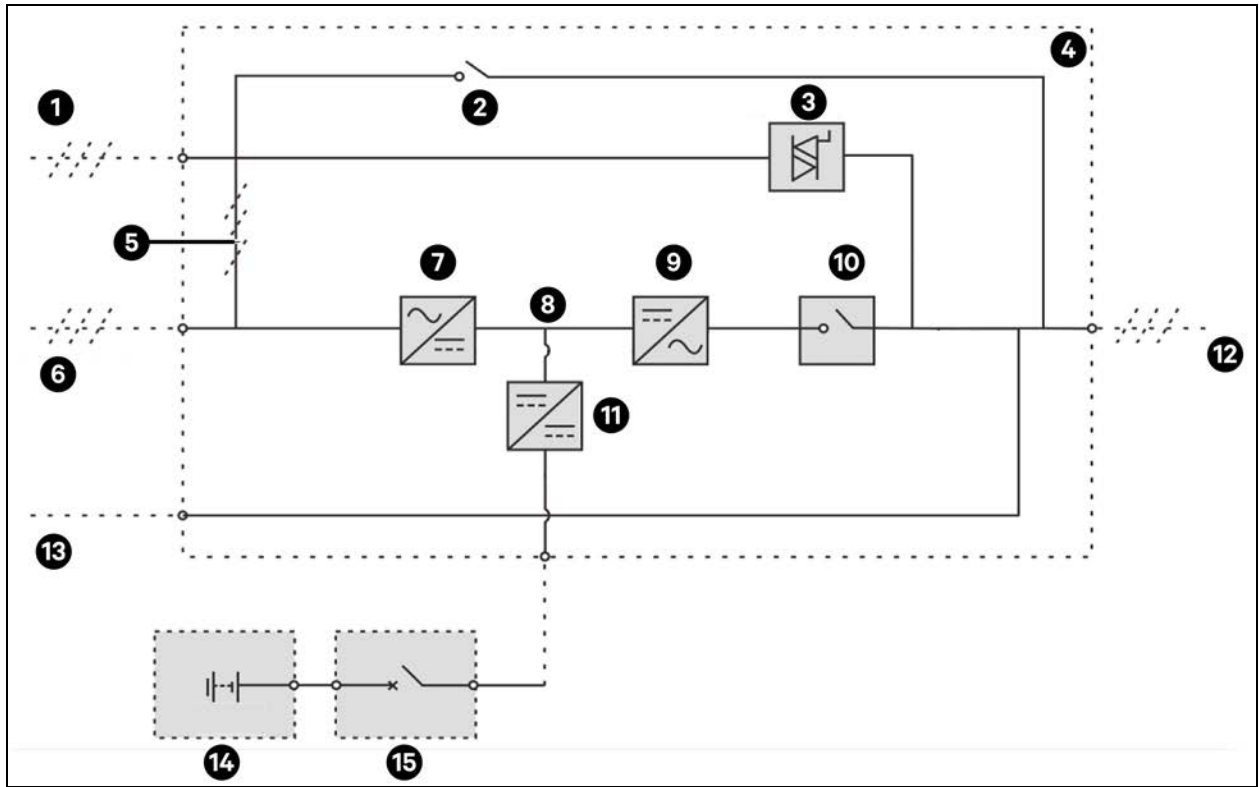
During the normal operation of the UPS, except for the maintenance bypass switch Q3, other switches shall be closed.

Figure 2.4 UPS Power Supply Switch Configuration Without Switch



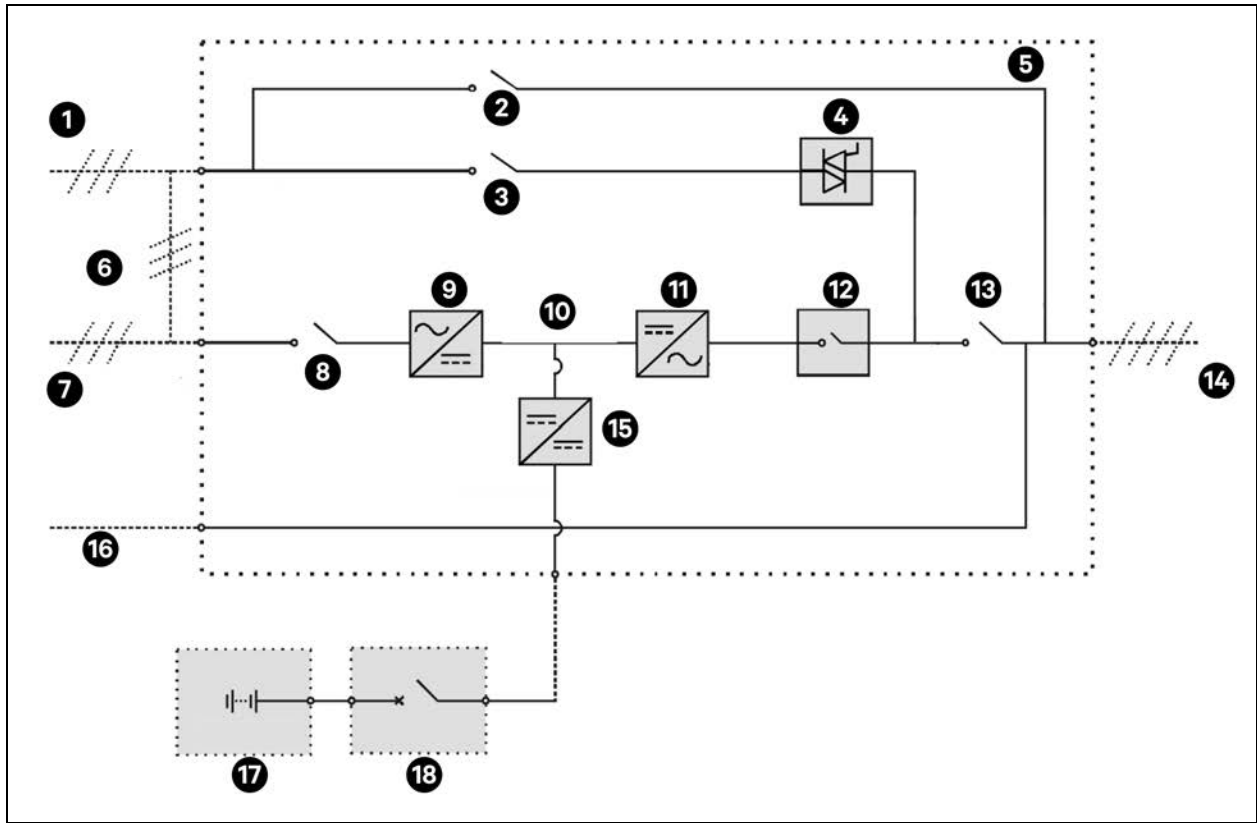
Item	Description	Item	Description
1	Bypass input	8	Inverter
2	Shorting copper bar of input configuration	9	Automatic inverter switch
3	Static switch	10	Charger/discharger
4	UPS	11	UPS output
5	Mains input	12	Neutral line input
6	Rectifier	13	Battery
7	DC bus	14	Battery circuit breaker

Figure 2.5 UPS Power Supply Switch Configuration Single Switch



Item	Description	Item	Description
1	Bypass input	9	Inverter
2	Maintenance bypass switch Q3	10	Automatic Inverter switch
3	Static switch	11	Charger/discharger
4	UPS	12	UPS output
5	Shorting copper bar of input configuration	13	Neutral line input
6	Mains input	14	Battery
7	Rectifier	15	Battery circuit breaker
8	DC bus		

Figure 2.6 UPS Power Supply Switch Configuration Four Switches



Item	Description	Item	Description
1	Bypass input	10	DC bus
2	Maintenance bypass switch Q3	11	Inverter
3	Bypass input switch Q2	12	Automatic Inverter switch
4	Static switch	13	Output switch Q5
5	UPS	14	UPS output
6	Shorting copper bar of input configuration	15	Charger
7	Mains input	16	Neutral line input
8	Rectifier input switch Q1	17	Battery
9	Rectifier	18	Battery circuit breaker

NOTE: The mains input and bypass input is connected to the same neutral line.

2.2.5 Battery circuit breaker (BCB)

The external battery is connected to the UPS through the BCB. The BCB cabinet is optional, and is installed near the battery. The BCB is closed manually. The BCB has a shunt tripping coil. When the system is faulty and the BCB needed to be disconnected, the UPS control circuit will send a signal to the shunt tripping coil to trip the BCB. It also has a magnetic trip facility for overload protection and short circuit protection.

2.3 Parallel System

Up to 4 UPS units can be parallelly connected to form a parallel system to increase the system capacity and reliability. The load is equally shared between the paralleled UPS modules.

Moreover, 2 UPS units or parallel system can comprise a dual bus system. Each parallel system has independent output. Output synchronization is achieved through the LBS cable or LBS adapter, enabling seamless load transfer between the 2 parallel systems or single units through the STS device.

2.3.1 Parallel system features

1. The hardware and software of parallel system are completely the same as those of the single module. The parallel system configuration is achieved through settings in configuration software.
2. Parallel cables are connected in a ring, providing both system reliability and redundancy.
3. The total load of the parallel system is identified from the touchscreen of each UPS module.

2.3.2 Parallel system requirements

A group of parallel units operate as if it is one large UPS with higher reliability. To ensure that all units are equally utilized and to comply with relevant wiring rules, make sure that the following requirements are met.

1. All UPS units must be in the same model, and connect to the same bypass source.
2. The bypass and rectifier input sources must be connected to the same neutral line input terminal.
3. Any RCD, if installed, must be of an appropriate setting and located upstream of the common neutral line input terminal. Alternatively, the device must monitor the protective earth current of the system.



WARNING! High earth leakage current. Earth connection is essential before connecting input power (including power supply and battery).

2.4 Operation Modes

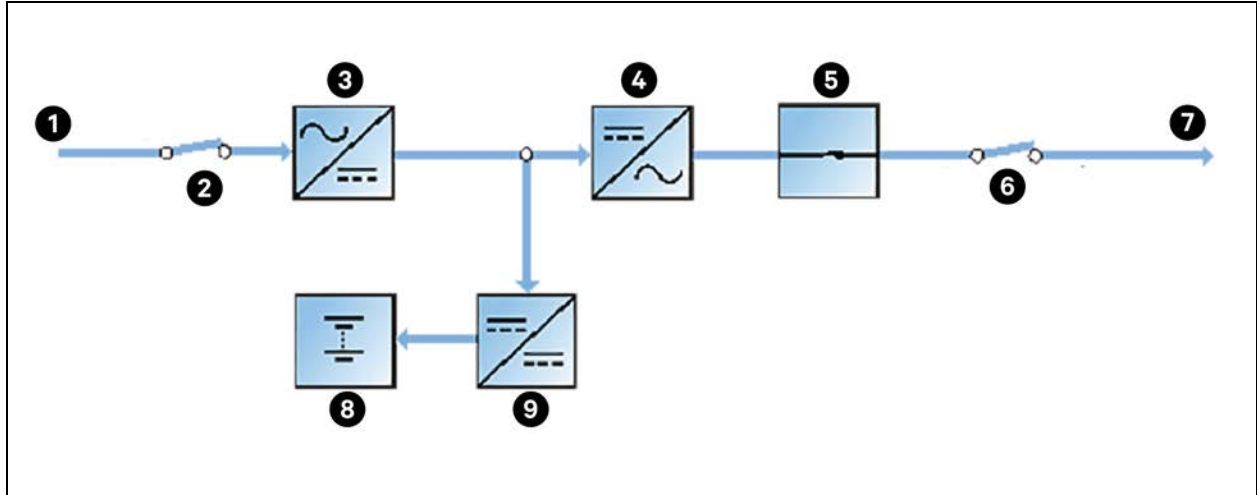
The UPS has the following operation modes:

- Normal mode
- Battery mode
- Automatic restart mode
- Bypass mode
- Maintenance mode
- ECO mode
- Parallel redundancy mode
- Frequency converter mode
- LBS mode
- Dynamic online mode

Normal mode

As shown in **Figure 2.7** below, the mains is rectified by the UPS rectifier and inverted by the inverter to supply uninterrupted AC power to the loads. At the same time, the charger will charge the battery.

Figure 2.7 Schematic Diagram of Normal Mode

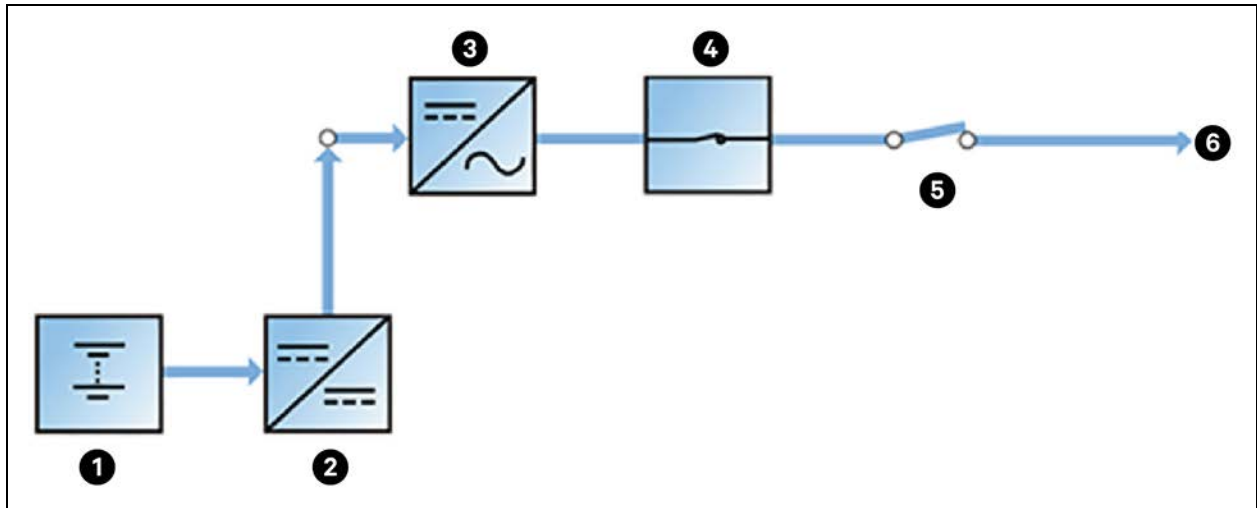


Item	Description	Item	Description
1	Mains input	6	Output switch
2	Rectifier input switch	7	UPS output
3	Rectifier	8	Battery
4	Inverter	9	Battery charger
5	Automatic inverter switch		

Battery mode

As shown in **Figure 2.8** on the facing page, the operation mode in which the battery provides backup power supply to the loads through the rectifier and inverter is called battery mode. Upon mains failure, the system will automatically transfer to the battery mode with no load power interruption. When the mains is recovered, the system will automatically transfer back to the normal mode without any manual intervention, and the power to the load will not be interrupted.

Figure 2.8 Schematic Diagram of Battery Mode



Item	Description	Item	Description
1	Battery	4	Automatic inverter switch
2	Battery charger/discharger	5	Output switch
3	Inverter	6	UPS output

NOTE: Battery cold start function is available for switching the UPS ON from Battery (charged) mode directly during mains failure. Therefore, the battery power supply is used independently to improve the availability of the UPS.

Automatic restart mode

The APM2 UPS has automatic restart function. When the inverter shuts down because the mains failure and the battery discharges to EOD voltage, if the mains is recovered, the UPS will restart automatically after a certain time of delay.

NOTE: These two functions must be set by a Vertiv authorized service engineer.

Automatic restart helps to delay the shut down process and the UPS will charge the battery to protect against the power OFF risk of the load device caused by mains power failure.

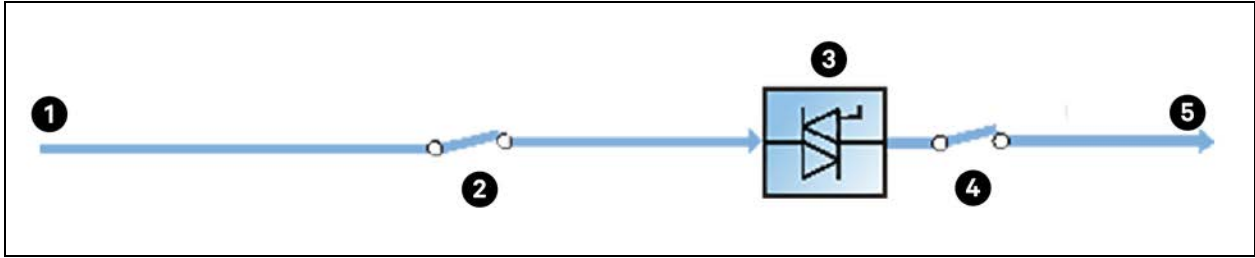
NOTE: The user can manually start the UPS through RESET FAULT function, if the automatic restart function has not set.

Bypass mode

When the UPS is in bypass mode **Figure 2.9** on the next page and the inverter fails or the inverter gets overloaded or the inverter is shutdown manually, the static switch will transfer the load from the inverter to bypass without interrupting the power to the load.

NOTE: While transferring of load from the inverter to the bypass, if both are not synchronized, power supply to the load has transitory interruption, with a time of less than 20 ms.

Figure 2.9 Schematic Diagram of Bypass Mode

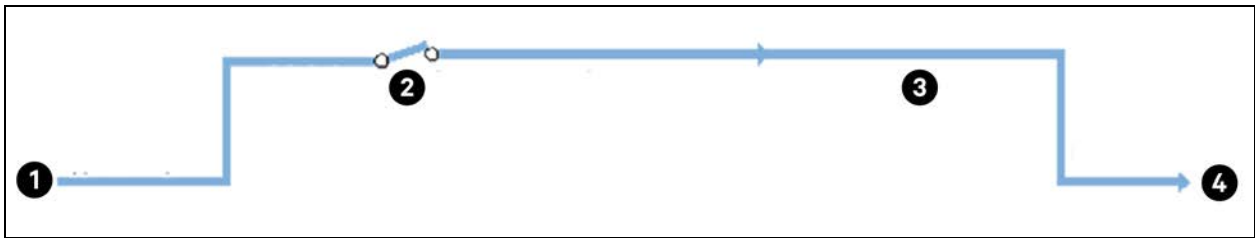


Item	Description	Item	Description
1	Bypass input	4	Output switch
2	Bypass input switch	5	UPS output
3	Static switch		

Maintenance mode

As shown in **Figure 2.10** below, if the UPS maintenance or service is required, use the manual maintenance bypass switch to transfer the load to maintenance bypass, with no interruption in power to the load. This maintenance bypass switch is fitted in all UPS units and rated for full load of a single module.

Figure 2.10 Schematic Diagram of Maintenance Mode

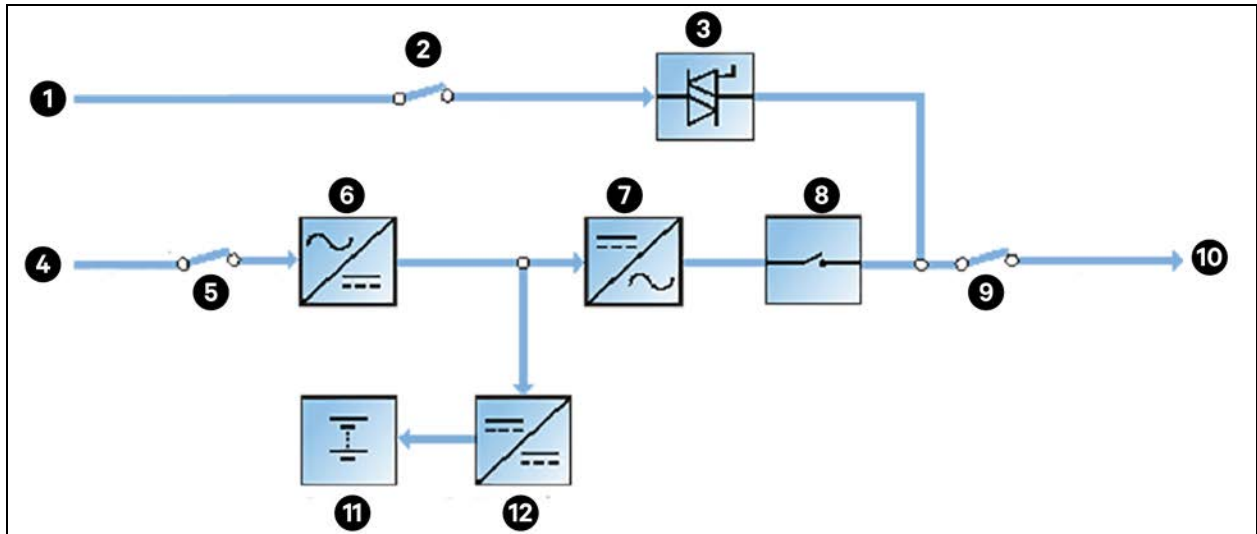


Item	Description	Item	Description
1	Bypass input	3	Maintenance bypass
2	Maintenance bypass switch	4	UPS output

ECO mode

As shown in **Figure 2.11** on the facing page, if ECO mode is selected, all power switches and the battery switches are closed except the maintenance bypass switch, and the system puts the load on the bypass mode, for energy saving. When the bypass supply is within the range of normal frequency and normal voltage (adjustable), the load is powered by the bypass, with the inverter on stand by; when the voltage and/or frequency of the bypass supply are beyond the pre defined and adjustable limits, the system will transfer to the inverter output. and the transfer time for switching from bypass to inverter is less than 2 ms (uninterrupted) and less than 5 ms (interrupted). In this mode, the system can normally charge the battery.

Figure 2.11 Schematic Diagram of ECO Mode



Item	Description	Item	Description
1	Bypass input	7	Inverter
2	Bypass input switch	8	Automatic inverter switch
3	Static switch	9	Output switch
4	Mains input	10	UPS output
5	Rectifier input switch	11	Battery
6	Rectifier	12	Battery charger

NOTE: If ECO mode is required, adjust the parameters through the touch screen.

The operation method of ECO mode is the same as the description in [Single UPS Operation](#) on page 103. In normal mode, the load is powered by the bypass, the touchscreen displays Bypass mode.

NOTE: In ECO mode, the load is not protected against mains distortion.

Parallel redundancy mode (system expansion)

For higher capacity or higher reliability, the outputs of multiple UPS units can be programmed for directly paralleling. The built in parallel controller in each UPS module ensures automatic load sharing. A parallel system can include up to four UPS modules. For the operation principle diagram of the parallel redundancy mode, see [Figure 8.1](#) on page 138.

Frequency converter mode

The UPS can be programmed into frequency converter mode for either 50 Hz or 60 Hz stable output frequency. The input frequency may vary from 40 Hz to 70 Hz. In this mode, open the maintenance bypass switch and disable the static bypass operation, and the battery becomes optional depending on any requirement to operate in battery mode. The frequency converter mode is set by the service engineer through the setting software.

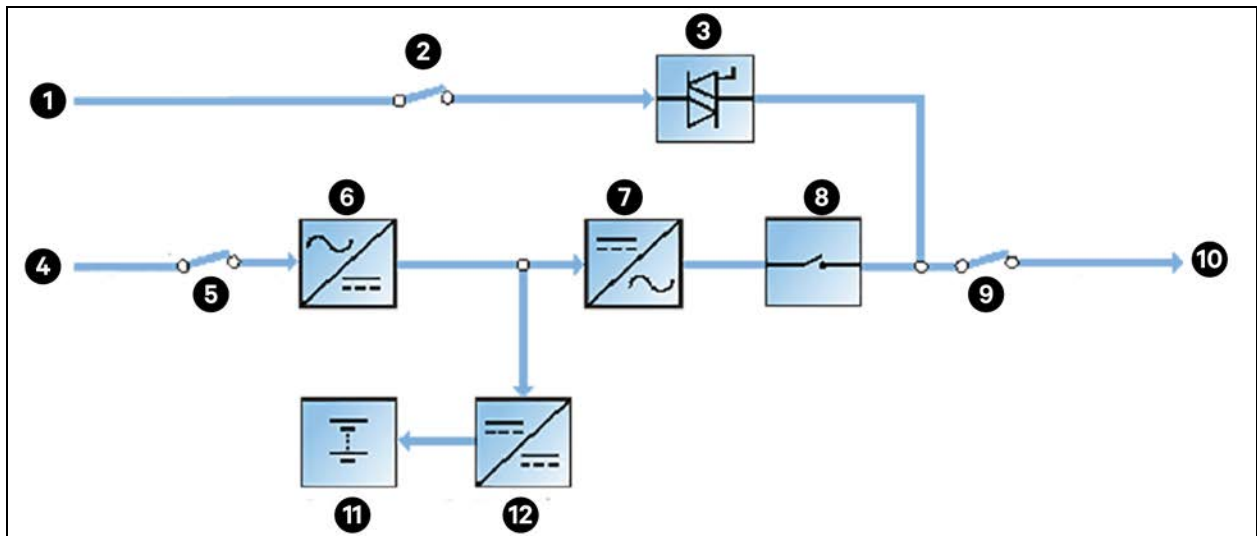
LBS mode

A dual bus system consists of 2 independent UPS systems, each containing one or more parallel UPS modules. The dual bus system has high reliability and is applicable to the load with multiple inputs. For single input load, an STS can be installed to power the load. For the operation principle diagram of the LBS mode, see **Figure 8.5** on page 144 and **Figure 8.6** on page 145.

Dynamic online mode

As shown in **Figure 2.12** below, when the UPS is in dynamic online mode, except the maintenance bypass switch, all other power switches and battery switches are turned ON. The load power is preferentially supplied by bypass to save energy. When the load power supply is provided by bypass, the inverter is in the mode of quality compensation for the bypass voltage. When the bypass voltage exceeds the normal range, the system will switch to the inverter output. In this mode, the battery can still be charged through the charger normally.

Figure 2.12 Dynamic Online Mode



Item	Description	Item	Description
1	Bypass input	7	Automatic Inverter switch
2	Static switch	8	UPS output
3	Bypass input switch	9	Rectifier input switch
4	Mains input	10	Output switch
5	Rectifier	11	Battery
6	Inverter	12	Battery charger

2.5 Battery Management System (BMS)

The battery management functions are set by the Vertiv service engineer through the setting software.

2.5.1 Normal function

- **Constant current boost charge**: Adopt the constant current (within battery charging limit) to charge the battery. The function is for fast recovery of battery capacity. The charge current can be set.
- **Constant voltage boost charge**: Adopt the constant voltage to charge battery. The function is for fast recovery of battery capacity. For VRLA batteries, the maximum boost charge voltage must not exceed 2.4 V/cell.
- **Float charge**: The charging method is for keeping battery in full capacity. The function can balance the capacity loss due to battery self discharge, and is used for battery capacity recovery. For VRLA batteries, the float charge voltage must be between 2.2 V/cell and 2.3 V/cell.
- **Automatic transfer to float charge**: When the charge current is less than Threshold of Equalize Charge to Float Charge or 0.5 A, the charger will automatically transfer from boost charge to float charge. When boost charge time exceeds the limit of Equalize Charge Protect Time Limit, the charger will transfer to float charge to protect the battery.
- **Float charge temperature compensation (optional)**: This function must be used with the battery temperature detection device. The Vertiv battery temperature sensor is a standard option for the selection.
- **EOD protection**: When the battery voltage drops to the EOD voltage, the battery converter shuts down automatically and the battery is inhibited to avoid further battery discharge. The EOD voltage is settable from 1.60 V/cell to 1.90 V/cell (VRLA).
- **Battery low pre-warning time**: The battery low pre warning time is adjustable between 3 min and 60 min. The default setting is 5 min.
- **Maximum battery discharge time**: When the battery has small current discharge for a long time, the battery is over discharged and even has unrecoverable damage, thus setting a battery discharge time to protect the battery is essential. The limit of time setting must be configured by service engineer through the Vertiv setting software.
- **Maximum boost charge protection time**: To protect against the battery overcharge damage caused by long time boost charge, a protect time setting is essential. The limit of time setting shall be configured by service engineer through the Vertiv setting software.

2.5.2 Advanced function

	Manual Battery Test	Automatic Battery Test	Remote Battery Test	Calibrated Battery Test
Load	0% <Load <100%	20% <Load <100%	20% <Load <100%	20% <Load <100%
Required Battery Voltage	≥ 97% of float charge voltage	≥ 97% of float charge voltage	≥ 97% of float charge voltage	≥ 97% of float charge voltage
Charger Status	Float charge ^(5h)	Float charge ^(5h)	Float charge ^(5h)	Float charge ^(5h)
Setting		Automatic battery test must be enabled and scheduled		
Trigger	From GHMI	Automatic	Through the input dry contractor	From GHMI
Action	Discharging until	Discharging until battery capacity is 80%	Discharging until battery capacity is 80%	Discharging until battery is close to EOD state

	Manual Battery Test	Automatic Battery Test	Remote Battery Test	Calibrated Battery Test
	battery capacity is 80%			
Info			Only be allowed when the utility power is present and there are no active alarm conditions.	
(5h) = float charge status required for at least 5h with VRLA, High discharge VRLA, Wet, Ni-Cd batteries.				

NOTE: The battery will continuously discharge to the battery under voltage shutdown threshold, then the battery transfer to the charging state. When the capacity self-test is finished, the system will update the battery curve table.

NOTE: The user can manually stop the capacity self-test operation using the touch screen.

2.5.3 Battery temperature compensation

The UPS system has battery charge temperature compensation function. When the ambient temperature is increased, the DC bus voltage (which charges the battery) will be reduced correspondingly to provide optimal charging voltage for the battery, thus prolonging the battery service lifetime.

This function must be used with the Vertiv battery temperature detection device (a standard option).

2.6 Battery Protection



WARNING! The user must select an appropriate MCCB to protect against short circuit and overload for the battery. It is recommended to use the Vertiv BCB box to provide a better solution.

The following battery protection functions are set by the service engineer through the Vertiv setting software.

Battery low pre-warning

The battery low pre-warning occurs before the EOD. After this pre-warning, the battery should have the capacity of 3 minutes discharging with full load. The time can be configured from 3 min to 60 min.

EOD protection

When the battery voltage drops to the EOD voltage, the battery shut down automatically. For VRLA batteries, the EOD voltage is adjustable from 1.60 V/cell to 1.90 V/cell (VRLA).

BCB alarm

The BCB alarm occurs when the external BCB opens, if the Vertiv BCB (optional) is selected.

The external battery connects to the UPS through the BCB. The BCB is manually closed and tripped by the UPS control circuit.

3 Mechanical Installation

This chapter provides brief instructions for mechanical installation of the Vertiv™ Liebert® APM2 UPS, including environmental requirements, mechanical requirements, and mechanical considerations that must be considered when planning the positioning and the cabling of the UPS equipment.

3.1 Precautions

The detailed installation steps are not provided in this section due to unique characteristic of each installation site. It presents a guide to general procedures and practices that should be observed by the installation engineer, so that they can properly handle the specific situation of the site.

NOTE: Professional installation required. Do not disassemble the package without permission of authorized service engineer. The UPS should be installed by an authorized engineer in accordance with the information provided in this chapter.

NOTE: The UPS can be connected to IT, TN and TT AC distribution systems (IEC60364-3), and must be of 3-phase, 5-wire (A, B, C, N, PE) system.



WARNING! Risk of electric shock. It can cause damage to the property, serious injury or death. When connecting batteries, the battery terminal voltage will reach 400 VDC. Take special care when installing batteries.

The following safety precautions must be followed while working on the batteries.

- Always wear protective equipment including eye wear and rubber gloves.
- Remove all the metal tools and jewelry, including finger rings, wristwatch, etc.
- Use tools with insulated handle.
- If the battery has electrolyte leakage or the battery is damaged, it must be replaced. Place the battery into the container that can withstand sulfuric acid and dispose of it according to the local regulations.
- If you come in contact with the battery's electrolyte, wash and flush the area with water immediately. If it comes in contact with your eyes, flush them with water and get medical aid immediately.

3.2 Transportation

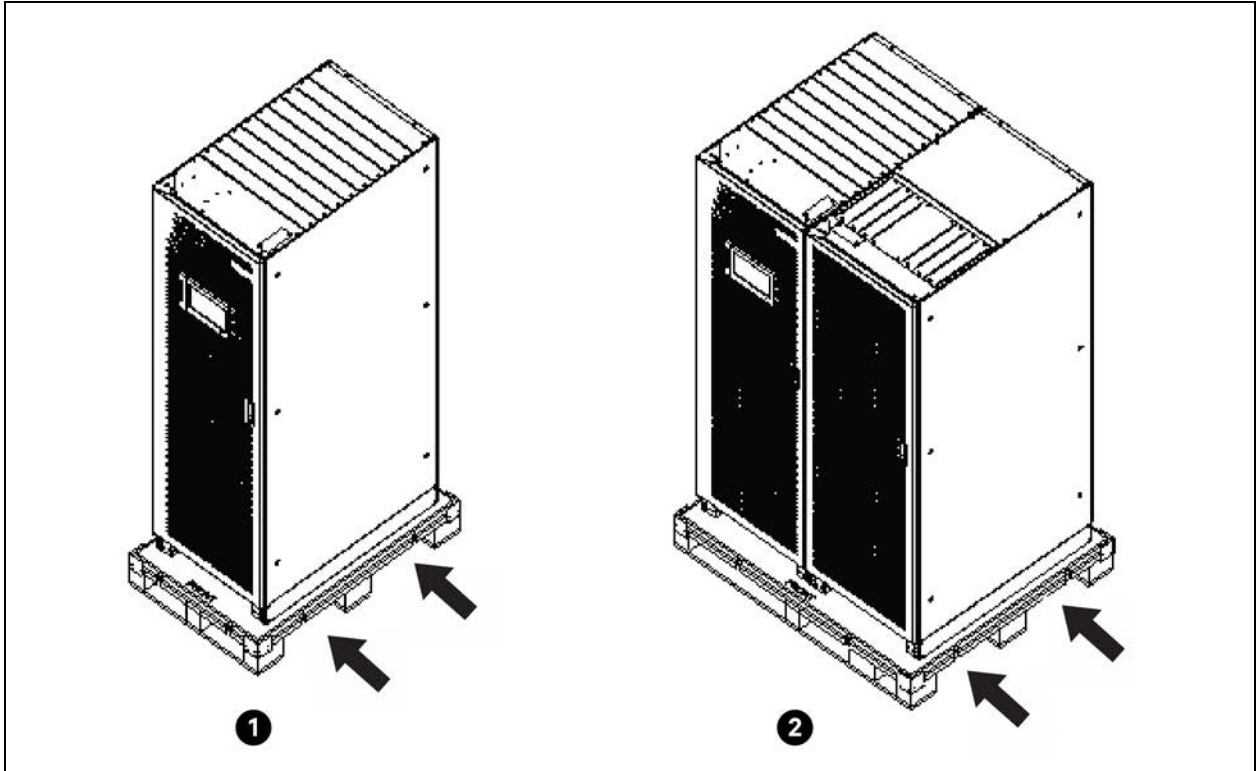
The recommended mode of transportation is railroad transportation and shipping. If truck transportation is necessary, choose smoother roads to protect the equipment.



WARNING! Risk of moving heavy unit and tipping over while moving. Can cause equipment damage, personnel injury, or death. The UPS cabinet is heavy. See Table 12.3 on page 170 weight of the cabinet. Make sure that any equipment that will be used to move the UPS cabinet has sufficient lifting capacity. The UPS cabinet presents a tipping hazard. Do not tilt the cabinet more than 15 degrees from vertical while transportation.

It is recommended to use mechanical equipment like an electric forklift to unload and transport the cabinet to the installation site. If an electric forklift is used, insert the tines of the forklift below the bottom pallet to prevent the cabinet from falling over. See Figure 3.1 on the next page.

Figure 3.1 Moving the Cabinet (Cabinet Front)

















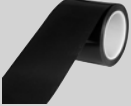


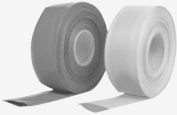




Item	Description
1	Without switch, single switch
2	Four switches

3.3 Tools



WARNING! Risk of electric shock and hazardous voltage. Can cause personal injury or death. The Installation tools under live operation must be insulated. The tools listed in **Table 3.1** on the facing page are for reference only. For onsite installation and connection, use the actual required tools.

Table 3.1 Tools

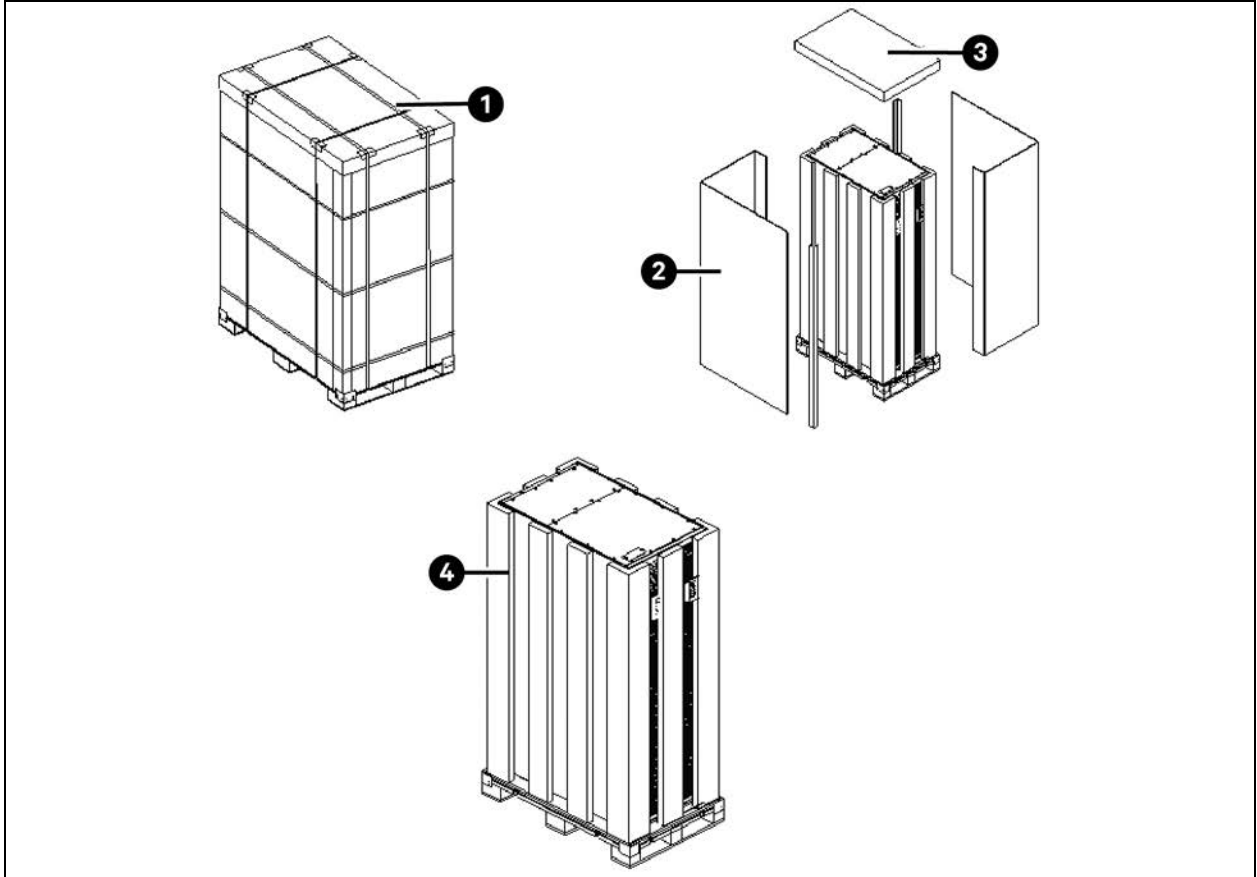
Name	Drawing	Name	Drawing
Electric hand drill		Adjustable wrench	
Slotted screwdriver		Cross head screwdriver	
Stepladder		Forklift	
Drill		Wire cutting plier	
Claw hammer		Diagonal cutting plier	
Insulating shoes		Antistatic gloves	
Electrician knife		Cable tie	
Insulating tape		Insulating gloves	
Crimping plier		Heat shrinkable tube	
Insulated torque wrench		Torque screwdriver	
Multimeter		Clip-on ammeter	

3.4 Unpacking

Before unpacking the UPS and battery, inspect for any visual damage or signs of mishandling. Under the guidance of authorized service engineer, follow the below steps to unpack the UPS and battery packages.

1. Remove the packing belts and honeycomb boards as shown in **Figure 3.2** below.

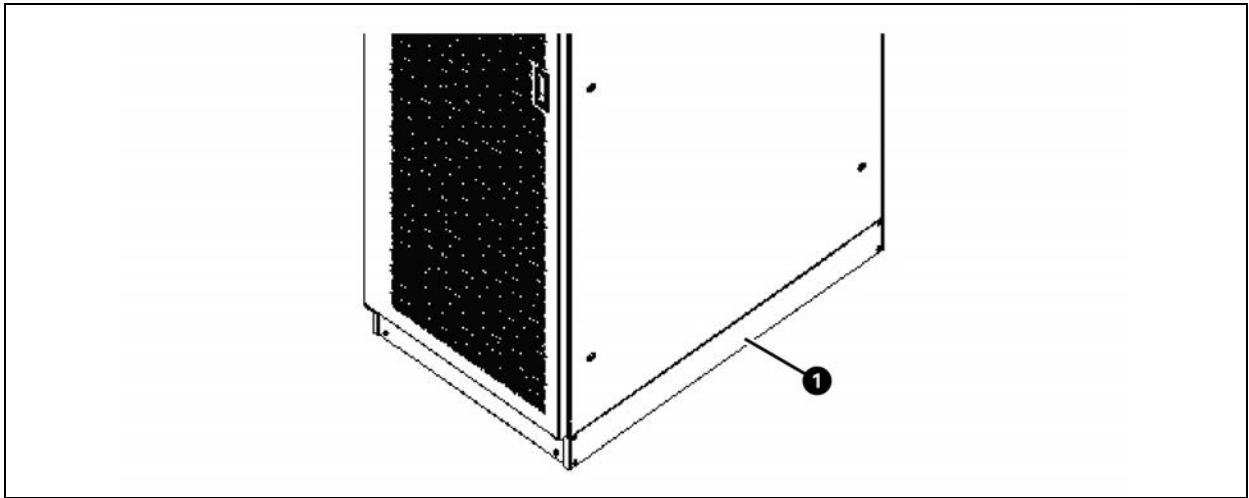
Figure 3.2 Removing the Packing Belts and Honeycomb Boards



Item	Description	Item	Description
1	Packing belt	3	Top cover
2	Carton box	4	Honeycomb board

- Remove the bottom ratguards, see **Figure 3.3** below.

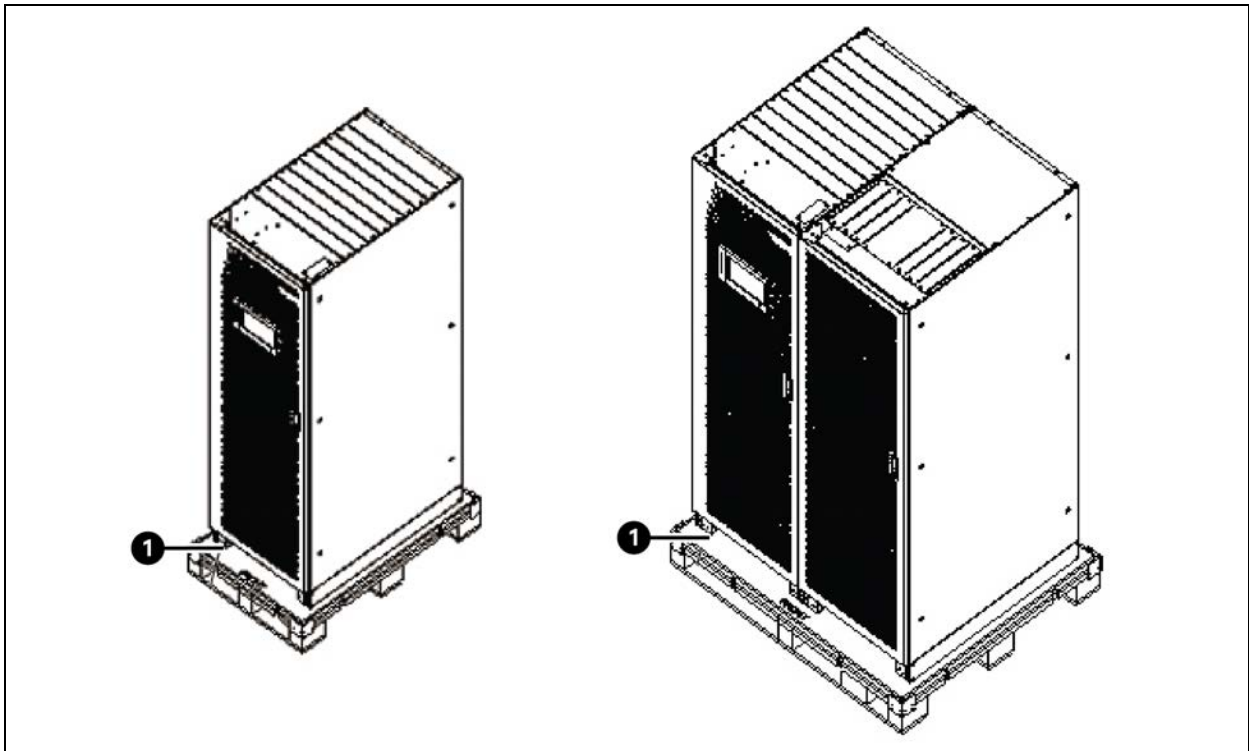
Figure 3.3 Removing Rat Guards



Item	Description
1	Rat guard

- Remove the fixing bolts at bottom of the cabinet as shown in **Figure 3.4** below.

Figure 3.4 Removing Bottom Fixing Bolts



Item	Description
1	Fixing bolt

4. Move the cabinet to the installation location using the forklift (see [Transportation](#) on page 21), and secure it to the ground as shown in **Figure 9.3** on page 155.
5. Make sure to reinstall the rat guards, when the Vertiv™ Liebert® APM2 UPS is installed.

3.5 Pre-installation Inspection

Before installing the UPS, carry out the following inspections:

1. Ensure that the UPS equipment room's environment complies with the environmental requirement specified in the [Environmental Characteristics](#) on page 169, especially the ambient temperature, ventilation conditions, and the dust situations.
2. Visually inspect the UPS and battery for any sign of transportation damage or mishandling. Do not attempt to install the system, if damage is apparent. Report it to the carrier or Vertiv representative immediately. Unpack the UPS and battery under the guidance of authorized service engineer.
3. Check the UPS label on the back of the door and confirm the contents match the UPS model, capacity and main parameters that were ordered.

3.6 Environmental Requirement

3.6.1 UPS location selection

Before installing the Liebert® APM2 UPS, verify that the environment of the room where the UPS is to be installed complies with the environmental requirements specified in relevant international standard and specifications and the operating ranges given in **Table 12.2** on page 169. Pay special attention to the ambient temperature and the air exchange system. Install the UPS in a cool, dry, clean air indoor environment with adequate ventilation and on concrete or other nonflammable, flat surfaces. The ambient environment should be free of conductive powder (Such as, metallic powder, sulfide, sulfur dioxide, graphite, carbon fiber, conductive fiber) and acid mist or other conductive media (strongly ionized substances).

The Liebert® APM2 UPS is cooled by internal fans. Cooling air enters the UPS through the ventilation grills at the front of the cabinet and is exhausted out through the ventilation grills at the back of the cabinet. To permit proper air flow and prevent overheating, do not block or cover the ventilation openings (ventilation grills) or blow air down onto the unit. The UPS requires at least 20 in. (500 mm) ventilation clearance at the rear side of the unit to avoid blocking the UPS heat dissipation, thus reducing the UPS internal temperature and improving the UPS life.

If necessary, install indoor extractor fans to aid cooling air flow to avoid increase in the room temperature. Air filters (optional) should be used when the UPS is to operate in a dirty environment.

NOTE: When installing the UPS, use M12 expansion bolts to fix the base of the cabinet on the floor to prevent the cabinet from falling due to uneven ground.

NOTE: When the battery cabinet is installed near the UPS, the maximum allowable ambient temperature is dependent on the battery rather than the UPS.

NOTE: If the UPS is working in ECO mode, the power consumption will be less than that in Normal mode. Proper air conditioning system shall be selected according to the normal operating mode.

3.6.2 Battery location selection

Batteries generate some hydrogen and oxygen at the end of a charge, so the fresh air volume of the battery installation environment must meet the EN50272-2001 requirements.

The ambient temperature is the main factor that affects the battery capacity and life. The normal operating temperature of the battery is 68 °F (20 °C). If the ambient temperature is higher than 68 °F (20 °C), the battery life will be reduced. If it is lower than 68 °F (20 °C), the battery capacity will be reduced. In normal situation, the allowable ambient temperature for the battery is 59 °F (15 °C) to 77 °F (25 °C). The ambient temperature of the battery shall be maintained constant, and the battery shall be kept away from heat source and air outlet.

Battery can be installed inside the specialized battery cabinet that must be close to the UPS. If the battery is placed on the raised floor, a bracket shall be installed under the floor, just as for the UPS. If the battery adopts rack mounting or is mounted far from the UPS with other installation mode, the battery circuit breaker shall be installed near the battery, and the cabling distance shall be minimized.

3.6.3 Storage

If the UPS will not be installed immediately, it must be stored with the original packaging indoors in a clean, dry, and cool location which should be protected from excessive humidity and heat sources (see **Table 12.2** on page 169). The battery needs to be stored in a dry and cool place with good ventilation. The most suitable storage temperature ranges from 68 °F (25 °C) to 77 °F (25 °C).



WARNING! During battery storage, periodically charge the battery according to the battery manufacturer instructions. In the charging process, temporarily connect the UPS to the mains and activate the battery by recharging the battery.

3.7 Mechanical Requirement

3.7.1 Composition

The 300 kVA UPS is a 600 mm wide cabinet with switch option (both top cable access and bottom cable access).

For 600 kVA UPS, the UPS without switch contains the cabinet of 600 mm width. The UPS with 4 switches contains the cabinet of 1200 mm width, which provides the rectifier input switch Q1, bypass input switch Q2, maintenance switch Q3 and output switch Q5.

3.7.2 Moving the cabinet



WARNING! The lifting equipment for moving the UPS cabinet must have enough lift capacity.



WARNING! The center of gravity of the UPS cabinet is high; avoid falling over during the cabinet movement.



WARNING! Vertical hanging of cabinet is prohibited.

The UPS cabinet presents a tipping hazard. Do not tilt the cabinet more than 15 degrees from vertical while transportation.

Ensure that the UPS weight is within the designated surface weight loading of any lifting equipment. See **Table 12.3** on page 170 for weight of the UPS.

The Vertiv™ Liebert® APM2 UPS cabinet can be moved by forklift or other similar lifting equipment.

3.7.3 Clearance

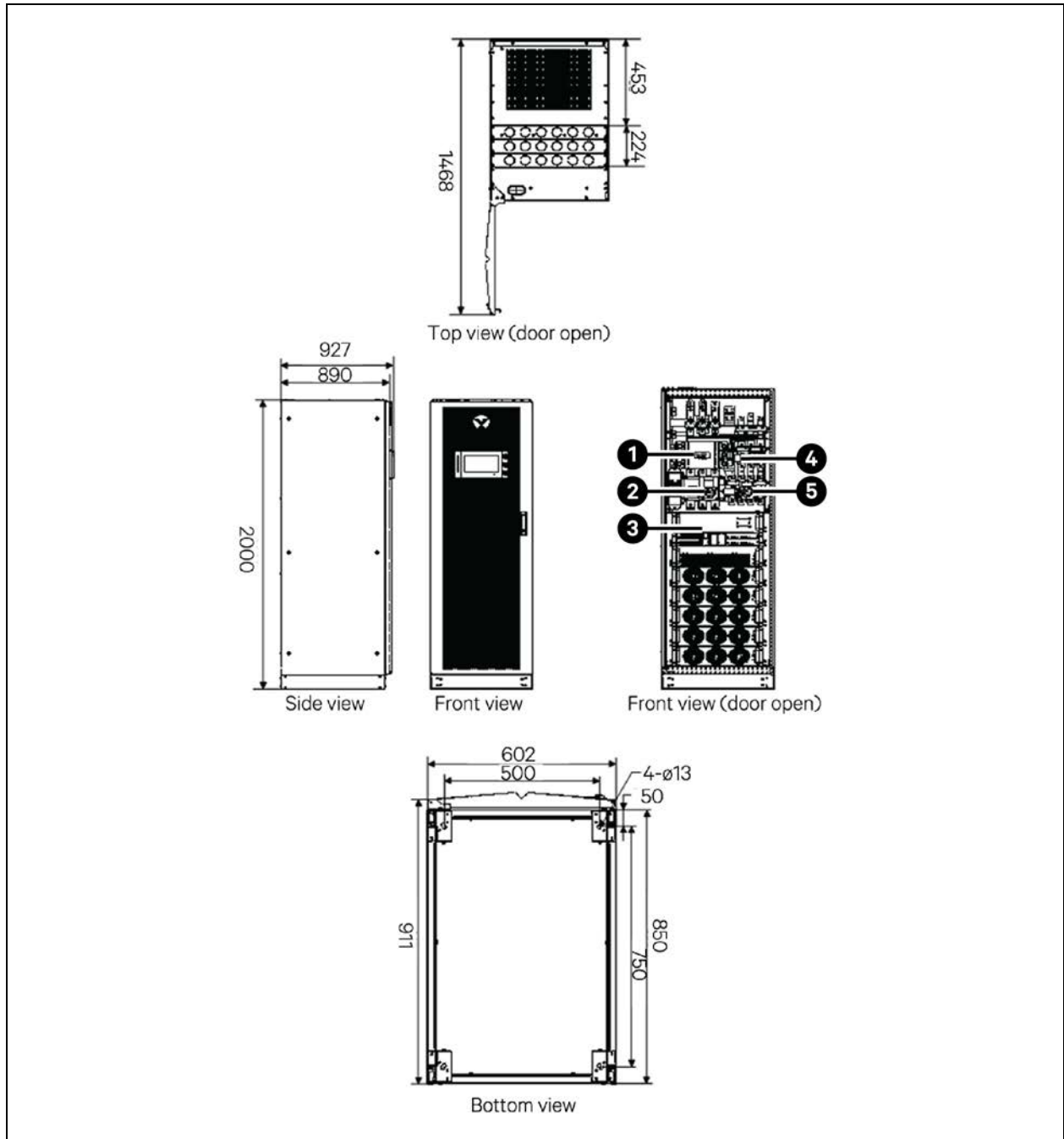
Provide at least minimum clearance required by the local regulations on all sides of the Liebert®APM2 UPS, including 47.24 in. (1200 mm) in front, to permit routine tightening power terminals within the UPS and free passage for personnel with the door fully opened and at least 19.68 in. (500 mm) in the rear of the UPS, to permit adequate circulation of air coming out of the UPS.

3.7.4 Cable access mode

The Liebert® APM2 UPS uses the top cable and bottom cable access method. Refer to [Power cable connection steps](#) on page 37 for more information.

3.8 Installation Drawings

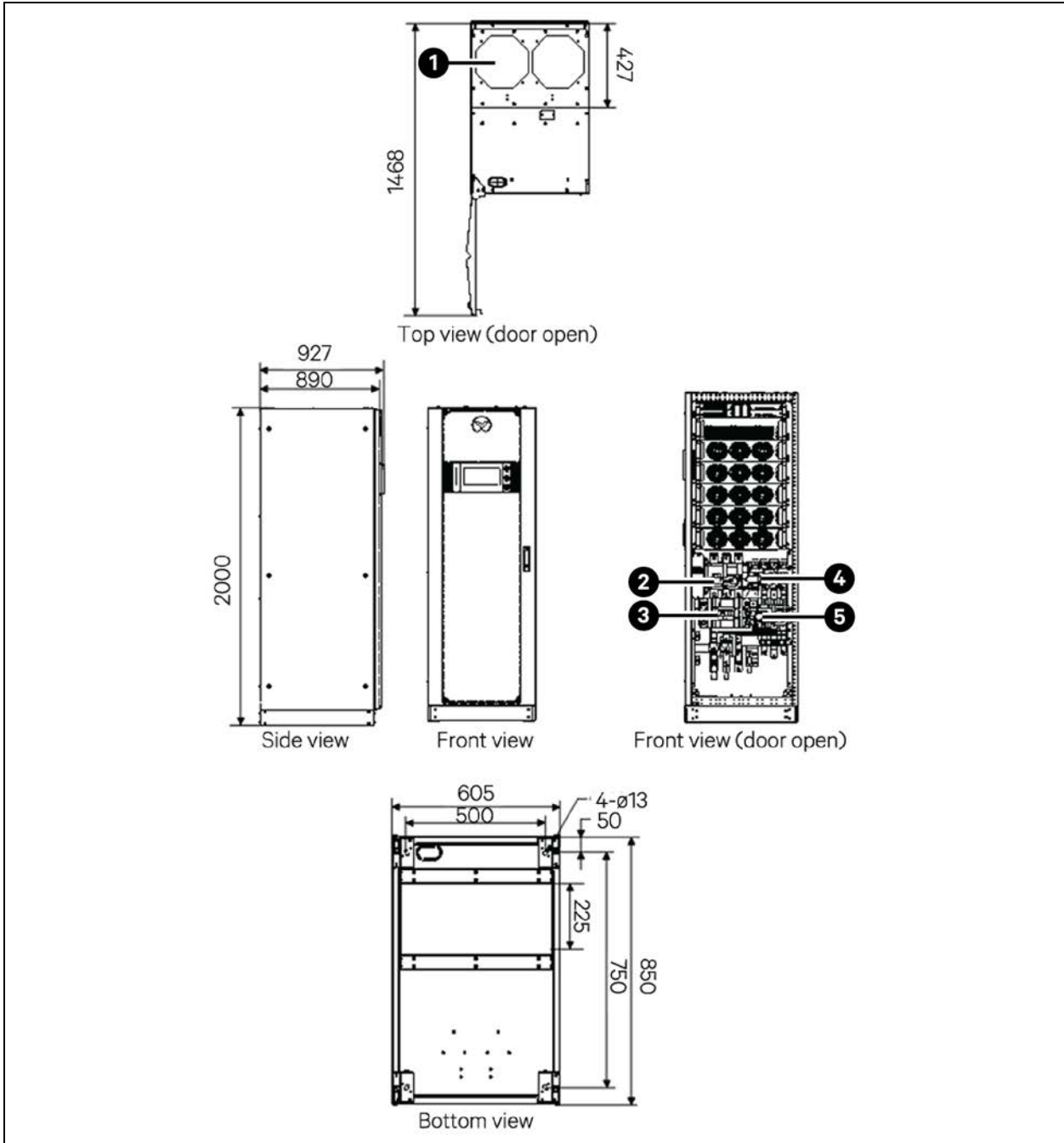
Figure 3.5 Schematic Diagram of Installing 300 kVA UPS (Top Cable Access)



Item	Description	Item	Description
1	Bypass switch	4	Maintenance switch
2	Rectifier switch	5	Output switch
3	Top fan kit		

NOTE: All dimensions are in mm.

Figure 3.6 Schematic Diagram of Installing 300 kVA UPS (Bottom Cable Access)



Item	Description	Item	Description
1	Top fan kit	4	Output switch
2	Rectifier switch	5	Maintenance switch
3	Bypass switch		

NOTE: All dimensions are in mm.

Figure 3.7 Schematic Diagram of Installing 600 kVA UPS (4 Switches)

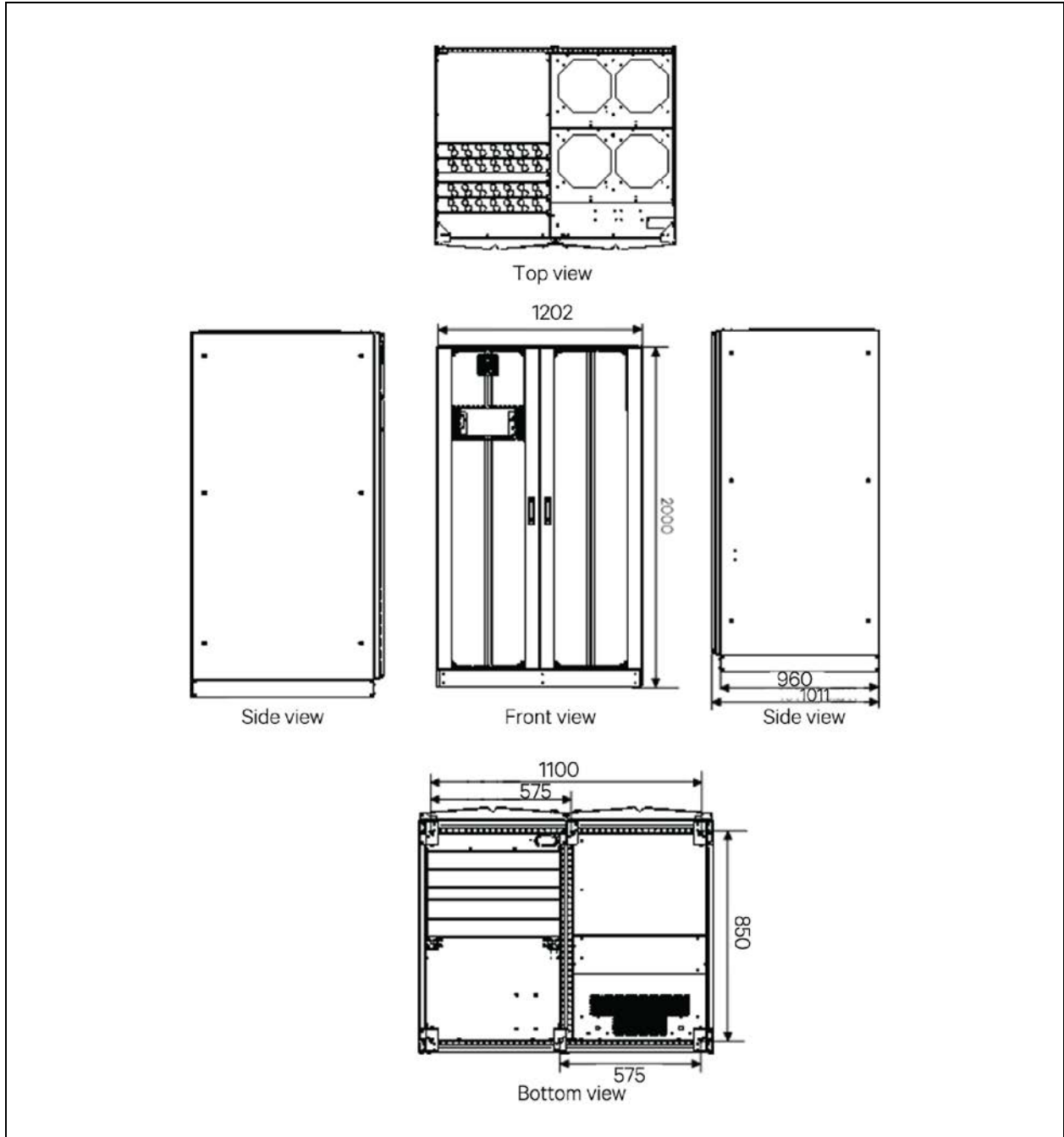
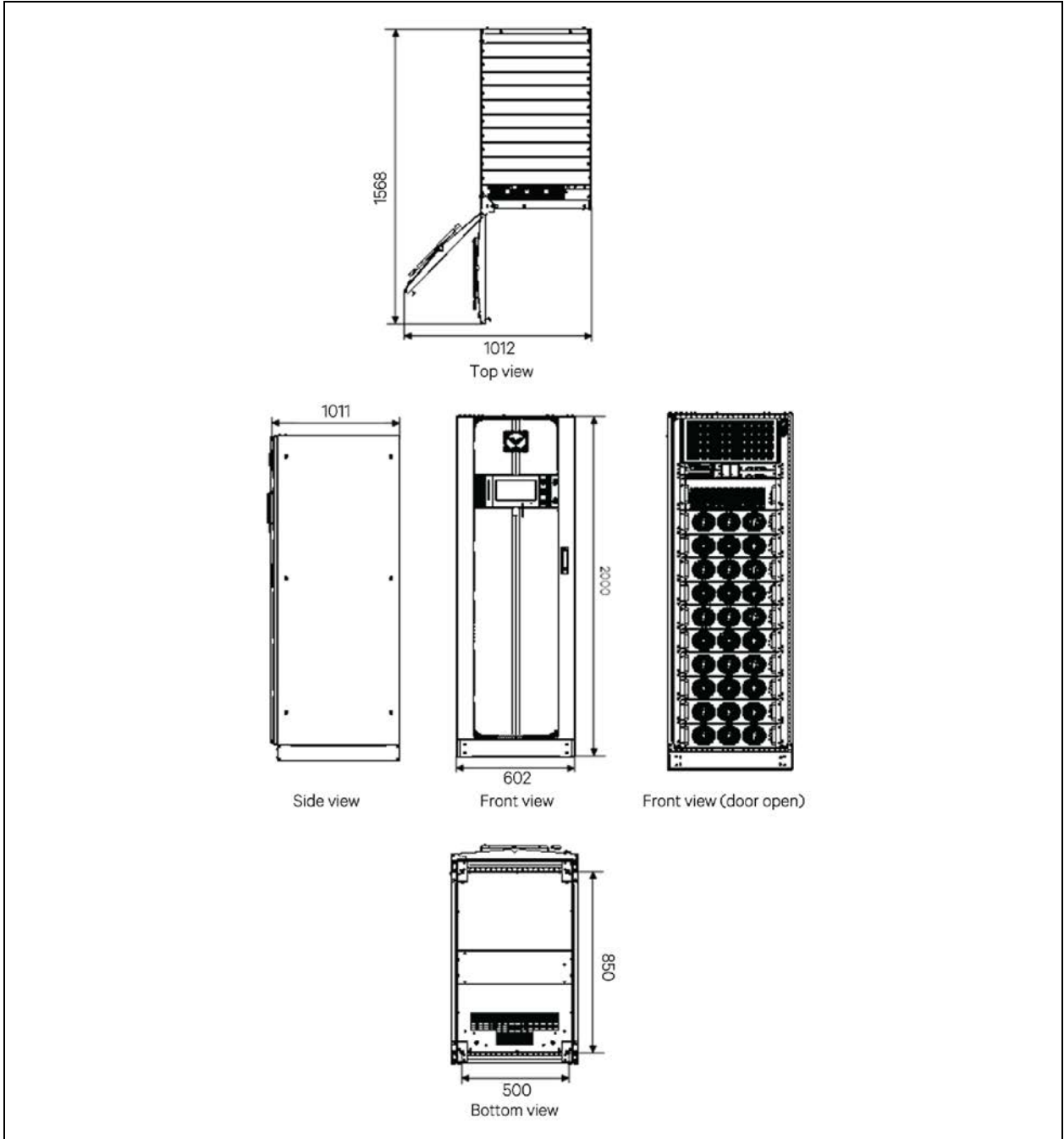


Figure 3.8 Schematic Diagram of Installing 600 kVA UPS (Without Switch)



4 Electrical Installation

This chapter describes the electrical installation of the Vertiv™ Liebert® APM2 UPS.

After completing the mechanical installation of the UPS, it is necessary to connect the power cable and signal cable of the UPS.

All the signal cables, whether shielded or not, should be kept away and routed separately from the power cables.



WARNING! Risk of electric shock and hazardous voltage. Can cause equipment, personnel injury, or death. Do not turn on power to the UPS before the arrival of authorized service engineer. Only an authorized engineer can route the APM2 UPS cables in accordance with the information given in this chapter.

4.1 Wiring of Power Cable

4.1.1 System configuration

The power cables of the system must be sized with respect to the following description:

UPS input cables

The UPS input cables must be sized for the maximum input current, including the maximum battery charge current, see **Table 4.1** on the next page, with respect to the UPS power ratings and the input AC voltages.

UPS bypass and output cables

The UPS bypass and output cables must be sized for the nominal output or bypass current, see **Table 4.1** on the next page, with respect to the UPS power ratings and the output AC voltages.

Battery cables

Each UPS connects to its battery through the three cables connecting to the positive pole, negative pole and neutral line. The cable size of the battery cable differs with the UPS power ratings, provided that it meets the battery discharge current requirement when the battery discharges to near EOD voltage, as shown in **Table 4.1** on the next page.

4.1.2 Maximum steady state AC and DC currents

The power cables must be selected in accordance with current and voltage values as given in **Table 4.1** on the next page as well as local wiring regulations and environmental conditions (temperature and physical media). Refer Table 3B in IEC 60950-1 for more information on size of the cables.

Table 4.1 Maximum Steady State AC and DC Currents

UPS Power (kVA)	Rated Current (A)				Bus Stud Bolt/Nut Specification		
	Max. Input Current ¹	Output/Bypass Current ² at Full Load			Battery Discharge ³ and ⁴ Current (+, -, N) at Rated Battery Voltage	Input, Battery, Output, Bypass/PE Cable	Recommended Torque (Nm)
		380 V	400 V	415 V			
300 kVA	600	455	435	417	805	M12	39±10%
600 kVA	1200	909	870	833	1610	M16	90±10%

1. Maximum input current is calculated according to the low voltage input of 176 V (L-N) and 100% load percentage.
2. Maximum output/bypass current is calculated according to the rated voltage and 100% load percentage.
3. The battery discharge current is calculated according to the battery cell number of 40, EOD voltage of 1.63 V and 100% load percentage.

4.1.3 Recommended CSA of UPS cable

The recommended CSA of the UPS cable is given in **Table 4.2** below.

Table 4.2 Recommended CSA of the UPS Single Module Cable (Unit: mm², Ambient Temperature: 77 °F (25 °C))

Model	Input	Output	Bypass	Neutral Line	Earth Cable	Battery
300 kVA	2 x 150	2 x 150	2 x 150	2 x 150	1 x 150	2 x 185
600 kVA	3 x 240	3 x 240	3 x 240	3 x 240	1 x 240	3 x 240

4.1.4 Selection of UPS I/O switch and battery switch

See **Table 4.1** above for the values of I/O current and battery current. The user can select the switch according to the actual configuration on site.

4.1.5 Distance between the UPS connection point and floor

Table 4.3 Minimum Distance Between UPS Connection Point and Floor

UPS Connection Point	Minimum Distance (mm)			
	300 kVA (Bottom Cable Access)	300 kVA (Top Cable Access)	Without Switch	Four Switches
Rectifier input	323	1900	1770	510
Bypass input	364	1868	1770	940
AC output	425	1800	1770	1266
Battery supply +/-	370/530	1853/1695	1770	1575/900
N	425	1805	1770	1266
PE terminal	480	1735	1750	1500

4.1.6 General information

The following points are for general guidance only. If there are relevant local regulations, then follow the local regulations.

1. The protective earth cables must be selected in accordance with the AC power failure level, cable length, and protection type. The shortest connection route must be used for the grounding wire connection.
2. The parallel connection of small cables can be used to make easier installation for cables which are carrying large current.
3. The battery cable size must be selected in accordance with the current value given in **Table 4.1** on the previous page and a maximum allowed voltage drop is 4 VDC.
4. Avoid creating the coils to reduce the generation of electromagnetic interference (EMI).
5. Make sure to leave sufficient wiring space before wiring.

4.1.7 Power cable connecting terminal

The rectifier input, bypass input, output, and battery power cables are connected to the respective terminals as specified in the [Power cable connection steps](#) on page 37.

4.1.8 Protective ground

The protective earth cable is securely connected to the PE input terminal through the fixing bolt (See [Power cable connection steps](#) on page 37). All the cabinets and cable conduits shall be grounded according to the local regulations. The grounding wires must be securely fastened to prevent the loosening of the grounding wire tightening screws when the grounding wires are pulled.



WARNING! Failure to ground as required may cause EMI, electric shock, or fire risk.

4.1.9 External protective devices

For safety concerns, it is necessary to install the external circuit breakers or other protective devices for the input and battery of the UPS system. This section provides generic practical information for the qualified installation engineers due to the different specific installations. The qualified installation engineers should be knowledgeable about local regulatory wiring standards on the equipment to be installed.

Rectifier and bypass input supply of the UPS :

1. Input overcurrent and short circuit protection

Install suitable protective devices in the distribution line of the incoming mains supply, considering the power cable current carrying capacity, system overload capacity (see **Table 12.6** on page 172 and **Table 12.7** on page 173) and the short circuit capability of the upstream power distribution. The protective devices should provide functions such as the overcurrent protection, short circuit protection, isolation protection and tripping upon backfeed.

2. Split bypass configuration

If the UPS uses split bypass configuration, a separate protective device should be installed respectively on the rectifier input and bypass input in the distribution lines.

NOTE: The rectifier input and bypass input must use the same neutral line.

NOTE: For IT grid system, 4-pole protective components must be installed for the UPS external input power distribution.

3. Ground fault protection

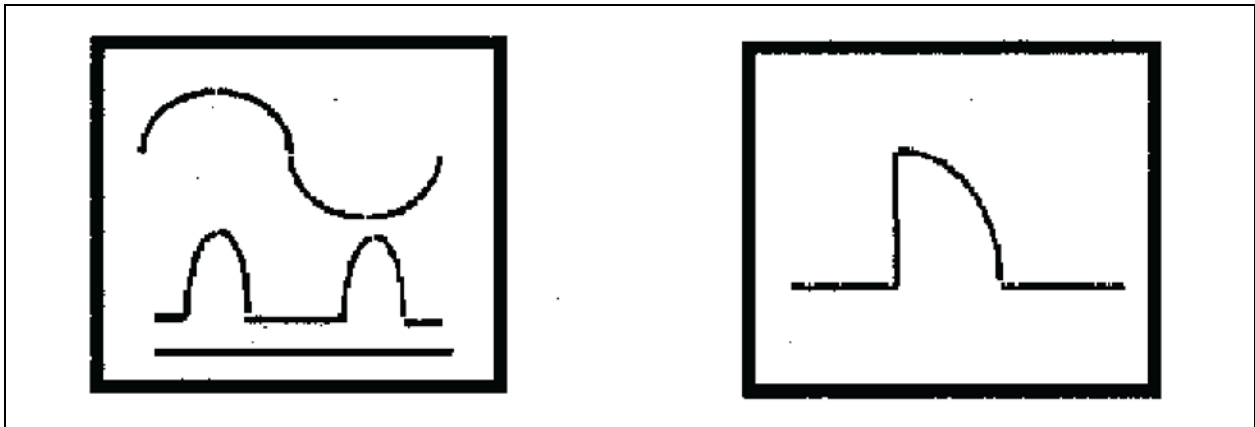
If the upstream input power supply has a residual current detector (RCD), the transient state and steady state ground leakage current upon the startup of the UPS shall be considered.

The residual current circuit breakers (RCCB) shall meet the following requirements:

- Must be sensitive to the DC unidirectional pulse (class A) of the whole distribution network.
- Must be insensitive to transient state current pulse.
- Must have an average sensitivity, adjustable between 0.3 A to 3 A.

The RCCB symbols are shown in **Figure 4.1** below.

Figure 4.1 RCCB Symbols



The UPS consist of an internal EMC filter; therefore the protective earth cable's leakage current is less than 3000 mA. It is recommended to verify the RCD sensitivity of the upstream input distribution and the downstream distribution (to the load).

External battery

The battery switch box (mandatory) must be installed for protecting the external battery. The UPS consist of an optional battery switch box cabinet to provide overcurrent protection, short circuit protection and automatic tripping functions for the external battery.

This battery switch box is important for the battery maintenance and is generally installed near the battery.

System output

The UPS output distribution must be configured with a protective device. The protective device must be different from the input distribution protection switch and able to provide overload protection (see **Table 12.6** on page 172 and **Table 12.7** on page 173).

NOTE: An IT grid system, 4-pole protective components must be installed for the UPS external input power distribution.

4.1.10 Power cable connection steps

Connection terminal

See **Figure 4.2** below and **Figure 4.4** on page 39 for the connection terminals of the 300 kVA UPS power cable.

See **Figure 4.6** on page 40 and **Figure 4.7** on page 41 for the connection terminals of the 600 kVA UPS power cable.

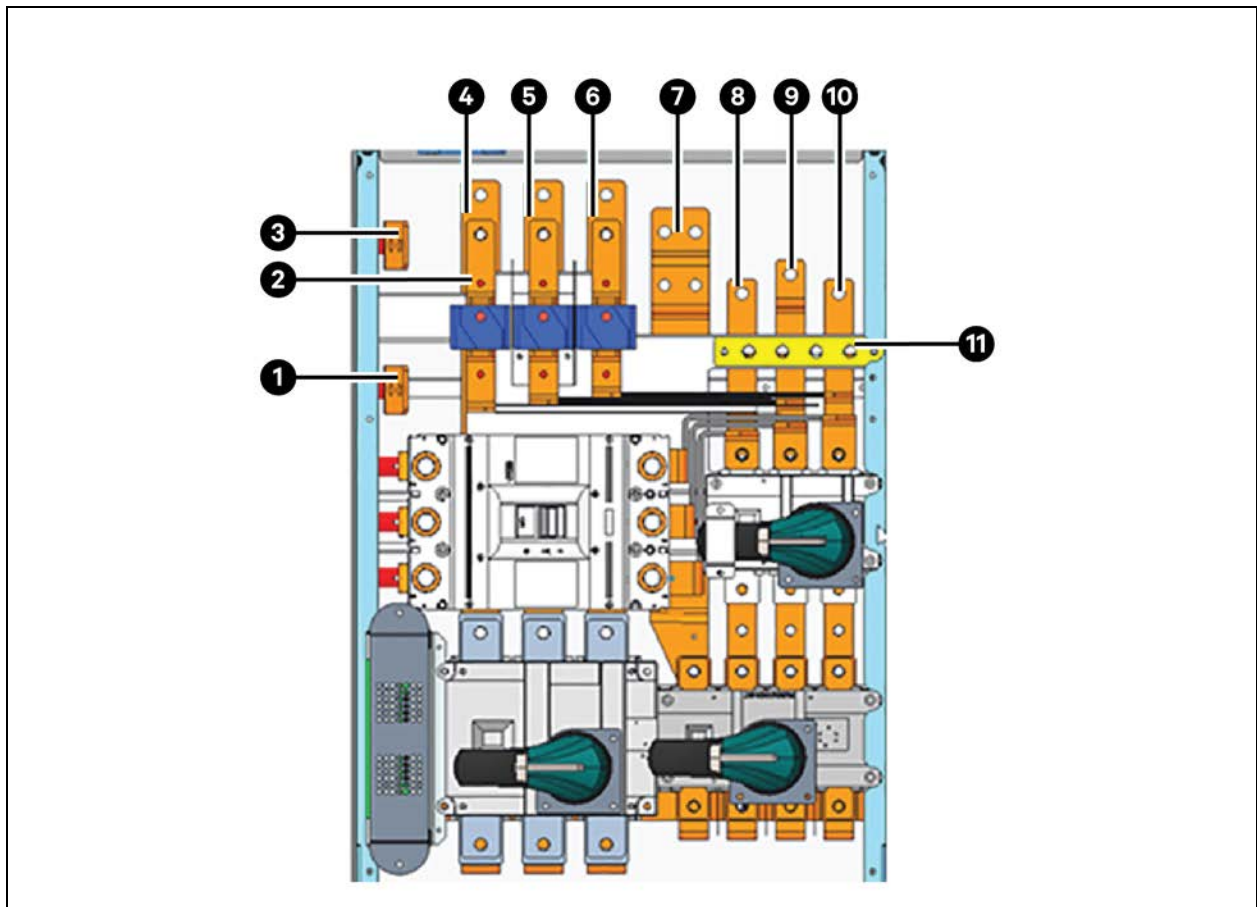
See **Figure 4.8** on page 42 and **Figure 4.9** on page 43 for cable routing and connection of the 300 KVA UPS.

See **Figure 4.10** on page 44 for cable routing and connection of the 600 KVA UPS.

NOTE: The power cables should be routed through tunnels or cable conduits to prevent cable damage due to mechanical stress. After that reduce the electromagnetic interference to the surrounding environment.

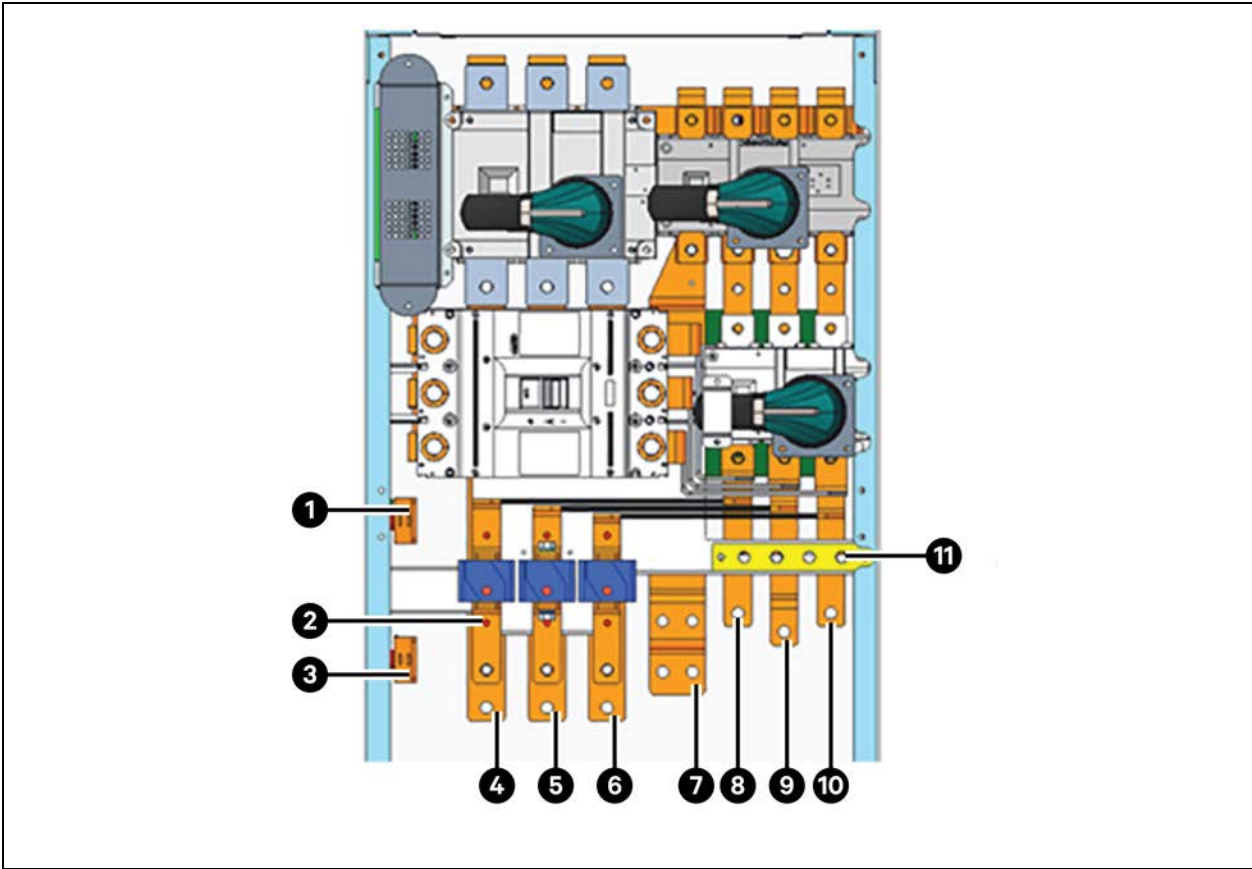
NOTE: It is necessary to tie and fix the cables when routing the cables inside the cabinets to prevent cable damage because of mechanical stress.

Figure 4.2 Power Cable Connection Terminals 300 kVA (Top Cable Access)



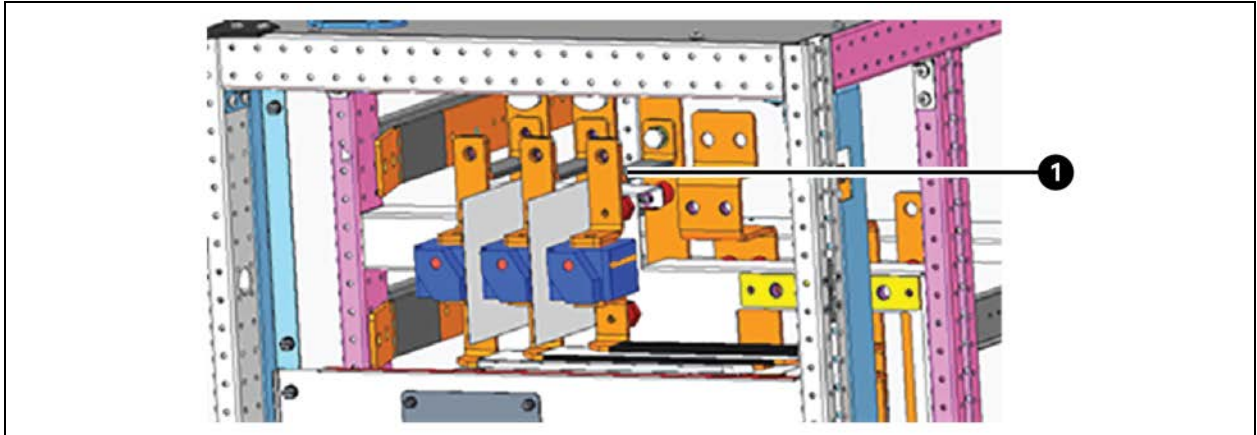
Item	Description	Item	Description
1	BAT-	7	mN, bN, oN
2	bA, bB, bC	8	oA
3	BAT+	9	oB
4	mA	10	oC
5	mB	11	PE
6	mC		

Figure 4.3 Power Cable Connection Terminals 300 kVA (Bottom Cable Access)



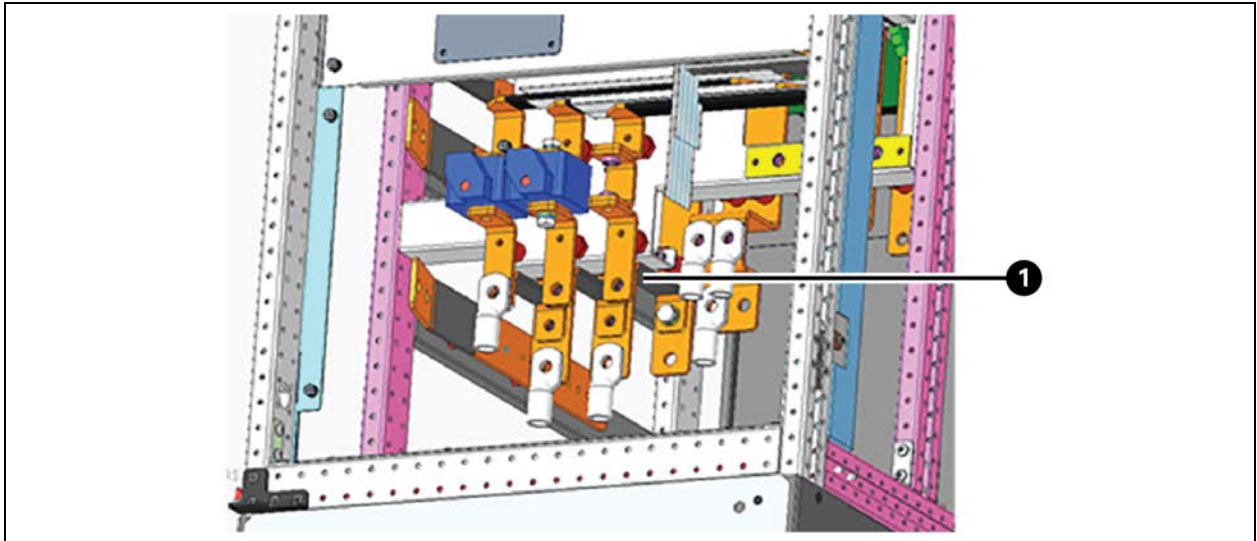
Item	Description	Item	Description
1	Bat -	7	mN, bN, oN
2	bA, bB, bC	8	oA
3	Bat+	9	oB
4	mA	10	oC
5	mB	11	PE
6	mC		

Figure 4.4 Power Cable Connection Terminals 300 kVA (Top Cable Access)



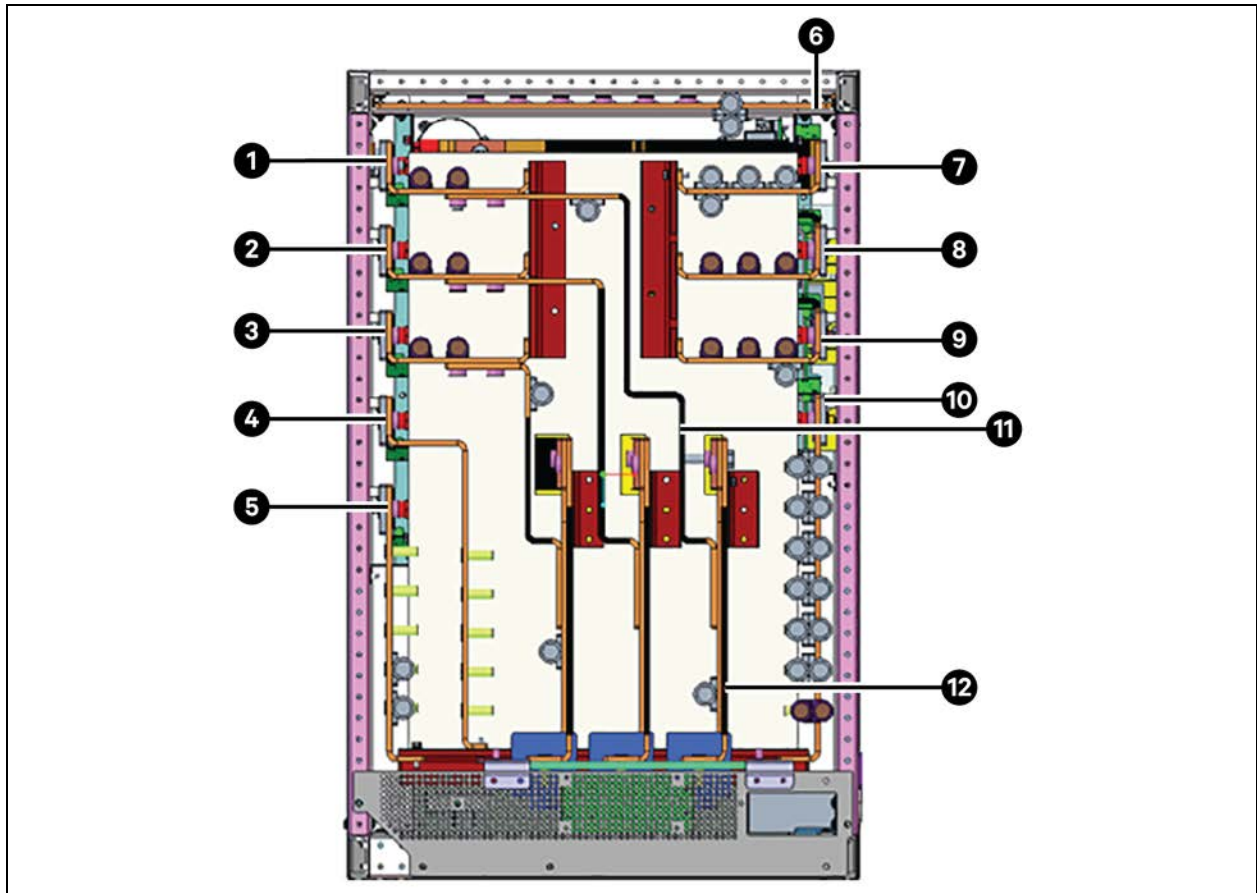
Item	Description
1	Shunting copper bar

Figure 4.5 Power Cable Connection Terminals 300 kVA (Bottom Cable Entry)



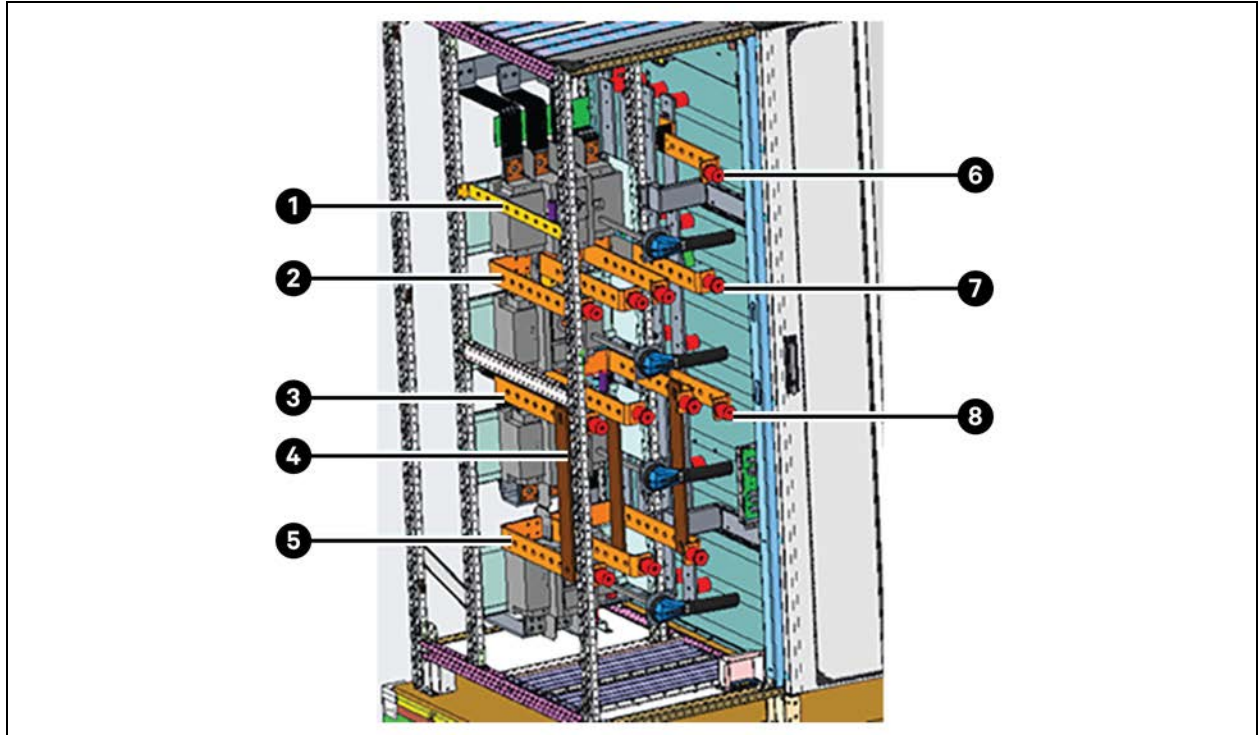
Item	Description
1	Shunting copper bar

Figure 4.6 Power Cable Connection Terminals 600 kVA Top View (Without Switch)



Item	Description	Item	Description
1	mC	7	oA
2	mB	8	oB
3	mA	9	oC
4	BAT-	10	mN, bN, oN
5	BAT+	11	Shorting copper bar
6	PE	12	bA, bB, bC

Figure 4.7 Power Cable Connection Terminals 600 kVA (Four Switches)



Item	Description	Item	Description
1	PE	5	mA, mB, mC
2	oA, oB, oC	6	BAT-
3	bA, bB, bC	7	mN, bN, oN
4	Shorting copper bar	8	BAT+

Cabling procedure

The 300 kVA UPS supports both top and bottom cable access. The 600 kVA UPS only supports top cable access.

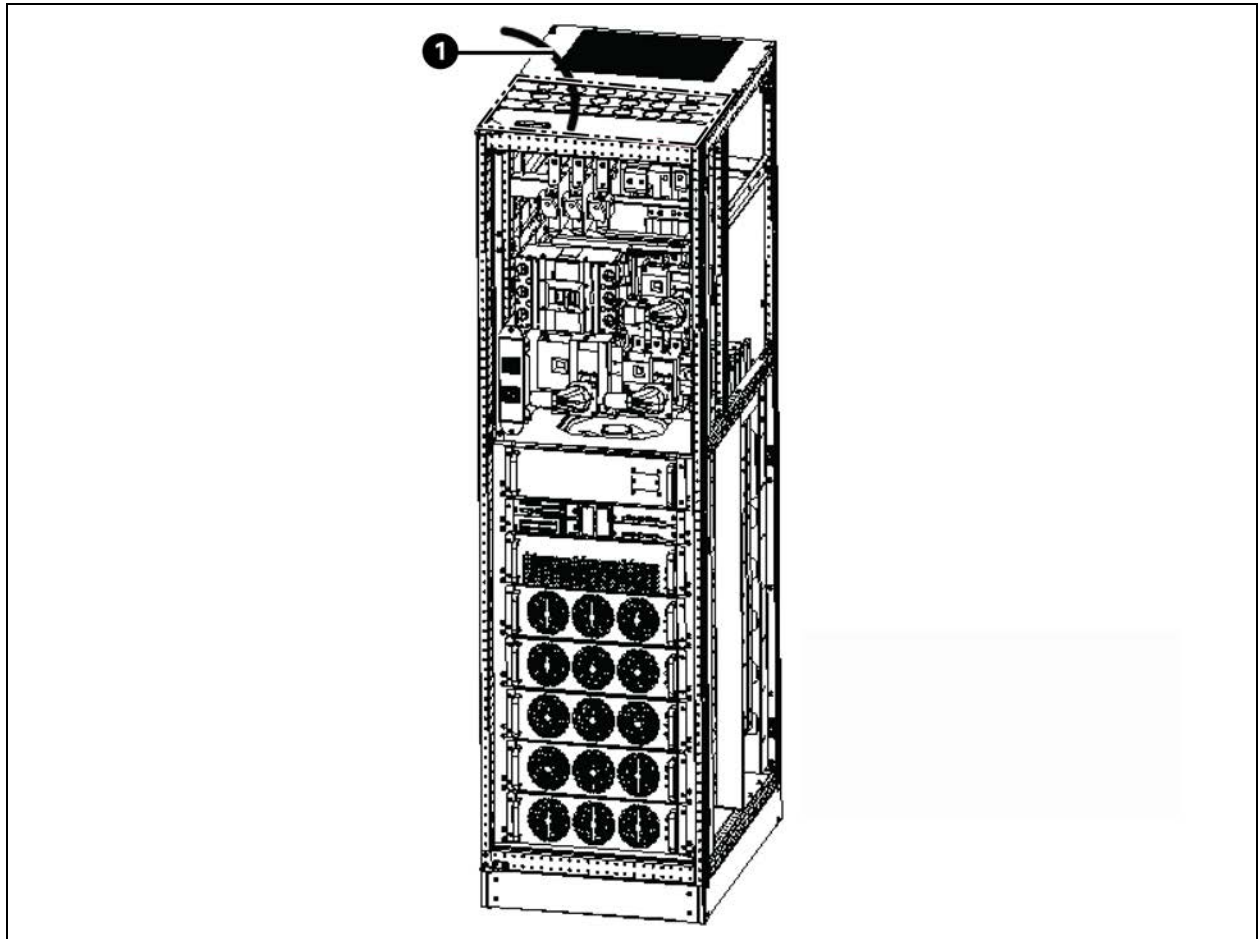
To route and connect the power cables, use the following procedure.

! WARNING! Risk of electric shock. Can cause equipment damage, personnel injury or death. Verify that all external and internal power switches of the UPS are turned off and locked out or tagged out before installing the cables or making any electrical connections. Also, measure the voltages between the UPS terminals and the voltages between the terminals and the earth.

For 300 kVA UPS power cable

1. Remove the top cover.
2. Lead the power cables into the cabinet.
3. connect them to corresponding terminals. See **Figure 4.8** below.

Figure 4.8 Power Cables Wiring Route 300 kVA (Top Cable Access)

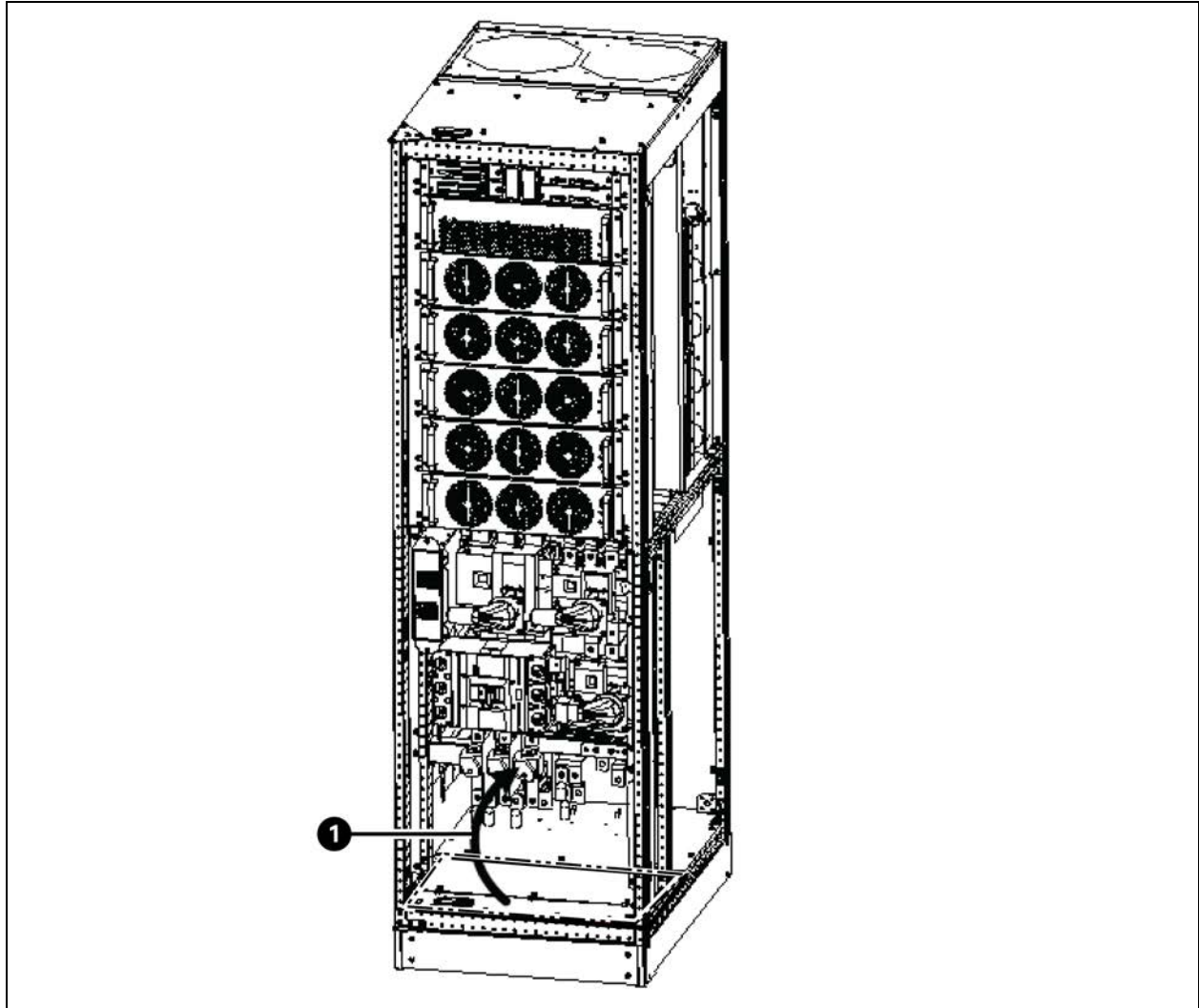


Item	Description
1	Power cable through top cabinet hole.

For 300 kVA UPS power cable

1. Remove the top cover.
2. Lead the power cables into the cabinet.
3. Connect them to corresponding terminals, See **Figure 4.9** below.

Figure 4.9 Power Cables Wiring Route 300 kVA (Bottom Cable Access)

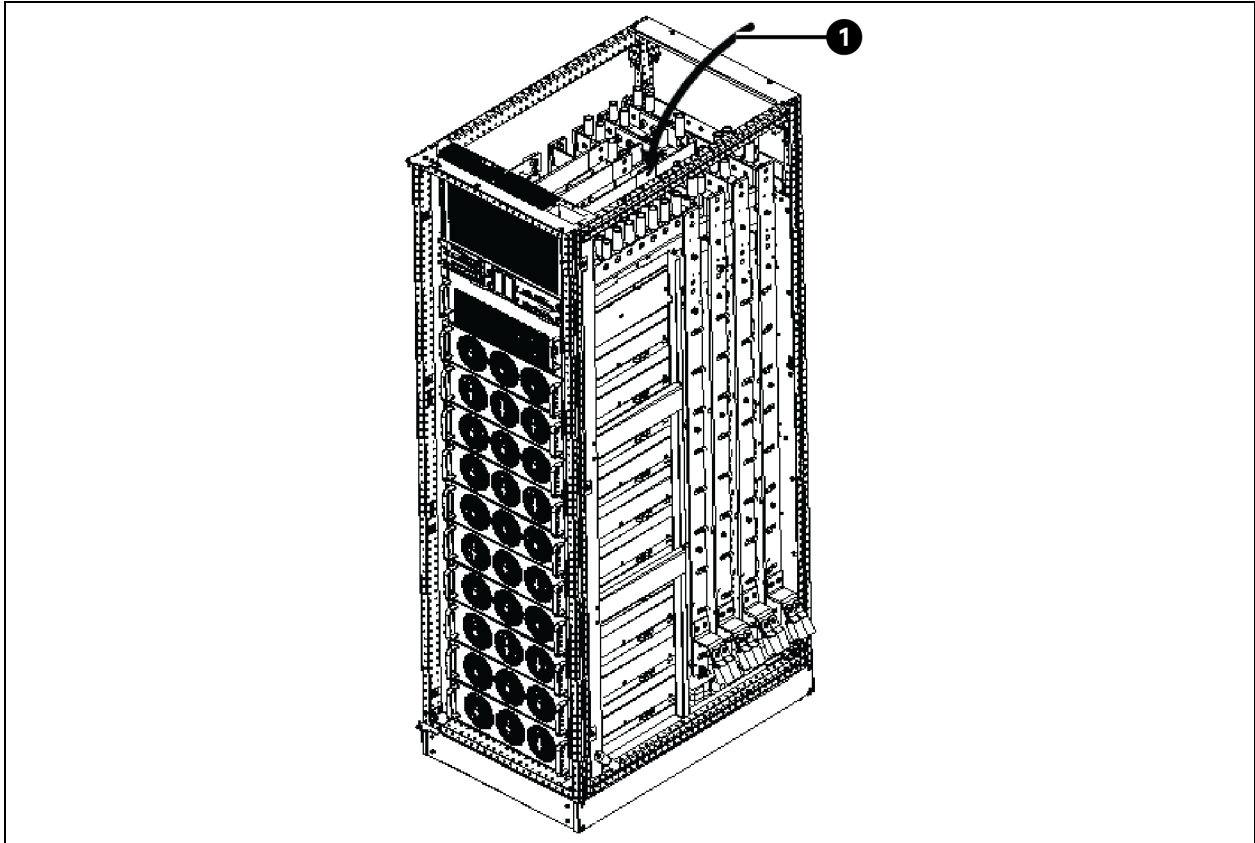


Item	Description
1	Power cable through the bottom cabinet hole .

For 600 kVA UPS power cable

1. Remove the top cover.
2. Put the power cables into the cabinet through cabinet hole. See **Figure 4.10** on the next page for top cable access.
3. Connect the power cables to the respective terminals.

Figure 4.10 Power Cables Wiring Route 600 kVA (Top Cable Access)



Item	Description
1	Power cable through the top cabinet hole

4. Open the front door of the UPS and remove the protective cover to gain access to the power cable connection terminals. See **Figure 4.8** on page 42 to **Figure 4.7** on page 41.
5. Connect the protective earth cable to the PE input terminal in the cabinet.



WARNING! Risk of electric shock or fire. Can cause equipment damage, personnel injury or death. The earth grounding cable and neutral line connection must comply with the national electrical code and all the applicable local code.

Connection of system input

1. Common input configuration

Connect the AC input cables to the bypass input terminals (bA-bB-bC) in the cabinet and tighten the connection. Connect the input neutral line to the neutral terminal N in the cabinet and tighten the connection. Ensure correct phase rotation.

NOTE: Ensure that the shorting copper bars (see **Figure 4.4 on page 39 to **Figure 4.7** on page 41) between the rectifier input terminals and the bypass input terminals are connected respectively.**

2. Split bypass configuration

Remove the shorting copper bars (see **Figure 4.4** on page 39 to **Figure 4.7** on page 41). Connect the rectifier input cables to the rectifier input terminals (mA-mB-mC) in the cabinet and connect the bypass input cables to the bypass input terminals (bA- bB-bC) in the cabinet and tighten the connection. Connect the rectifier input neutral line and bypass neutral line to the neutral terminal N in the cabinet and tighten the connection. Ensure correct phase rotation.

Connection of system output

Connect the system output cables between the output terminals (oA-oB-oC-N) in the cabinet and the load and tighten the connection. Refer to **Table 4.1** on page 34 for the torque value. Ensure correct phase rotation.



WARNING! Risk of electric shock and arc flash. Can cause equipment damage, property damage, personnel injury or death. Make sure that the system output cables are safely isolated at their end if a power supply is not required for the load equipment before arrival of the service engineer.

Connection of batteries

1. Ensure correct polarity of the connections from the battery string terminals to the battery switch box and from the battery switch box to the battery input terminals (BAT+, BAT-) in the UPS cabinet, that is, (BAT+) to (+) and (BAT-) to (-). Do not reconnect these links and do not close the battery switch box before authorized to do so by the service engineer.

NOTE: When connecting the cables between battery terminals and BCB, the connection should begin from the battery switch box terminal.

2. Refit all protective covers removed for cable installation.

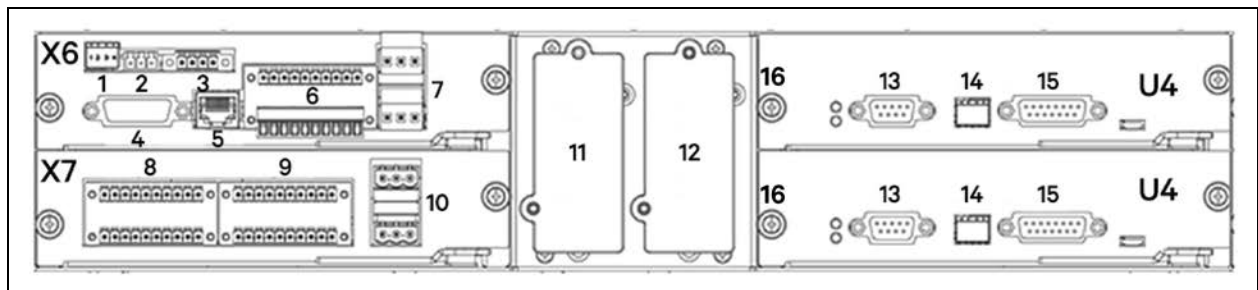
NOTE: After connection, make sure to seal the cable entry hole on the cabinet.

4.2 Wiring of Signal Cable

4.2.1 Overview

Based on the site's specific requirements, the Vertiv™ Liebert® APM2 UPS can require auxiliary connection to manage the battery system (including the external battery switch) management, communicate with a personal computer, provide alarm signal to the external devices, for the remote emergency power off (REPO) or provide bypass back feed circuit breaker signal and parallel communication. These functions are performed through the communication box in the APM2 UPS cabinet. The communication box provides the ports as shown in **Figure 4.11** below.

Figure 4.11 Overview of Communication Ports



Item	Description	Item	Description
1	X6 SW1	9	X7 J2: I/O dry contact ports
2	X6 RS-485	10	X7 J3: Other programmable output dry contact port
3	X6 REPO: REPO port	11	Intellislot 1
4	X6 HM: HMI port	12	Intellislot 2
5	X6 BATT: Battery temperature or BMS communication port	13	U4 LBS: LBS sync signal port
6	X6 J3: BCB and I/O dry contact ports	14	U4 SW
7	X6 J22: Backfeeding port	15	U4 parallel: Parallel communication port
8	X7 J1: BCB and I/O dry contact ports	16	Screw (8 pcs)

NOTE: The screws should be tightened after each board is inserted, as shown in **Figure 4.11** on the previous page to maintain proper grounding.

4.2.2 Dry contact port X6 J3

The schematic diagram of dry contact port J3 is shown in **Figure 4.12** below and the ports are described in **Table 4.4** on the facing page. The input dry contacts of this series provide 24 V / 10 mA signals, and the output dry contacts are relay contacts that can accept 24 V / 500 mA signals. The BCB drive signal can provide 12 V / 10 mA signal.

Figure 4.12 Dry Contact Port J3

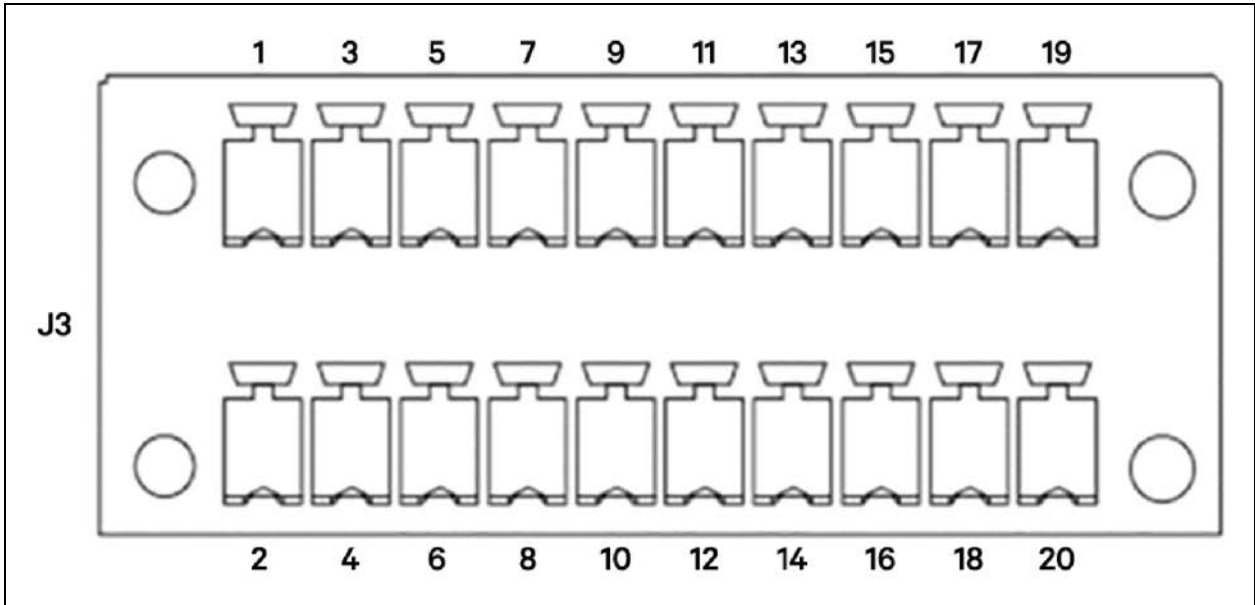


Table 4.4 Description of Dry Contact Port J3

Pin	Name	Meanings	Pin	Name	Meanings
1	Dry in	Input dry contact can be defined, the default setting is battery system failure.	2	BCB_Drive1	BCB1 drive signal
3	GND		4	Dry in	Input dry contact can be defined, the default setting is BCB1 status feedback.
5	Dry in	Input dry contact can be defined, the default setting is charger off.	6	GND	
7	GND		8	Dry in	Input dry contact can be defined, the default setting is BCB1 enabled.
9	NO	Output dry contact can be defined, the default setting is UPS alarm.	10	GND	
11	Com1		12	Dry in	Input dry contact can be defined, the default setting is battery grounding signal.
13	NC		14	GND	
15	NO	Output dry contact can be defined, the default setting is UPS fault.	16	PE	Shielding to PE
17	Com1		18	CAN+	CAN bus (reserved), set the matching resistor to PIN2 of SW1.
19	NC		20	CAN-	

NOTE: The BCB drive signal and external battery temperature signal must be carried through shielded cables, and both sides of the shielding coat must be securely connected to the enclosure.

The list of definable input dry contact described in **Table 4.5** below.

Table 4.5 Input Dry Contact Functions

No.	Function Description
1	External switch status (optional mains input/bypass input/external output/external maintenance bypass/load switch)
2	Turn off the inverter
3	BCB enabled (8 group settable)
4	BCB feedback status (8-group settable)
5	Fault clear
6	Battery system abnormal
7	Battery system fault
8	Battery low voltage
9	Battery room overtemperature
10	BCB tripping required
11	Charger off
12	Start battery manual test
13	Stop battery manual test
14	Generator mode
15	ECO mode paused
16	Battery grounding fault (8 group settable)

The list of definable output dry contact functions are described in **Table 4.6** on the next page.

Table 4.6 Output Dry Contact Functions

No.	Function Description
1	UPS alarm
2	UPS fault
3	On inverter
4	On battery
5	On bypass
6	On maintenance bypass
7	Input voltage abnormal
8	Battery low voltage

4.2.3 Dry contact port X6 J22

The schematic diagram of dry contact port J22 is shown in **Figure 4.13** below and described in **Table 4.7** below. The dry contact voltage is 24 VDC / 250 VAC, and the current is 5 A.

Figure 4.13 Dry Contact Port J22

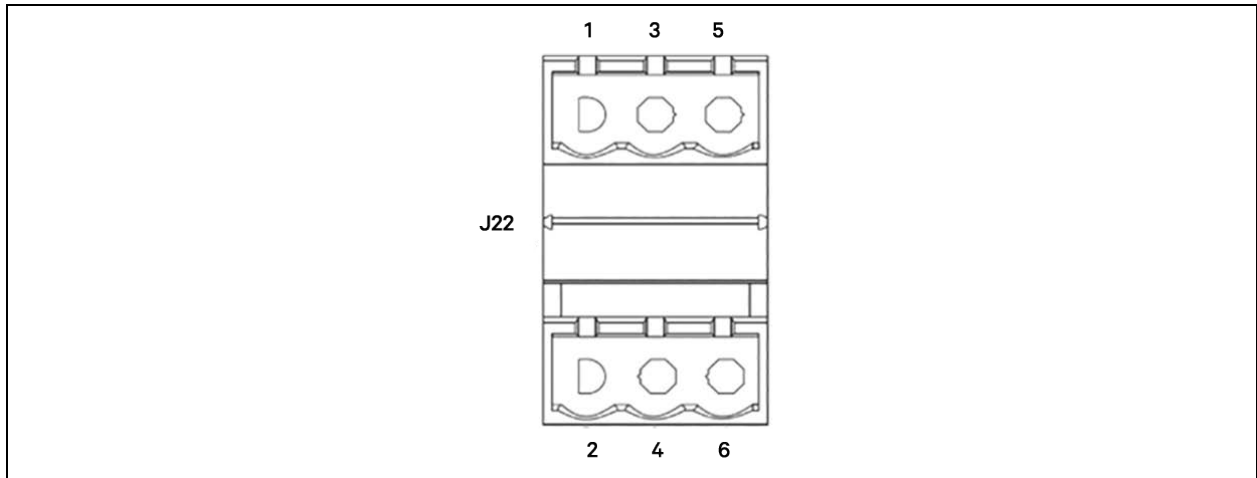


Table 4.7 Description of Dry Contact Port J22

Port	Pin	Name	Meanings
Bypass Backfeed	J22-1	BFP_O	Normally open. Closed when bypass has backfeed
	J22-3	BFP_S	Bypass backfeed protection relay common
	J22-5	BFP_C	Normally closed. Open when bypass has backfeed
Bypass Drive Power	J22-2		
	J22-4	24 V	24 V bypass backfeed drive power (options should be configured)
	J22-6	24 V GND	24 V power ground

4.2.4 Output dry contact X7 J1 (option)

The schematic diagram of output dry contact port J1 is shown in **Figure 4.14** below and described in **Table 4.8** below. The input dry contacts of this series provide 24 V / 10 mA signals, and the output dry contacts are relay contacts that can accept 24 V / 500 mA signals. The BCB drive signal can provide 12 V / 10 mA signal.

Figure 4.14 Dry Contact Port J1

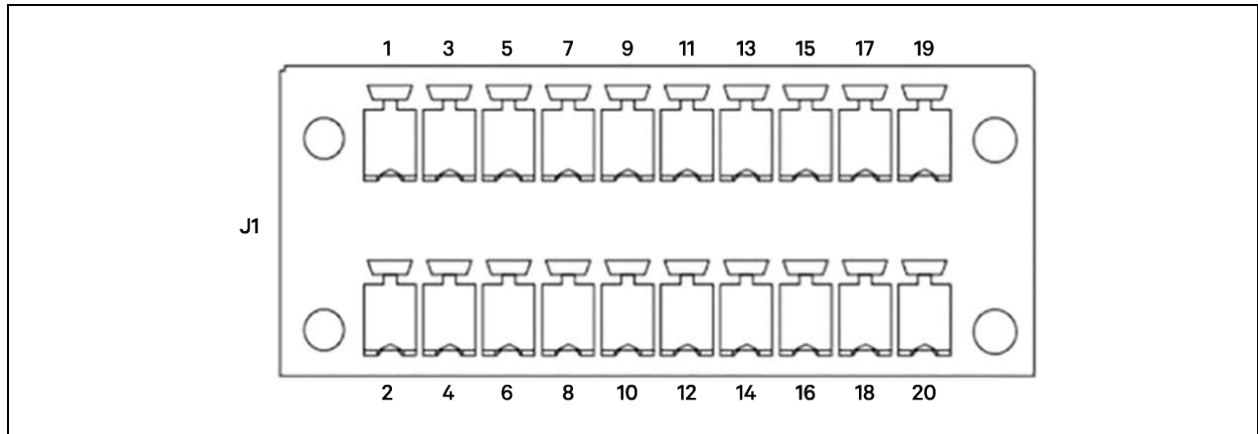


Table 4.8 Description of Dry Contact Port J1

Pin	Name	Meanings	Pin	Name	Meanings
1	BCB_Drive2	BCB2 trip signal	2	BCB_Drive3	BCB3 drive signal
3	GND		4	GND	
5	Dry in	Input dry contact can be defined, the default setting is BCB2 status feedback	6	Dry in	Input dry contact can be defined, the default setting is BCB3 status feedback
7	GND		8	GND	
9	Dry in	The input dry contact can be defined, and the default setting is BCB2 enable signal	10	Dry in	The input dry contact can be defined, and the default setting is BCB3 enable signal
11	GND		12	GND	
13	Dry in	The input dry contact can be defined, and the default setting is to turn off the inverter	14	Dry in	The input dry contact can be defined, and the default setting is the state of the external output switch MOB/QE
15	GND		16	GND	
17	Dry in	The input dry contact can be defined, and the default setting is the maintenance switch MBB/QBP state	18	Dry in	The input dry contact can be defined, and the default setting is the state of the system total output switch MIB/QOP
19	GND		20	GND	

NOTE: The programmable dry contacts must be set in Paramset.

When using parallel system, if you want to use the dry contact function of the external maintenance isolation circuit breaker, the auxiliary contact signal must be connected to the respective dry contacts on all single racks in the parallel system at the same time.

4.2.5 Output dry contact X7 J2 (option)

The schematic diagram of output dry contact port J2 is shown in **Figure 4.15** on the next page and described in **Table 4.9** on the next page. The input dry contacts of this series provide 24 V / 10 mA signals, and the output dry contacts are relay contacts that can accept 24 V / 500 mA signals. The BCB drive signal can provide 12 V / 10 mA signal.

Figure 4.15 Dry Contact Port J2

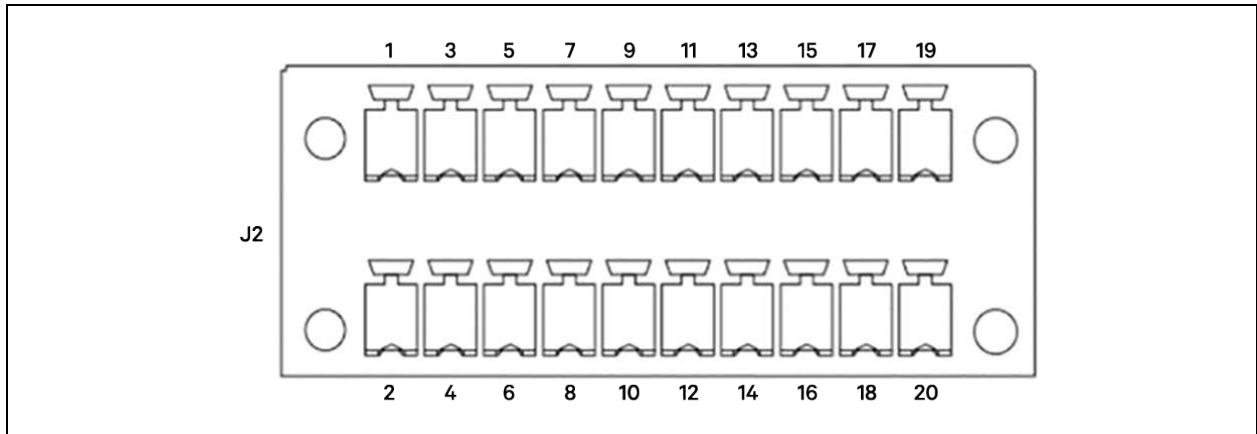


Table 4.9 Description of Dry Contact Port J2

Pin	Name	Meanings	Pin	Name	Meanings
1	Dry in	The input dry contact can be defined, and the default setting is the load test switch LLBB state.	2	BCB_Drive4	BCB4 drive signal
3	GND		4	GND	
5	Dry in	The input dry contact can be defined, and the default setting is the state of the main input switch RIB/Q1.	6	Dry in	The input dry contact can be defined, and the default setting is BCB3 status feedback.
7	GND		8	GND	
9	NO	The output dry contact can be defined, and the default setting is bypass power supply.	10	Dry in	The input dry contact can be defined, and the default setting is BCB3 enable signal.
11	COM		12	GND	
13	NC		14	Dry in	The input dry contact can be defined, and the default setting is the state of the bypass input switch BIB/Q2.
15	NO	16	GND		
17	COM	The output dry contact can be defined, and the default setting is battery mode.	18	NA	NA
19	NC		20	GND	

NOTE: The programmable dry contacts must be set in Paramset.

When using parallel system, if you want to use the dry contact function of the external maintenance isolation circuit breaker, the auxiliary contact signal must be connected to the respective dry contacts on all single racks in the parallel system at the same time.

4.2.6 Output dry contact X7 J3 (option)

The schematic diagram of output dry contact interface J3 is shown in **Figure 4.16** below and described in **Table 4.10** below. The dry contact voltage is 24 VDC / 250 VAC, and the current is 5 A.

Figure 4.16 Dry Contact Port J3

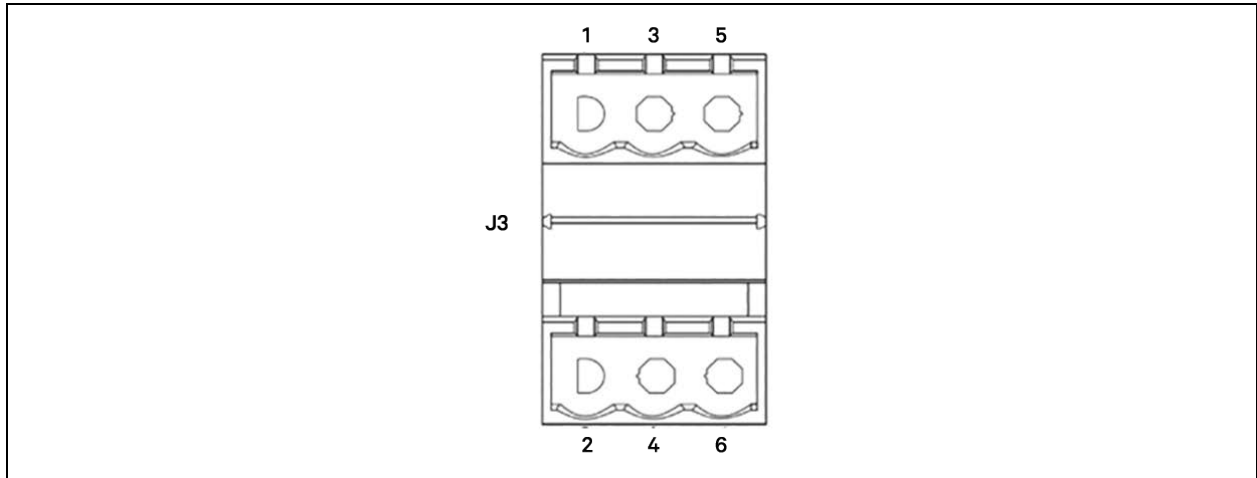


Table 4.10 Description of Dry Contact Port J3

Port	Pin	Name	Default Signal
MBB and MIB interlock signal	J3-1	NO	Normally open. External maintenance bypass MBB and system inverter main switch MIB interlock signal
	J3-3	COM	Common contact
	J3-5	NC	Normally closed
ATS transfer enable signal	J3-2	NO	Normally open. Provide remote dry contact signal to enable upstream ATS switching
	J3-4	COM	Common contact
	J3-6	NC	Normally closed

NOTE: X7 J3 pins are programmable contacts.

4.2.7 REPO port

The UPS consist of an EPO function that operates by either an EPO button on the touchscreen of the UPS or a remote contact provided by the user. The REPO button has a protective cover.

Within 100 m of the communication line, use a shielded wire, and both ends of the shielded wire are grounded. If the length exceeds 100 m, the shielded wire must go through a metal pipe.

The schematic diagram of REPO port is shown in **Figure 4.17** on the next page and described in **Table 4.11** on the next page.

Figure 4.17 REPO port

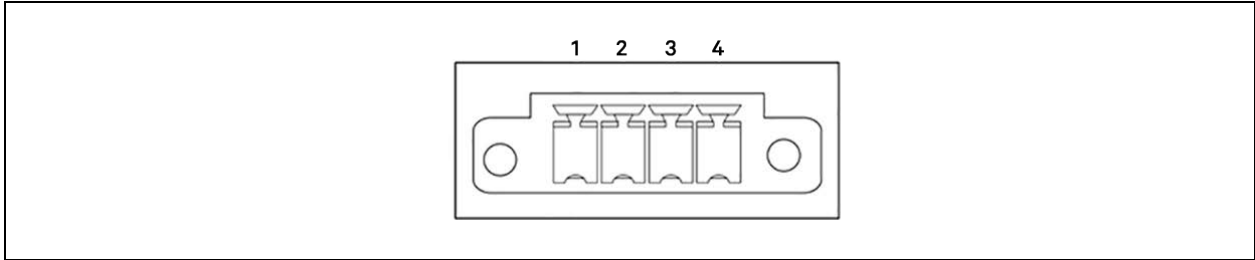


Table 4.11 Description of REPO port

Pin	Name	Meanings	Pin	Name	Meanings
1	EPO-NC	EPO activated when opened to Pin 2	3	+ 12 V	EPO activated when shorted to Pin 4
2	+ 12 V	EPO activated when opened to Pin 1	4	EPO-NO	EPO activated when shorted to Pin 3

The EPO is triggered when the pins 3 and 4 are shorted or the pins 2 and 1 are opened.

If an external EPO function is required, pins 1 and 2 or 3 and 4 are reserved for this function. The external EPO facility is also connected to the normally open or normally closed remote EPO switch between these two terminals using shielded cable. If this function is not required, pins 3 and 4 must be opened and pins 1 and the 2 must be closed.

NOTE: The EPO action of the UPS shuts down the rectifier, the inverter and the static bypass, but it does not internally disconnect the mains input power supply. To disconnect all power to the UPS, open the external power switch, bypass input switch, output switch and BCB after the EPO is activated.

4.2.8 Parallel and LBS communication ports

See Figure 4.11 on page 45 for the positions of the parallel and LBS communication port.

4.2.9 Vertiv™ Liebert® IntelliSlot™ port

The Vertiv™ Liebert® APM2 UPS consist of 2 Liebert® IntelliSlot™ ports which allows field installation of the optional communication cards, including IS-UNITY-DP card, IS-Relay card, SIC card, and RS-485 card. Table 4.12 below describes the models and installation positions of the optional cards. For the detailed installation of the optional cards, refer to the respective contents in the Vertiv™ Liebert® APM2 Option Configurations .

Table 4.12 Models and Installation Positions of Optional Cards

Optional Card	Model	Installation Position
IS-UNITY-DP/IS-UNITY-DP card	IS-UNITY-DP/IS-UNITY-DP	Intellislot ports 1 to 2
SIC card	UF-SNMP810	Intellislot ports 1 to 2
IS-Relay card	IS-RELAY	Intellislot ports 1 to 2
UF-RS-485 card	UF-RS-485	Intellislot port 1

NOTE: When using a SIC card or RS-485 card, it is necessary to set the IS RS-485 bus protocol to YDN23 on the HMI interface.

NOTE: When using the IS-UNITY/IS-UNITY-DP card, it is necessary to set the IS RS-485 bus protocol to Velocity on the HMI interface.

NOTE: The Unity card can be inserted in either Intellislot port 1 or 2, or both. When using, it is necessary to set the protocol of IS RS-485 bus to Velocity.

NOTE: SIC card and RS-485 card cannot be used with Unity card at the same time.

4.2.10 Signal cable connection steps

NOTE: The power cables and signal cables should be routed respectively. The shielding coat of signal cable must be reliably earthed.

See **Figure 4.18** on the next page and **Figure 4.19** on page 55 for cable routing of 300 kVA UPS. See **Figure 4.20** on page 56 for cable routing of 600 kVA UPS. See **Figure 4.11** on page 45 for communication port for connecting signal cables to respective ports.

To route and connect the power cables, follow the below procedure.

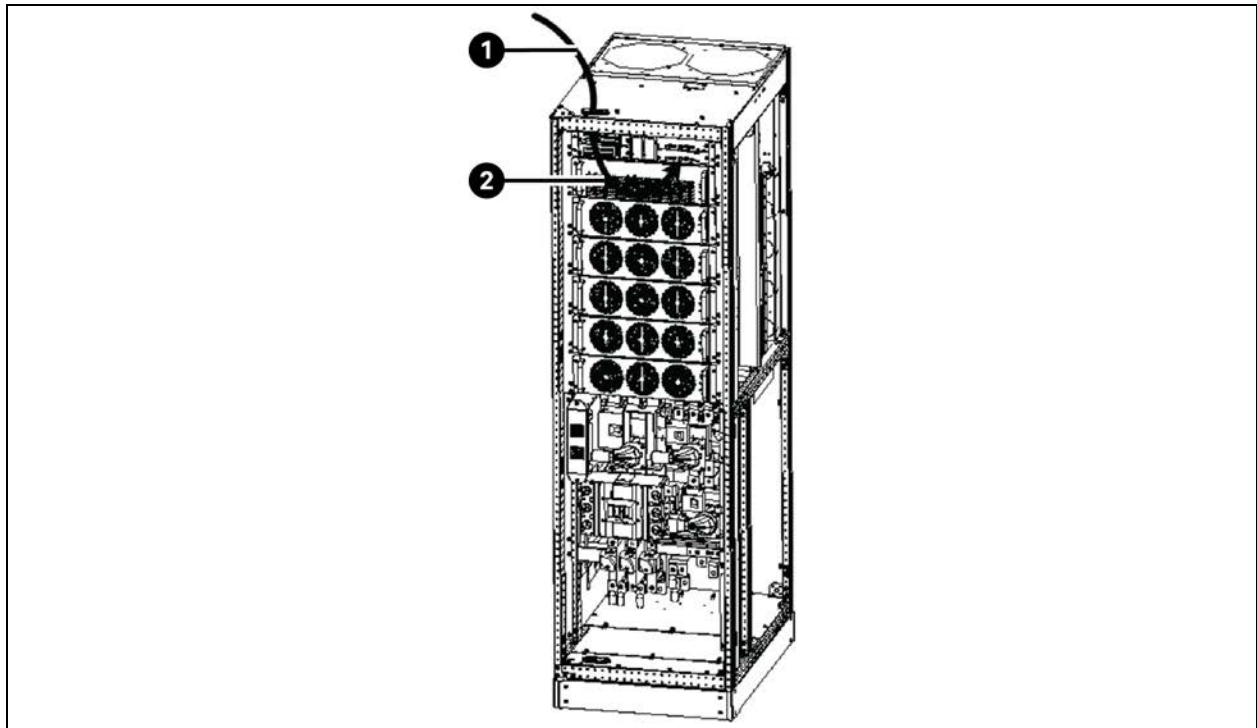


WARNING! Risk of electric shock. Can cause equipment damage, personnel injury or death. Verify that all external and internal power switches of the UPS are turned off and locked out or tagged out before installing the cables or making any electrical connections. Also, measure the voltages between the UPS terminals and the voltages between the terminals and the earth.

For 300 kVA UPS:

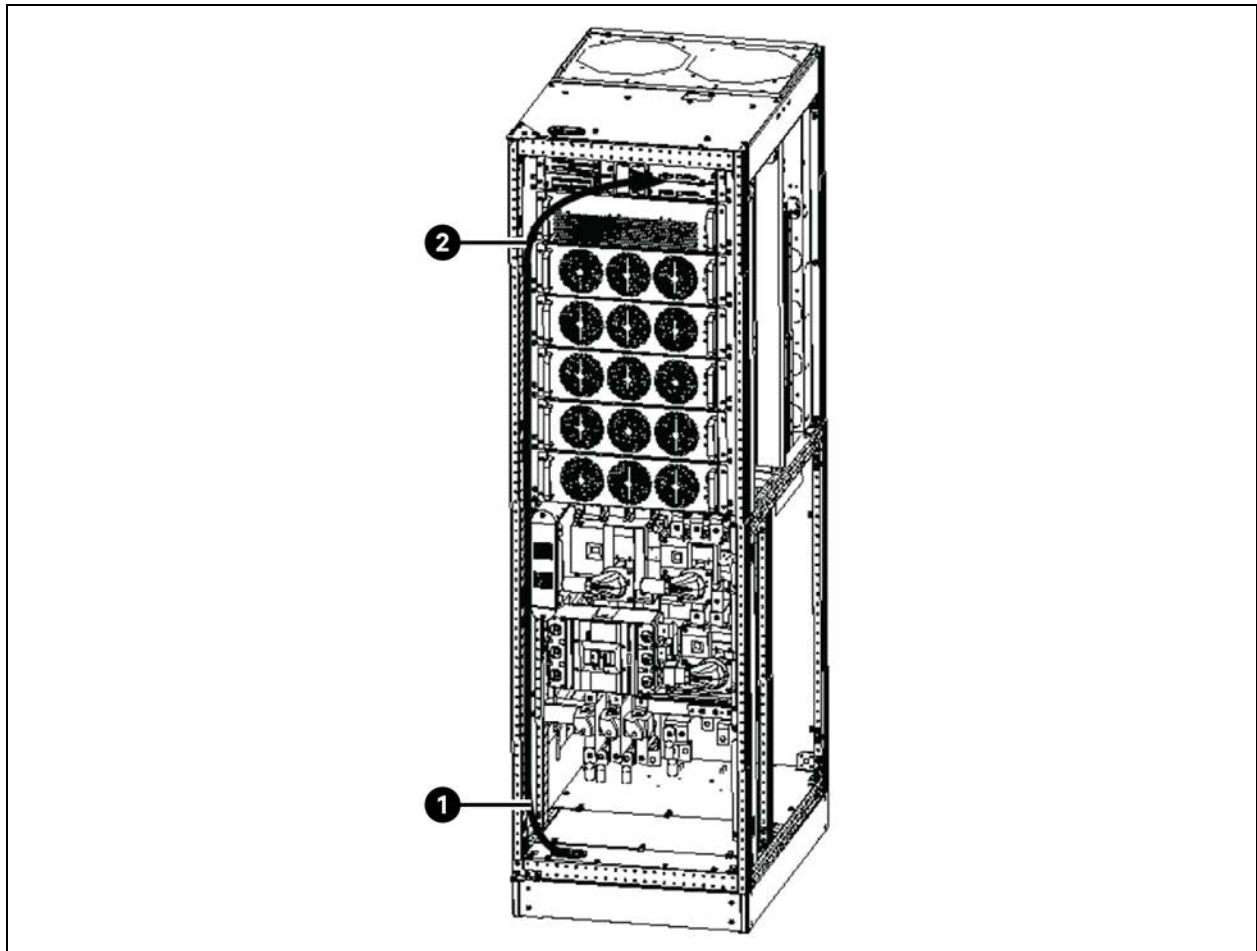
1. Remove the top cover.
2. Put the cables into the cabinet through cabinet hole. See **Figure 4.18** on the next page for top cable access and **Figure 4.19** on page 55 for bottom cable access.
3. Connect the signal cables to the respective terminals.

Figure 4.18 Signal Cables Wiring Route of 300 kVA (Top Cable Access)



Item	Description
1	Lead the signal cables into the cabinet through this cabling hole.
2	Connect them to corresponding terminals.

Figure 4.19 Signal Cables Wiring Route of 300 kVA (Bottom Cable Access)

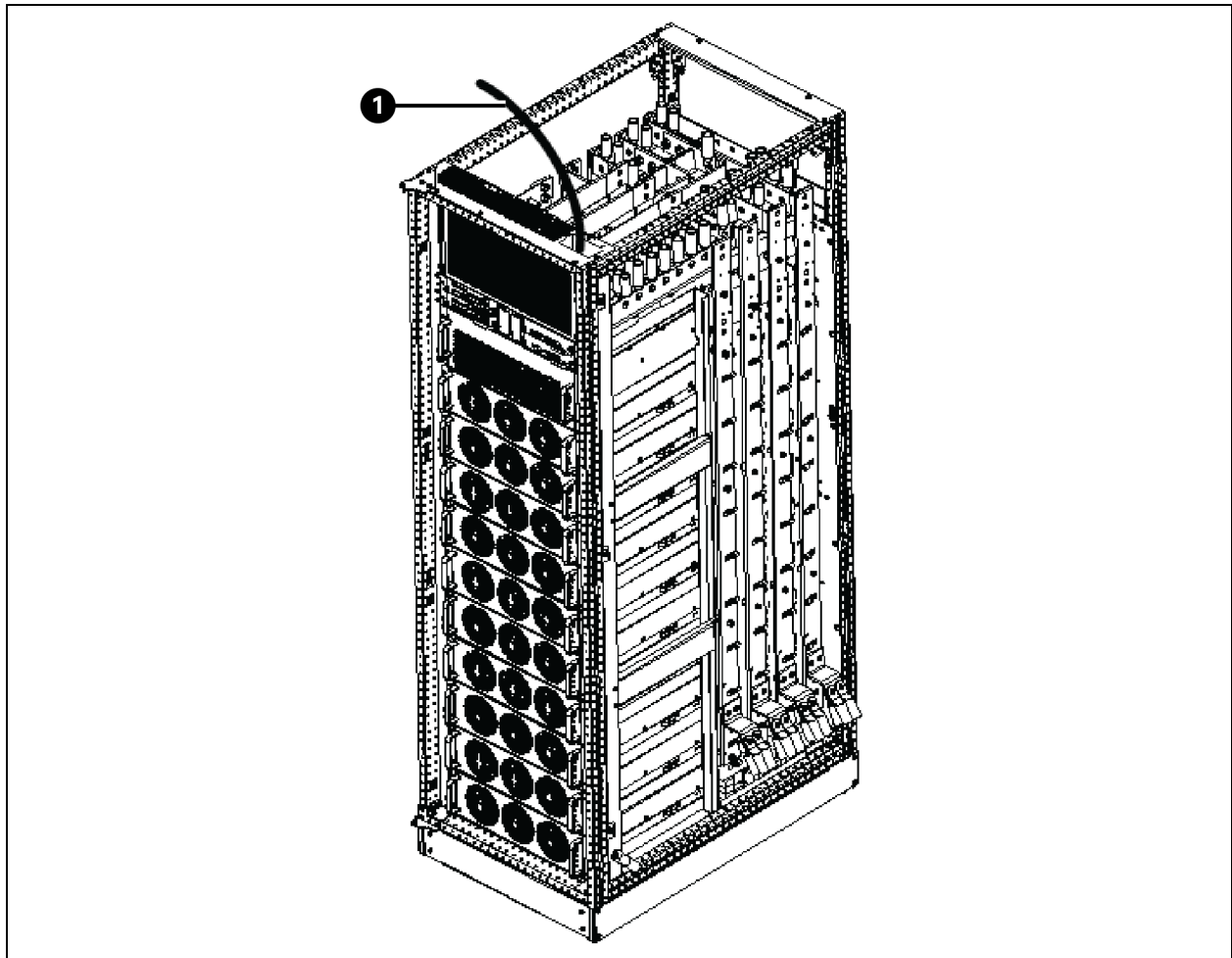


Item	Description
1	Power cable through top cabinet hole.
2	Power cable connection to respective terminal.

For 600 kVA UPS:

1. Remove the top cover.
2. Put the cables into the cabinet through cabinet hole. See **Figure 4.20** on the next page for top cable access.
3. Connect the signal cables to the respective terminals.

Figure 4.20 Signal Cables Wiring Route of 600 kVA (Top Cable Access)



Item	Description
1	Power cable through top cabinet hole.

5 Operator Control and Display Panel

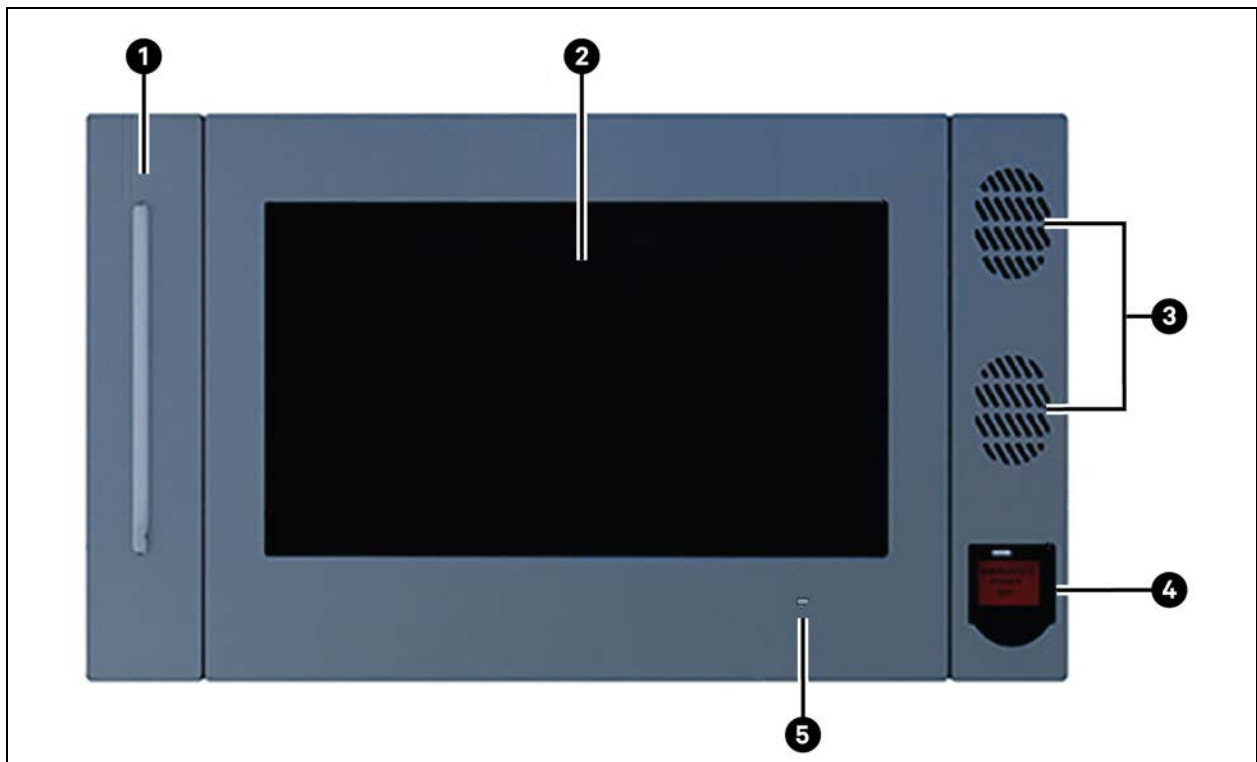
5.1 Introduction

The integrated display of touchscreen control panel of the Vertiv™ Liebert® APM2 simplifies monitoring and managing single or multiple Liebert UPS modules. The control collects a profusion of information about the health of the modules and presents it in a standardized format. This simple, dynamic display speeds operator response to changing power input and demand. Most of the settings will depend on the UPS type and features. Other settings will be made during the UPS setup by Vertiv Tech service personnel. The Liebert® APM2 touchscreen control panel's display will show data either graphically or in text. The status scroll bar at the top of the touchscreen shows the system conditions. The bar changes color to indicate status and includes an icon matched to the status. The Status Gauge displays details as power demand from the connected load, input power quality, output and bypass on each phase and battery capacity.

The Liebert® APM2 touchscreen display shows the comprehensive system information that the operator needs like: Is input power connected? Are there any alarms? Which breakers are open and which are closed? Is the UPS on battery? How much run time is available?

Checking a particular component is as simple as touching it on the mimic display—detailed data appears, allowing the operator to respond. Visual and audible alarms alert personnel to the faults and alarms requiring immediate attention. Passcodes for each level of access—Operator, Administrator and Service—secure the UPS against unauthorized changes. Personnel without a passcode can view UPS status, but cannot change any functions or the appearance of the display.

Figure 5.1 Liebert® APM2 touchscreen control panel Components



Item	Description
1	UPS Status LED
2	Touchscreen LCD
3	Speakers (not used)
4	EPO Switch
5	UPS Status LED

5.2 Navigating through the Vertiv™ Liebert® APM2 Touchscreen

The Liebert® APM2 touchscreen control panel is active when the UPS has input power. The Touchscreen on the front of the UPS permits:

- [Login to the Vertiv™ Liebert® APM2 touchscreen control panel](#) on page 65.
- To customize the user interface, see [Customizing the display](#) on page 66.
- To check the status of the UPS and its external batteries, including all measured parameters, events and alarms, see [Viewing UPS Status](#) on page 79 and [Viewing UPS Component Status](#) on page 89.
- Silencing alarms—Silence an Alarm.
- Turning the UPS On—Inverter On.
- Turning the UPS Off—Inverter Off.
- Resetting faults—Reset Fault.
- Enabling Energy Saving Mode—Energy Saving Mode Activation.

The Liebert® APM2 touchscreen control panel's display default view is two panes: One line graphic screen and UNIT STATUS. The appearance can be changed to multiple panes that show other data. Customizing the appearance is detailed in [Customizing the display](#) on page 66.

5.2.1 Access level login

The Liebert® APM2 touchscreen control panel provides security by limiting the authority to change how the UPS operates. The 4 access levels offer different authority:

- **Observer:** Viewing permission only; can choose graphic or text display. No PIN is required.
- **Operator:** Permission to start the UPS, shut the system down, reset faults and enable or disable Eco Mode operation. PIN is required.
- **Administrator:** All functions of Operator plus permission to change PINs for Operator and Administrator level. PIN is required.
- **Service:** All functions of Administrator plus permission to alter system configuration, choose serial communication protocol, enable equalize battery charging and change Service PIN. PIN is required.

Vertiv™ Liebert® Tech Services provide PINs when setting up the UPS. These default PINs may be changed by those with Administrator or Service access.

Default PINs are:

- Operator: 1234
- Administrator: 2345



CAUTION: Risk of unauthorized changes to operational settings. Can cause equipment damage. The default PIN numbers should be changed immediately to prevent unauthorized personnel from changing UPS operation or even shutting down the UPS. The PINs for Operator and Administrator may be changed by logging in with either Administrator or Service level access.

5.2.2 Vertiv™ Liebert® APM2 touchscreen control panel components

The main areas of the Liebert® APM2 touchscreen control panel are shown in **Figure 5.2** below. The display arrangement and the information displayed can be changed. At login for all access levels, the Liebert® APM2 touchscreen control panel opens to the STATUS screen in graphic display. The STATUS screen will show the graphic screen and system status readings at each login level. The appearance will differ only in the function menus displayed (see **Figure 5.3** below).

Figure 5.2 Interface Overview — STATUS Screen Graphic Display

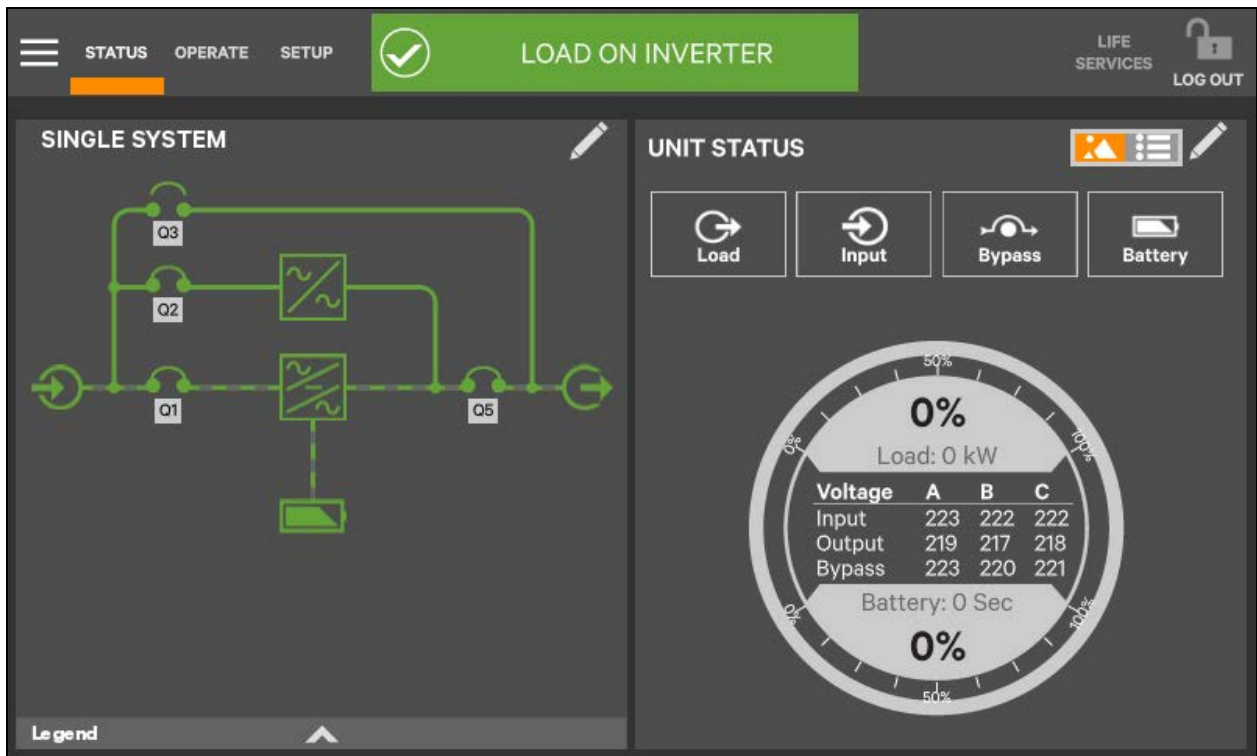
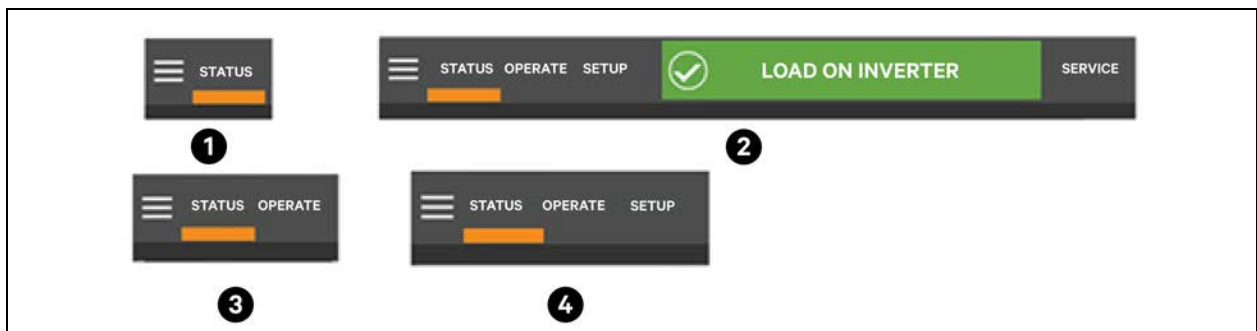


Figure 5.3 Control Display by Access Level



Item	Description
1	Observe level (or no login)
2	Service level
3	Operator level
4	Administrator level

Information and control are different under each Function Menu. The Function Menus displayed are specific to the access level.

- **STATUS:** Condition of the UPS components and data affecting operation and performance. Visible to all access levels.
- **OPERATE:** UPS operation controls, such as inverter on, inverter off, energy saving status. Visible to Operator, Administrator and Service.
- **SETUP:** Manage permissions through PINs. Visible to Administrator and Service.
- **SERVICE:** Input wiring and breaker configuration, protocol used and battery charging method. Visible to Service.

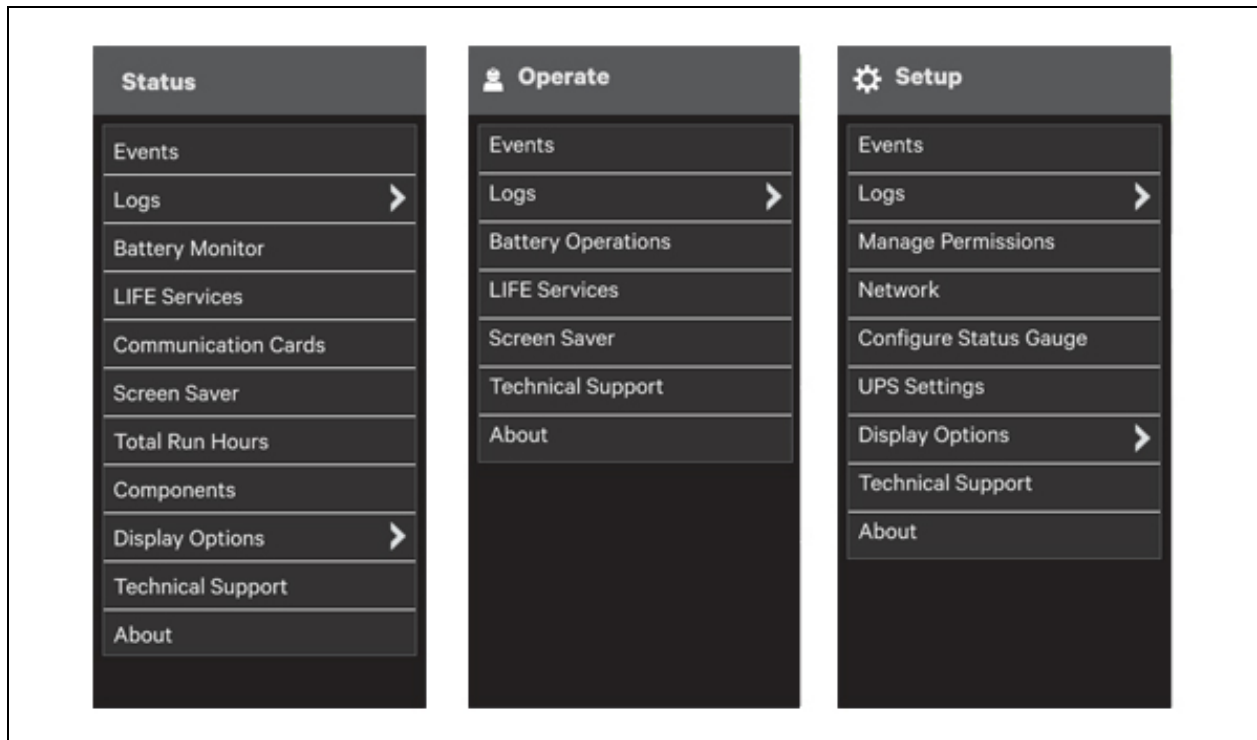
5.2.3 Menu

Context Menu

The Context Menu, available at the top left corner of the interface, displays information about the UPS and permits changing various settings. The functions possible through the Context Menu are determined by the user's access level and on the Function Menu that is active (see **Figure 5.4** on the facing page).

The menus under Display Options on STATUS, for example, differ for each access level. Some information available through the Context Menu, is alarms and run hours, are available through other areas of the Vertiv™ Liebert® APM2 touchscreen control panel.

Figure 5.4 Context Menus



The menu will either show the data or expand the menu to show additional options.

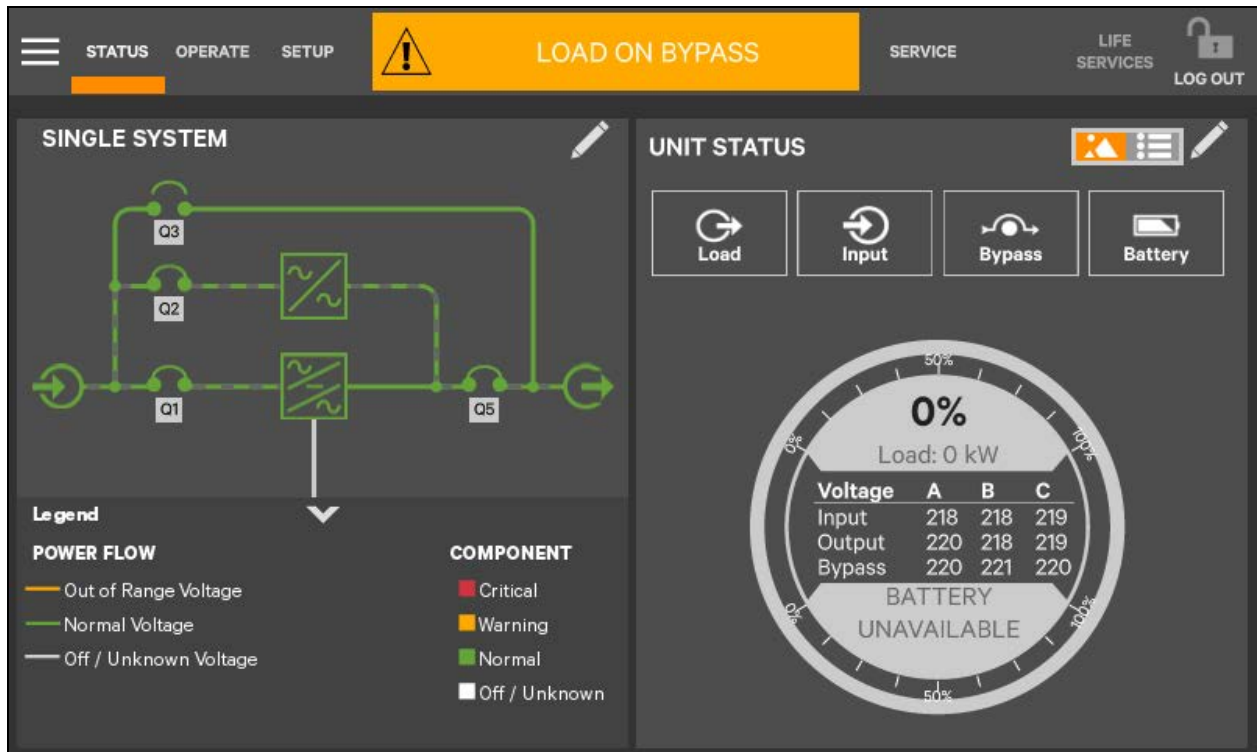
- **Alarms:** Date and time of occurrence, type of alarm, Event ID, component affected and description — see [Using the Edit Icon to Customize Layout](#) on page 69. The same options are available for all access levels, except that Observers cannot acknowledge alarms.
- **Logs:** UPS Event Log with date and time of occurrence, type of event, Event ID, status, component affected and description — see [Using the Edit Icon to Customize Layout](#) on page 69. The same options are available for all access levels.
- **Battery monitoring:** Battery discharge statistics, battery discharge curve, lithium battery BMS information (configured as multi module lithium battery), and battery module (configured as multi module lead acid).
- **Screen Saver:** Display Sleep Mode notification (immediate entry into screen saver) — screen goes dark and user is logged off. Interface reactivated by touching the screen. The same options are available for all access levels
- **Total Run Hours:** Component and hours it has operated. Touching a component displays details in the right panel. See [Using the Edit Icon to Customize Layout](#) on page 69.
- **Components:** Component status, name, and details.
- **Display Options:** Changes affect view for all access levels.
- **Customize Layout:** Change panel content and layout. See [Customizing the display](#) on page 66. Not available to Observer.
- **Display Properties:** Language, backlight timer, alarm timeout, auto log out timer, display brightness, status indicator brightness and touchscreen calibration. See [Customizing the display](#) on page 66. Language and display brightness only are available to Observer.
- **Date & Time:** Drop down lists for time zone, date, local time and UTC time (Coordinated Universal Time) . See [Customizing the display](#) on page 66. Not available to Observer.

- **Formats:** Drop down lists for date and time format and measurement system (metric or imperial). See [Customizing the display](#) on page 66.
- **Technical Support:** Manufacturer's support: web site, e-mail address, and telephone numbers.
- **About:** Information about the UPS and its software and firmware — UPS model, rating, configured capacity, model number, and serial number.

Graphic display components

The graphic display shows each configured major component of the UPS system, for both single module and multiple module systems. The graphic display is the same for all access levels. The power path is shown by animated lines and the moving dashes show the active power path. Breakers are shown as open or closed (see [Figure 5.5](#) below), but are not interactive. Components in the mimic display signify their operational status by their color, green, yellow, or red. [Table 5.1](#) on page 93 through [Table 5.3](#) on page 94 describe the various states of the indicators.

Figure 5.5 Graphic Display, Normal Operation



UNIT STATUS pane components

The UNIT STATUS pane is identical for all PIN access levels (see [Figure 5.6](#) on the facing page). Viewers will not have the Edit icon. In the default graphic view, the UNIT STATUS pane shows:

- Status Gauge connected load shown in kW and as a percentage of capacity; input, output and bypass voltage for each phase (default data may be changed; see [Viewing UPS data with the status](#) on page 79).
- Input Detail Icon
- Battery Detail Icon
- Bypass Detail Icon
- Load Detail Icon

Touching any of the detail icons will show additional data about that selection in the opposite pane. The data pane is closed by touching the Close radio button or by touching the same or another detail icon. The read only information is available to all access levels (see **Figure 5.7** on the next page).

NOTE: If the Status Gauge shows, not more than 4 detail icons will be visible at a time. Removing the Status Gauge shows all 5 detail icons. The view is customized to show fewer than 4 icons.

Figure 5.6 Unit Status Panel Components

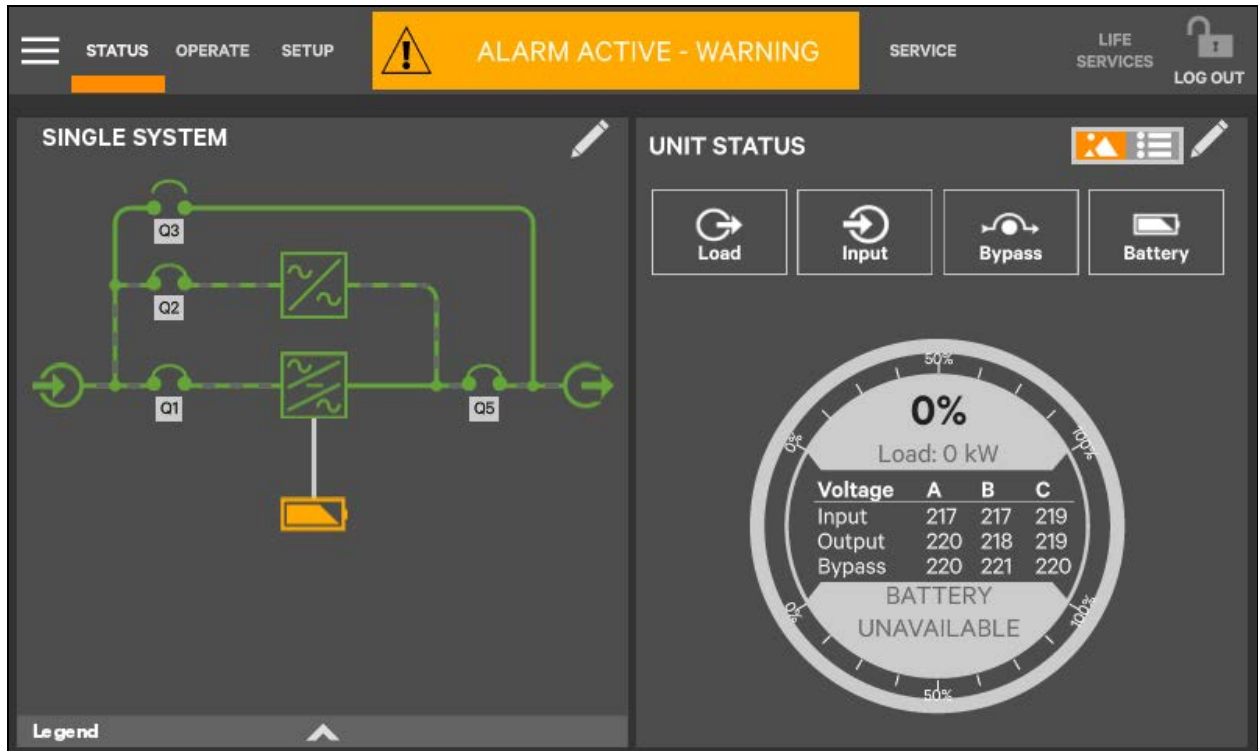


Figure 5.7 Unit Status Panel—Input Details

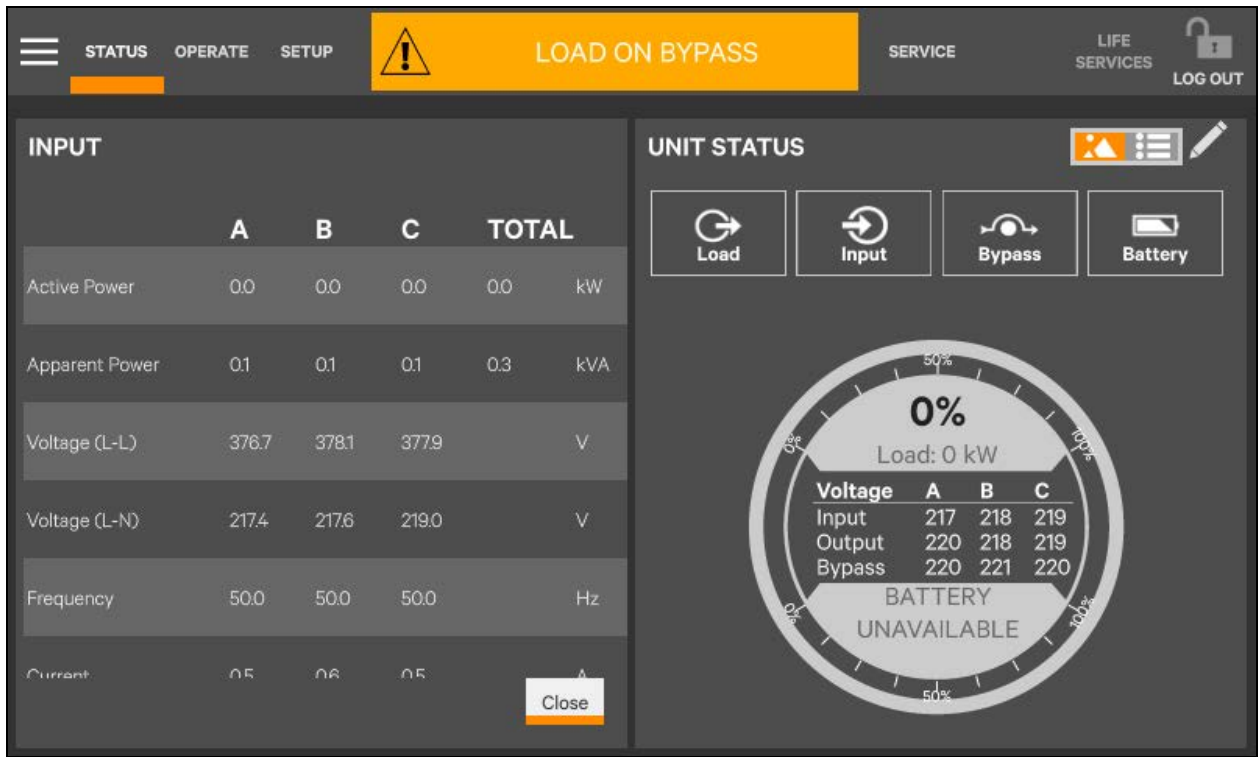


Figure 5.8 Unit Status Panel—Bypass Details

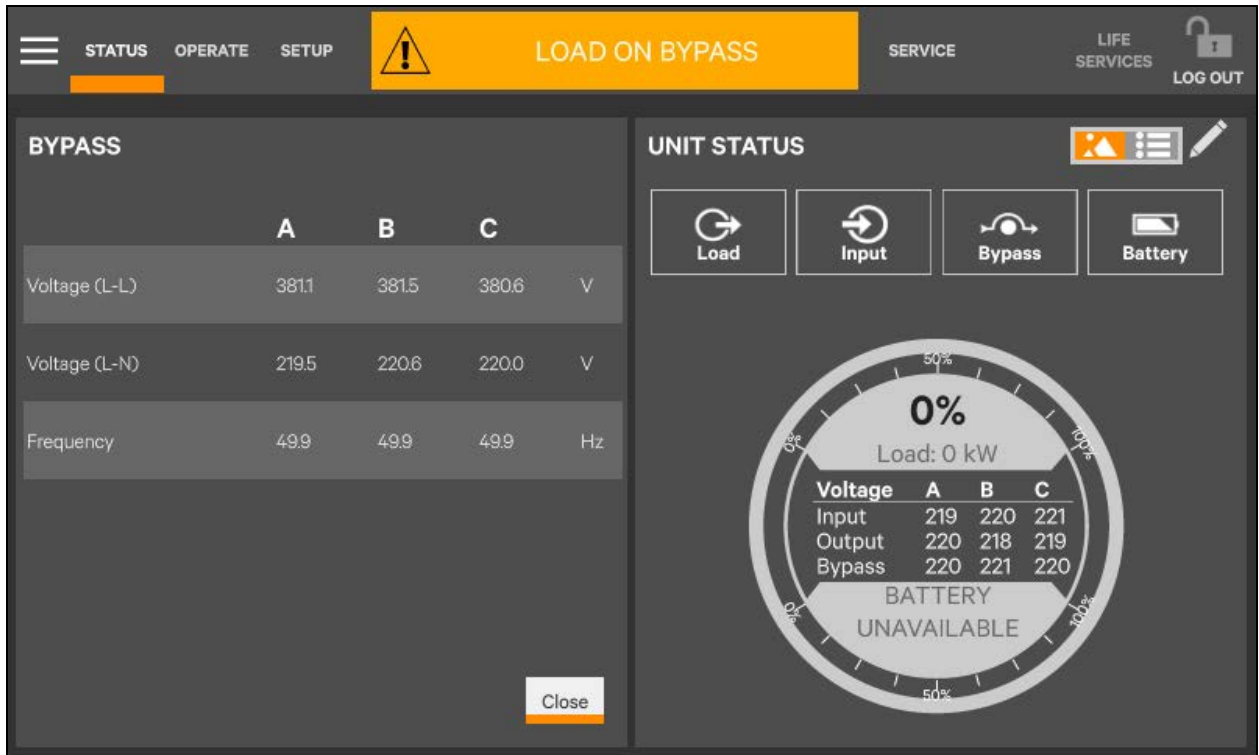
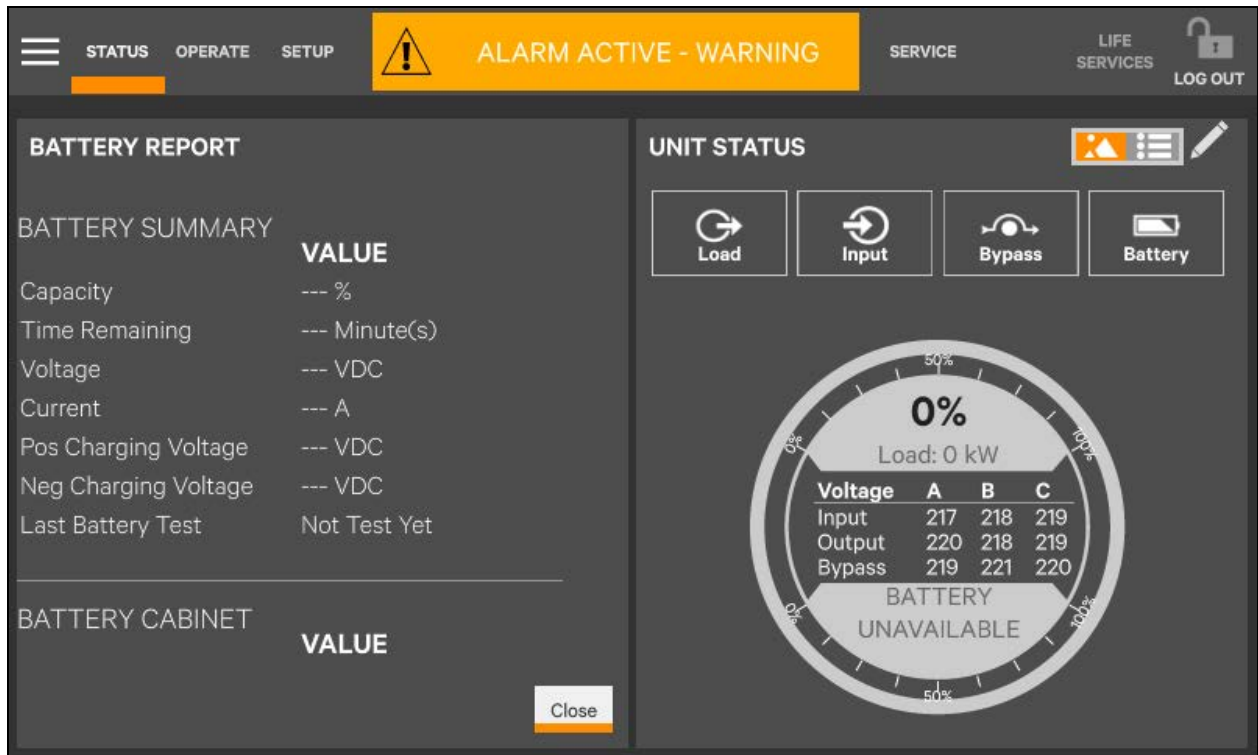


Figure 5.9 Unit Status Panel—Battery and Cabinet Details




5.3 Operation

5.3.1 Login to the Vertiv™ Liebert® APM2 touchscreen control panel

The Liebert® APM2 touchscreen control panel is ON when the UPS has control power. It is inactive and appears dark, depending on its settings. Touch the touchscreen to turn it ON.

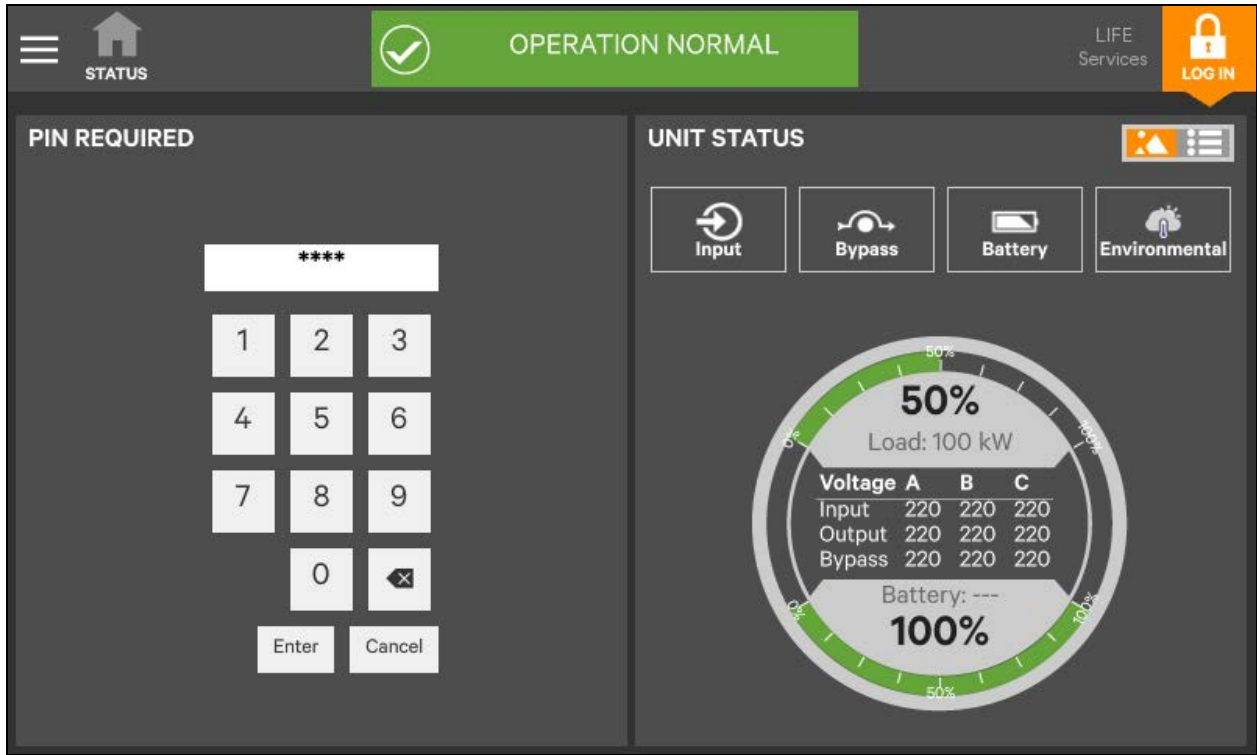
To log in to the Liebert® APM2 touchscreen control panel:



1. Touch the login icon  at the top right of the screen. The lock and background will change color and open the PIN REQUIRED screen, which has a keypad.
2. Enter a PIN at the screen below.
3. Touch Enter.

NOTE: If you enter an incorrect PIN, a screen stating the number is invalid is displayed.

Figure 5.10 Login Screen



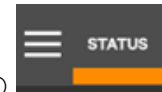
5.3.2 Customizing the display

The Vertiv™ Liebert® APM2 touchscreen control panel’s default appearance is adequate for most installations, but the Status panels can be altered to show additional or different data. Layouts may be chosen by a user with Operator, Administrator, or Service access. The layout chosen is applied to all users. Layouts may be created or altered only with Administrator or Service Access.

NOTE: The original configuration, Default View 1, cannot be deleted. New views can be created by customizing the appearance using the instructions provided below. The Default View 1 can be modified with the Edit icon shown in the upper right of the display (see Using the Edit Icon to Customize Layout on page 69).

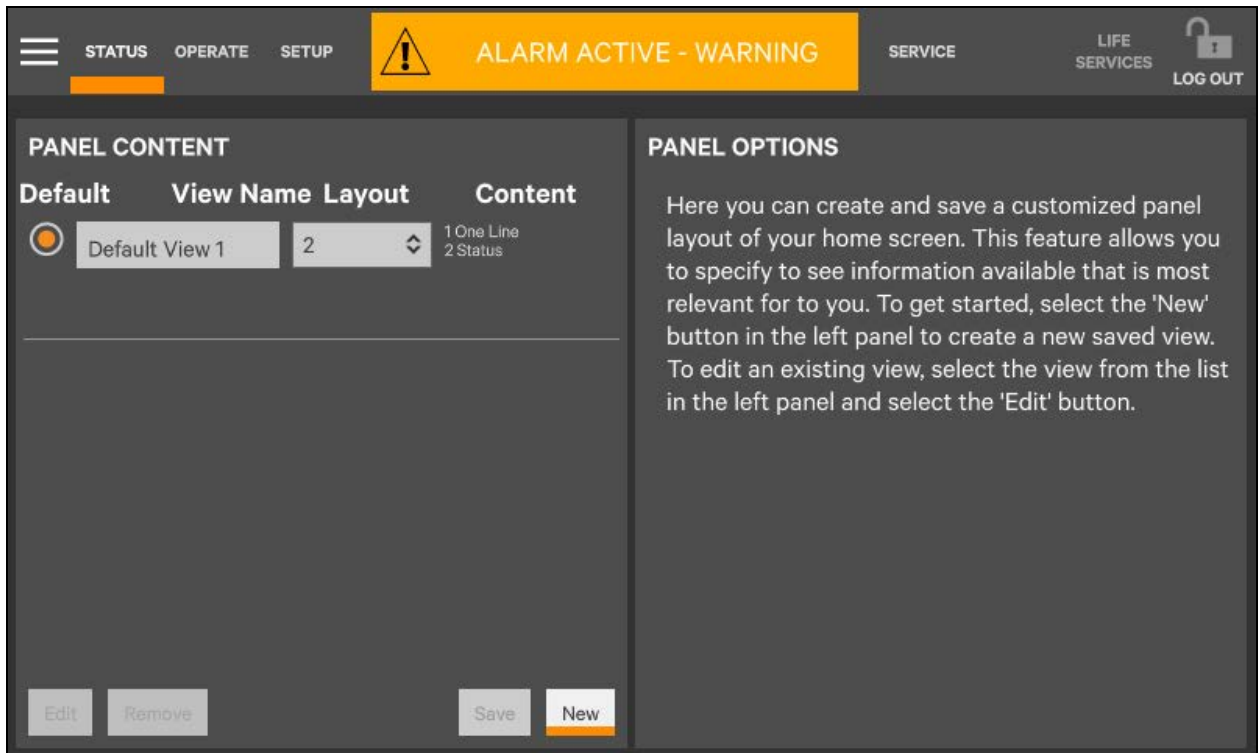
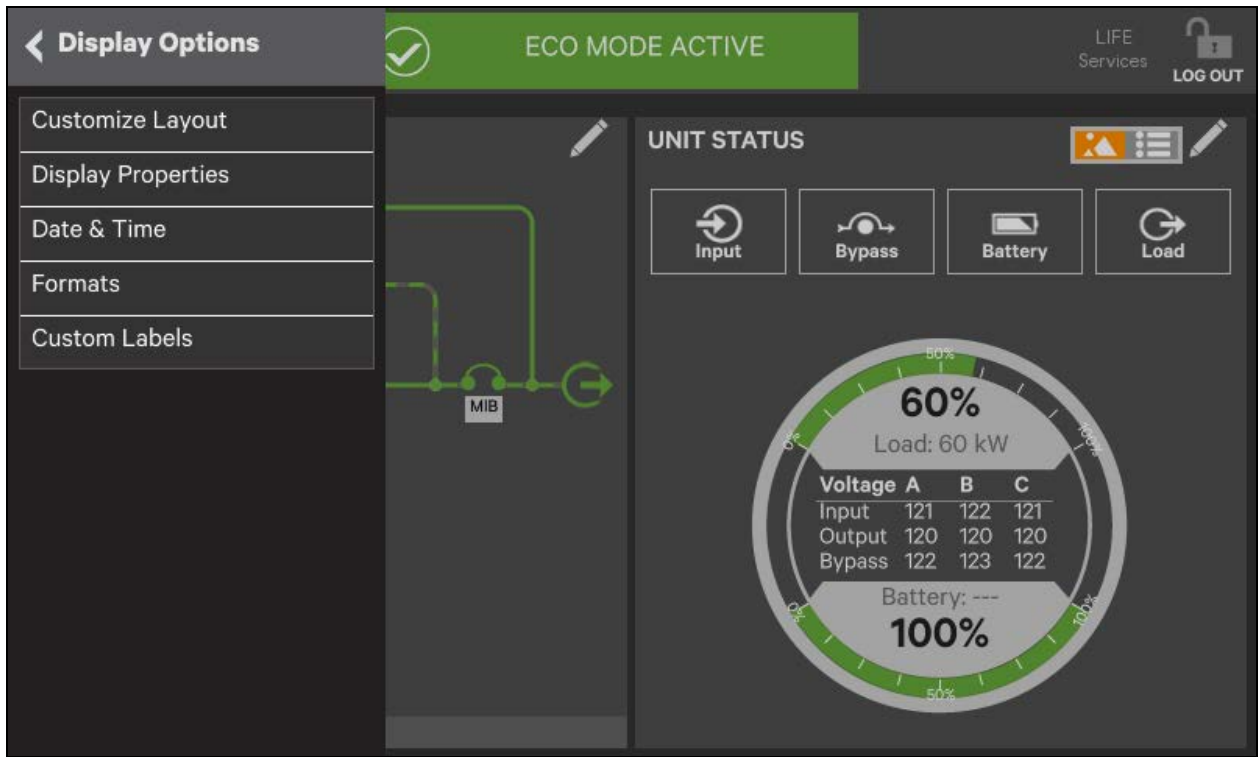
To customize the display’s appearance:

1. Login to the Liebert® APM2 touchscreen control panel as Administrator or Service detailed in Login to the Vertiv™ Liebert® APM2 touchscreen control panel .



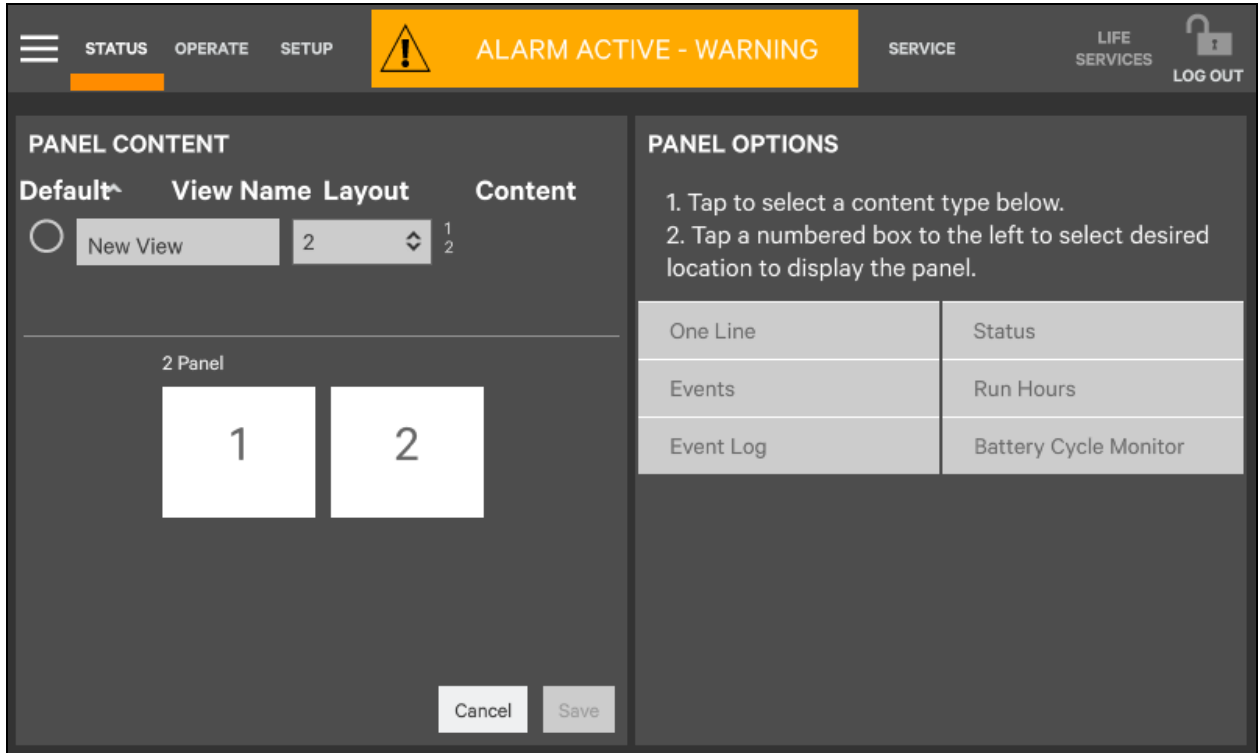
2. In the STATUS view, touch the Context Menu icon in the top left corner (shown at right).
3. In Display options, select Customize layout and then edit or create view touch Edit a view.
4. Touch a view to highlight it or touch Edit to change that view. Create a View.
5. Touch the New button to create a view.

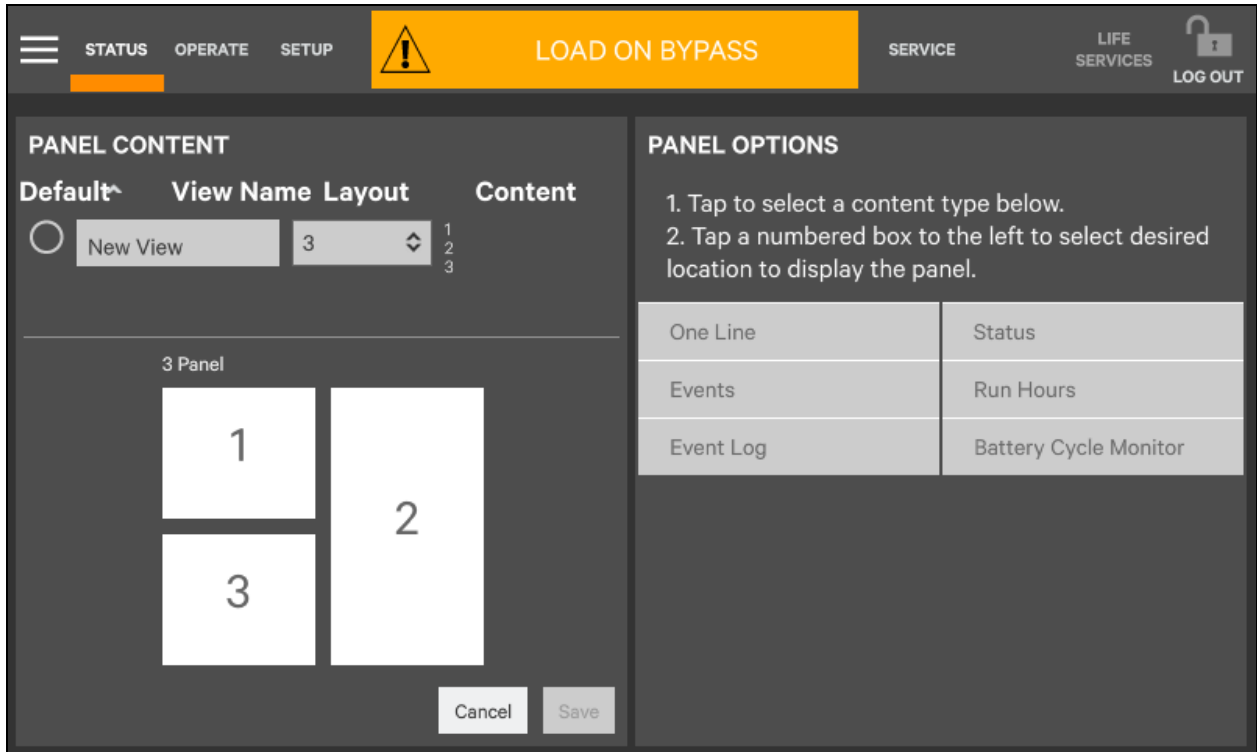
Figure 5.11 Customizing the Display



6. Either accept the generated name (New View) or touch the view's name to rename it using the on screen keyboard (maximum length is 14 characters). Touch the Enter key on the on screen keyboard after entering the new name.
7. From the drop down list in the Layout heading, select the number of panes to be placed in the new or edited view. The maximum is 4.
8. Choose the data to be displayed in each pane by touching a choice in the **Panel options** and then touching the appropriate panel. Repeat for each pane.
9. Touch the Save button to keep the changes or touch the Cancel button to exit the screen without saving.

Figure 5.12 Set Number of Panels and Choose Data





10. When the window returns to two screens **Panel content** and **Panel options**, touch the radio button beside the new view to activate it (this puts a dot inside the circle).
11. Touch Save.
12. Touch the STATUS menu icon to see the new appearance.

To choose an existing layout, navigate to the **Panel content** screen and touch the radio button beside the layout, then touch the STATUS menu icon.


Remove a Layout

To delete a layout, Log in with Administrator or Service access.

Using the Edit Icon to Customize Layout

The Vertiv™ Liebert® APM2 touchscreen control panel layout can also be changed with the Edit icons on the screen for a user logged in as Operator, Administrator or Service. The Edit icon can be used to add or remove panels, resize panels, rearrange panels and change monitored parameters.

To use the Edit icon:

1. Touch the Edit icon  on the panel to be edited and hold it until a Change content button appears on the panel (about 1 second).
2. Touch an icon to choose the data to be displayed in the panel. See **Figure 5.13** on the next page. Choices are:
 - One Line Run Hours
 - Status Event Log
 - Alarms Battery Cycle Monitor Summary
 - Change UNIT STATUS Panel Content


3. To change the UNIT STATUS data displayed in panel:
 - a. Touch the Edit icon on the UNIT STATUS panel and hold it until the Change Content button and X's appear beside the parameters.
 - b. Touch the X beside the parameter to be removed from the panel. The Add Parameter icon (+) will appear in the panel if another parameter can be added. The number of parameters possible is based on whether the Status Gauge is showing.
 - c. Touching the Add Parameter icon  brings up a window to add parameters not already shown on the UNIT STATUS panel.
 - d. Touch a parameter's icon to add it to the UNIT STATUS panel.
4. To resize or remove a panel, touch and hold the Edit icon again while the Change content button is displayed.
5. Release the icon. Resize handles will appear around the panel and a large X will appear at the top right corner.
6. Pull on a handle to resize the panel, or touch the large X to delete the panel.
7. To rearrange the panels, with the resize/remove handles visible, touch the circle in the center of the panel and drag the panel to its new position.
8. To exit edit mode, it will deactivate after some changes. If all changes have been made and Edit Mode is active, touch the panel's header area.

Figure 5.13 Change Panel Content or Resize/Remove a Panel

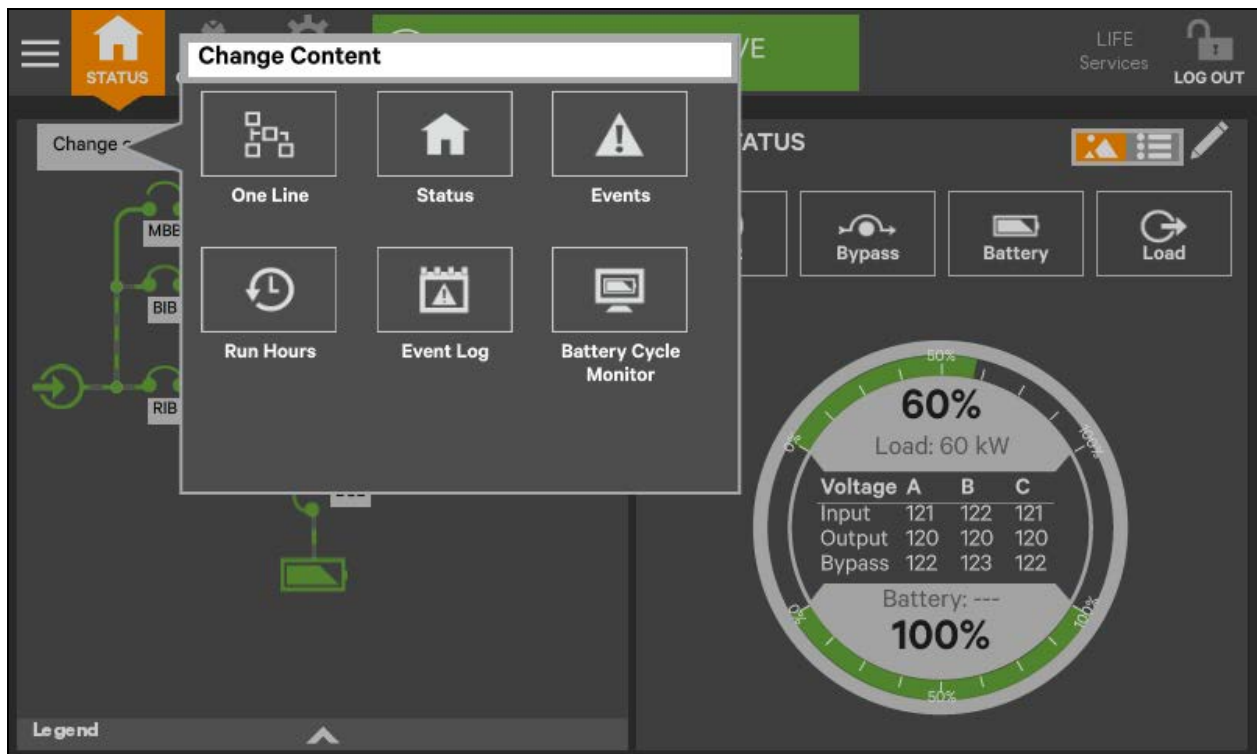
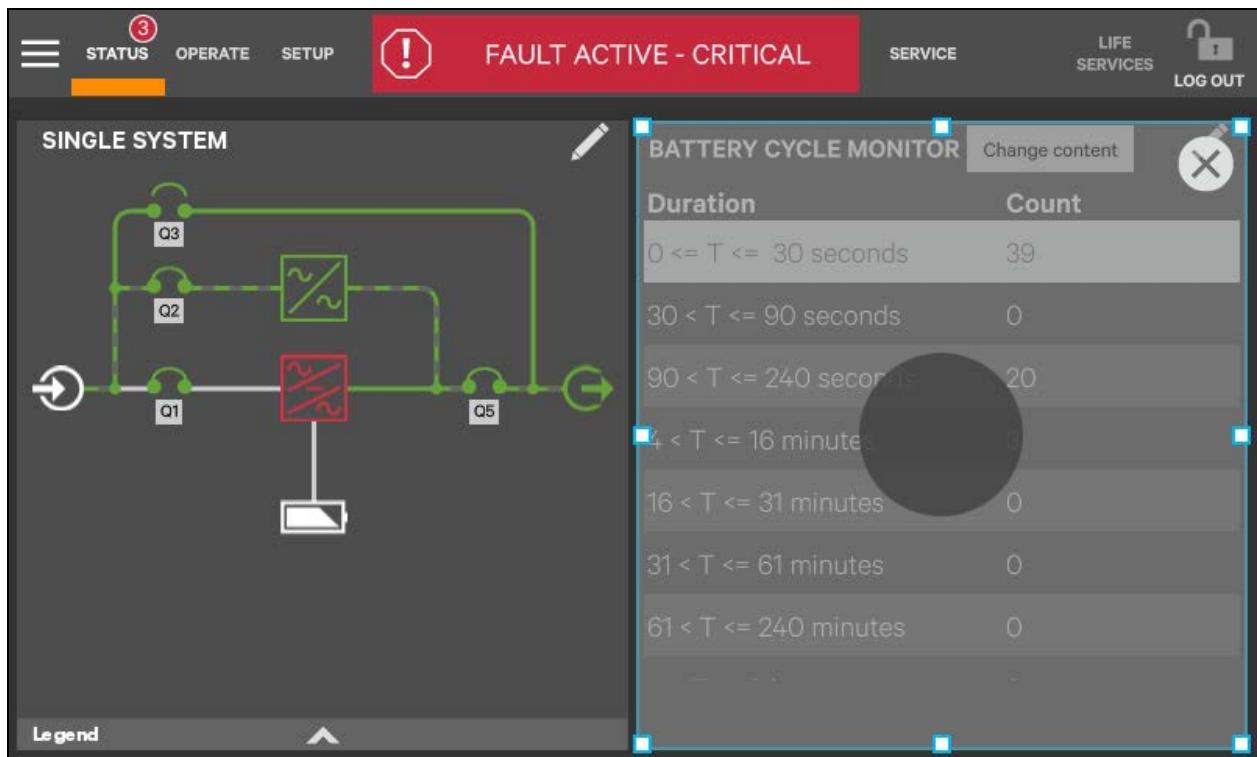


Figure 5.14 Resize or Remove a Panel



Edit UNIT STATUS Panel with the Edit Icon

The UNIT STATUS panel may be changed to add or remove data. The panel has four default parameters. Any or all can be deleted or replaced with the Editing icon.

Possible parameters for the UNIT STATUS panel are:

- Input
- Bypass
- Battery
- Load

NOTE: Changes made to the UNIT STATUS panel will be applied to all views using the panel.

To edit the UNIT STATUS panel:



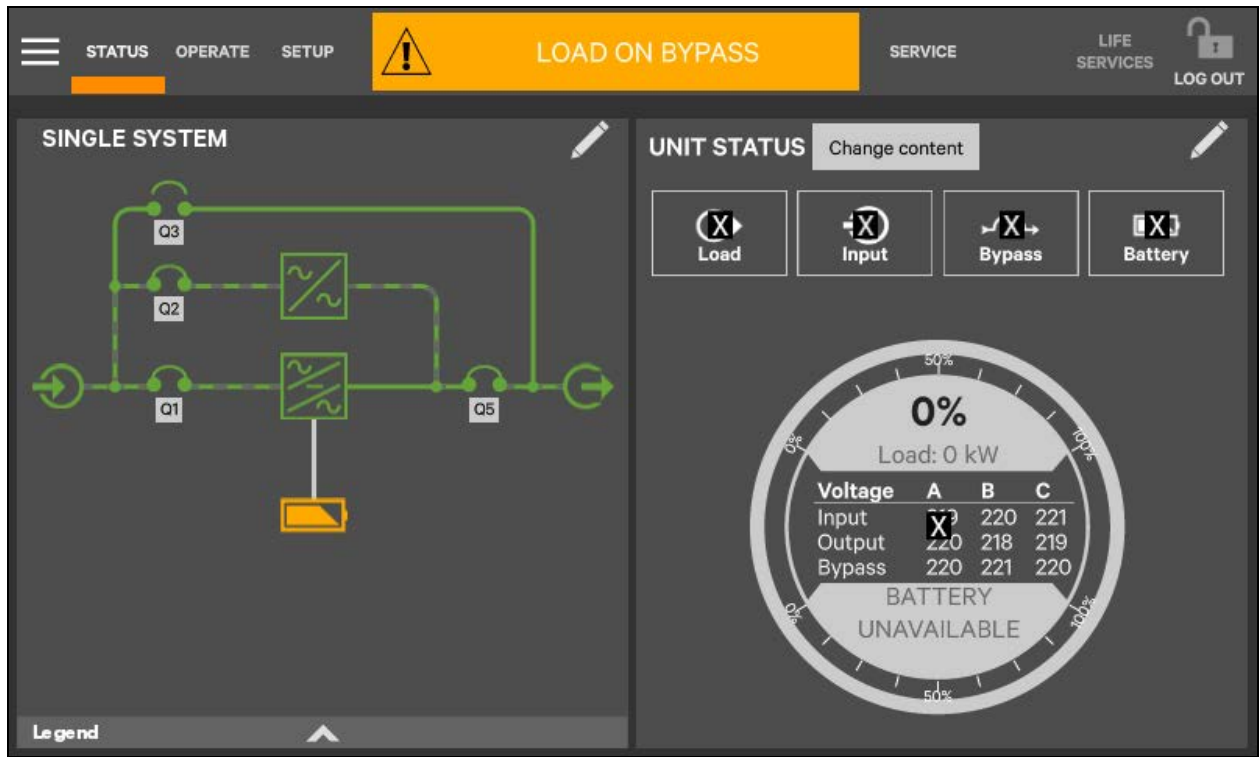
1. Touch and hold the Edit icon on the UNIT STATUS panel, to activate the editing mode.
2. Touch the large X  by a parameter icon to delete it or touch the + icon  at the bottom right of the panel to add a parameter icon.
3. Touch the header area to deactivate the edit mode.

Figure 5.15 Edit UNIT STATUS Panel



5.3.3 Operator controls

The Operator login enables control of UPS functions:

- Silence (Alarm)
- Inverter On
- Inverter Off
- Reset Fault
- Energy Saving Mode Activation
- Battery Operations

Each command is available under the OPERATE menu. The OPERATE menu may be used by logging in with Operator, Administrator, and Service access.

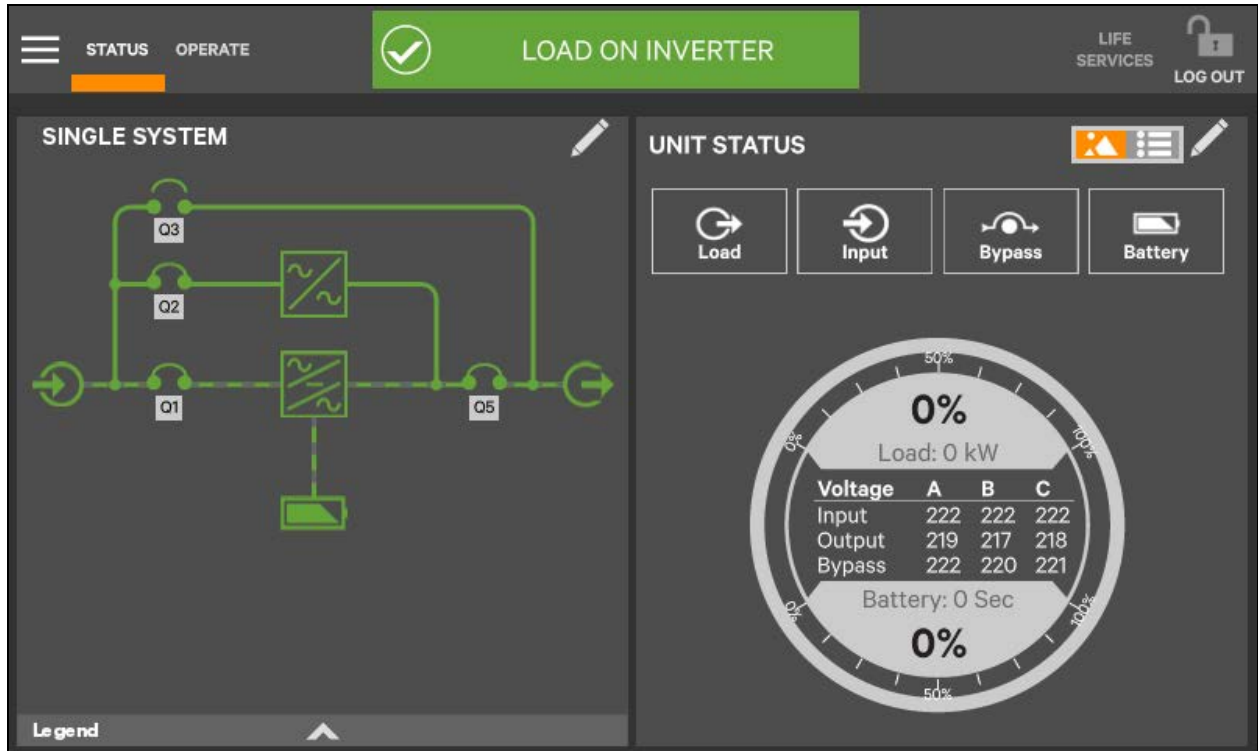


CAUTION: Risk of improper operation. Can cause load drop resulting in equipment damage. The Inverter On, Inverter Off, Reset Fault and Energy Saving Mode Activation commands will be available whenever the UPS is operating. Before executing any command, verify that the UPS status is suitable for the command to be performed.

Operate menu commands

All Operator commands are available from the OPERATE menu. The menu is available when the UPS has input power. The UPS need not be supplying power to the load for the menu to be available. The graphic screen is not linked to data in this view—touching a component will not cause it to display data.

Figure 5.16 OPERATE Menu — Operator Login



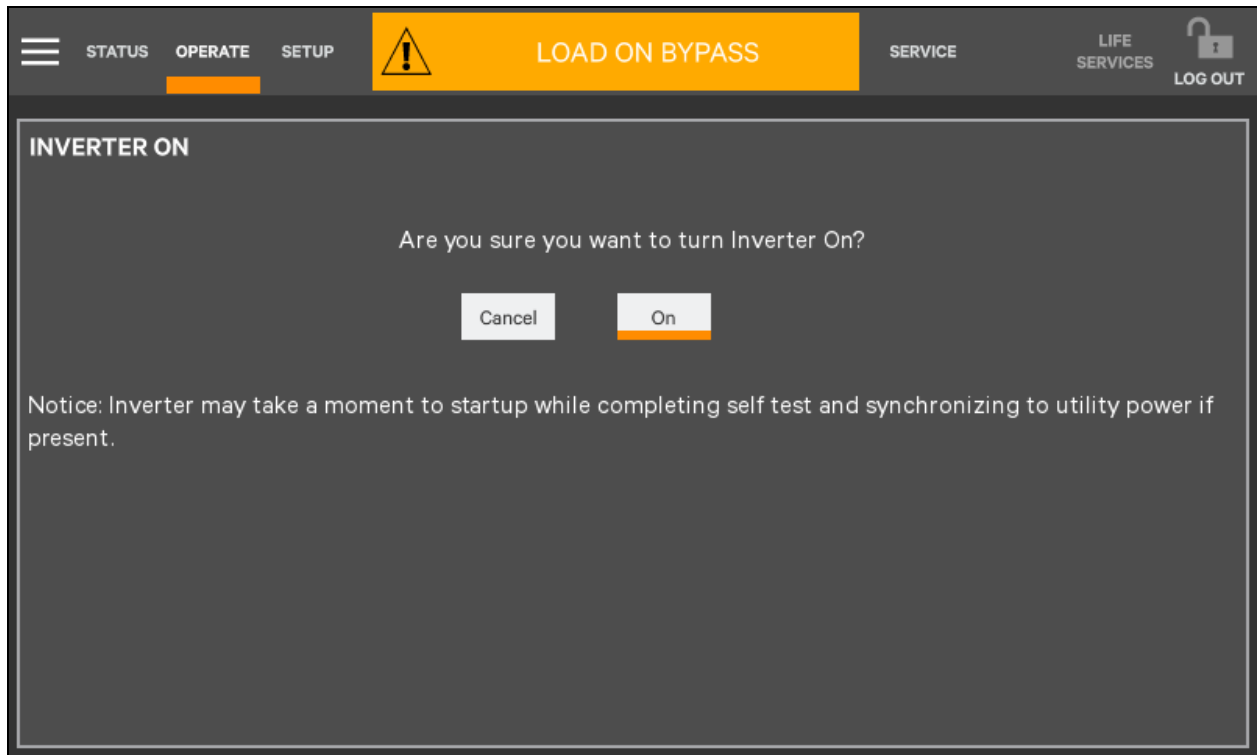
Silence an alarm

To silence an alarm, touch the Silence radio button at the top of the panel. The time the alarm will remain silenced varies, depending on the UPS type, type of alarm, and configuration.

Inverter on

The Inverter On menu item is available when the UPS has input power and the inverter is OFF. Before executing the command, verify that the UPS is prepared for the inverter to start. When the operator access is shown, commands are the same for all access levels. The Vertiv™ Liebert® APM2 touchscreen control panel displays a message asking for confirmation. Click OK to confirm, see [Figure 5.17](#) on the next page. The control then displays a progress window while the inverter starts.

Figure 5.17 Inverter On Screen



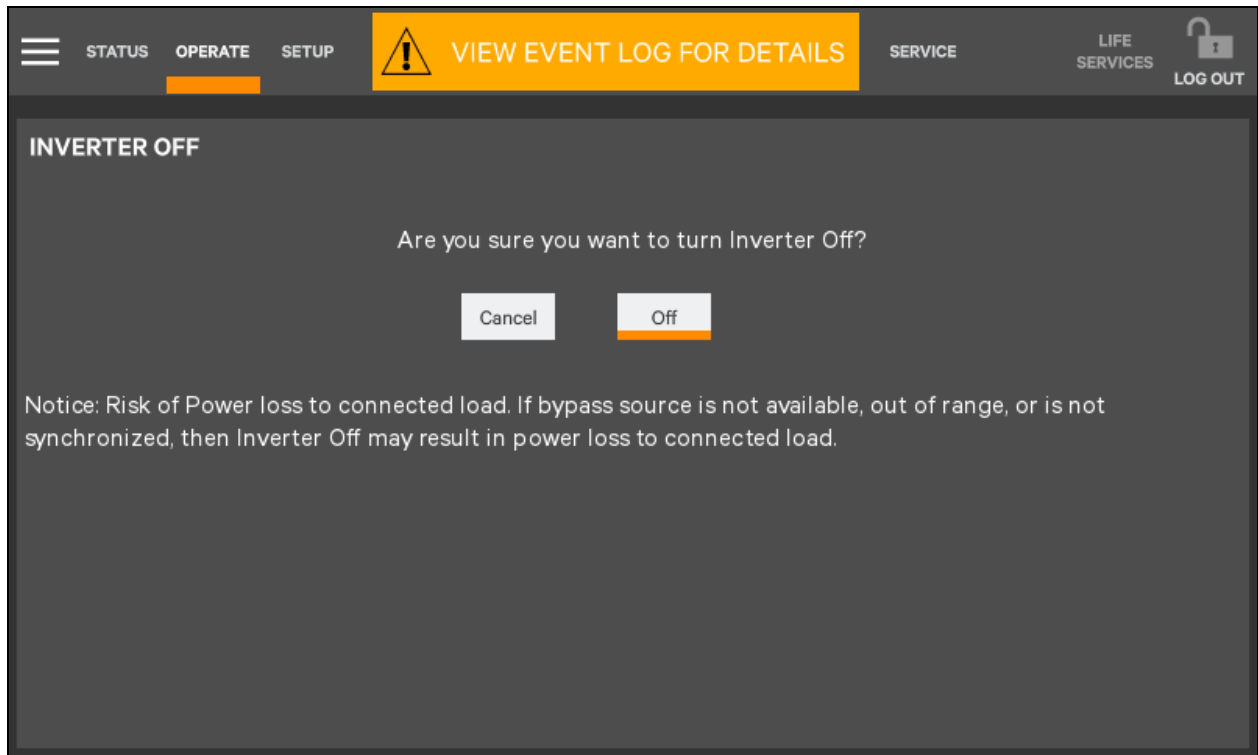
Inverter off

The Inverter Off menu item is available whenever the UPS has input power and the inverter is Off. Before executing the command, verify that the UPS and connected load are prepared for the inverter to be shut down. Click Off to turn the inverter Off.



CAUTION: Risk of improper operation. Can cause load drop resulting in equipment damage. The Inverter Off will shut off power to the connected load unless bypass power is available. Before executing this command, verify that the connected load is either shut off or that input power to the load will be supplied by another source, such as bypass.

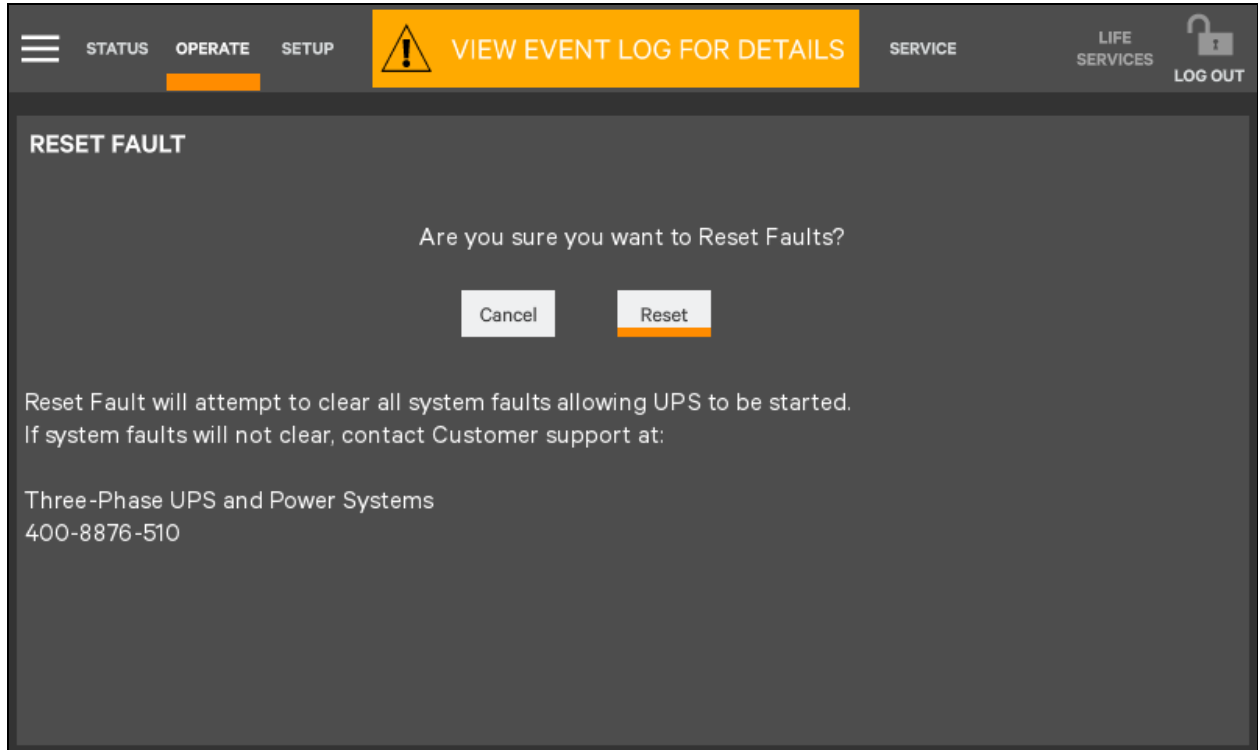
Figure 5.18 Inverter Off Screen



Reset fault

Faults may be reset with the Reset radio button.

Figure 5.19 Reset Fault Screen



Suspended time remaining

The Suspended time remaining box is not configurable. It is the time remaining when energy savings mode is suspended. It is active when energy saving mode has been going active and inactive too much and the system will suspend its activation for a period.

Module redundancy status

Module redundancy is usually chosen during system setup. Redundancy may be enabled only with Administrator or Service permissions. Proper operation requires the presence of at least a second module, but the system may encompass more modules.

To enable module redundancy:

1. Log in with Administrator or Setup permissions.
2. Touch the SETUP tab.
3. Touch the Context Menu icon and select Settings.
4. In the Module Redundancy drop down menu, touch Enable.
5. Touch the Save button to save the new setting or touch Cancel to exit without saving.

Figure 5.20 Enable Module Redundancy—Settings

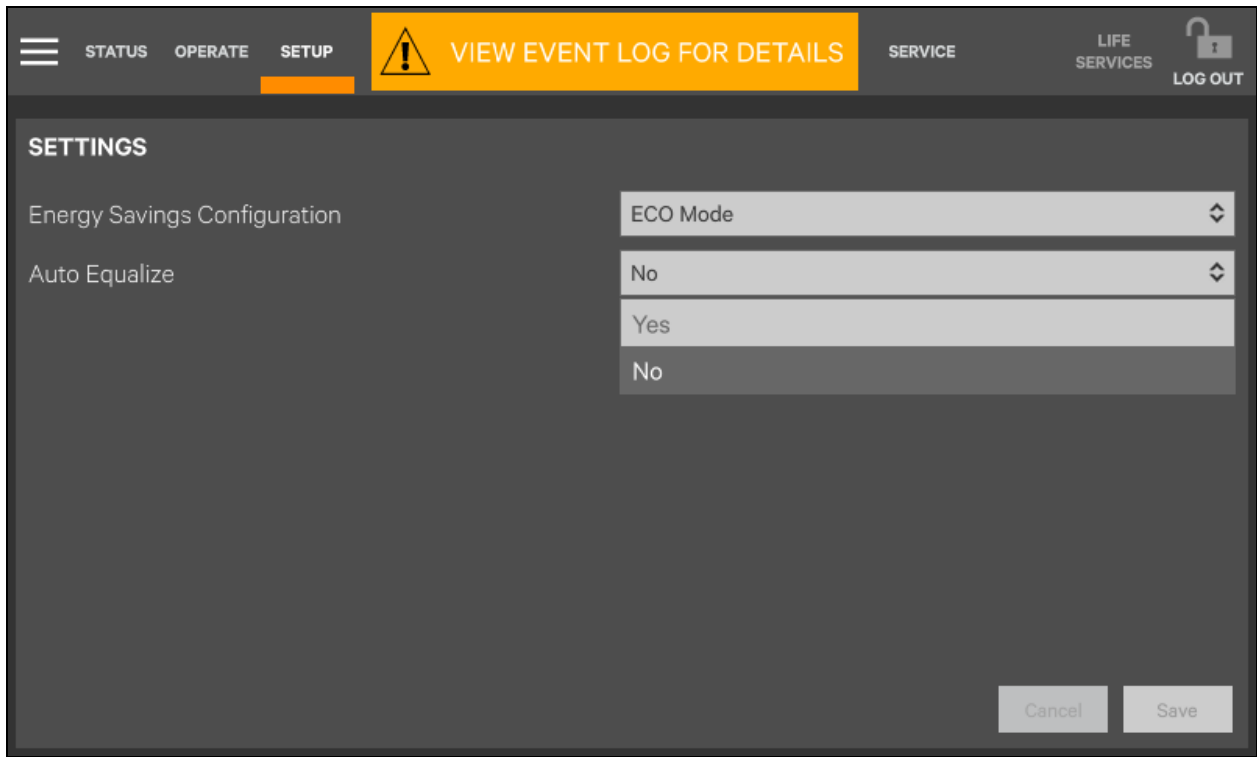
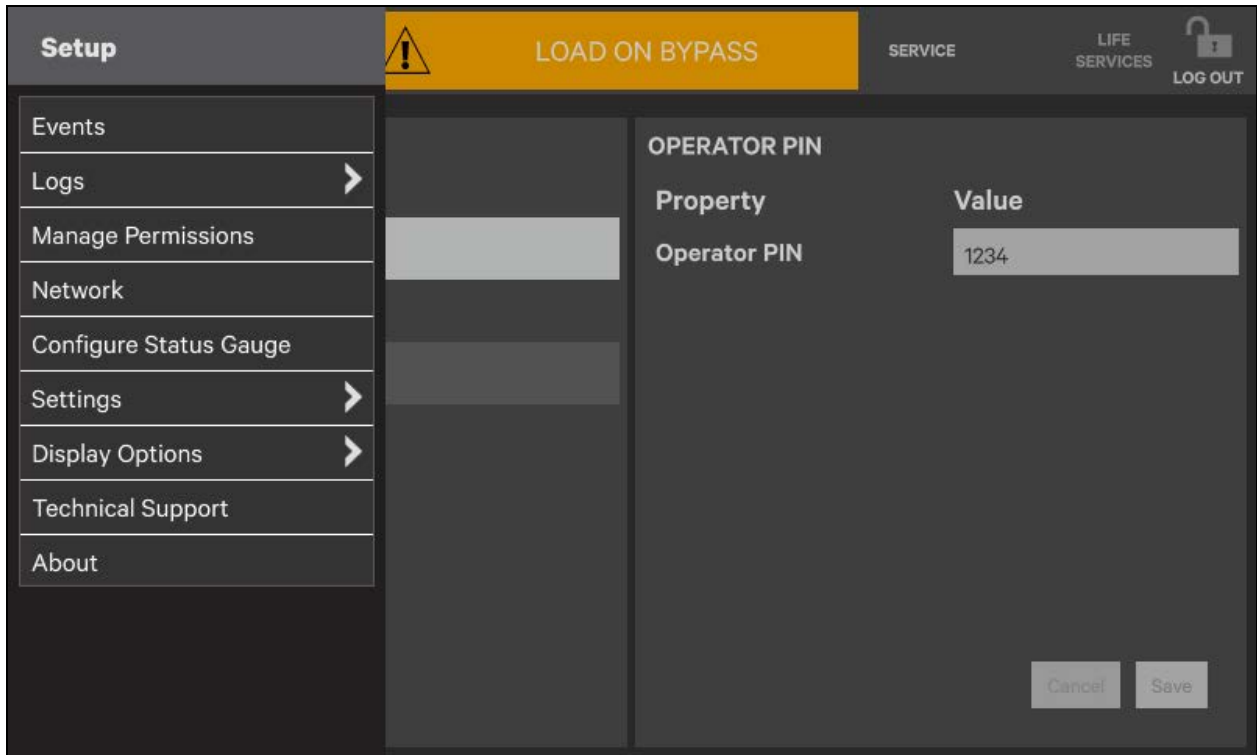


Figure 5.21 Enable Module Redundancy—Setup



Energy saving mode activation

NOTE: Read this manual carefully before activating energy saving mode. An Operator can only enable or disable Energy Saving Mode. The available modes vary according to the UPS type and system configuration. The types available must be set up by either Administrator or Service personnel.

Energy Saving Mode may be activated or deactivated through the OPERATE menu screen. Two modes are available as Eco Mode and Intelligent Parallel Mode.

Eco Mode permits the UPS to reduce power consumption by powering the load through bypass power when utility supplied power is within acceptable ranges. The inverter will remain in a state that will permit it to resume supplying power if the utility power goes outside acceptable ranges.

Intelligent paralleling puts units in a sleep mode until required.

To activate or deactivate Energy Saving Mode:

1. Touch the Setup radio button for Energy Saving Mode Activation.
2. Enable or disable Energy Saving Mode.
3. Touch the Save button. The Save button is inactive until the activation state is changed.

Figure 5.22 Activating Energy Saving Mode

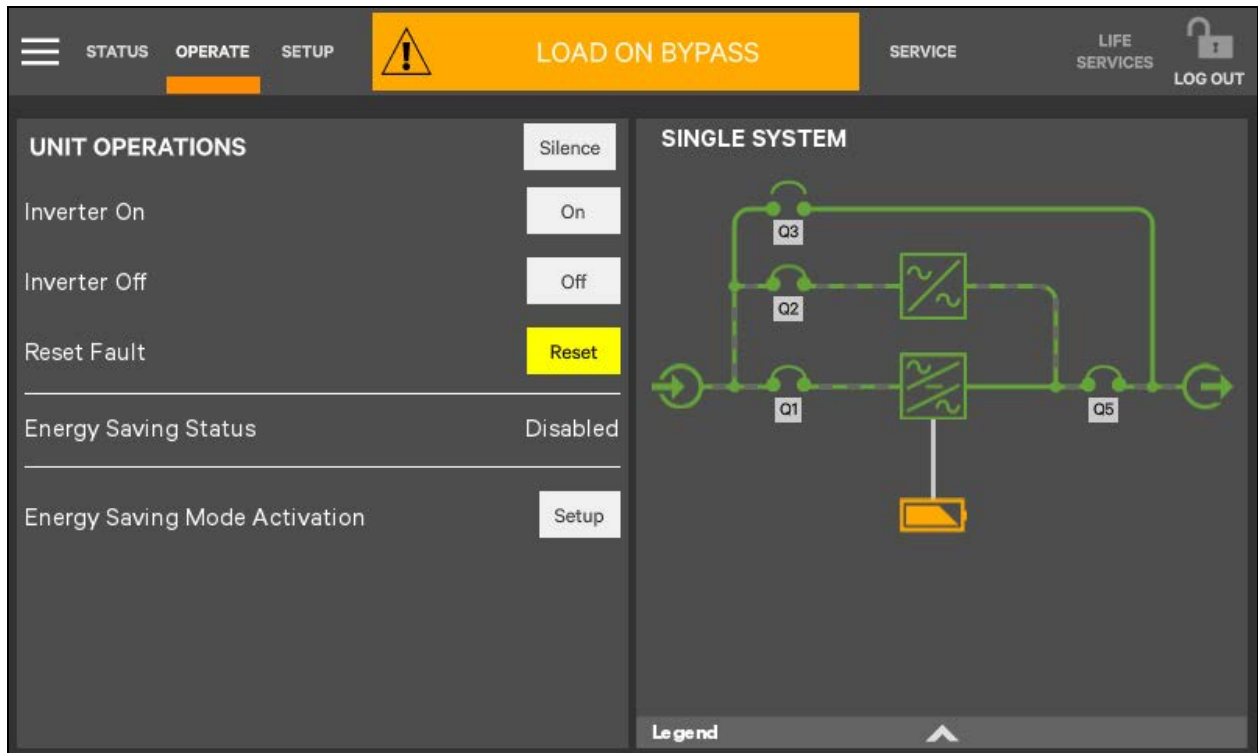
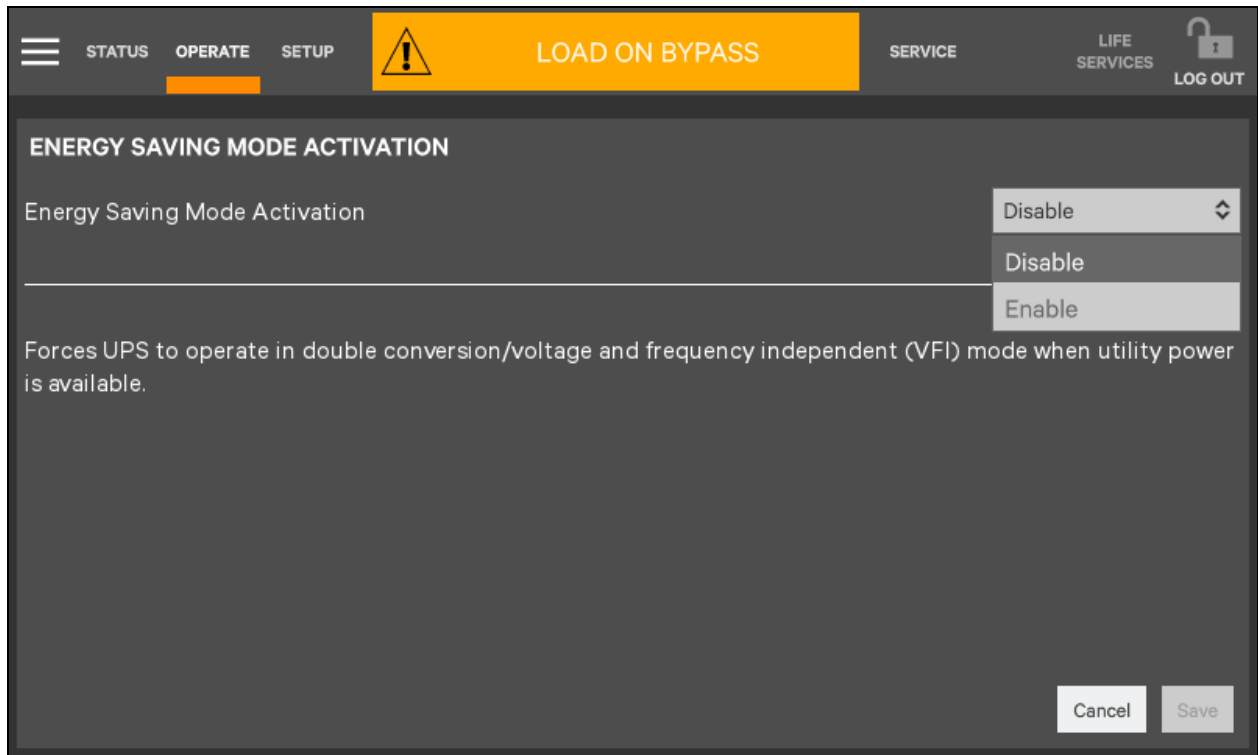


Figure 5.23 Energy Saving Mode Activation



5.4 Viewing UPS Status

The Vertiv™ Liebert® APM2 Touchscreen display reports UPS status in multiple ways. The graphic views and text views will show the same readings.

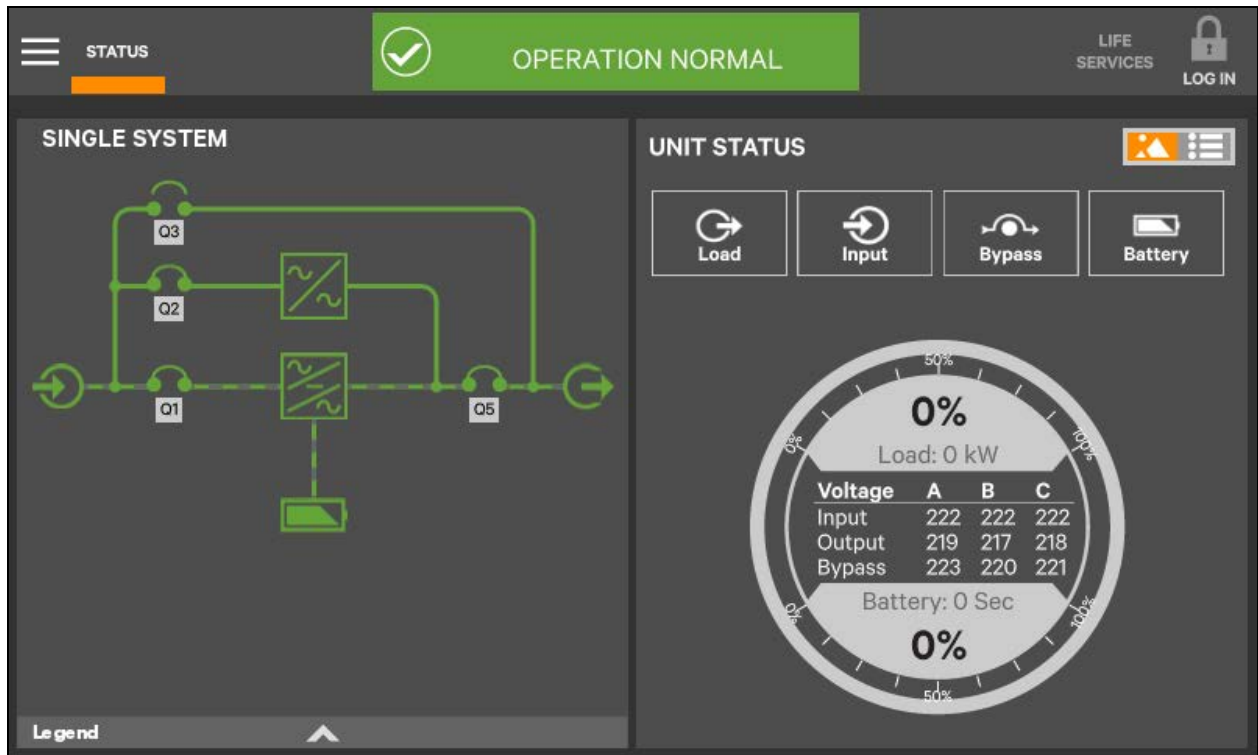
Alarms and certain events will trigger audible alarms and the LED on the bezel, the light bar and the status header will change color. (Audible alarms do not sound unless enabled.) The scrolling information bar at the top of the interface summarizes information about the UPS status. The Status Gauge on the UNIT STATUS pane gives additional details about the UPS status.

5.4.1 Viewing UPS data with the status

The Status Gauge offers a quick summary of the UPS status. The information shown depends on the type of UPS and its configuration and upon the choices made in the gauge setup. The data can be chosen by someone with Administrator or Service access.

The additional data will not replace the information shown in the center of the Status Gauge. Touching the center of the Status Gauge multiple times will cycle through the data.

Figure 5.24 Default Status Gauge View



To change the values shown on the Status Gauge:

1. Log in with either Administrator or Service access.
2. Touch the SETUP menu icon.
3. Touch the Context menu icon.
4. Touch Configure Status Gauge. This opens the DIAL CONTROL SETUP pane, which holds settings for the readings in the center of the gauge and for the upper and lower metering.

To change the data shown in the center of the gauge:

1. Expand the Center Readings menu by touching the arrow beside it.
2. Put a check mark in the check box beside each value to be displayed (see Figure 5.25 on the facing page and Figure 5.26 on page 82).

To change the data shown in the gauge's upper or lower section:

1. Expand the Upper Meter or Lower Meter menu by touching the arrow beside it.
2. Use the drop down menu to choose whether the Upper Meter or Lower Meter shows data for the Battery or Load. (Either the upper or lower part of the Status Gauge may be used to show Load or Battery readings.)
3. Use the sliders to change the Warning Threshold or Critical Threshold (see Figure 5.25 on the facing page and Figure 5.26 on page 82).
4. Touch the Save button to keep the changes or touch Cancel to exit without saving the changes.

NOTE: The DIAL CONTROL SETUP pane may also be accessed by touching the Status Gauge and holding it for about 2 seconds. This requires Administrator or Service access.

Figure 5.25 Access Status Gauge Settings

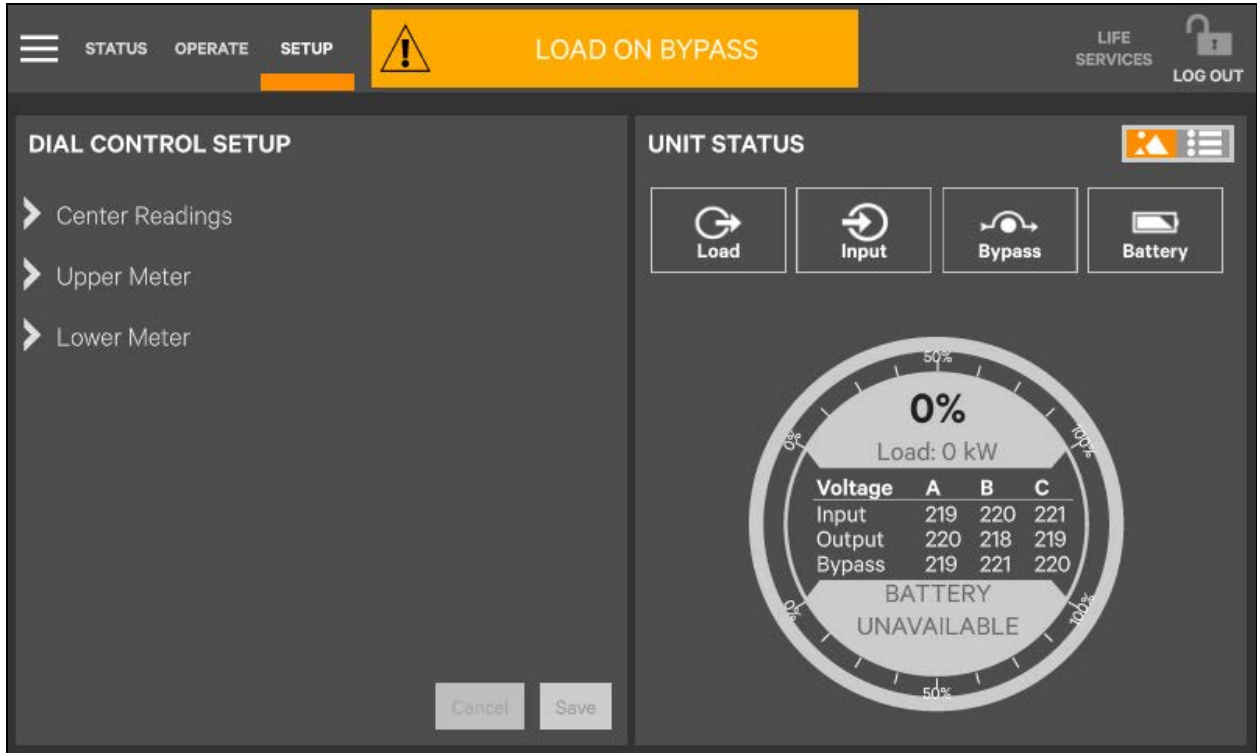


Figure 5.26 Status Gauge Setting Options_1

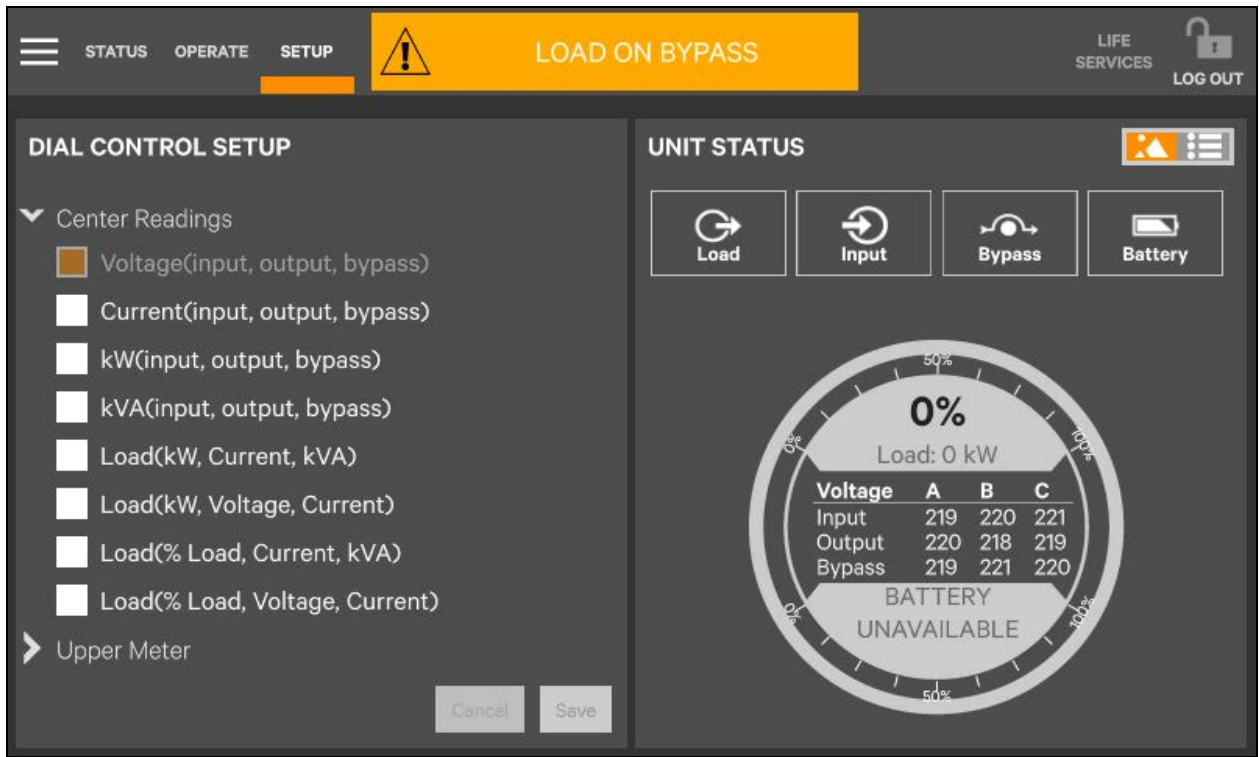


Figure 5.27 Status Gauge Setting Options_2

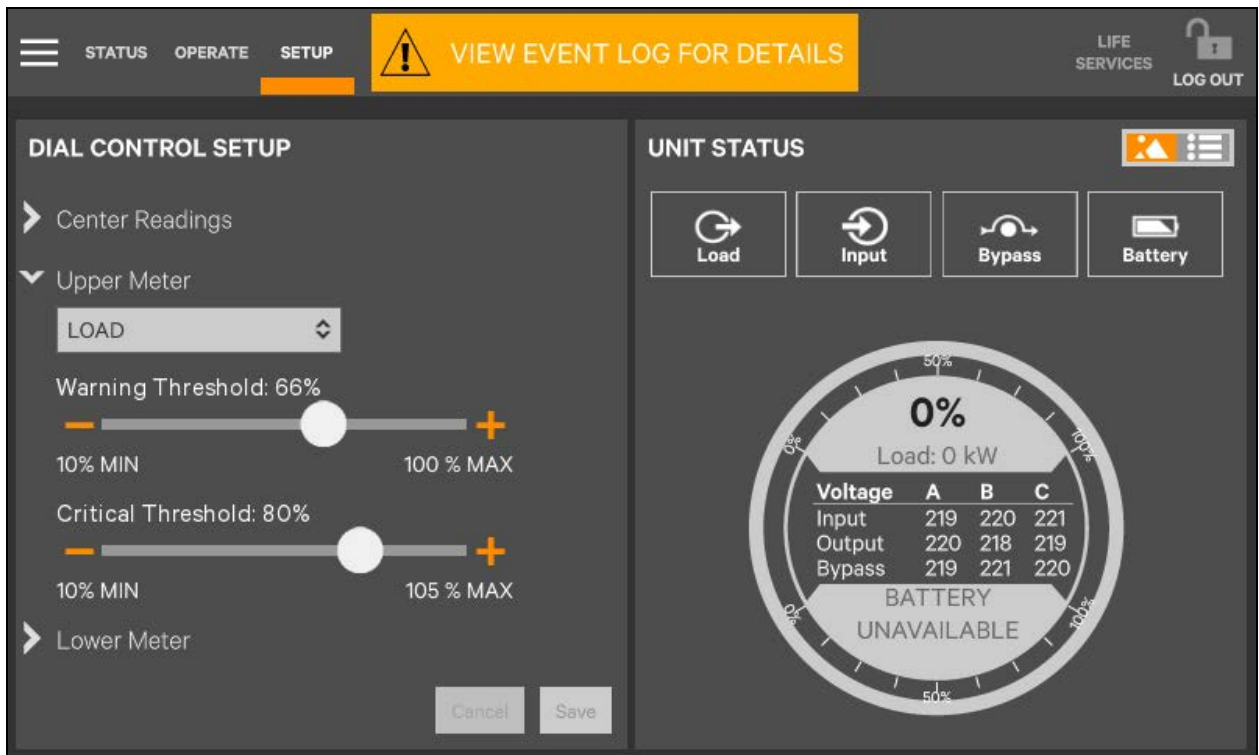
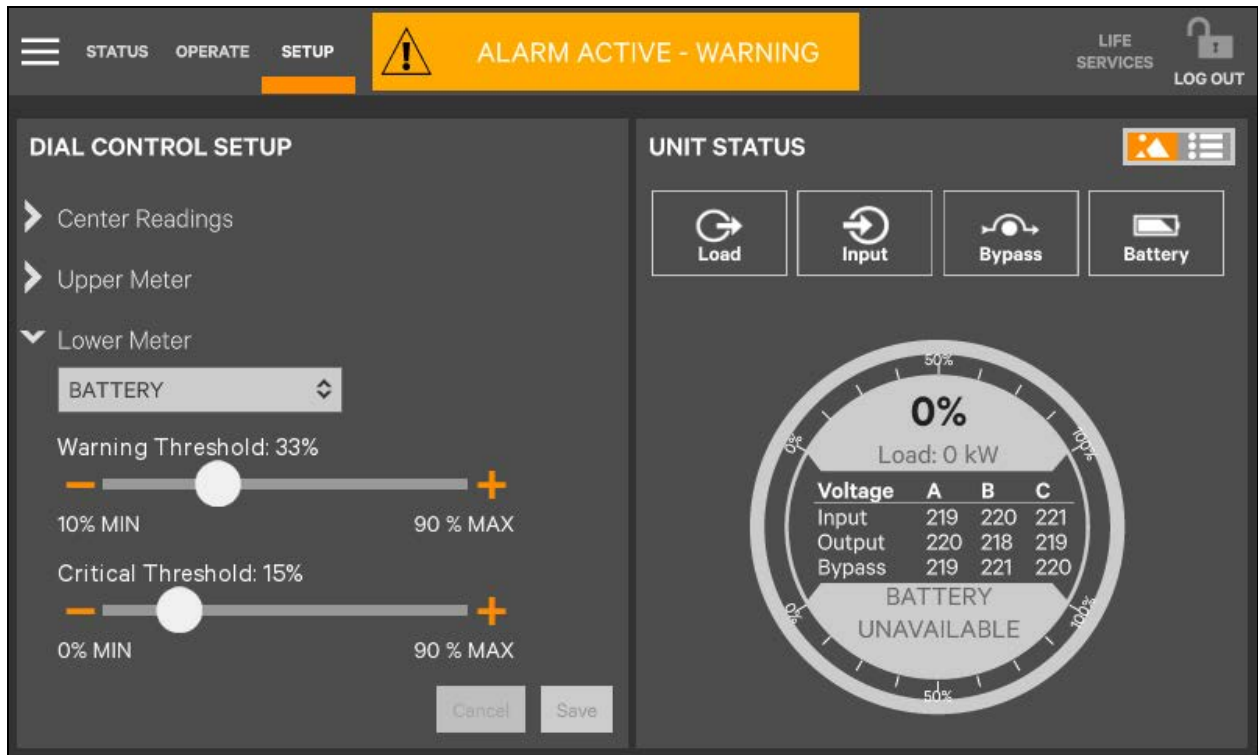


Figure 5.28 Status Gauge Setting Options_3



5.4.2 Viewing UPS data with the status panel

More detailed information about the UPS status is readily available through the Status panel. Touching a component in the graphic screen display brings up data about the component on another pane. Touching a parameter icon on the Unit Status pane shows details about that parameter.

The same data can be viewed by switching to the text view. The length of the lists and order of the details may require scrolling to find the desired data.

NOTE: A parameter must be visible on the graphic view of the Unit Status screen for details to be viewed, even in the text view.

Figure 5.29 Unit Status—Input Details

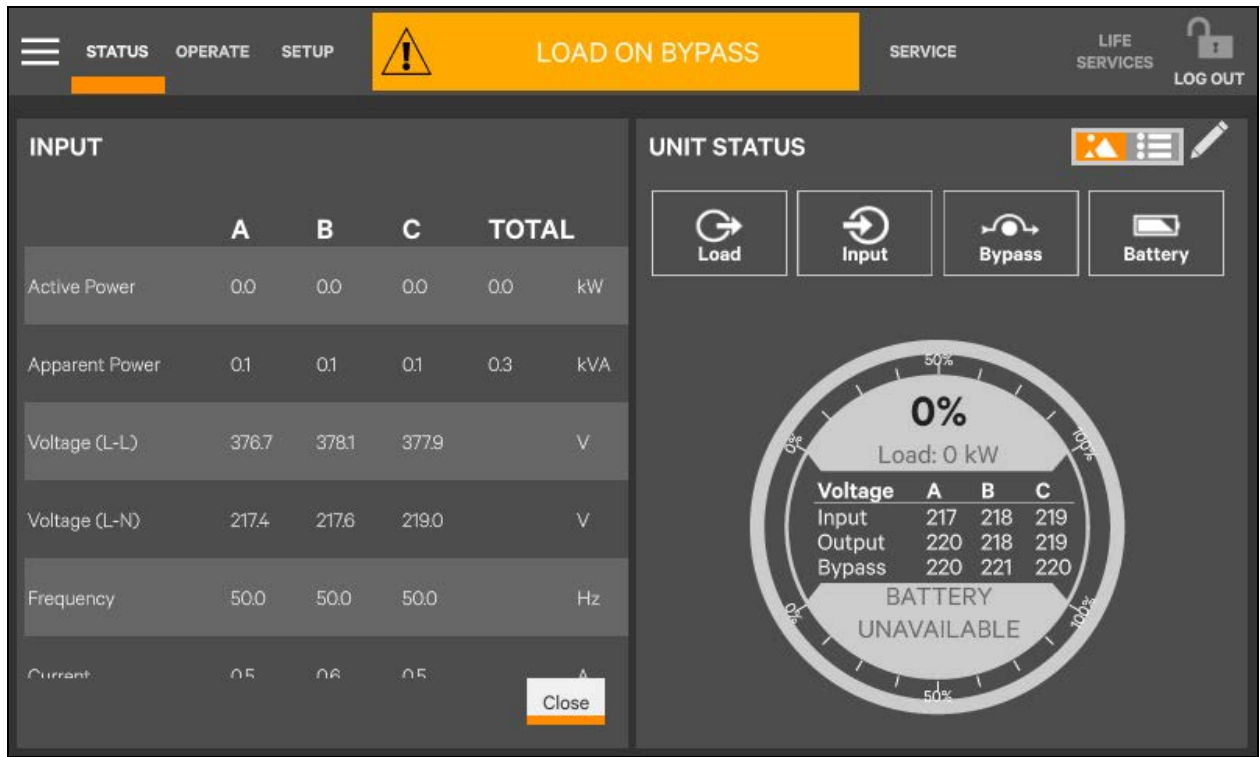


Figure 5.30 Input Details—Single System

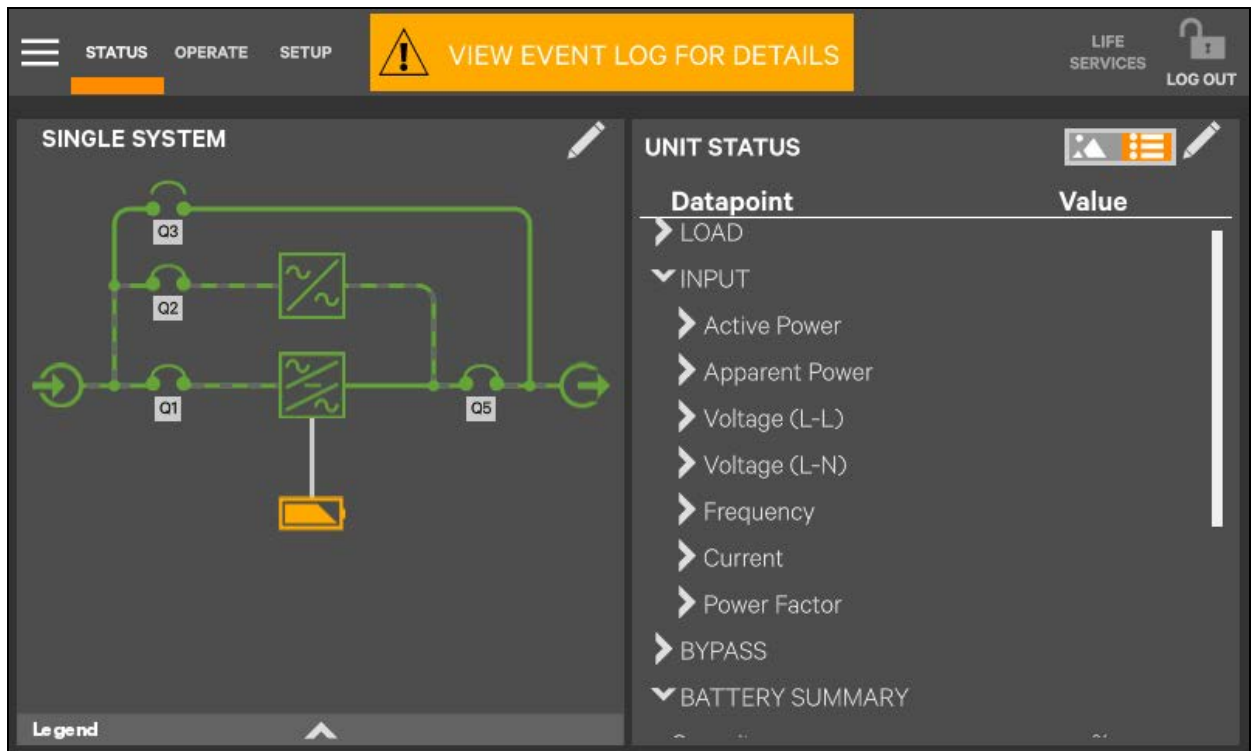


Figure 5.31 Unit Status—Bypass Details

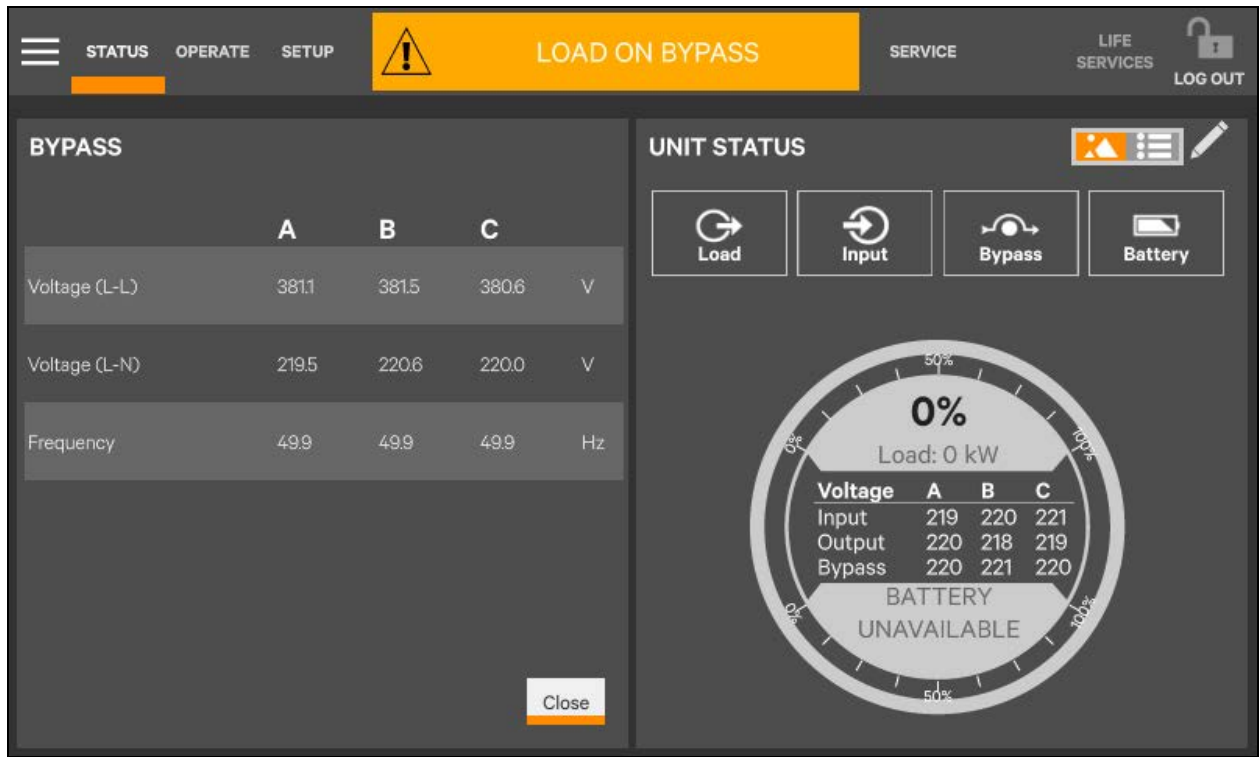


Figure 5.32 Bypass Details—Single System

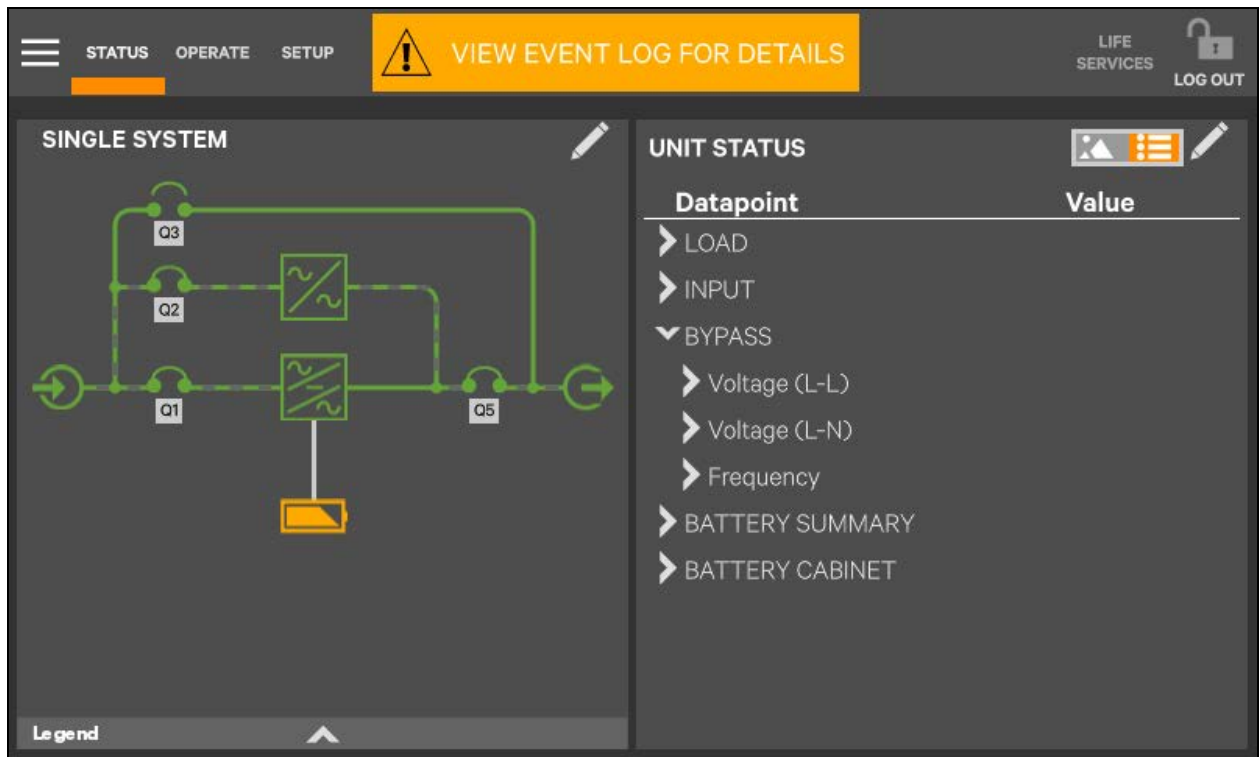


Figure 5.33 Unit Status—Battery Details

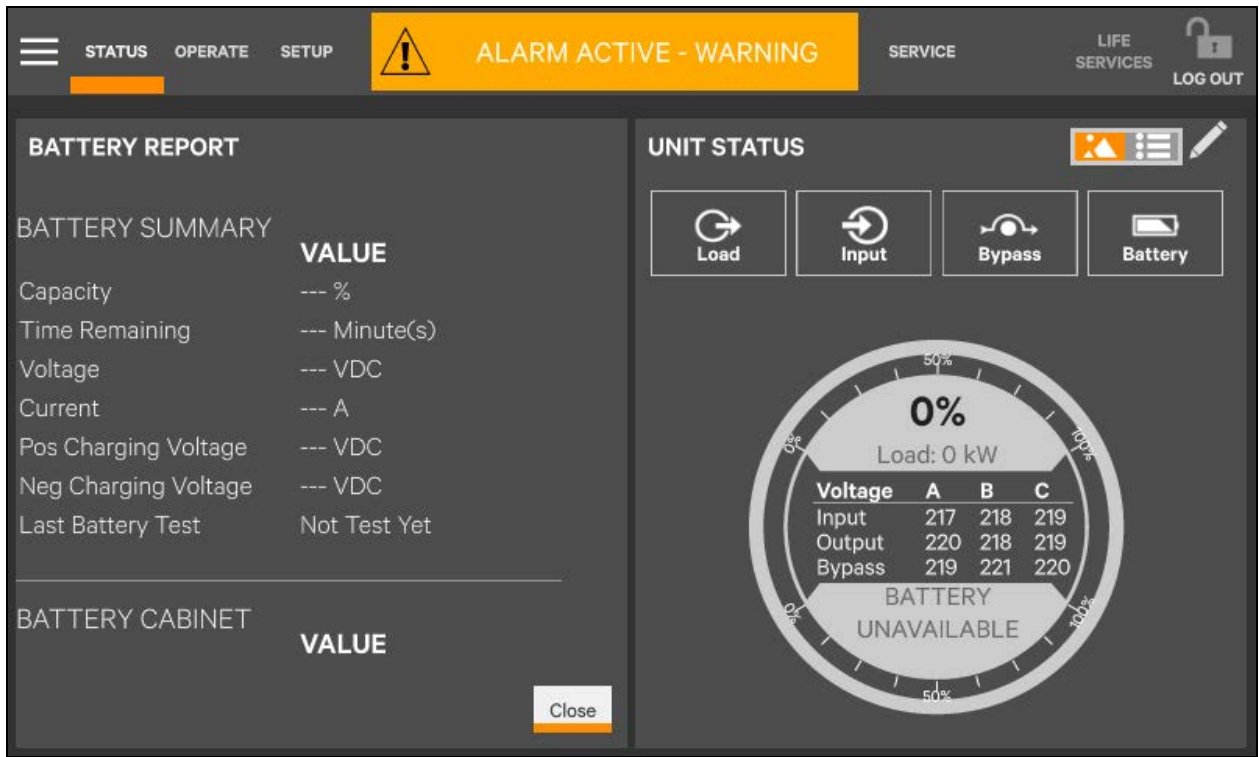


Figure 5.34 Battery Details—Single System

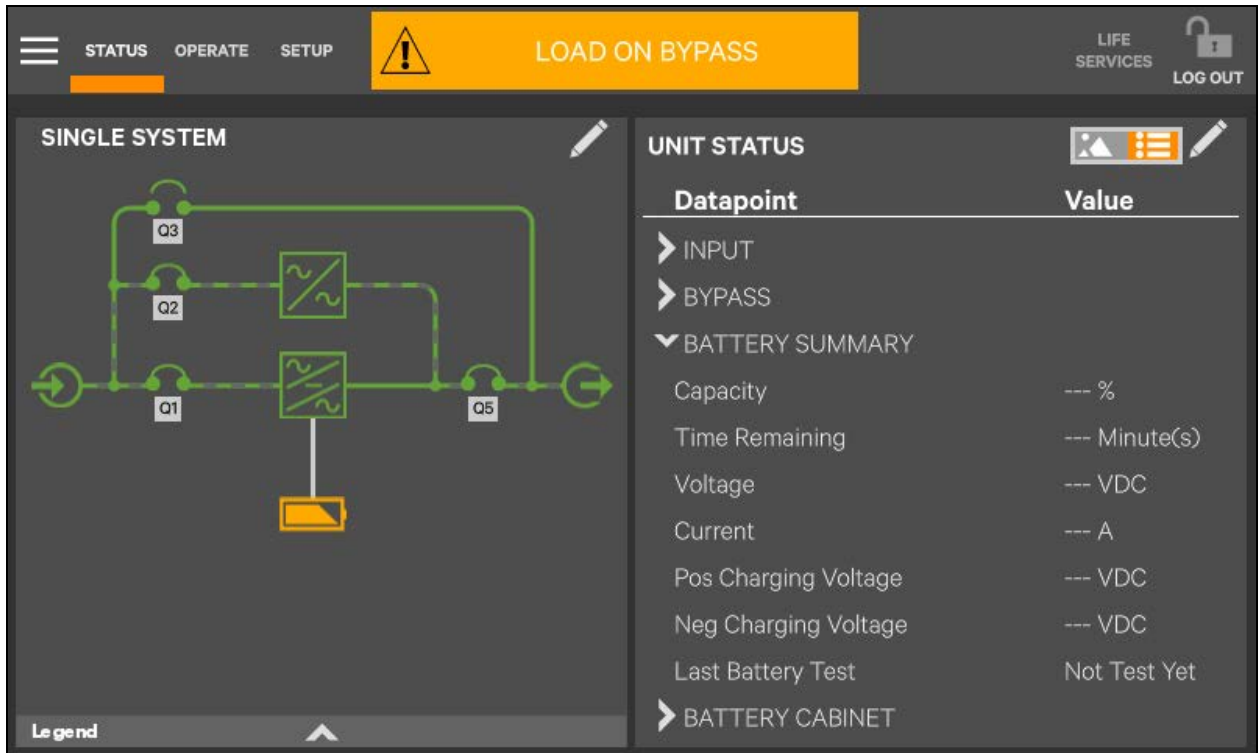


Figure 5.35 Unit Status—Load Details_1

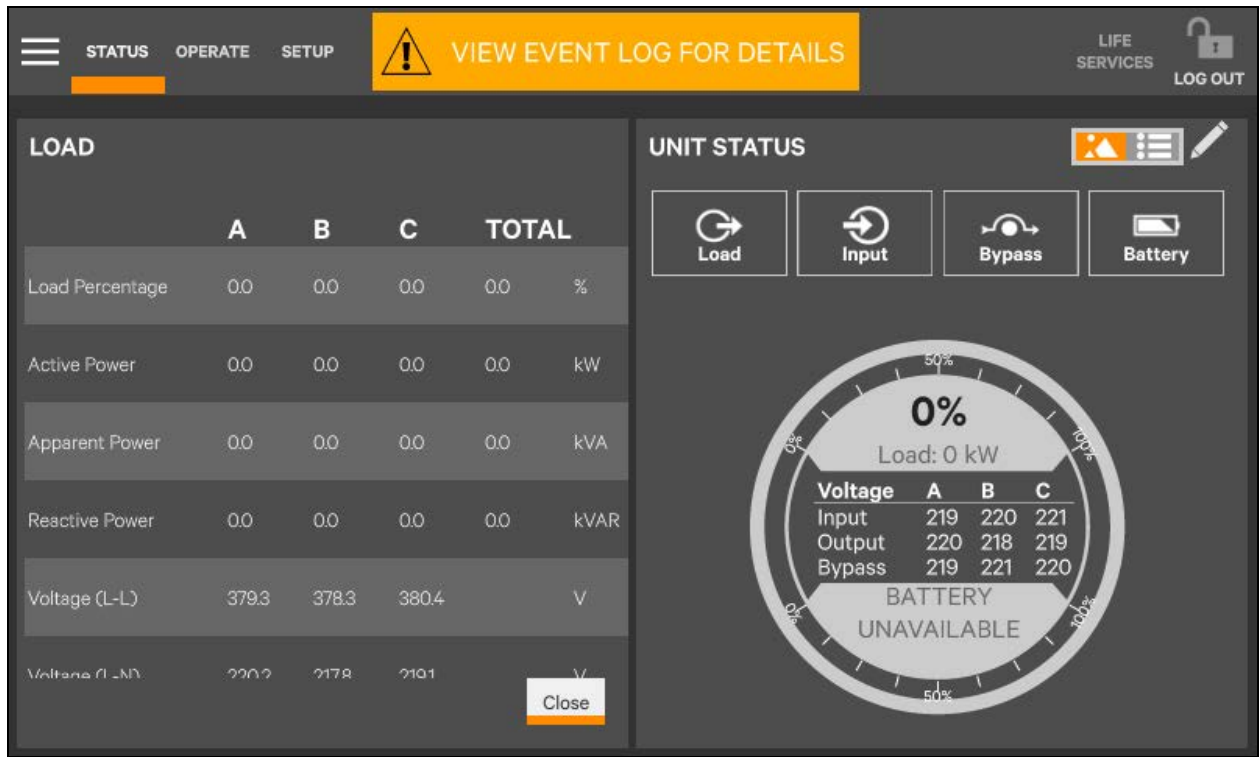
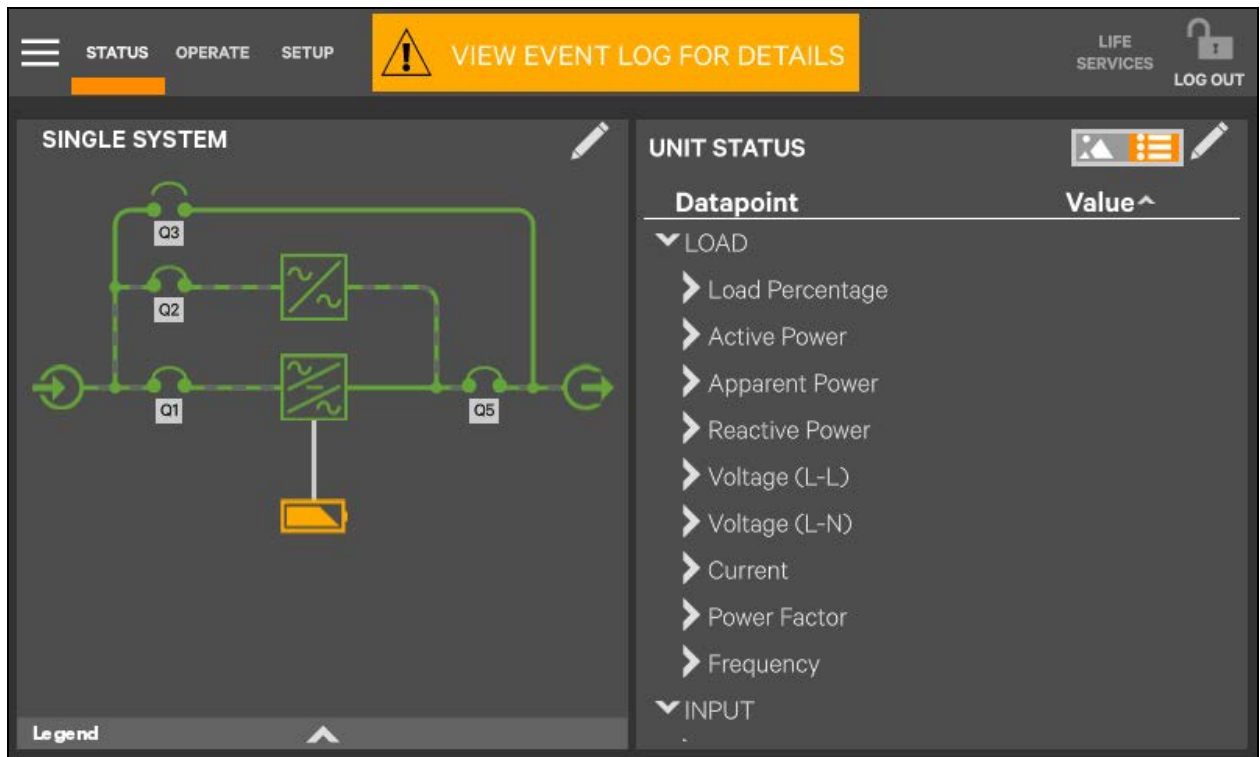



Figure 5.36 Unit Status—Load Details_2



5.4.3 Logs alarms and events

The Context Menu, when opened from the Status pane, permits viewing logs of alarms and events that have occurred on the UPS. Both logs include the date and time of occurrence, type, an ID, component affected and a description of the alarm or event. The information is available to Observers, those who are able to without a log in passcode.

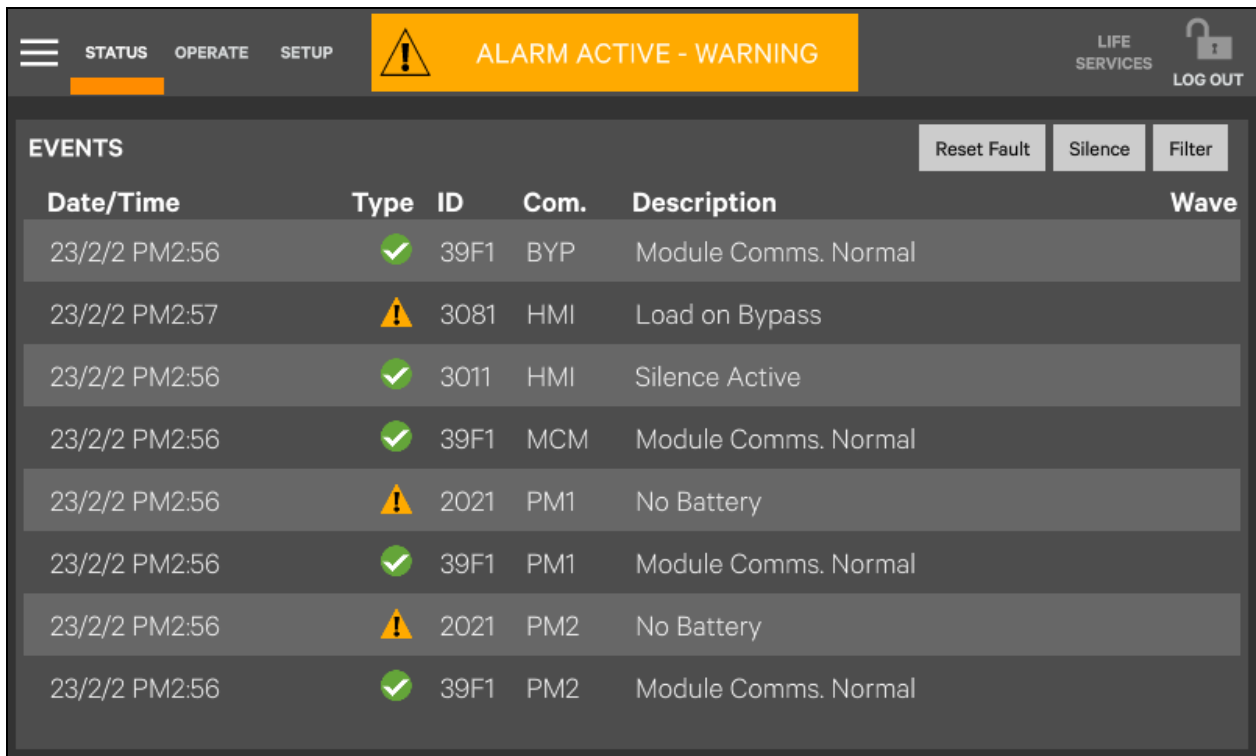
To view the alarms or events:

1. Navigate to the Status pane , if required.
2. Touch the Context Menu icon.
3. Touch the log to view, alarms or events. See **Figure 5.37** below.

Touch the logs to see the UPS event log screen.

Touch Alarms to open a list of alarms.

Figure 5.37 View Alarms or Events



EVENTS						Reset Fault	Silence	Filter
Date/Time	Type	ID	Com.	Description	Wave			
23/2/2 PM2:56	✓	39F1	BYP	Module Comms. Normal				
23/2/2 PM2:57	⚠	3081	HMI	Load on Bypass				
23/2/2 PM2:56	✓	3011	HMI	Silence Active				
23/2/2 PM2:56	✓	39F1	MCM	Module Comms. Normal				
23/2/2 PM2:56	⚠	2021	PM1	No Battery				
23/2/2 PM2:56	✓	39F1	PM1	Module Comms. Normal				
23/2/2 PM2:56	⚠	2021	PM2	No Battery				
23/2/2 PM2:56	✓	39F1	PM2	Module Comms. Normal				

EVENT LOG							Export	Filter
Date/Time	Type	ID	Status	Com.	Description	Wave		
23/2/2 PM2:57	Warning	3081	Set	HMI	Load on Bypass			
23/2/2 PM2:57	Critical	30B1	Clr	HMI	Load Off			
23/2/2 PM2:57	Critical	30B1	Set	HMI	Load Off			
23/2/2 PM2:57	Critical	39A1	Clr	HMI	Power Hardware Mismatch			
23/2/2 PM2:57	Info	10B1	Clr	PM2	Inverter in Setting			
23/2/2 PM2:57	Info	10B1	Clr	PM1	Inverter in Setting			
23/2/2 PM2:57	Info	1881	Clr	BYP	Bypass in Setting			

5.5 Viewing UPS Component Status

The graphic screen permits viewing details about the main components installed and configured in the UPS. The data list opens on the opposite side of the screen and, for most parameters, expands to show all details for the component touched.

The same component information is obtained by selecting Status and then selecting the Components menu.

Figure 5.38 Unit Status—Input Details

COMPONENTS

Status	Name
●	Input
●	Battery
●	Output
●	Bypass Module
●	Power Module 1
●	Power Module 2

COMPONENT DETAILS

Property	Value
Fault Number	0
Alarm Number	0
Voltage	217.1 217.4 219.0 V
Main Input Current	0.6 0.6 0.5 A
Frequency	50.0 50.0 50.0 Hz
Main Input Power Factor	0.00 0.00 0.00

Figure 5.39 Unit Status—Output Details

COMPONENTS

Status	Name
●	Input
●	Battery
●	Output
●	Bypass Module
●	Power Module 1
●	Power Module 2

COMPONENT DETAILS

Property	Value
Fault Number	0
Alarm Number	0
Status	Load on Bypass
Voltage	220.4 217.6 219.1 V
Current	0.0 0.0 0.0 A
Crest Factor	0.0 0.0 0.0
Frequency	49.9 49.9 49.9 Hz
Power Factor	0.00 0.00 0.00
Active Power	0.0 0.0 0.0 kW
Apparent Power	0.0 0.0 0.0 kVA
Reactive Power	0.0 0.0 0.0 kVAR
Load Percentage	0.0 0.0 0.0 %

Figure 5.40 Unit Status—Bypass Details

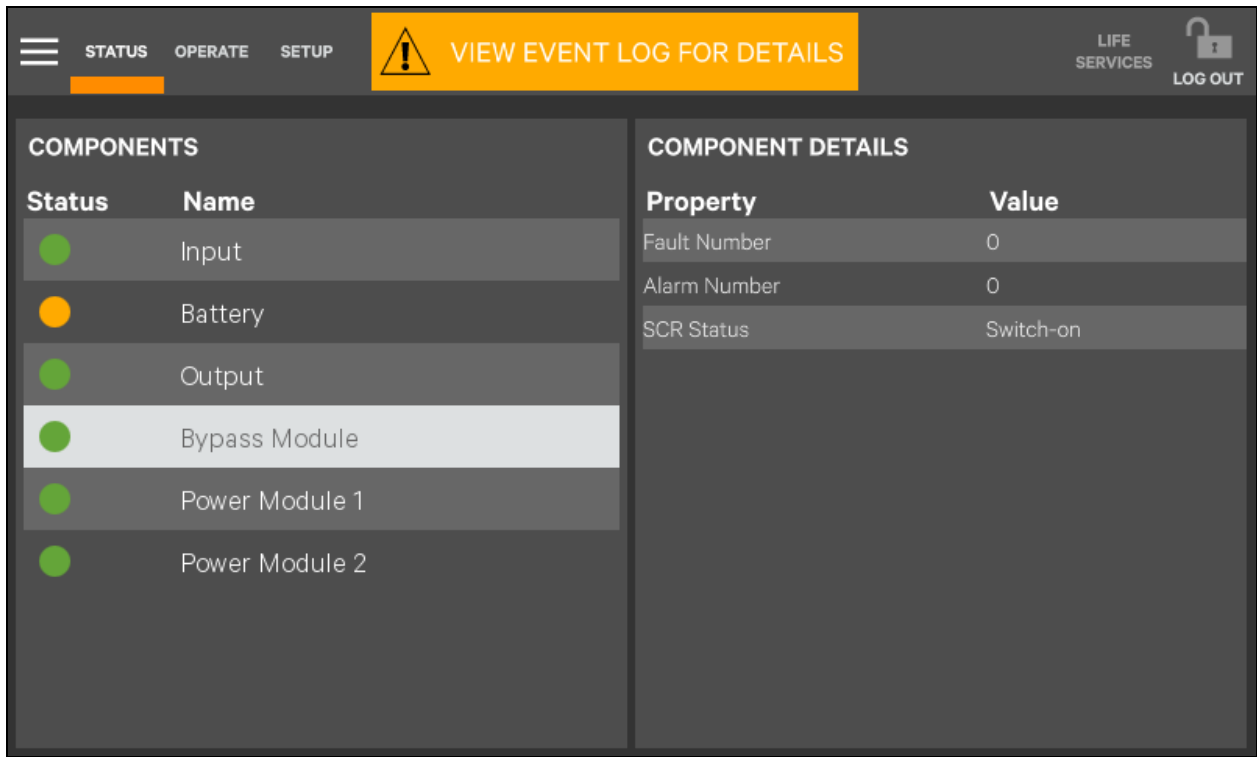


Figure 5.41 Unit Status—Power Module Details

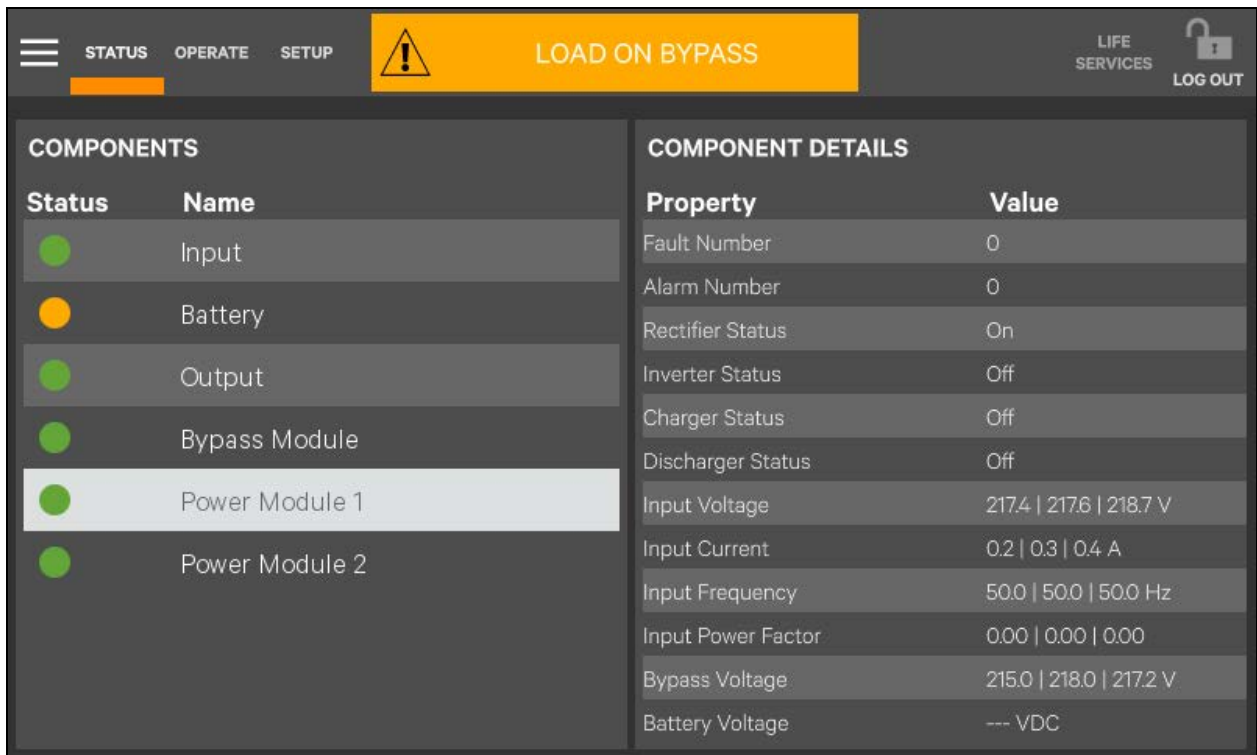


Figure 5.42 Unit Status—Battery Details

Status	Name
●	Input
●	Battery
●	Output
●	Bypass Module
●	Power Module 1
●	Power Module 2

Property	Value
Fault Number	0
Alarm Number	2
Status	Unavailable
Positive Charging Voltage	--- VDC
Negative Charging Voltage	--- VDC
Voltage	--- VDC
Current	--- A
Temperature	--- °C
Capacity	--- %
Time Remaining	--- Minute(s)
Discharge total time	1 Hour(s) 24 Minute(s)
Discharge times	62

5.6 Status Bar Component

The status bar indicates UPS status by:

- Scrolling messages to inform viewers. See [Status bar messages](#) below.
- Changing color. Color indicators are green for normal, yellow for warning, and red for alarm.
- Showing an icon inside the bar, shown in [Figure 5.43](#) below.

5.6.1 Status bar messages

Figure 5.43 Status Bar Messages



Up to 3 messages may scroll through the status bar to the right of the status icon. Each message will have a duration of 4 seconds, except they change immediately if the system's status changes.

Table 5.1 Normal Status Messages

Message 1	Message 2	Message 3	Definition
Load on inverter	Frequency converter mode active	Output frequency X Hz	This system is in normal operating mode, supplied by the inverter and operating as a frequency converter.
Load on inverter	Energy saving mode active	/	This system is in normal operating mode, supplied by the inverter, and has one of the energy saving modes active.
Load on inverter	Operation normal	/	This system is in normal operating mode, supplied by the inverter, and has no special configurations.
Load on bypass	Energy saving mode active	/	This system is in normal operating mode, supplied by the bypass, and has one of the energy saving modes active.
Load on battery	Battery test in progress	/	This system is in normal operating mode, supplied by the inverter via the battery, and a battery test is actively running.
Load off	Energy saving mode active	/	This system is in normal operating mode, load not supplied by this unit, and has one of the energy saving modes active.
Load on inverter	Test mode active	/	This system is in normal operating mode, for the test mode that is activated.

Table 5.2 Warning Status Messages

Message 1	Message 2	Message 3	Definition
Load on inverter	Output overload	/	This system is in warning operating mode, supplied by the inverter, and the system is in overload. This means the system will go off inverter at some point.
Load on inverter	Alarm active – Warning	View alarm log for details	This system is in warning operating mode, supplied by the inverter, and has an active warning. This means the system is operating, but something was detected to be outside of normal.
Load on bypass	Load manually transferred to bypass	Load unprotected	This system is in warning operating mode, supplied by the bypass. The user transferred the load to the bypass so the system cannot protect itself from source variations.
Load on battery	X minutes remaining	/	This system is in warning operating mode, supplied by the inverter via the battery. There are X minutes of calculated run time remaining. This is used before the battery low voltage warnings are generated.
Load on bypass	Alarm active – Warning	View alarm log for details	This system is in warning operating mode, supplied by the bypass, and has an active warning. This means the system is operating after a transfer to bypass and something was determined to be outside normal range.
Load on inverter	Energy saving mode active	Alarm active – Warning	This system is in warning operating mode, supplied by the inverter, one of the energy saving modes is active, and has an active warning. This means the system is operating, but something was determined to be outside normal range.
Load on bypass	Energy saving mode active	Alarm active – Warning	This system is in warning operating mode, supplied by

Table 5.2 Warning Status Messages (continued)

Message 1	Message 2	Message 3	Definition
			the bypass, one of the energy saving modes is active, and has an active warning. This means the system is operating, but something was determined to be outside normal range.
Load off	Energy saving mode active	Alarm active – Warning	This system is in warning operating mode, load off, one of the energy saving modes is active, and has an active warning. This means the system is operating, but something was determined to be outside normal range.
Load on inverter	Test mode active	Alarm active – Warning	This system is in warning operating mode, supplied by the inverter, running in a system test mode, and has an active warning. This means the system is in TEST MODE, and something was determined to be outside normal test operations.
Load on bypass	Test mode active	Alarm active – Warning	This system is in warning operating mode, supplied by the bypass, running in a system test mode, and has an active warning. This means the system is in TEST MODE, and something was determined to be outside normal test operation.
Load on battery	Test mode active	Alarm active – Warning	This system is in warning operating mode, supplied by the battery, running in a system test mode, and has an active warning. This means the system is in TEST MODE, and something was determined to be outside normal test operations.
Load on inverter	Frequency converter mode active	Alarm active – Warning	This system is in warning operating mode, supplied by the inverter, operating as a frequency converter, and has an active warning. This means the system is operating, but something was determined to be outside normal range.

Table 5.3 Critical Status Messages

Message 1	Message 2	Message 3	Definition
Load on inverter	Output overload	Transfer to bypass pending	This system is in critical operating mode, supplied by the inverter, and the load is about to be transferred to the bypass due to overload timeouts.
Load on inverter	Alarm active – Critical	View alarm log for details	This system is in critical operating mode, supplied by the inverter. There is a critical fault in the system that the user needs to view.
Load on bypass	Load Automatically transferred to bypass	View alarm log for details	This system is in critical operating mode, supplied by the bypass. The system moved the load to the bypass due to a critical fault in the system.
Load on bypass	Alarm active – Critical	View alarm log for details	This system is in critical operating mode, supplied by the bypass. The system is running on bypass not due to auto transfer, and a critical fault is active in the system.
Load on battery	X minutes remaining	Load shutdown imminent	This system is in critical operating mode, supplied by the inverter via the battery. The battery is extremely low and the load will turn Off or transfer to bypass soon.
Load off	Alarm active – Critical	View alarm log for details	This system is in critical operating mode, load not

Table 5.3 Critical Status Messages (continued)

Message 1	Message 2	Message 3	Definition
			supplied by this unit. The load is not supplied for any reason and a critical fault is active.
Load off	/	/	This system is in critical operating mode, load not supplied by this unit. The load is not supplied and no active fault is present.
Load on battery	Alarm active – Critical	View alarm log for details	This system is in critical operating mode, supplied by the battery. The system is running on inverter via the battery, is not in imminent shutdown and a critical fault is active in the system.
Load off	Service mode active	/	This system is Off with a service mode active.
Load on inverter	Energy saving mode active	Alarm active – Critical	This system is in critical operating mode, supplied by the inverter. The system is running on inverter, with an energy saving mode active and a critical fault is active in the system.
Load on bypass	Energy saving mode active	Alarm active – Critical	This system is in critical operating mode, supplied by the bypass. The system is running on bypass, with an energy saving mode active and a critical fault is active in the system.
Load off	Energy saving mode active	Alarm active – Critical	This system is in critical operating mode. The system is NOT running, with an energy saving mode active and a critical fault is active in the system.
Load off	Test mode active	/	This system is off with a TEST MODE active.
Load on inverter	Test mode active	Alarm active – Critical	This system is in critical operating mode, supplied by the inverter, running in a system test mode, and has an active fault. This means the system is in TEST MODE and something critical was determined to be outside normal test operations.
Load on bypass	Test mode active	Alarm active – Critical	This system is in critical operating mode, supplied by the bypass, running in a system test mode, and has an active fault. This means the system is in TEST MODE, and something critical was determined to be outside normal test operation
Load on battery	Test mode active	Alarm active – Critical	This system is in critical operating mode, supplied by the inverter via the battery, running in a system test mode, and has an active fault. This means the system is in TEST MODE, and something critical was determined to be outside normal test operation.

Table 5.3 Critical Status Messages (continued)

Message 1	Message 2	Message 3	Definition
Load off	Test mode active	Alarm active – Critical	This system is in critical operating mode, with LOAD OFF, running in a system test mode, and has an active fault. This means the system is in TEST MODE, and something critical was determined to be outside normal test operation.
Load on inverter	Frequency converter mode active	Alarm active – Critical	This system is in critical operating mode, supplied by the inverter, operating as a frequency converter, and has an active fault. This means the system is operating, but something critical was determined to be outside normal range.
Load off	Frequency converter mode active	Alarm active – Critical	This system is in critical operating mode, load NOT supplied, operating as a frequency converter and has an active fault. This means the system is operating, but something critical was determined to be outside normal range.

5.7 Alarm List

Table 5.4 below provides the complete list of UPS alarm messages that display either on the Event menu or on the Records menu.

Table 5.4 Alarm List

Alarm	Explanation
Input Phase Reversed	The AC input phase rotation is reversed.
Input Voltage Abnormal	The mains voltage is outside specifications and results in rectifier shutdown.
Input Freq. Abnormal	The mains frequency is outside specifications and results in rectifier shutdown.
Input Undervoltage	At least one phase main input voltage is within 132 V to 176 V, thus the load should be derated.
Input Fuse Fail	The main circuit input fuse of the module is disconnected.
Input Backfeed	Battery voltage fed back to rectifier input.
Input Current Abnormal	Battery load sharing imbalance or rectifier input current abnormal.
Input Current Limit	Input current over limit.
Input Neutral Missing	AC rectifier input neutral line not detected.
Rectifier Fault	Rectifier failure (bus voltage is too high or too low, or battery discharge SCR short circuit).
Rec. Soft Start Fail	Owing to low DC bus voltage, the rectifier will report this alarm.
Rectifier in Setting	The rectifier starts up and is in synchronization.
Inverter Fault	The inverter starts up and is in synchronization.
DC Bus Abnormal Shutdown	The DC bus voltage is abnormal and results in inverter shutdown. The load transfers to bypass.
DC Bus Overvoltage	The rectifier, inverter and battery converter shut down because the DC bus voltage is too high. The load transfers to bypass.
Load Impact Transfer	A transfer to bypass occurred due to a large step load. The UPS can recover automatically. Turn on the load equipment in stages to reduce the load impact on the inverter.

Table 5.4 Alarm List (continued)

Alarm	Explanation
Excess Auto Rexfers	The load remains on bypass power owing to excessive number of transfers that occurred within the one hour.
Excess ECO Auto Xfers	The load remains on bypass power owing to excessive number of transfers that occurred within the one hour.
Other Module Xfer	All UPSs in the parallel system transfer to bypass at the same time when one of them needs to transfer to bypass. This message appears on the touchscreen of the UPS with passive transfer to bypass.
Load Sharing Abnormal	The UPSs in a parallel system are not sharing the load current correctly.
Byp. Abnormal Shutdown	Both the bypass and inverter voltages are abnormal, and the output is off.
Inverter in Setting	The inverter parameters of this machine are being monitored and synchronized.
Inverter Asynchronous	The output voltage and bypass voltage are misaligned in phase. This alarm resets automatically once the condition is no longer true.
Inverter Relay Fail	At least one of the inverter relays is opened or shorted. This fault is locked until mains power off
Overvoltage N-GND	The neutral ground voltage is too high. Check whether the output wiring is shorted to the chassis.
Bypass Abnormal	The amplitude or frequency of the bypass voltage exceeds the limit. This alarm automatically resets once the bypass voltage returns to normal.
Bypass Phase Reversed	The phase rotation of the bypass voltage is reversed.
Bypass Out of Sync	The bypass voltage and frequency are not within the set tracking range.
Bypass overcurrent	The bypass current is outside the rated current.
Bypass STS Fail	At least one of the STSs at the bypass side is open or shorted. This fault is locked until power off.
Other Bypass STS Fail	The adjacent bypass STS open circuit fault or short circuit fault.
Bypass backfeed	The bypass backfeed is faulty.
Bypass Overtemperature	The bypass has overtemperature.
Bypass in Charge	The bypass detects an inverter signal when the system runs normally. When the output voltage is abnormal, the system will transfer to bypass mode for power supply .
Bypass in Setting	The bypass module is initialized and synchronized.
Bypass Not Available	In generator mode, the bypass output is disabled.
Bypass Overcurrent Timeout	When the bypass overload delay time expires, the bypass is closed.
Bypass Fuse Fail	Bypass Fuse Fail
Charger Fault	Battery charger has failure.
Battery Reversed	Reconnect battery and check battery wiring.
No battery	The battery is not connected, check the battery insurance, check the battery and battery wiring.
Battery Overtemp.	The battery temperature is over limit.
Battery Maintain	The battery maintenance is required.
Low Battery	Before the EOD, battery low pre warning will occur. After this pre-warning, the battery will have the capacity for 3 min discharging with full load. The time is user-settable from 3 min to 6 min.
Batt. End of Discharge	Inverter turned off due to battery EOD.

Table 5.4 Alarm List (continued)

Alarm	Explanation
Battery Ground Fault	Battery has ground fault
Batt. Room Temp. Abn.	Battery room has overtemperature (option included).
Battery Switch Box Open	Battery battery switch box is opened
Battery Switch Box Closed	Battery battery switch box is closed
Battery Switch Box Status Abnormal	Logic conflict between battery switch box drive signal and backfeed signal.
Battery Reset	The battery related aging coefficient capacity information is reset, which occurs when changing battery related configuration information or manually resetting the battery.
Battery Terminal Abnormal	There are signs of short circuit on the positive and negative terminals of the battery. Check the battery wiring, battery and machine ports, check the battery insurance, and see if there is any trace of short circuit and arcing.
Discharger Curr. Limit	Discharge current is over limit, close the discharger
Internal Battery Switch Open	The auxiliary contact of the internal battery air switch is disconnected.
Discharger Fault	Bus voltage abnormal
Balance Circuit Fault	The balance circuit cannot stabilize the positive and negative bus voltage difference.
Balance Circuit Overcurrent	Balance circuit current exceeds wave by wave current limit.
Charger Shutdown	Dry contact signal, the dry contact gives the charger shutdown command, and the charger will shut down.
Battery Voltage High	When the battery is connected, it is detected that the battery voltage exceeds the high voltage range. Check if the battery terminal voltage is out of the normal range.
Battery Deep Discharge Alarm	In CPSS applications, the battery discharge reaches the termination voltage, the battery stops discharging, and the inverter shuts down.
Battery Voltage Low	The battery voltage is too low, which is caused by the wrong configuration of the number of battery cells or a problem with the battery.
Batt. Temp Sensor Abnor.	The difference of the battery temperature detection point is too large, or the temperature detection is out of range, or the temperature detection communication is abnormal.
Discharger Shutdown	The arrester needs to be turned off in the case of non arrester failure, and the arrester needs to be turned off if the joint power supply state is not required.
Output Overload	This alarm appears when the load arises above 105% of the nominal rating. The alarm automatically resets once the overload condition is removed.
Out. Overload Timeout	The UPS overload status continues and the overload times out. When the time has expired, the load automatically transfers to the bypass.
Output Fuse Fail	At least one of the inverter output fuses is blown.
Output Volt. Abnormal	At least one phase of the output voltages is abnormal.
Output Fuse Fail	At least one phase module inverter relay or open fuse fault.
Output Voltage Abnormal	Abnormal output voltage of at least one phase.
Fault Clear	Operator control panel fault clear command options.
Silence Active	Operator control panel alarm mute command options.
Silence Inactive	SILENCE ON/OFF key on the operator control and display panel pressed in alarm silence state.

Table 5.4 Alarm List (continued)

Alarm	Explanation
Inverter Manual On	INVERTER ON key on the operator control and display panel pressed to turn on the inverter.
Inverter Manual Off	INVERTER OFF key on the operator control and display panel pressed to turn off the inverter.
Autostart	After UPS shutdown at EOD, the inverter automatically starts upon mains restoration.
EPO	EPO button on operator control and display panel pressed or external EPO command received.
Load on Bypass	UPS is in bypass mode
Load on Inverter	The UPS is in normal mode, that is, the input is in the main power supply mode, and the output is in the inverter power supply mode.
Load on Battery	The UPS is in battery power supply mode, that is, the input is in battery discharge mode, and the output is in inverter power supply mode.
Load Off	The UPS shuts down, and the bypass and inverter have no output.
Output Disabled	EOD event happened. Check the battery voltage.
Automatic Battery Test	Regular automatic battery maintenance discharge test in progress (20% capacity discharge).
Calibrated Battery Test	The user starts the battery capacity discharge test (100% capacity discharge).
Manual Battery Test	User initiates battery maintenance discharge test (20% capacity discharge).
Rectifier DSP Update	Upgrading rectifier DSP software.
Inverter DSP Update	Inverter DSP software is being upgraded.
Inverter FPGA Update	Upgrading inverter FPGA software.
Bypass DSP Update	Upgrading bypass DSP software.
Bypass FPGA Update	Upgrading bypass FPGA software.
HMI Update	Upgrading monitoring software.
Remote Turn On	Turn on the inverter through the service command.
Remote Turn Off	Turn off the inverter through the service command.
Batt. Equalize Charge	The battery is forced to be in boost charge state.
Equalize Chg. Timeout	The actual float charging time exceeds the time set by the setting software.
Battery Test Fail	Battery test failed.
Battery Test Stopped	Battery test stopped.
Load on Maintenance Bypass	The maintenance bypass is closed and the load is supplied.
Inverter On Cancel	Inverter on cancel
Inverter On Fail	Power on failure, possibly due to invalid operation (eg service switch closed), DC bus or rectifier not ready.
MonCAN Comms. Abnormal	Communication failure between internal supervisory board and inverter, rectifier, bypass.
ParaMonCAN Comms. Abnormal	Communication failure between internal inverter, rectifier, bypass.
PowerCAN Comms. Abnormal	ParaPowerCAN communication between bypass and bypass fails.
Discrete Bus Comms. Abnormal	The discrete bus communication in the rack is abnormal, it is recommended to check whether the communication cable connection on the back of the rack is reliable.

Table 5.4 Alarm List (continued)

Alarm	Explanation
ParaDiscrete Bus Comms. Abn.	The discrete CAN communication between the bypass and the bypass fails, it is recommended to check the parallel cable and the bypass board.
Batt. System Comms. Abnor.	The MODBUS communication between UPS and BMS is abnormal.
Ambient Overtemperature	Ambient temperature over-temperature detection, can be set.
Control Power Fail	Auxiliary power failure or brownout.
Fan Abnormal	At least one power module fan has failed.
Bypass SCR Fan Abnormal	At least one bypass module fan has failed.
Operation Invalid	User operation error (for example, the maintenance switch is closed when the inverter is outputting in parallel, the output switch and the maintenance switch are closed after the inverter is turned on, etc.).
On Generator	Dry contact signal, indicating that the generator is connected.
Input Switch Open	Input circuit breaker is disconnected.
Maint. Switch Open	Maintenance switch disconnected.
QBP Open	External maintenance circuit breaker disconnected.
QOP Open	External maintenance isolation circuit breaker disconnected.
Maint. Switch Closed	Maintenance switch closed.
QBP Closed	External maintenance circuit breaker closed.
Output Switch Open	Output switch open.
QE Open	The external output circuit breaker is disconnected.
Bypass Switch Open	Bypass switch open.
System Interrupt Transfer	Intermittent switching is performed when the bypass is super tracking and the inverter is not phase locked
Parallel Cable Abnormal	Parallel cable connection is abnormal.
LBS Cable Abnormal	Abnormal LBS cable connection.
Loss of Redundancy	Loss of redundant capacity.
MMS Capacity Exceeded	When the output load of the N+X parallel system is greater than N, the alarm prompts that the input and output switches and cables are bearing more than the designed rated power.
LBS Active	LBS is enabled.
LBS Abnormal	LBS is abnormal.
Rectifier DSP SW Error	There is an error in the DSP program of the rectifier control board. It may be that other programs such as inverter or bypass DSP have been recorded.
Inverter DSP SW Error	There is an error in the DSP program of the inverter control board. It may be that other programs such as rectification or bypass DSP have been recorded.
Inverter FPGA SW Error	There is an error in the FPGA program of the inverter control board. It may be that other programs such as the bypass FPGA have been recorded.
Bypass DSP SW Error	There is an error in the DSP program of the bypass control board. It may be that other programs such as rectification or inverter DSP have been recorded.
Bypass FPGA SW Error	There is an error in the FPGA program of the bypass control board. It may be that other programs such as the

Table 5.4 Alarm List (continued)

Alarm	Explanation
	inverter FPGA have been recorded.
Power Hardware Mismatch	The model information set in the background is inconsistent with the actual.
Parameter Config. Fail	DSP configuration EEPROM operation failed, or MON failed to deliver DSP parameters.
Input Transf. Overtemp	Input Transformer Overtemperature.
Module Overtemperature	The rectification and inverter power tubes in the module are overheated.
Charger Overtemperature	The power tube of the charger in the module is overheated.
Balance Circuit Overtemp	Balance circuit power tube radiator over temperature.
Module in Sleeping	When the module is in sleep mode, the inverter does not work. Only the machines with smart parallel mode or smart parallel demonstration mode have this state.
Module Comms. Normal	Monitor and module communication is normal.
ECO Mode Enabled	The machine is configured in ECO mode.
ECO Mode Active	The machine works in ECO mode.
Intell. ECO Mode Enabled	The machine is configured in smart ECO mode.
Intell. ECO Mode Active	The machine works in intelligent ECO mode.
Intell. ECO Mode Demo Enabled	The machine is configured in smart ECO demo mode.
Intell. ECO Mode Demo Active	The machine works in the smart ECO demo mode.
Freq. Converter Mode Enabled	The machine is configured in frequency converter mode.
Freq. Converter Mode Active	The machine works in inverter mode.
IP Mode Enabled	The machine is configured in intelligent parallel mode, that is, sleep mode.
IP Mode Active	The machine works in intelligent parallel mode, that is, sleep mode.
IP Mode Demo Enabled	The machine is configured as an intelligent parallel demonstration mode, that is, a sleep demonstration mode.
IP Mode Demo Active	The machine works in the intelligent parallel demonstration mode, that is, the sleep demonstration mode.
Regen. Mode Enabled	The machine is configured in self aging mode.
Regen. Mode Active	The machine works in self aging mode.
Testing Mode Enabled	The machine is configured in commissioning mode.
Testing Mode Active	The machine is working in commissioning mode.
Pwr. Conditioner Mode Enabled	The machine is configured in power regulator mode.
Pwr. Conditioner Mode Active	The machine works in power regulator mode
MMS Inv. Manual Off	There is a machine that presses the manual shutdown button, and chooses to shut down the parallel system uniformly.
MMS Inv. Manual On	There is a machine that presses the manual start button, and selects the parallel system to start at the same time.
By. Mod. Unauthorized	The bypass module is not authorized, and the bypass cannot work. Please contact the manufacturer's customer service to obtain relevant authorization.

Table 5.4 Alarm List (continued)

Alarm	Explanation
Pwr. Mod. Unauthorized	The power module is not authorized, the module cannot work, please contact the manufacturer's customer service to obtain the relevant authorization.
HMI Unauthorized	The monitoring is not authorized, the machine cannot work, please contact the manufacturer's customer service to obtain the relevant authorization.
Mod. Unauthorized	Power module ready lock not ready.
Suspend ECO Mode	It is forbidden to work in ECO mode, UPS gives priority to inverter power supply, and comes from configurable input dry contact control commands.
Out of Warranty	When the equipment is out of warranty, it will prompt according to the expiration time set on the UPS panel.
Time for Service	The service time is up, according to the service time reminder set by the UPS panel.
DC Cap Life Pre-warning	The bus capacitor life is about to expire, according to the bus life reminder set on the UPS panel.
DC Cap Life Warning	The bus capacitor life has expired, according to the bus life reminder set on the UPS panel.
Fan Life Pre-warning	The fan life of the power module is about to expire, according to the bus life prompt set on the UPS panel.
Fan Life Warning	The service life of the fan of the power module has expired, according to the bus service life prompt set on the UPS panel.
Bypass Fan Life Pre warning	The bypass fan life is about to expire, according to the bus life reminder set on the UPS panel.
Bypass Fan Life Warning	The life of the bypass fan has expired, according to the bus life prompt set on the UPS panel.
Batt. System Abnormal	There is an alarm or an alarm event is detected in the BMS.
Batt. System Fault	There is a fault or a fault event is detected in the BMS.

6 Single UPS Operation

This chapter briefly describes the operating precautions and routine operations for the APM2 UPS single module. For the operating precautions and routine operating methods of UPS parallel system, refer to [Parallel System and LBS System](#) on page 137.

6.1 Introduction

6.1.1 Precautions

NOTE: The user can perform the next operation only after the authorized engineer completes the first power ON and test of the UPS.



WARNING! Risk of electric shock and hazardous voltage of mains system and battery. The improper operation can cause equipment damage, personnel injury or death. The AC input and output terminals of the UPS have dangerous voltage. If the cabinet is equipped with an EMC filter, the filter may have dangerous voltage.

There are no operator serviceable parts are located behind the covers that require a specific tool for removal. Only a qualified service engineer can remove the covers.

1. For the detail operation procedure of the control keys and touch screen, refer to [Operator Control and Display Panel](#) on page 57.
2. The audible alarm sounds at various points during operation procedures. The alarm canceled at any time by pressing the SILENCE ON/OFF key.
3. When UPS uses traditional lead acid battery, the system provides boost charge optional function. If the lead acid battery is used, when the mains returns after an extended mains failure, the charging voltage of the battery will be higher than the normal charging voltage. This is normal, and the charging voltage of the battery will return to normal value after a few hours charging.

6.1.2 Power switch

The power switches are inside the Vertiv™ Liebert® APM2 UPS cabinet, that can be accessed by opening the front door of the UPS as shown in [Figure 6.1](#) on the next page and [Figure 6.2](#) on page 105, which includes the below switches:

- Q1 Rectifier input switch which connects the UPS to the main circuit power.
- Q2 Bypass input switch which connects UPS to the bypass.
- Q3 Maintenance bypass switch (with error proof operation buckle) which supplies power to the load when UPS is being maintained.

NOTE: If the UPS system consists of more than two parallel UPS modules, do not use the internal maintenance bypass switch.

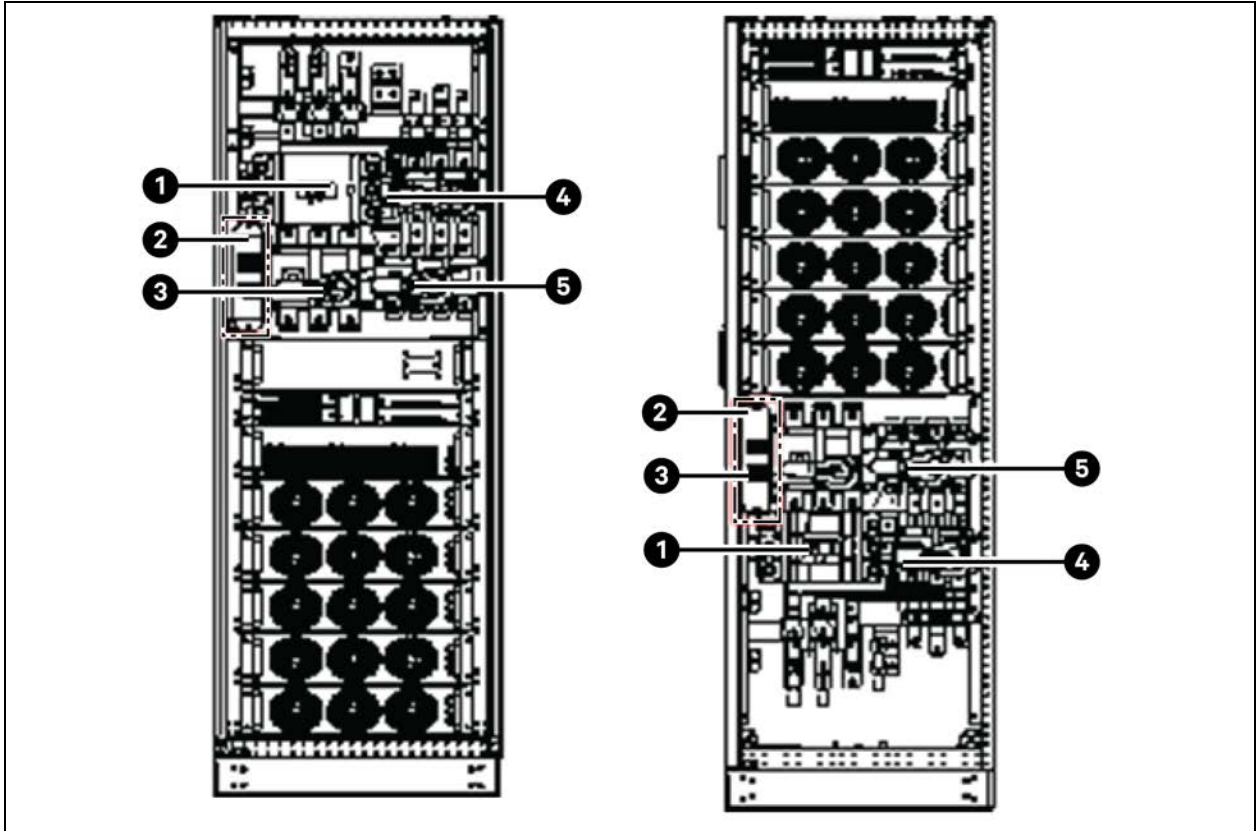
- Q5 Output switch which connects UPS output to the load.

NOTE: Q1, Q2, and Q5 are available for the four switches model while Q3 is available for the single switch.

NOTE: When you are using Q3 or the UPS without switch, install all other switches (including external maintenance bypass switch) for the UPS maintenance and dust removal.

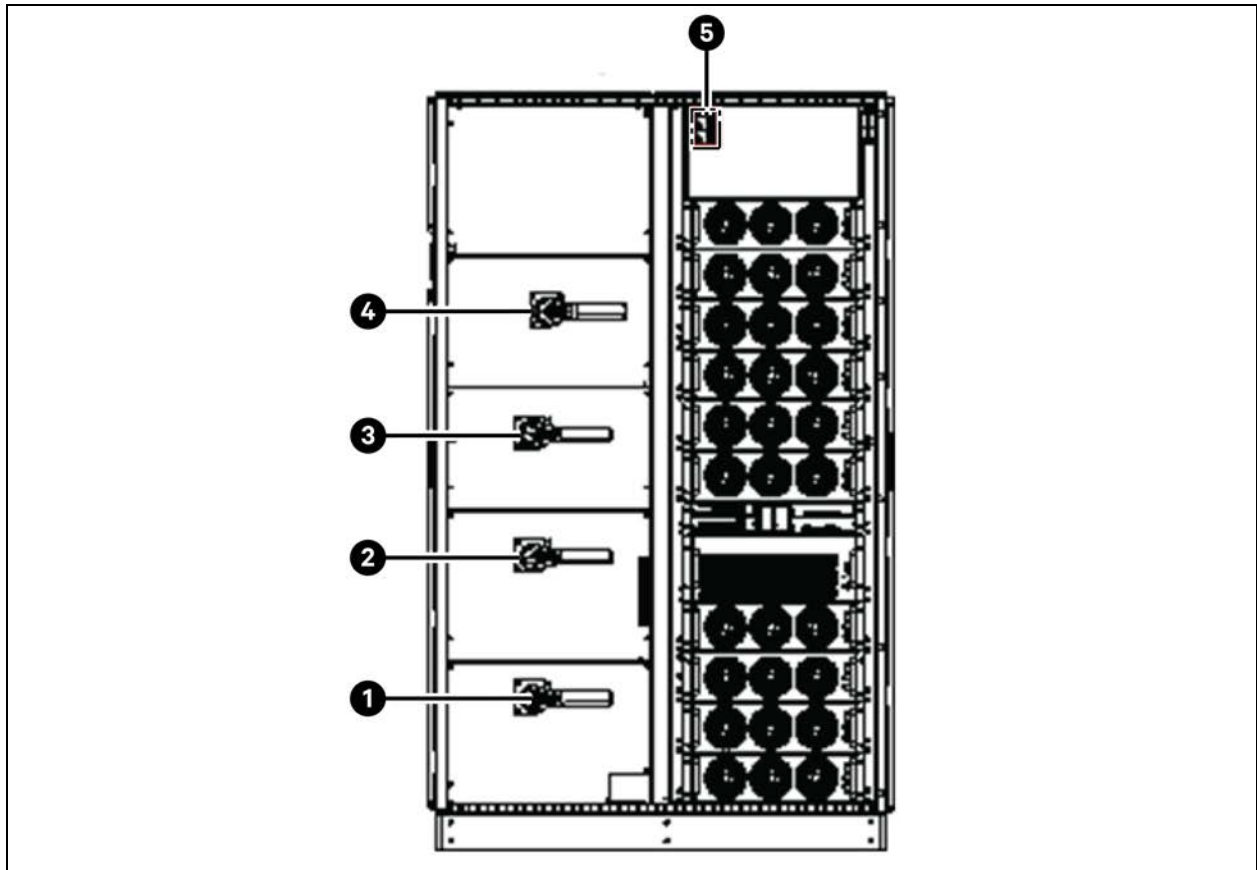
NOTE: The input/output (I/O) neutral line inside the UPS is interoperable. If the external neutral line is not disconnected during maintenance, pay attention to safety.

Figure 6.1 UPS Power Switch Four Switches (300 kVA)



Item	Description	Item	Description
1	Q2	4	Q3
2	Position of lightning protection board.	5	Q5
3	Q1		

Figure 6.2 UPS Power Switch Four Switches (600 kVA)



Item	Description	Item	Description
1	Q1	4	Q5
2	Q2	5	Position of lightning protection board
3	Q3		

6.2 UPS Startup Procedures

The Vertiv™ Liebert® APM2 UPS must be completely installed and commissioned before startup by an authorized engineer. The external power supply switch must be closed. After these conditions are met, the UPS can be started.

6.2.1 Startup procedures in normal mode



WARNING! These procedures result in mains voltage being applied to the UPS output terminals.



WARNING! If any load equipment is connected to the UPS output terminals, check with the user that it is safe to apply power. If the load is not ready to receive power, please disconnect the downstream load switch, and stick a warning label on the connection point of the load.

To start the UPS from a fully powered down condition, follow the below procedure:

1. Open the front door of the UPS.

NOTE: Ensure that the internal maintenance bypass switch Q3 is disconnected, while the input cables and copper bars are reliably connected.

2. Close the external input switch.
3. Ensure that the UPS input voltage, frequency, and phase are normal.



WARNING! In parallel UPS configuration, all operations related to disconnecting or connecting of the maintenance bypass switch must be executed within three seconds to avoid overload situations and damage to the maintenance bypass switch.

4. In the following order, close these switches output switch Q5, bypass input switch Q2, rectifier input switch Q1, and all external output isolating switches (if any) of the UPS.

Now, the system is powered ON, and the startup screen pops up.



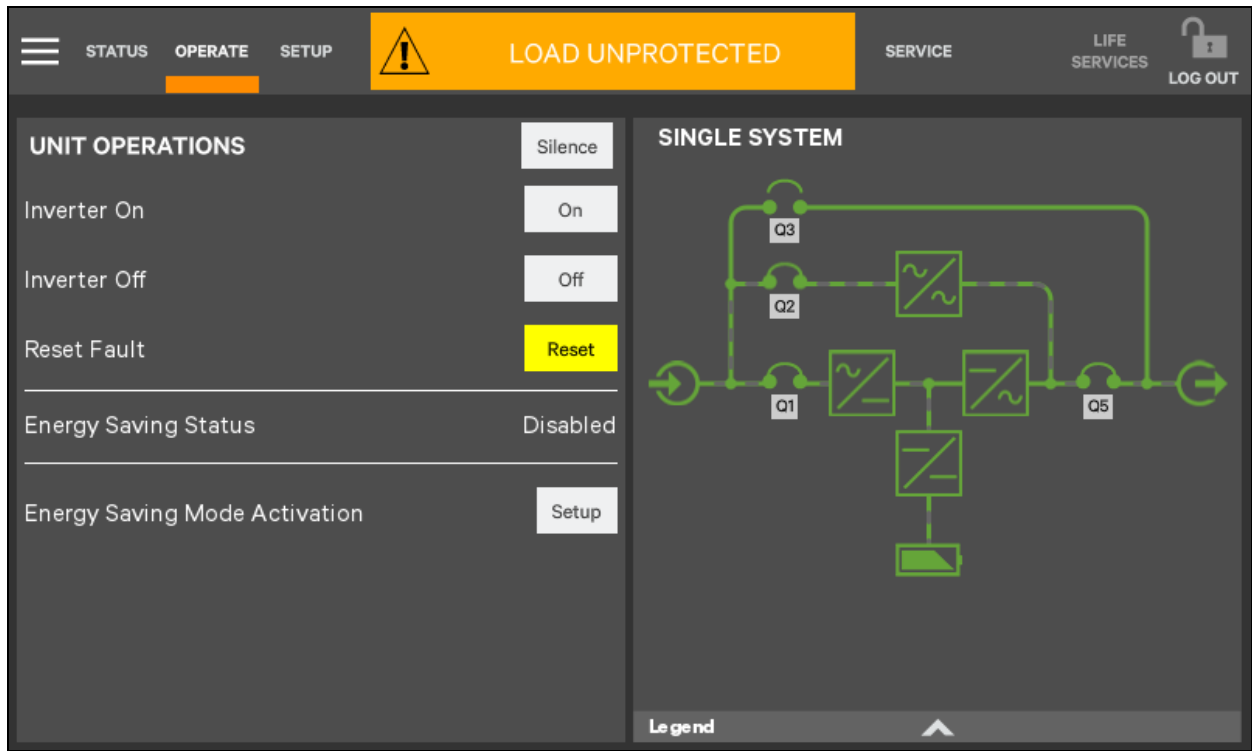
After about 25 seconds later, click the login icon to enter the system by typing correct password.

Figure 6.3 Inputting Password



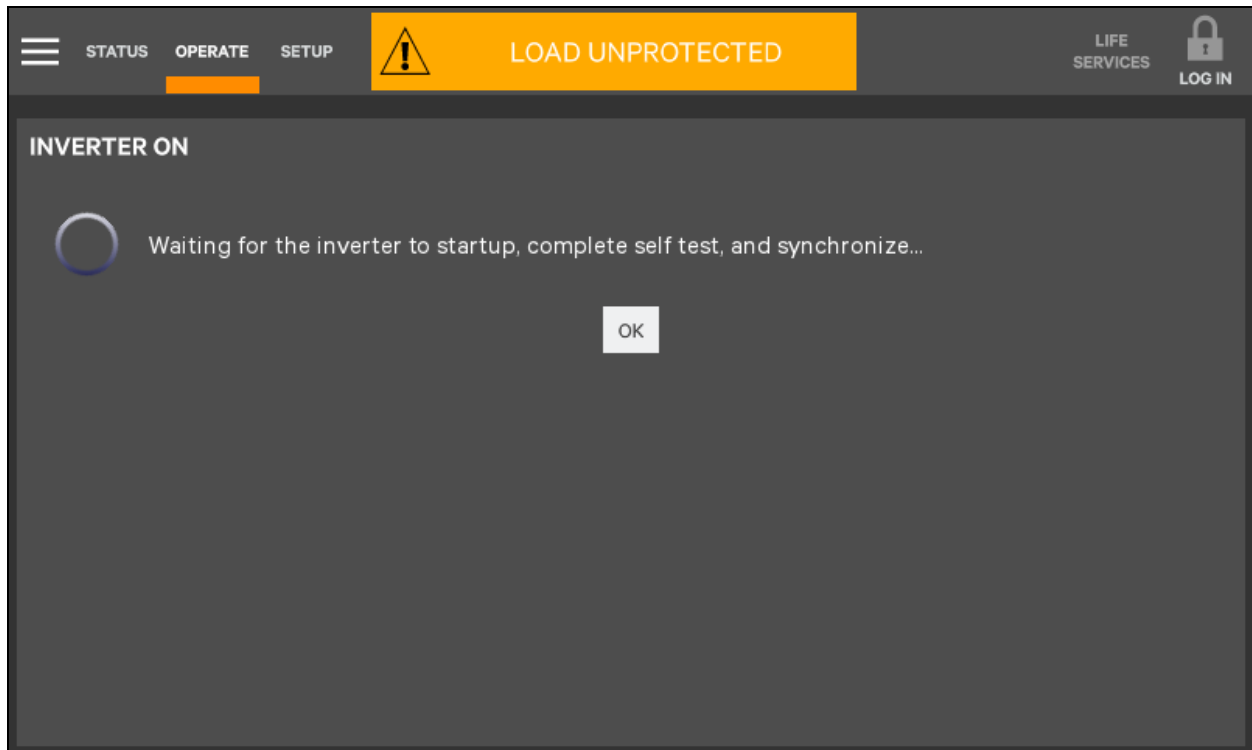
5. When the rectifier start process is finished, close the battery circuit breaker. The system run in Bypass mode. See Power flow shown in Figure 6.4 on the facing page. Click the On key (Refer to Operator Controls shown in Navigating through the Vertiv™ Liebert® APM2 Touchscreen on page 58).

Figure 6.4 Clicking Inverter ON Key



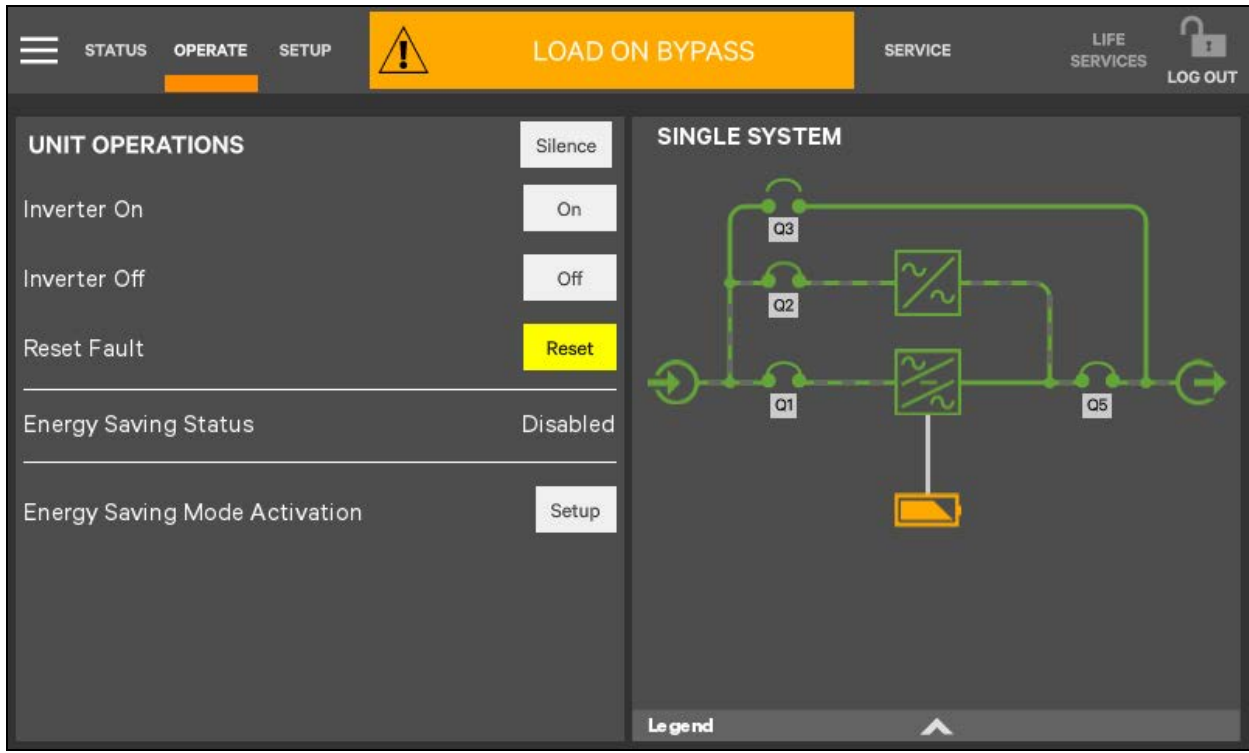
6. The inverter starts a self-test and sync.

Figure 6.5 Inverter Self-Test and Sync



- Startup is finished.

Figure 6.6 Start Up Finished



6.2.2 Startup procedures in ECO mode

- Open the front door of the UPS.

NOTE: Ensure that the internal maintenance bypass switch Q3 is disconnected, and that the input cables and copper bars are reliably connected.



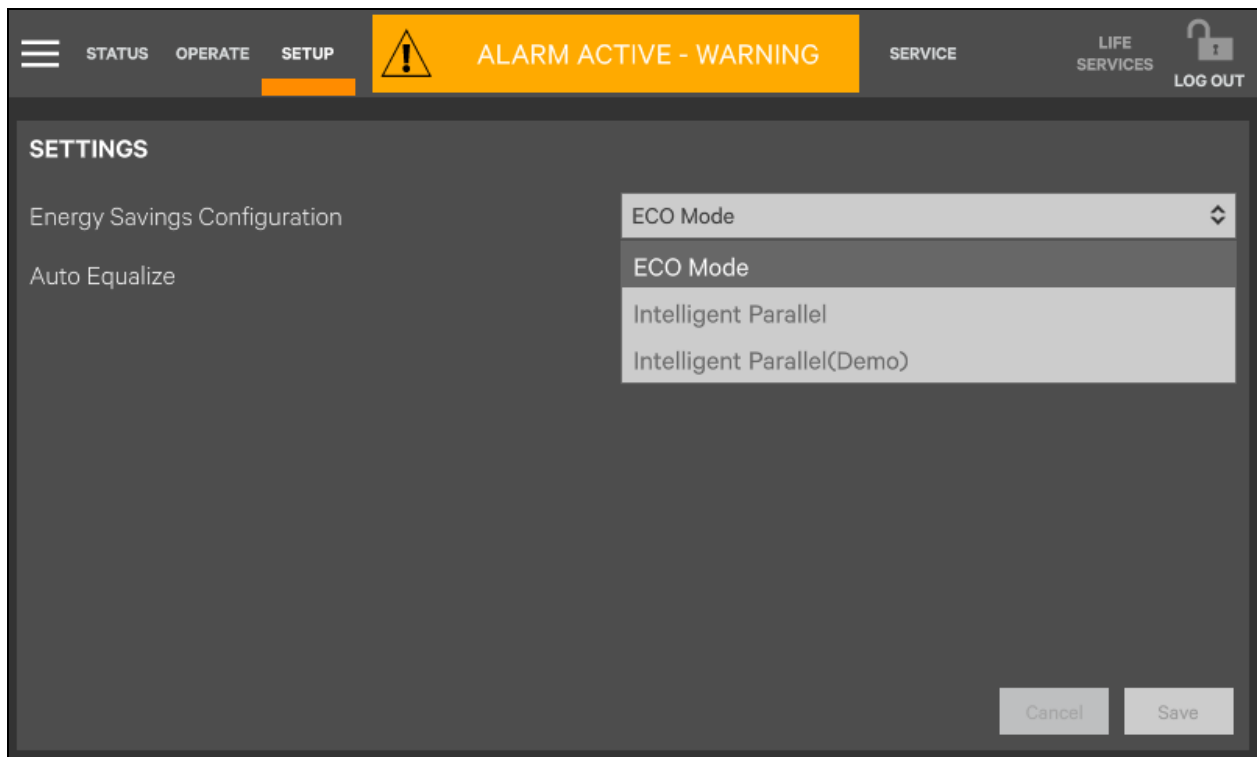
WARNING! In parallel UPS configuration, all operations related to disconnection or connection of the maintenance bypass switch shall be executed within 3 seconds to avoid overload situations and damage to the maintenance bypass switch.

- Close the output switch Q5, bypass input switch Q2, rectifier input switch Q1, and all external output isolating switches (if any) of the UPS in turn.

Now the system is powered on, and the startup screen activates.

- If ECO mode is necessary, contact a Vertiv service engineer to activate it through the software setting. If you wish to activate it by yourself, you can enable it through the Energy Saving Mode Activation on the Touchscreen. For details, refer to [Operator controls](#) on page 72.
- Touch Setup next to the Energy Saving Mode Activation.
- In the drop-down menu, touch ECO Mode.
- Touch Save.

Figure 6.7 Setting ECO Mode



7. When the rectifier is started, start the system according to Startup Procedures in Normal Mode ([UPS Startup Procedures](#) on page 105).

After the inverter runs normally, if the bypass voltage is within the range of ECO power supply, then the system works in ECO mode; otherwise the system will transfer to inverter. The system will automatically work in ECO mode after the bypass voltage is within the range of ECO power supply and lasts for five minutes.

6.2.3 Startup procedures in battery mode (battery cold start)

NOTE: Press and hold the battery cold start button for 1 second to perform the above procedures.

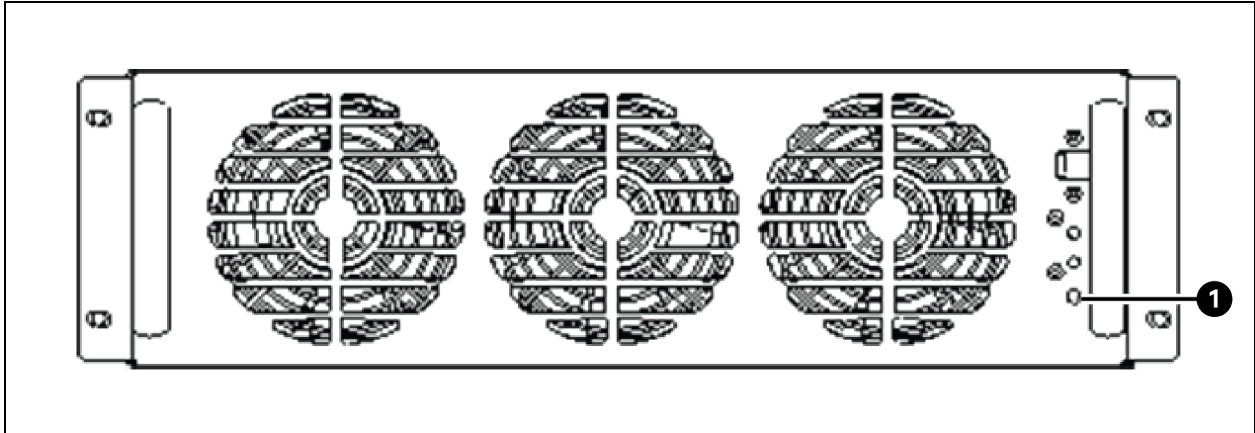
NOTE: Do not press the battery cold start button before switching on the BCB.

1. Verify that the battery has been connected, close the battery loop switch, and the battery voltage is transferred to the input terminal of the battery.
2. Wait for 30 seconds after the battery path switch is closed.
3. Press the battery cold start button (see [Figure 6.8](#) on the next page for its position) of any module.
4. When the rectifier starts, start the system according to steps 4 to 6 in Section [Startup procedures in normal mode](#) on page 105.



WARNING! Start the UPS strictly following the above procedures. Failure to do so can cause the device to malfunction.

Figure 6.8 Battery Cold Start Button



Item	Description
1	Battery cold start button

6.3 Procedures for Transfer Between Operation Modes

6.3.1 Transfer from normal mode to battery mode

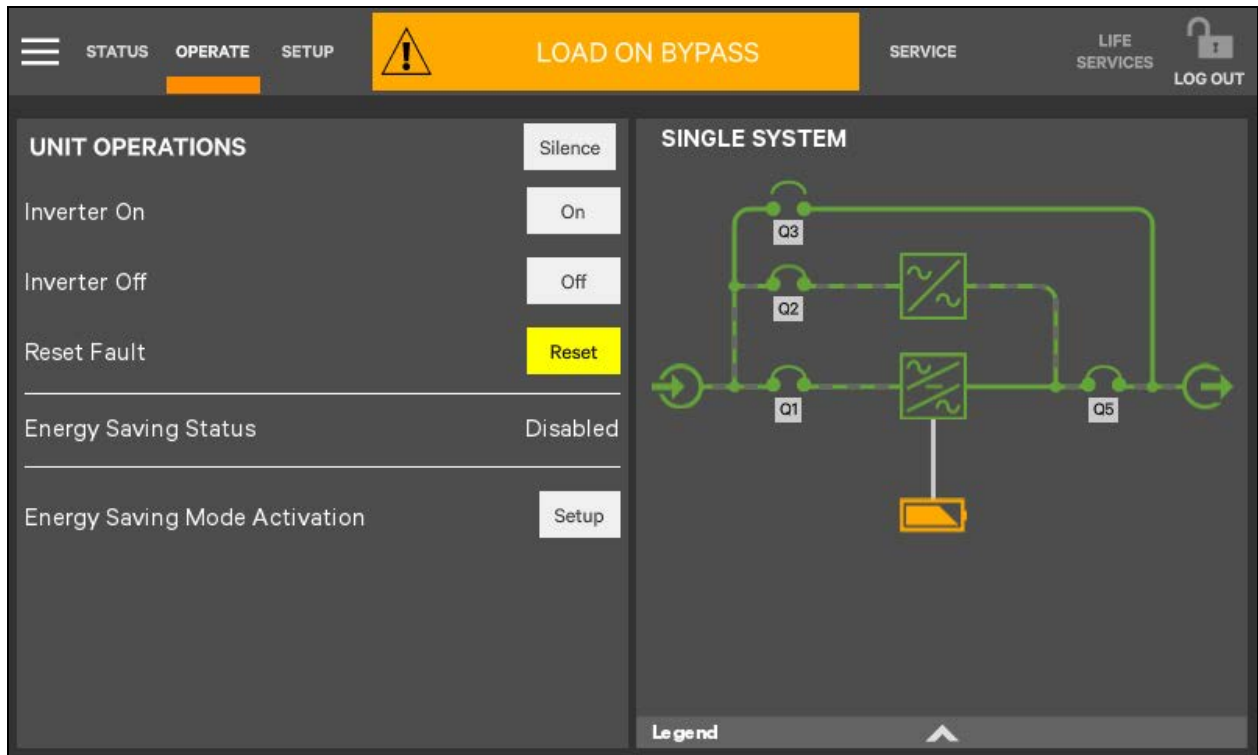
Open the external power switch to isolate the mains power and initiate the UPS on battery mode. To transfer the UPS back to normal mode, close the external power switch to reconnect the mains power to the UPS. The rectifier restarts automatically in about 10 seconds and the UPS works in normal mode.

6.3.2 Transfer from normal mode to bypass mode

Procedure to transfer the load from the normal mode to the bypass mode.

1. Activate the system and log in to the system.
2. Touch the Operate tab.
3. Touch the Off button next to the Inverter Off. See **Figure 6.9** on the facing page, and the UPS will transfer to bypass mode.

Figure 6.9 Transfer UPS to Bypass Mode



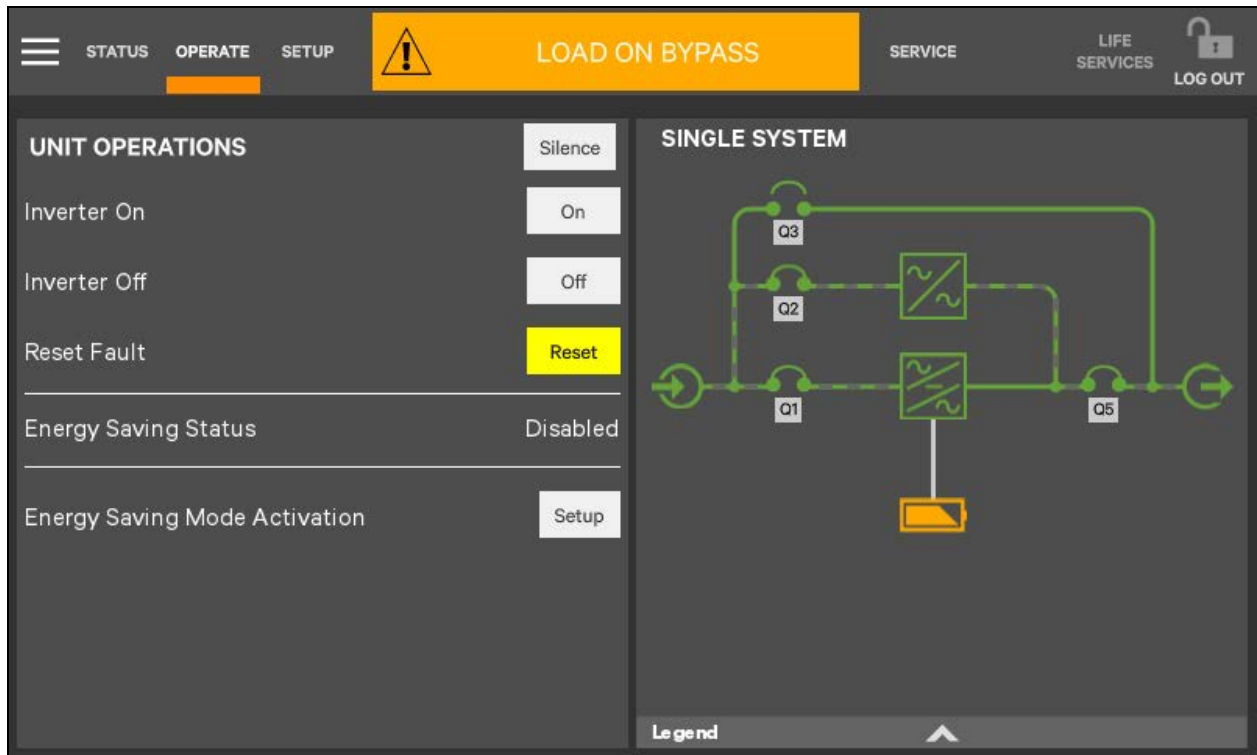
NOTE: In bypass mode, the load is directly supplied by the mains power instead of the pure AC power from the inverter.

6.3.3 Transfer from bypass mode to normal mode

Follow the procedure below to transfer the load from the bypass mode to the normal mode.

1. Activate the system and login to the system.
2. Verify that the APM2 UPS is in bypass mode.
3. Touch the OPERATE tab.
4. Touch the On button next to the Inverter On. See **Figure 6.10** on the next page. Then the UPS will transfer to normal mode from the bypass mode.

Figure 6.10 Transfer UPS to Normal Mode



6.3.4 Transfer from normal mode to maintenance mode

The following procedures will transfer the UPS from inverter output mode to the maintenance bypass mode.



CAUTION: Power supply interruption danger of the load: Before performing this operation, read the information on the touchscreen to make sure that the bypass supply is normal and that the inverter is synchronous with the bypass supply so as not to risk a short interruption in power to the load.

1. Shut down the inverter according to [Transfer from normal mode to bypass mode](#) on page 110.

NOTE: The alarm can be silenced but the alarm message displayed until the alarm condition is rectified.

2. Close the maintenance bypass switch Q3.
3. The maintenance bypass parallels with the UPS static bypass.
4. The Touchscreen displays **Maint. Switch Closed**.



CAUTION: When the UPS is in maintenance mode, the load is not protected against abnormal mains supply.

5. Pressing the EPO button stops the operation of rectifier, inverter, static switch and battery, but this action will not affect the maintenance bypass power the load normally.

NOTE: Under maintenance mode, the load is directly fed by the mains power instead of the pure AC power from the inverter.

6. Disconnect the rectifier input switch Q1, bypass input switch Q2, and output switch Q5.

All the internal power supply is off and the TOUCH SCREEN does not display any more.

NOTE: If the maintenance is required, wait 10 minutes for the internal DC bus capacitance discharging.



WARNING! The UPS maintenance must be done by qualified person only. The parts of UPS circuits also have hazardous voltage, though the rectifier input switch, bypass input switch and battery switch are disconnected.



WARNING! For models without Q1, Q2, and Q5, when the external input switch is not disconnected, there is a hazardous voltage inside the UPS. To perform UPS maintenance and dust removal other switches (including external maintenance bypass switches) must be installed when using Q3 or the UPS without switch only.

6.3.5 Transfer from maintenance mode to normal mode

Follow the procedure below to transfer the maintenance bypass mode of the UPS to normal mode.

1. Close the output switch Q5, external power bypass switch, bypass input switch Q2, external power main switch, and rectifier input switch Q1 in turn.
2. Verify that the touchscreen is ON and the UPS runs in Bypass mode.
3. Disconnect the maintenance bypass switch Q3.
4. Start the system according to steps 4 to 7 as specified in [Startup procedures in normal mode](#) on page 105.

The UPS runs in Normal mode.

IMPORTANT! Start the bypass first, then disconnect the maintenance bypass switch. Failure to do so may cause output load power failure.

The load has transferred to UPS normal mode.

6.4 Battery Test Procedures

The battery test function is disabled by default. If you need this function, please contact Vertiv's customer service.

The battery self-test includes periodical self-test and manual maintenance self-test.

- When the load factor is 0 to 20%, the system only supports manual maintenance self-test.
- When the load factor is 20% to 100%, the system supports periodical self-test and manual maintenance self-test.

The battery discharges 20% of total battery energy.

Periodical self-test is to test the battery activity. The periodical self-test is regular and the self-test period can be configured via the Vertiv setting software. During the periodical self-test, if the battery maintenance requirement is met, the system generates audible/visual alarm and corresponding records. The periodical self-test does not update the battery curve table.

The mode of the manual maintenance self-test is similar to that of the periodical self-test, except for the maintenance self-test mode is started manually, and this operation is valid only one time, that is the system will not automatically start up the self-test once you exit. When the load factor is 20% to 100% and the battery maintenance requirement is satisfied during the maintenance self test, the system will generate audible/visual alarm and corresponding records. The maintenance self-test does not update the battery curve table.

NOTE: The periodical self-test should satisfy the conditions of battery float charge at least 5 hours, and generator not connected, while the manual maintenance self-test just satisfies the conditions of battery fully charged.

How to do a test

1. **Manual maintenance self-test:** Via the Touchscreen.
2. **Periodical self-test:** A self-test period can be configured via the Vertiv setting software. The range of battery self-test period is 30 days to 360 days. The default is 60 days.

Self-test startup conditions

1. System load rate is within 0 to 100% (manual maintenance) or 20% to 100% (periodical self-test), stable output.
2. Battery in fully charged state, battery float charge at least 5 hours and generator not connected.
3. Current system is in float charge state.

self-test exit conditions

1. Confirm that the system is not in self-test state for at least 10 seconds and battery mode or rectifier is closed. The system shifts to battery supply state.
2. During the self-test, the system will shift to float charge state if the load fluctuation, UPS module overload or no battery occurs.
3. During the self-test, if the battery voltage is lower than the calculated pre-alarm voltage, or the battery discharge exceeds the protection time, then the system will shift to float charge state.
4. The user can manually stop the maintenance test via the Touchscreen.
5. During the manual maintenance self-test, when the load rate ranges from 0 to 20%, the system will shift to float charge state after the battery discharge for 5 mins.

NOTE: After the self-test is successful, the system will fully clear the self-test interval counter. If the self-test fails this time, then exits the system; when self-test conditions are satisfied again, enters self-test once more.

Procedures for battery self-test



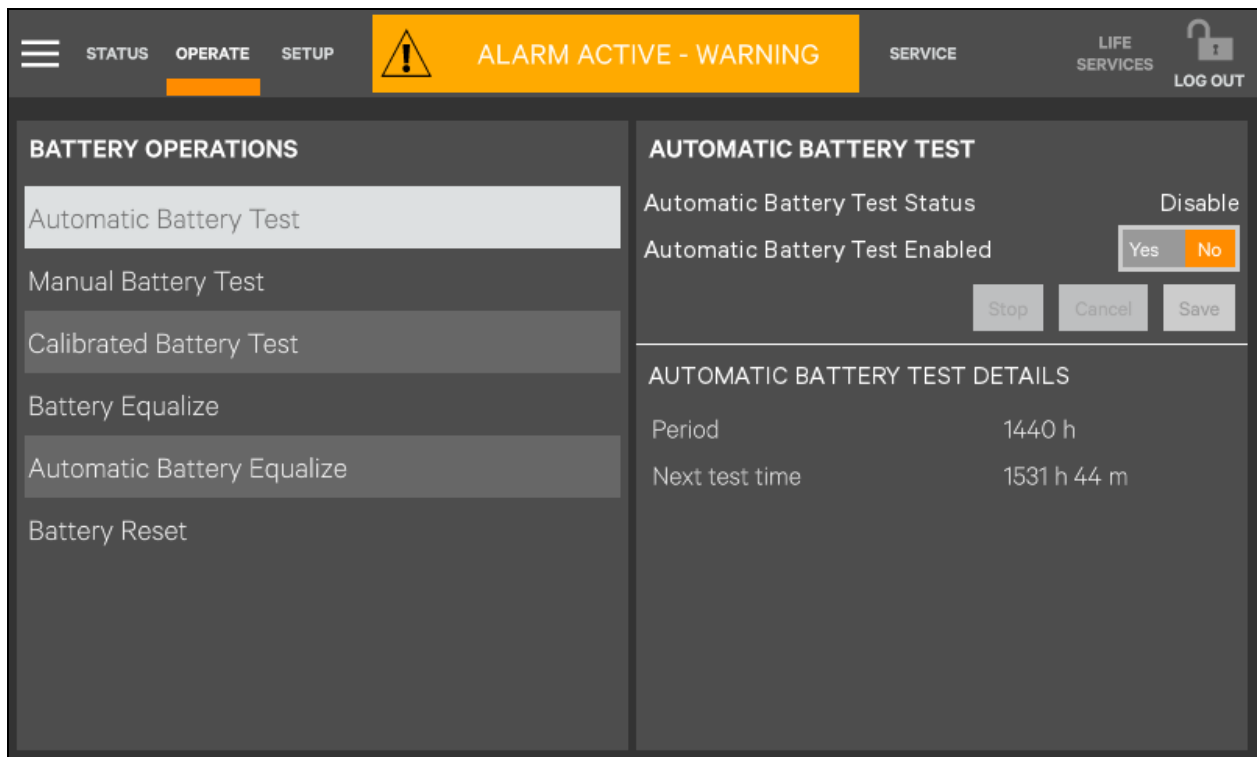
1. Enter the level of **Operate**.
2. Click the Operate icon .
3. Click the menu icon  on the upper left corner.
4. Click the Battery Operations to display the interface shown in **Figure 6.11** on the facing page.

Figure 6.11 Battery Management Interface



5. Respectively click **Automatic Battery Test**, **Manual Battery Test**, **Calibrated Battery Test** and **Battery Equalize**, then you can execute corresponding settings and operation.

6.5 UPS Shutdown Procedures

6.5.1 Procedures to completely power down the UPS

Follow the below procedure to completely shutdown the UPS and load power off. All power switches, isolating switches, and breakers are disconnected, and then UPS no longer supplies power to load.



CAUTION: The following procedures will cut off the load power, making the load completely power off.

1. Touch the INVERTER Off key to stop the operation of the inverter (Refer to [Operator controls](#) on page 72), then press the EPO button to stop the operation of the rectifier, static switch and battery.
2. Disconnect the external battery switch.
3. Disconnect the rectifier input switch Q1, bypass input switch Q2, output switch Q5. Now, all the internal power supply is off, and the TOUCH SCREEN does not display any more.



WARNING! Paste a notice at the AC input distribution (generally far away from the UPS) to alert that the UPS maintenance is being operated.

IMPORTANT! Wait 10 minutes for the internal DC bus capacitance discharging. Then the UPS is completely shuts down.



WARNING! Hazardous battery voltage. The battery terminals still have hazardous voltage after the UPS is completely shut down.

6.5.2 Procedures for completely powering down UPS while maintaining power to load

The following procedures are suitable for completely powering down the UPS and keeping the power supply to the load. Refer to the procedures in [Transfer from normal mode to maintenance mode](#) on page 112.

6.6 EPO Procedures

The EPO is designed to switch off the UPS in emergency conditions (such as fire, flood). To carry out EPO, you just need to press the EPO button, then the system will turn off the rectifier, inverter and stop powering the load immediately (including the inverter and bypass), and the battery stops charging or discharging.

After EPO, if the input mains is present, the UPS control circuit will remain active; however, the output will be turned off. To remove all power from the UPS, first disconnect the external power switch of the UPS.

6.7 UPS Reset Procedures after EPO

After shutting down the UPS through EPO or the UPS fault condition, clear the fault according to the alarm message appearing on TOUCH SCREEN. Then carry out the following reset procedures to make UPS resume normal operation.

After confirming the fault has been cleared and no remote EPO signal is received, the user can carry out the following procedures:

1. Click the **Reset Fault** button (see [Operator controls](#) on page 72), the system will exit the EPO/abnormal OFF state, and the alarm indicator flashes in red color.
2. After the rectifier start up is finished, normally start the UPS according to [Transfer from bypass mode to normal mode](#) on page 111.

NOTE: The rectifier will start automatically when the overtemperature fault disappears five minutes after the disappearance of overtemperature signal.

3. After the EPO button is pressed, if the mains input is switched off, the UPS will shut down completely. When the mains input restored, the UPS will enable the bypass. Restore the power at the output terminal of the UPS.



WARNING! If the maintenance bypass switch Q3 is closed, and UPS has input power, it means UPS has outputs.

6.8 Automatic Restart

The UPS uses the battery system to supply power to the load equipment in the event of mains failure until the batteries are discharged. When the UPS reaches its EOD threshold, it will shut down.

The UPS will automatically restart and enable output power only when the following conditions are met:

1. If Auto Recovery after EOD Enabling is enabled.
2. After the Auto Recovery after EOD Delay Time expires (the default delay is 10 minutes), the UPS restarts bypass, then inverter. During the automatic recovery delay, the UPS will charge its batteries to provide a safety margin for equipment shutdown if input power fails again.

NOTE: During the automatic restart process, manual startup is disabled. Automatic restart must be set by Vertiv's authorized service engineer through Vertiv setting software.

6.9 Selecting Language

Use the following procedures to select the language:



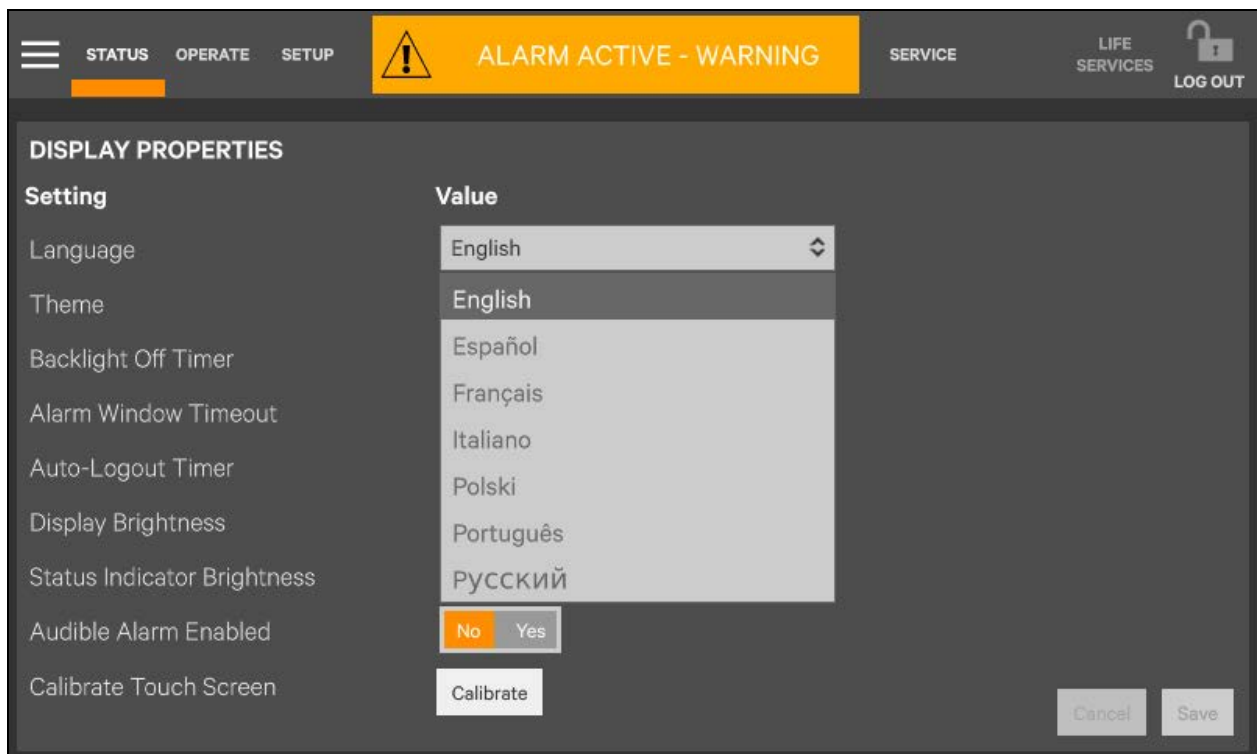
1. Click the icon .
2. Click the icon .
3. Click the item of Display.
4. Click **Display Properties**.
5. As shown in **Figure 6.12** below, click **Language** to set the language you need.

Figure 6.12 Setting Language



6.10 Changing Current Date and Time

To change the system date and time, follow the below procedure:

1. Activate the system and log in to the system.

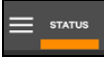

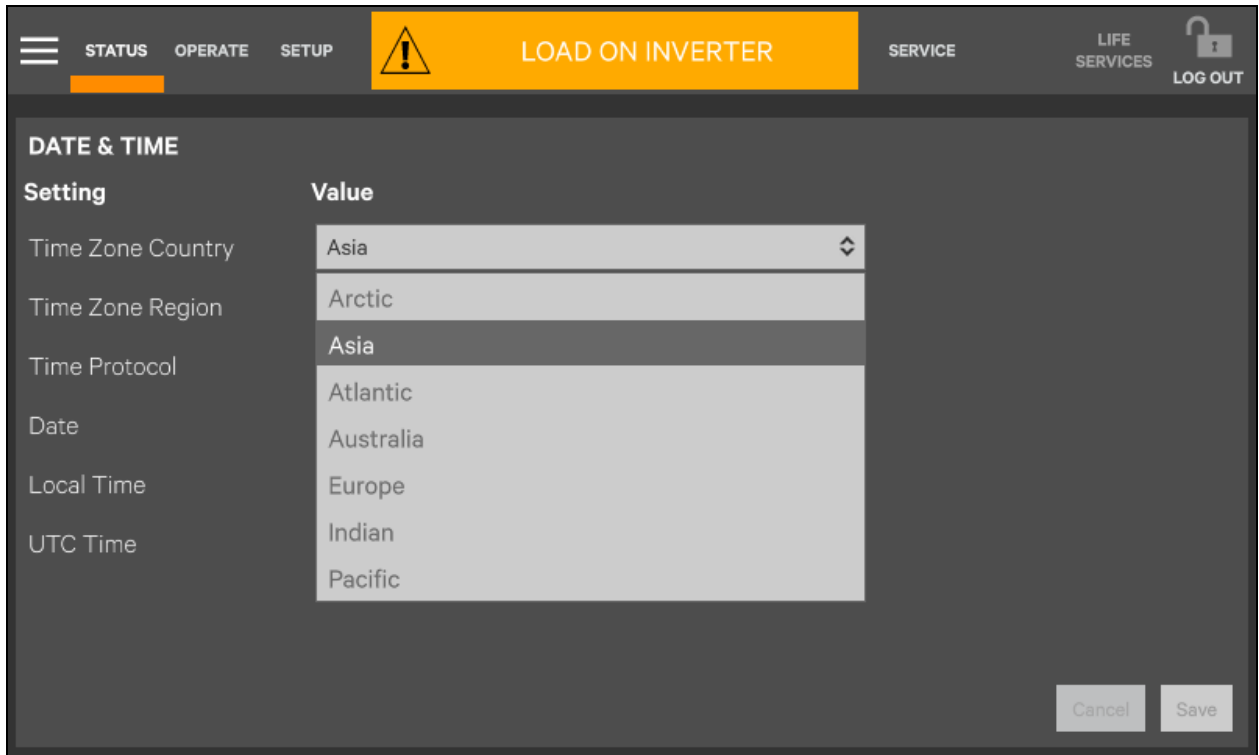
2. Click the icon .
3. Click the icon .
4. Click the item of Display.
5. Click **Date & Time**.
6. Refer to **Figure 6.13** below.
7. Click SAVE

Figure 6.13 Setting Date and Time



6.11 Control Password

To change password, carry out the following procedures:


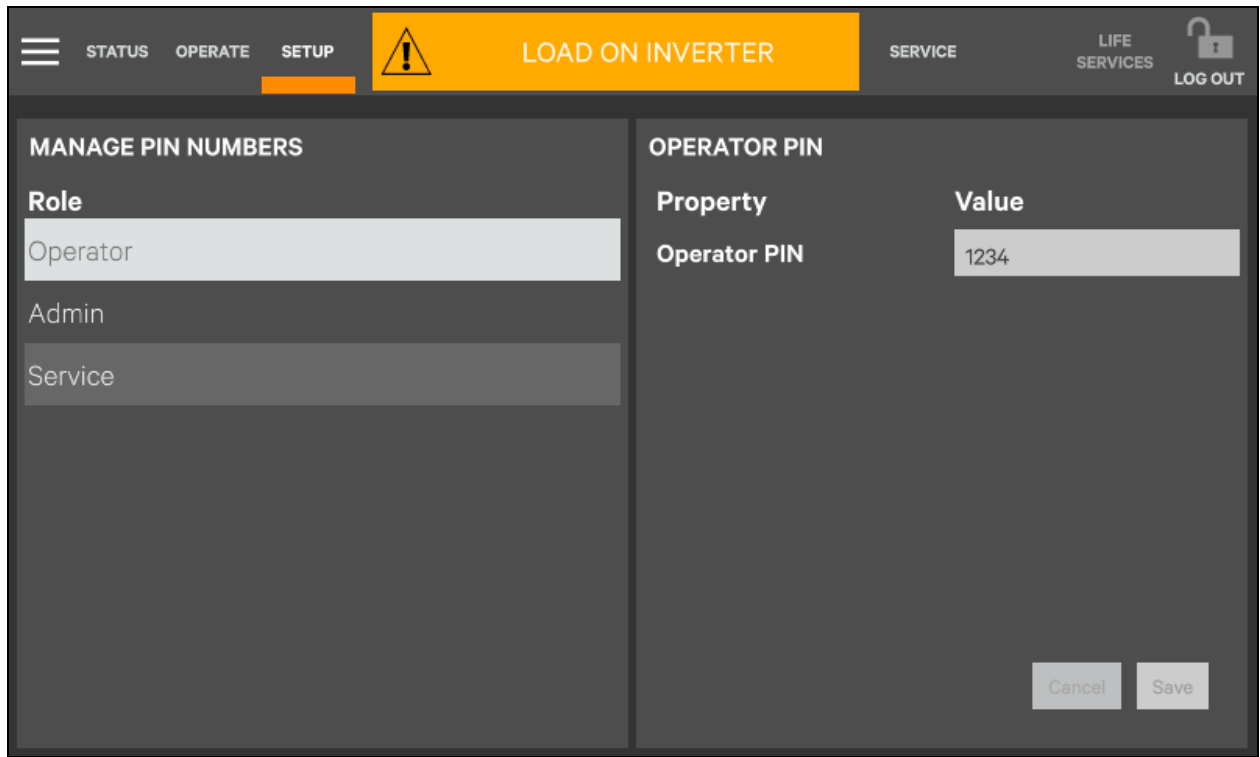
1. Activate the system and log in to the system
2. Enter **Setup** level.
3. Click the icon .
4. Enter the pin in the field under Value and next to the Operator PIN. See **Figure 6.14** on the facing page.

Figure 6.14 Setting Password



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7 Battery

This chapter provides information about the battery, the battery types, charging/discharging, battery cold start, safety, installation and maintenance information, battery protection function, and the connection of BCB cabinet (option), battery temperature sensor (option), and battery ground fault detector.

7.1 Introduction

The UPS battery string consist of several batteries in series connection and provides rated DC input voltage for the UPS inverter. The required battery backup time (that is the time for battery to supply load upon mains failure) is subject to the ampere hour value of the battery. Sometimes, it is necessary to connect several battery strings in parallel.

To facilitate the UPS installation, the battery is generally installed on the specially designed battery rack or in the battery room.

During the maintenance or repair, the battery must be disconnected from the UPS. This operation is carried out with the battery circuit breaker of proper capacity. This circuit breaker must be located as close as possible to the battery connecting terminal. The wiring distance of the power and signal cables connected to the UPS must be minimized.

When several strings of battery are connected in parallel to increase the battery backup time, disconnecting device shall be equipped, so that the maintenance operation on a certain battery string will not affect the normal operation of other battery strings.

7.2 Safety



WARNING! Work carefully with the batteries connected to the UPS when all the blocks are connected, the battery string voltage can be up to 540 VDC. This is potentially dangerous. Follow the precautions for high voltage operation. Only qualified personnel can install and maintain the battery.

To ensure safety, the external batteries are to be installed inside a lockable cabinet or in a purpose designed, dedicated battery room, so that they are only accessible to qualified service personnel.

Make sure that the battery switch has been disconnected before battery maintenance.

7.2.1 Hazardous battery voltage present behind covers

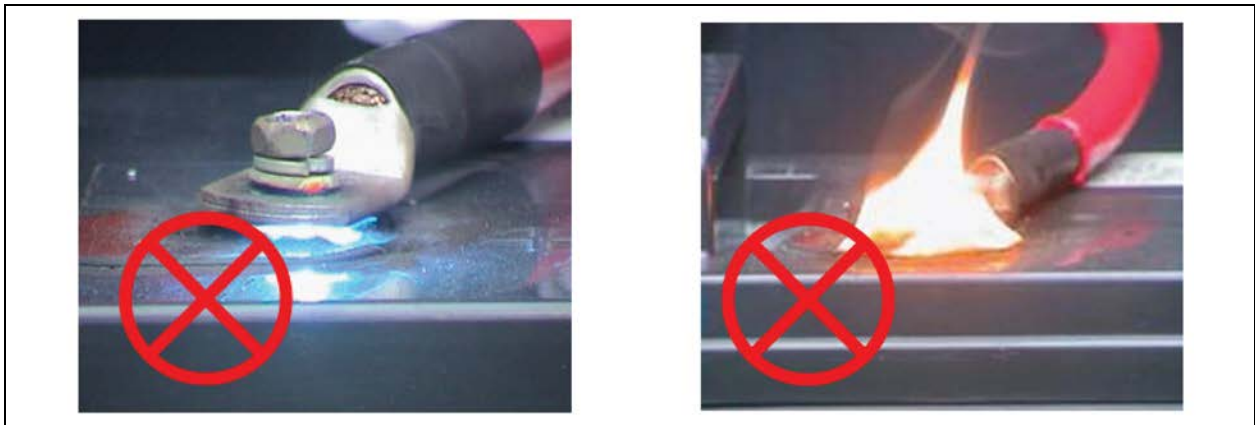
1. No user serviceable parts are located behind covers that require a tool for their removal. Only qualified service personnel are authorized to remove such covers.
2. Before working on the copper bars connected to the external battery, please ensure they are disconnected from all power supplies.

Figure 7.1 Proper Connection Mode



Tighten the terminal bolt of the battery with specified torque.

Figure 7.2 Improper Connection Mode



Too large or too small torque may cause poor connection of the terminal. Under certain conditions, the terminal may have arcing or heat accumulation, which finally will cause fire.

3. Observe the following safety precautions when working on the batteries:
 - a. The battery must be firmly and reliably connected. After the connection is completed, the screw connections between all the terminals and the batteries shall be calibrated. The requirements on torque specified in the specifications or user manual provided by the battery manufacturer shall be satisfied. The connections between all the wiring terminals and the batteries shall be inspected and tightened at least once a year. Otherwise it may cause fire.
 - b. The battery appearance must be inspected before accepting and using the battery. If there exists any package damage, dirty battery terminal, terminal erosion, rust, or enclosure crack, deformation or liquid leakage, replace it with a new battery. Otherwise, battery capacity reduction, electric leakage or fire may be caused.

Figure 7.3 Battery Damaged during Handling or Transportation**Figure 7.4 After a Week of Normal Charge/Discharge Experiment**

- c. The battery is very heavy. Please use proper method to move and lift the battery, so as to prevent any damage to human being or the battery terminal. Severe damage to the battery may cause fire.
- d. The battery connecting terminal shall not be subject to any force, such as the pulling force or twisting force of the cable, otherwise, the internal connection of the battery may be damaged. Severe damage to the battery may cause fire.
- e. The battery shall be installed and stored in a clean, cool and dry environment. Do not install the battery in a sealed battery chamber or a sealed room. The battery room ventilation shall at least meet the requirement of EN50272-2001. Otherwise, battery bulging, fire or even human injury may be caused.
- f. The battery shall be installed far away from the heating products (e.g. transformer), used or stored far away from any fire source, and shall not be burnt or put into fire for heating. Otherwise, battery leakage, bulging, fire or explosion may be caused.
- g. Do not directly connect any conductor between the positive and negative terminals of the battery. Remove the finger rings, watch, necklace, bracelet and other meta items before operating the battery, and ensure that the tools (e.g., wrench) are covered with insulating material. Otherwise, battery burning, human death/injury or explosion may be caused.
- h. Do not disassemble, modify or demolish the battery. Otherwise, battery short circuit, liquid leakage or even human injury may be caused.
- i. Clean the battery enclosure with the wringed wet cloth. To avoid any static or arcing, do not use dry cloth or duster to clean the battery. Do not use the organic solvent (such as thinner, gasoline, volatile oil) to clean the battery. Otherwise, the battery enclosure may be cracked. In worst case, fire may be caused.

- j. The battery has diluted sulfuric acid. In normal use, the diluted sulfuric acid will be absorbed to the baffle and polar plate of the battery. However, if the battery is damaged, the acid may leak from the battery. Therefore, personal protective equipment (e.g., protective glasses, rubber gloves and apron) must be used when operating the battery. Otherwise, if the diluted sulfuric acid enters the eyes, blindness may be caused; if it contacts the skin, the skin may be burnt.
- k. The battery may have short circuit, electrolyte dry-up or positive pole erosion failure at the end of its life. If it is still used under this state, the battery may have thermorunaway, bulging or liquid leakage. Please replace the battery before it becomes this state.
- l. Before connecting or disconnecting the battery connection cables, please isolate the charging power.
- m. Check if the battery has been unexpectedly earthed. If this is the case, remove the earth connection. Contact with any part of the earthed battery may result in an electric shock.

7.3 UPS Battery

The UPS generally adopts valve regulated battery. **Valve regulated** means the **sealed type** or **maintenance free**.

The valve regulated battery is not completely sealed, when it is over charged, there is gas escape. The volume of the gas escape is less than with a water injection battery. However, during the installation design of the battery, temperature rise should be considered, and enough room must be reserved to ensure good ventilation.

The valve regulated battery is not maintenance free. The valve regulated battery must be kept clean, and inspected regularly to check for corrosion and that the connection is reliable.

It is recommended to connect no more than 4 strings of batteries in parallel. Batteries of different types, names or newness shall not be used together. Otherwise, the battery inconsistency will cause frequent over discharge or under charge of certain battery. At last, the battery will have premature failure, and the entire string of battery will have insufficient backup time.

Batteries must be stored in a fully charged state. Batteries will lose some capacity because of self discharge during transportation or storage. Charge the battery before use. During the storage, ensure that the ambient temperature shall not exceed the range of -15 °C to +45 °C, and the optimal temperature is 20 °C to 25 °C. To compensate for the self discharge of the battery during the storage, the battery shall be charged every 3 months during the storage. The specific time may differ for different batteries. For details, refer to the requirement of the battery manufacturer.

It is very important to fully charge the battery testing the battery backup time onsite. The test may take several days. Therefore, it should be conducted after the battery is float charged uninterrupted for at least 1 week .

When the battery is running for several weeks or subject to 2 to 3 charge and discharge cycles, the battery performance will increase.

To avoid the battery over charge or under charge, set the battery management parameters according to the equalizing/float charge voltage and temperature compensation factor specified in the manuals provided by the battery manufacturer. Please charge the battery immediately after discharge.

7.4 Precautions for Installation Design

NOTE: Use and maintenance of the battery are described in the relevant battery manual provided by the battery manufacturer. The safety precautions described in this section include the important precautions that must be considered during the installation design. The design results may be changed according to the local situations.

7.5 Battery Installation Environment and Number of Batteries

7.5.1 Installation environment

7.5.2 Fresh air volume (EN50272-2001)

The operating environment of the battery must be ventilated. During the operation of the battery, the following requirement for the fresh air ventilation shall be satisfied:

$$Q=0.05 \times n \times I_{\text{gas}} \times C_{\text{rt}} \times 10^{-3} \text{ [m}^3\text{/h]}$$

Where:

Q - The fresh air ventilation volume per hour, the unit is m³/h

n-Number of cells

I_{gas} - The gas evolving current density under battery float charging or boost charge conditions, the unit is mA/Ah

I_{gas}=1, under the float charging condition of 2.27 V/cell

I_{gas}=8, under the boost charge condition of 2.35 V/cell

C_{rt}- 20 hr battery rated capacity

Temperature

Table 7.1 Ambient Temperature Range

Type	Temperature Value	Remark
Recommended optimal temperature	20 °C to 25 °C	The ambient temperature for the battery operation shall not be too high or too low. If the average operating temperature of the battery rises from 25 °C to 35 °C, the service life of the battery will be reduced by 50%. If the operating temperature of the battery is over 40 °C, the service life of the battery will be reduced exponentially each day.
Short time allowable temperature	-15 °C to 45 °C	

The higher the temperature is, the shorter the battery service life will be. At low temperature, the charge/discharge performance of the battery will be reduced.

The battery must be installed in cool and dry environment with the humidity less than 90%, and be protected from the heat source and direct sun rays.

The ambient temperature, ventilation, space, float/boost charge voltage and ripple current will affect the battery temperature. Uneven temperature among the battery strings will cause uneven voltage distribution and thus result in problem. Therefore, it is important to maintain balanced temperature in the battery string, and the temperature difference between batteries of different layers should be kept within 3 °C. Valve regulated battery is very sensitive to the temperature, therefore the valve regulated battery should be used in 15 °C to 25 °C. If the battery cabinet is installed near the UPS, the maximum design ambient temperature should be determined according to the battery rather than the UPS. That is, if valve regulated battery is used, the indoor ambient temperature shall be 15 °C to 25 °C rather than the operating temperature range of the main equipment. Under the precondition that the average temperature will not exceed 25 °C, it is allowed to have short time temperature deviation.

7.5.3 Number of batteries

The number of batteries, EOD voltage, and float charging voltage under the 380 V/400 V/415 V voltage system are consistent, as shown in **Table 7.2** below.

Table 7.2 Number of Batteries

Parameter	380 V/400 V/415 V
Number of cells (standard)	180 to 300 lead acid batteries, even numbers can be set consecutively; 240 to 300, UPS output power no derating.
EOD voltage	1.60 VDC/Cell to 1.90 VDC/Cell, 1.67 V/cell recommended.
Float charging voltage	2.2 VDC/Cell to 2.3 VDC/Cell, 2.27 V/cell recommended.

7.6 Battery Protection

IMPORTANT! Users must choose appropriate switching devices to protect the battery from short circuit and overload. It is recommended to use the Vertiv BCB to provide better battery protection.

The battery is connected to the UPS through the BCB. The BCB is manually closed and has the electronic tripping device controlled by the UPS control circuit. If the battery adopts rack mounting (or is far away from the UPS cabinet), the BCB shall be installed as close to the battery as possible, and the wiring distance of the power and signal cables connected to the UPS shall be minimized.

The BCB has the following features:

- Isolation
- Short circuit protection
- In case the inverter locked by battery under voltage, the switch automatically disconnects, avoid the damage of battery over discharge.
- If equipped with a remote EPO button, can use the EPO button to remotely disconnect the BCB.

To obtain the required backup time, the batteries may be connected in parallel. In this case, each battery string must be connected to a separate BCB.

NOTE: Only trained personnel must operate and maintain the battery circuit breaker.

7.7 Battery Installation and Connection



WARNING! Only qualified engineer should install and connect the batteries. The battery has hazardous high voltage, and requires reliable insulated tools for safety protection.

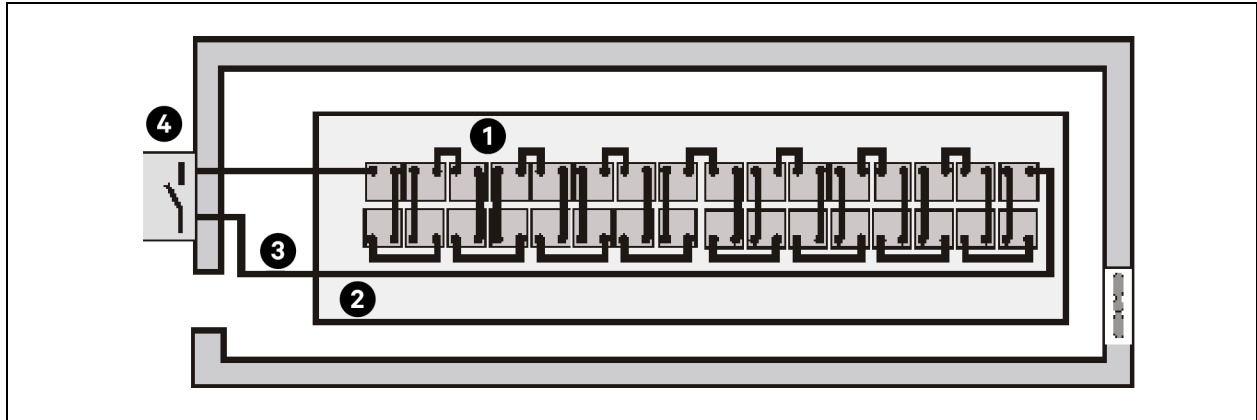
1. Before installation, check the battery appearance to ensure that there is no damage, inspect and count the accessories, and carefully read this manual and the user manual or installation instruction provided by the battery manufacturer.
2. Make sure that there is at least 10 mm gap between the batteries in vertical direction, for the free circulation of the ambient air of the batteries.
3. Certain clearance should be maintained between the battery top and the upper layer to facilitate for the monitoring and maintenance of the battery.

- The batteries should be installed from the bottom to top to avoid a too high gravity center. The batteries should be properly installed and protected from vibration or shock.

7.8 Design of Battery Room

Pay attention to the below items while designing the battery room.

Figure 7.5 Design of Battery Room



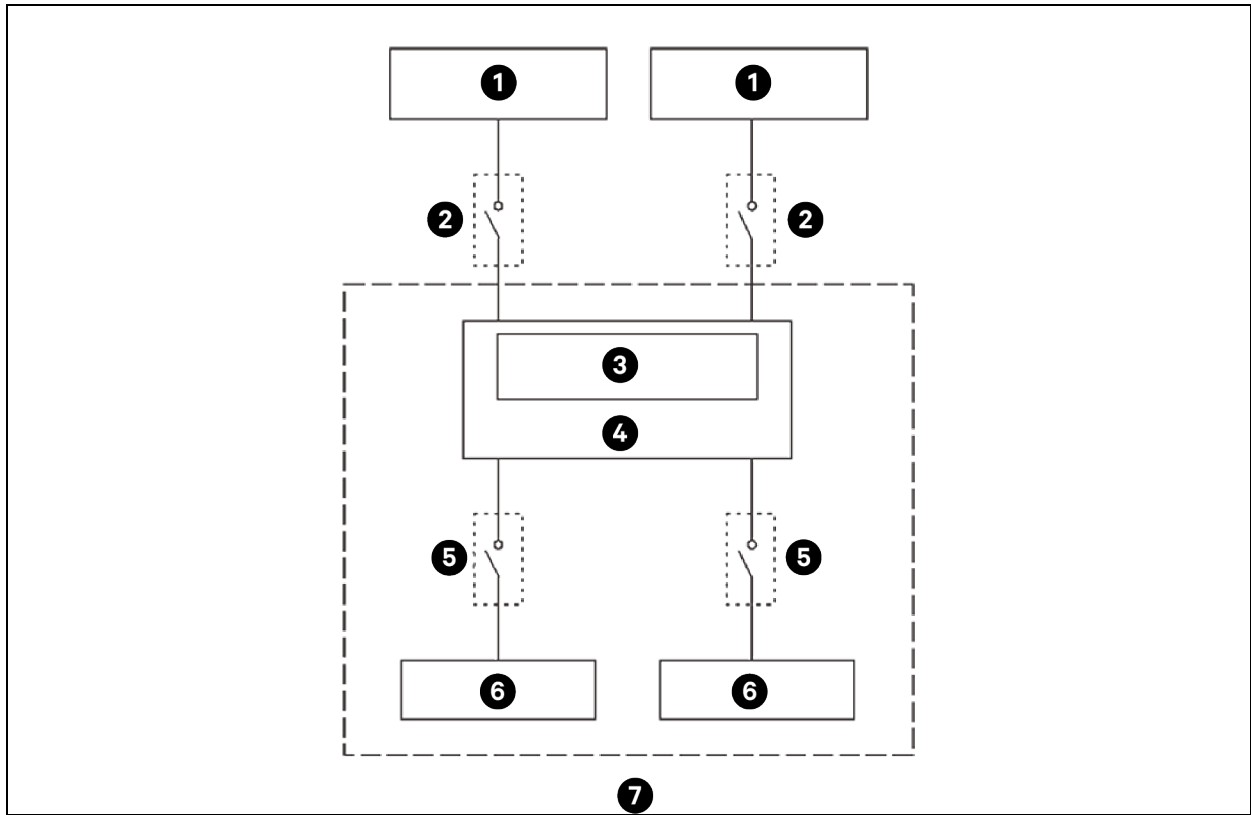
Item	Description
1	<p>Layout of cells</p> <p>The battery should not get in contact with 2 naked live parts with the potential difference over 150 V at the same time. If it is unavoidable, insulated terminal shield and insulated cable must be used for the connection.</p>
2	<p>Workbench</p> <p>The workbench (or pedal) must be skid proof and insulated, and at least 1 m wide.</p>
3	<p>Wiring</p> <p>All the wiring distances should be minimized.</p>
4	<p>BCB</p> <p>The BCB is generally installed in the wall mounted box near the battery.</p>

7.9 Common Battery String

The UPS supports common battery string function, which indicates that each unit in the parallel system shares the same battery string for energy saving, space saving and efficiency improving. The cables connection for common battery string is shown in **Figure 7.6** on the next page. Make sure that the below requirements are fulfilled before connecting the common battery string:

- All the units in parallel system share the same battery string, and no intermixing of common battery string with independent battery.
- Each unit should use the common battery string.
- Each UPS has its own BCB box.

Figure 7.6 Connection of Common Battery String



Item	Description	Item	Description
1	UPS	5	BCB box
2	BCB	6	Battery
3	Bus	7	Battery System
4	Junction box		

7.10 BCB Cabinet (Optional 1)

Users can choose the BCB cabinet according to the onsite configuration. The BCB cabinet plays the role of electrical isolation between the UPS and the battery, minimizing the danger to the maintenance personnel when working.

The BCB cabinet provides the below functions:

- Short circuit protection and EOD protection. The BCB opens automatically when the battery voltage drops to the EOD voltage point.
- Support the UPS EPO function. The BCB opens automatically when the EPO switch on the touchscreen of the UPS is pressed.

The BCB cabinet should be installed close to the battery. It can be installed on a horizontal surface.

Besides the local regulations, to enable routine operation of switches in the BCB cabinet within the BCB cabinet, it is recommended that clearance on the front of the UPS should be larger than 1200 mm provide access to the maintenance personnel. At the rear side there should be clearance of at least 500 mm to provide adequate air circulation.

The BCB cabinet can use bottom cable entry method. It provides one big and one small cable entry holes on both the top plate and bottom plate. The big one is for power cable entry, and the small one is for signal cable entry. After connection, take appropriate measures to seal the cable entry holes.

NOTE: The signal cable W812 must be connected separately from the battery power cables. The signal cable is a shield cable, both ends of its shield layer must be connected to the enclosure. The UPS and BCB cabinet must be earthed separately.

NOTE: Make sure that the UPS rectifier has started before closing the BCB.

NOTE: Put a mark on the batteries of the string when configuring the divided BCB cabinet, and note that the marked number must be correspond to the battery terminals in the BCB cabinet when connecting the power cables.

7.11 BCB Box (Optional 2)

The UPS provides a BCB box as an option. The BCB cabinet works as electrical isolation between the UPS and the battery, minimizing the danger to the maintenance personnel when working.

The BCB provides the following functions:

- Short circuit protection and EOD protection. The BCB opens automatically when the battery voltage drops to the EOD voltage point.
- Support the UPS EPO function. The BCB opens automatically when the EPO switch on the touchscreen of the UPS is pressed.

Figure 7.9 on page 132 provides the mechanical specifications of the BCB box.

Table 7.3 Parameters of BCB Box

Dimensions (H * W * D) (mm)	Weight (kg)	Recommended Screw
650 × 1000 × 285	65	M8

The BCB box should be installed close as possible to the battery. It can be installed on a wall or a horizontal surface through the installation holes shown in Figure 7.7 on the next page.

See Figure 7.7 on the next page to Figure 7.9 on page 132 to install and connect the BCB box. There are connection terminals in the BCB box for connecting the power cables from the UPS and battery. For signal cable connection, connect the accessory cable W812 shown in Figure 7.9 on page 132.

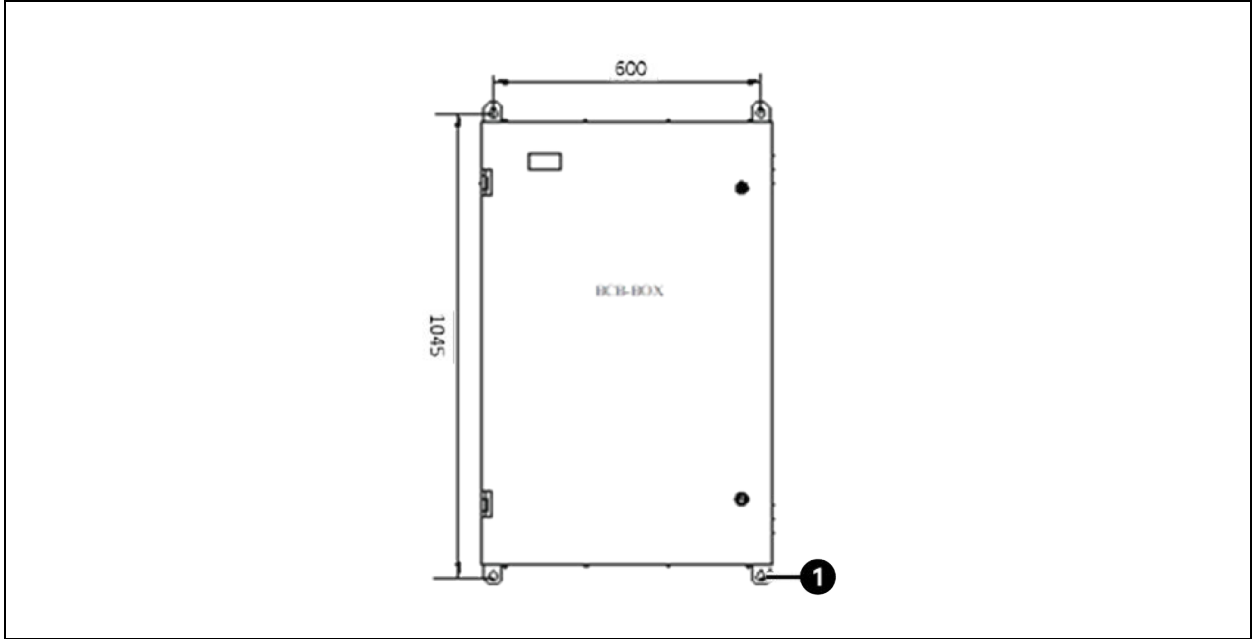
The BCB box can use top cable entry and bottom cable entry. It provides one big and one small cable entry holes on both the top plate and bottom plate. The big one is for power cable entry, and the small one is for signal cable entry. After connection, take appropriate measures to seal the cable entry holes.

NOTE: The signal cable W812 must be connected separately from the battery power cables. The signal cable is a shield cable, both ends of its shield layer must be connected to the enclosure. The UPS and BCB box must be earthed separately.

NOTE: Two or more battery switch boxes are used in parallel, pay attention to the equal length of the connecting cables of the battery switch boxes, so that there is a good current sharing between the battery switch boxes, and prevent one of the battery switches from malfunctioning due to uneven current. The number of switch boxes connected in parallel should not exceed 4.

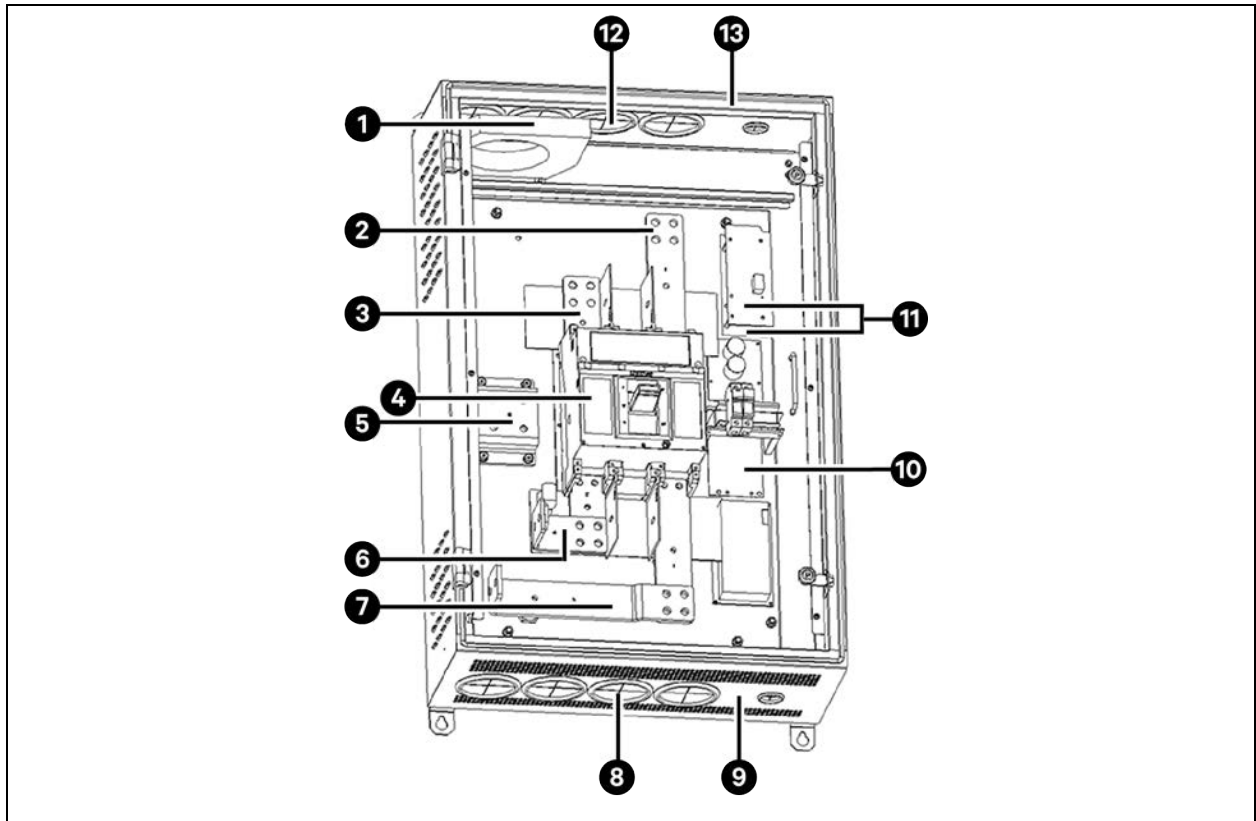
NOTE: The battery switch must be closed only after the UPS rectifier is started.

Figure 7.7 Installation Hole Dimension of BCB Box (Units: mm)



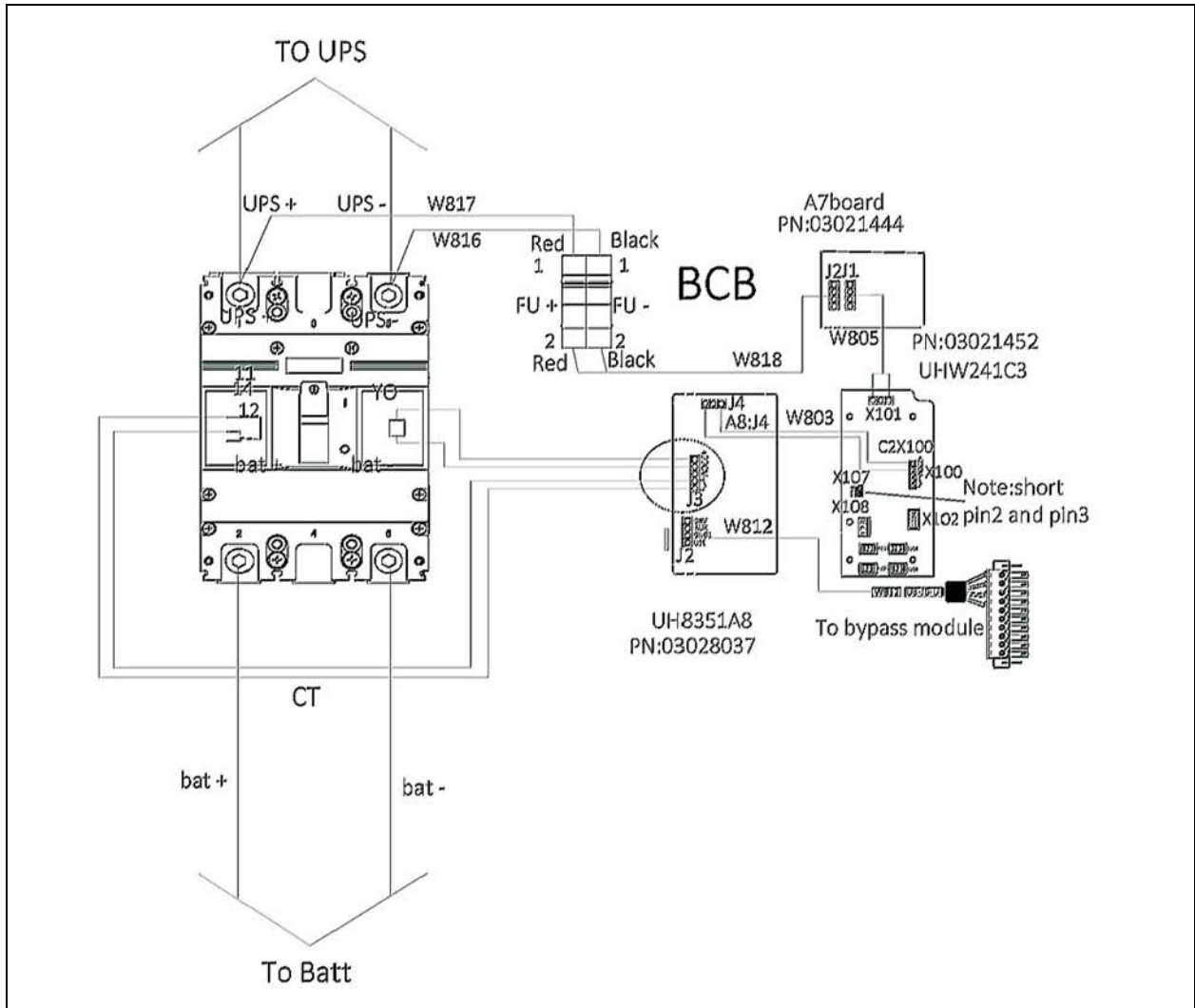
Item	Description
1	Installation hole

Figure 7.8 Internal Structure of BCB Box



Item	Description	Item	Description
1	Battery ground fault detector	8	Bottom entry hole
2	UPS terminal (-)	9	Bottom plate
3	UPS terminal (+)	10	PCB board of battery ground fault detector
4	BCB	11	BCB Control board
5	PE	12	Top cover
6	Battery terminal (+)	13	Top entry
7	Battery terminal (-)		

Figure 7.9 Connection Diagram of BCB Box



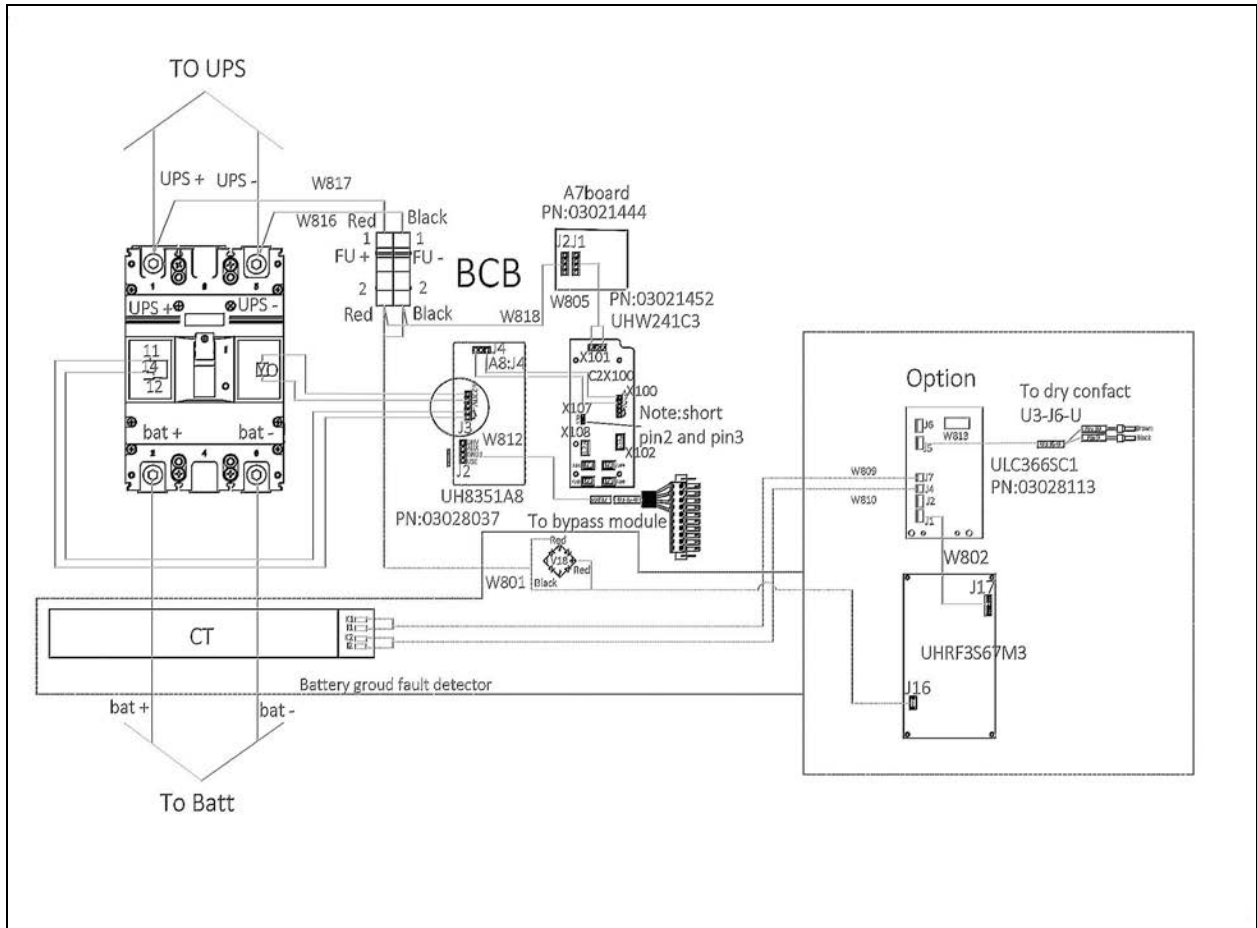
7.12 Battery Ground Fault Detector (Optional)

Vertiv provides an optional battery ground fault detector. It includes a mutual inductor and a PCB, that is installed in the BCB cabinet.

- If the BCB cabinet uses top cable entry, the mutual inductor should be installed on the inside of the top plate of the BCB cabinet.
- If the BCB cabinet uses bottom cable entry, the mutual inductor should be installed on the inside of the bottom plate of the BCB cabinet. Connect the PCB as shown in **Figure 7.10** on the facing page.

NOTE: If a battery ground fault detector is installed, the positive, negative and neutral battery cables from the battery into the BCB cabinet must be routed through the hole of the mutual inductor of the battery ground fault detector, while other cables must bypass the mutual inductor for connection.

Figure 7.10 Connection of Battery Ground Fault Detector



7.13 BCB Reference Current and Connection

Table 7.4 below provides recommended BCB rated current and battery maximum discharge current at full load. Refer to Table 3B in IEC60950-1, and select appropriate cable CSA according to local electrical codes and standards.

Table 7.4 BCB Rated Current and Battery Max. Discharge Current at Full Load (Recommended)

Items	Unit	UPS Rated Power (kVA)		
		300	600	
30-block to 40-block battery	Rated battery discharge current at full load	A	780	1560
	Reference rated current of BCB	A	1000	2000
	CSA of connection cable	mm ²	2X240	4X240
42-block battery	Rated battery discharge current at full load	A	752	1504
	Reference rated current of BCB	A	1000	1800
	CSA of connection cable	mm ²	2X240	4X240

Table 7.4 BCB Rated Current and Battery Max. Discharge Current at Full Load (Recommended) (continued)

Items		Unit	UPS Rated Power (kVA)	
			300	600
44-block battery	Rated battery discharge current at full load	A	718	1436
	Reference rated current of BCB	A	1000	1600
	CSA of connection cable	mm ²	2X240	3X240
46-block battery	Rated battery discharge current at full load	A	687	1373
	Reference rated current of BCB	A	800	1600
	CSA of connection cable	mm ²	2X185	4X185
48-block battery	Rated battery discharge current at full load	A	658	1316
	Reference rated current of BCB	A	800	1600
	CSA of connection cable	mm ²	2X185	4X185
50-block battery	Rated battery discharge current at full load	A	632	1263
	Reference rated current of BCB	A	800	1600
	CSA of connection cable	mm ²	2X185	4X185

NOTE: Current calculation in the Table 7.4 on the previous page is according to the DC/AC efficiency of 0.95 and EOD voltage of 1.63V/cell.

NOTE: A DC breaker, with DC rated voltage of the breaker no less than the total voltage at the battery end is recommended.

7.14 Battery Maintenance

For the battery maintenance and maintenance precautions, refer to IEEE-Std-1188-2005 and the relevant manuals provided by the battery manufacturer.

Important maintenance steps to be followed:

1. Periodically check and tighten screws at the battery connection points.
2. Ensure that all safety devices are operating normally.
3. Make sure that all battery management parameters are set properly.
4. Measure and record the air temperature inside the battery room.
5. Make sure that the battery terminals have no damage or heat generating trace.
6. Ensure the battery enclosure and terminal shields are intact.

7.15 Disposal of Used Battery

If the battery has liquid leakage or is damaged, place the battery into the container that can withstand sulphuric acid and discard it according to the local regulations.

Used lead acid storage battery belongs to dangerous. The storage, transportation, use and disposal of the battery must comply with the national and local laws and regulations on dangerous waste and used battery pollution prevention and other standards.

According to the relevant national regulations, the used lead acid storage battery shall be recycled and must not be disposed using other methods. Random discard or any other improper disposal of the used lead acid storage battery may cause severe environment pollution and the relevant person will be investigated of corresponding legal responsibilities.

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8 Parallel System and LBS System

This chapter gives details on the installation of the parallel system and load bus synchronization (LBS) system.

8.1 General

The parallel system is comprised of up to 4 UPS units of the same power rating and connected in parallel without the need for a centralized mains static bypass. Instead the bypass static switches of each UPS share the load when the system transfers to the mains bypass supply.

In a parallel system, each module is internally identical to the single module configuration. A parallel system requires inter module control signals to manage the load sharing, synchronizing and bypass switching. The control signals are connected through the parallel cables, which are multicore ribbon cables connected between the units of the system to form a closed loop.

8.2 System installation procedures

The basic installation procedure of a parallel system is the same as that of single module system. The installation of a parallel UPS should follow the installation procedure for a single UPS module with the additional requirements detailed in this section.

8.2.1 Preliminary checks

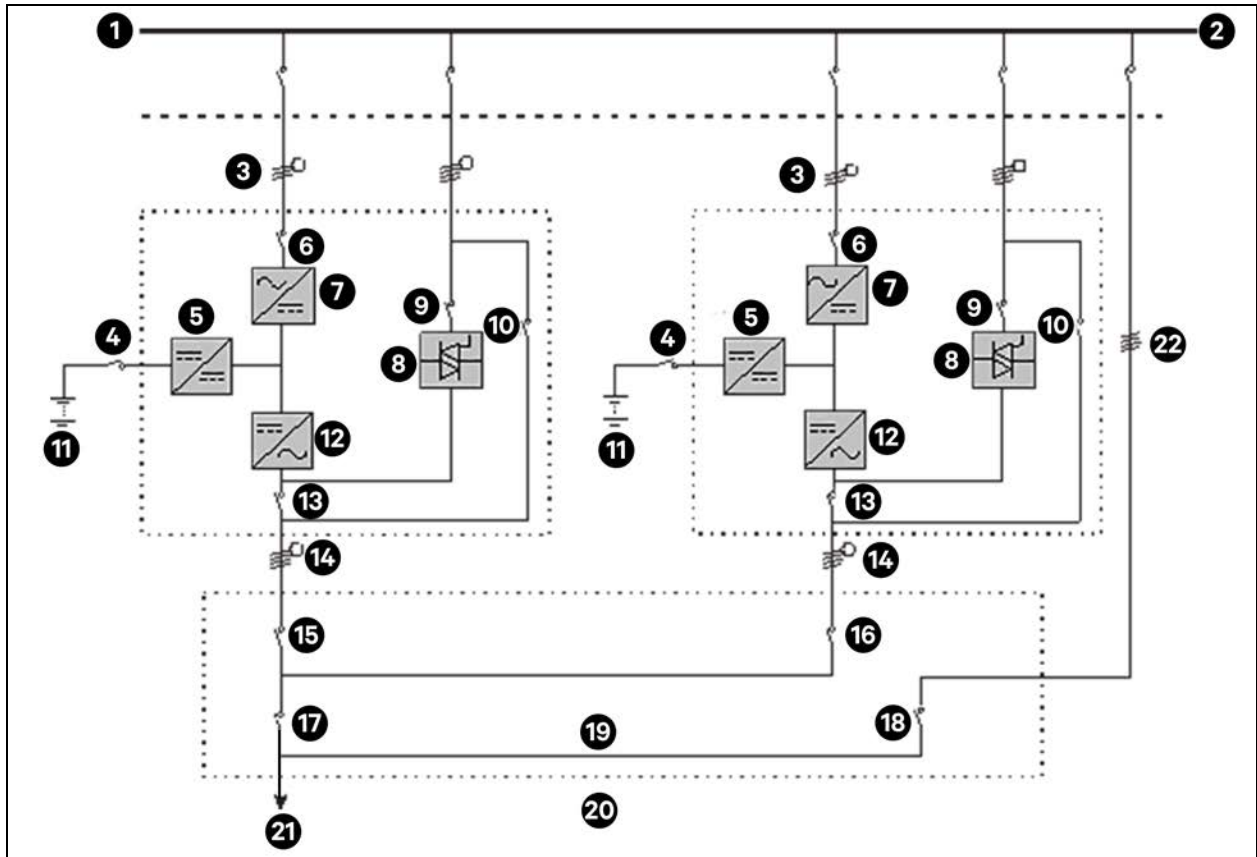
Ensure that the selections of the parallel cables are correct, and that the modules are of the same rating, model, and with the same software and hardware release.

IMPORTANT! Vertiv service personnel must configure each module separately using Vertiv setting software to achieve coordinated operation of the modules in the parallel system.

8.2.2 Cabinet installation

Place the UPS units side by side and interconnect as shown in **Figure 8.1** on the next page. The output distribution mode (QE1, QE2 must be configured) shown in **Figure 8.1** on the next page is recommended to facilitate maintenance and system testing.

Figure 8.1 Schematic of Typical Parallel System with Common Input, Separate Batteries and Output



Item	Description	Item	Description
1	Input power supply	12	Inverter
2	External bypass switch	13	Q5
3	Mains input L1, L2, L3, N	14	L1, L2, L3, N
4	BCB	15	QE1
5	Charger	16	QE2
6	Q1	17	QOP
7	Rectified	18	QBP
8	Static switch	19	Output distribution
9	Q2	20	QBP
10	Q3	21	To load
11	Battery 1	22	External maintenance bypass

NOTE: Q1, Q2, and Q5 are optional while Q3 is standard.

8.2.3 External protective device



WARNING! High earth leakage current. Earth connection is essential before connecting the input supply (including both mains supply and battery). The equipment must be earthed in accordance with the local electrical regulations.

8.2.4 Power cable

The power cable wiring is done same as that of a single UPS module. Refer to [Wiring of Power Cable](#) on page 33.

The bypass and rectifier should be connected with same neutral line input terminal. The current leakage protective device must be installed on the upstream of the neutral line input terminal.

NOTE: The power cables (the bypass input cable and the UPS output cable) of each UPS module should be of the same length and specifications to facilitate load sharing.

8.2.5 Parallel cable

The cables must be interconnected in a ring shaped connection between the UPS modules, as shown in [Figure 8.2](#) below. The ring connection ensures the reliability of the control of the parallel system.

NOTE: Shielded and double insulated parallel cables are available in lengths of 5 m, 10 m and 15 m.

The specific connection method is: The parallel cable of one single UPS is connected from the PARA1 port of the communication box to the PARA2 port of the immediate next single machine communication box and is in sequence. The front panel of the communication module provides parallel ports, as shown in [Figure 8.3](#) on the next page. Make sure to check all the reliable cable connections before starting up the UPS system.

Figure 8.2 Parallel Signal Cables Connection (Parallel System)

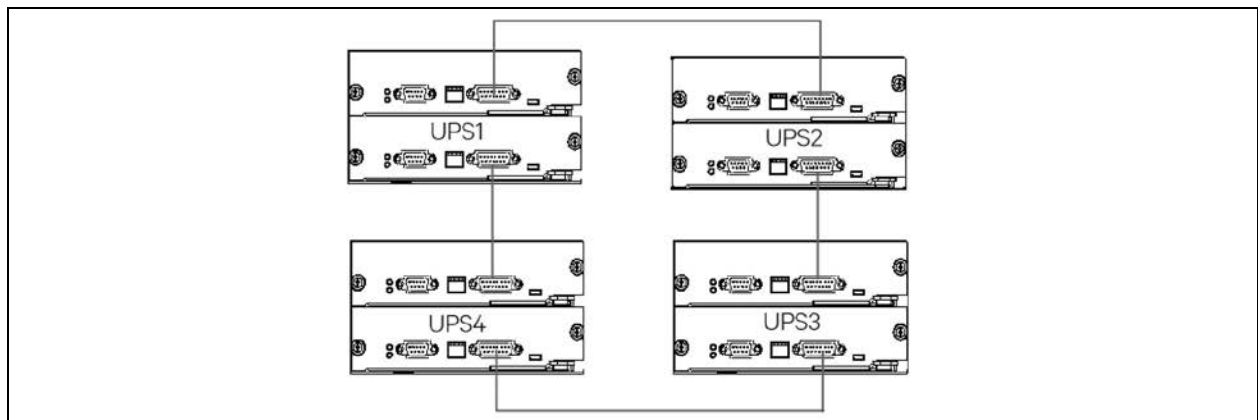
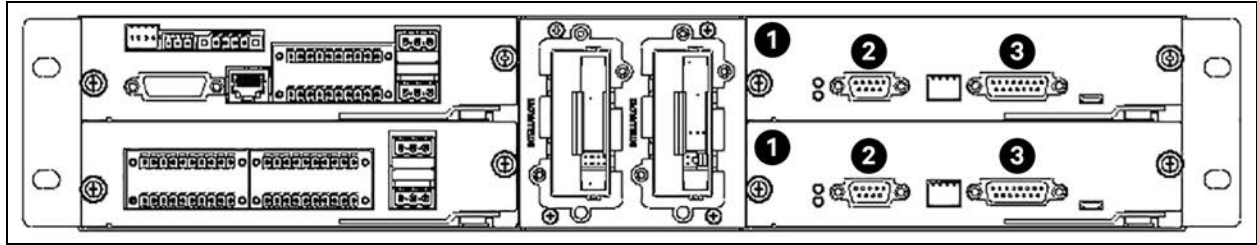


Figure 8.3 Parallel Port on the System Control Module



Item	Description
1	U4
2	LBS
3	Parallel

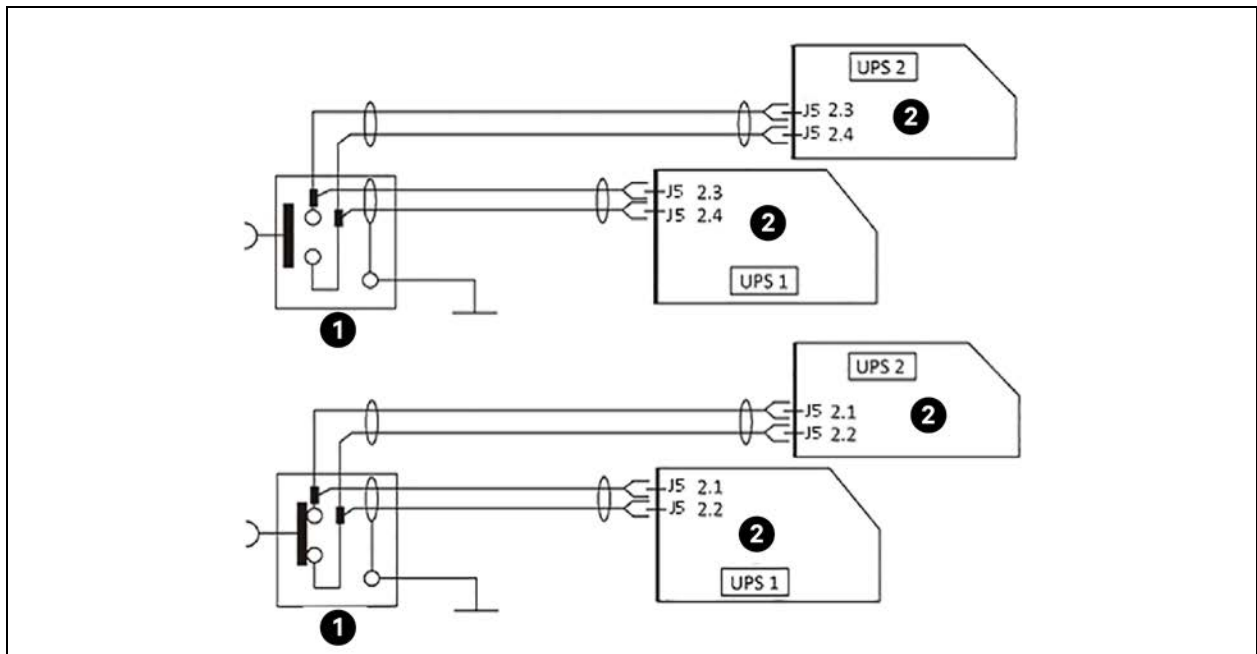
8.2.6 Remote emergency power OFF (EPO)

In addition to the EPO switch provided on the operator control and display panel of each UPS module for controlling the EPO of each module respectively, the parallel system also provides remote EPO function for controlling all UPS modules to shut down simultaneously from a remote terminal, as shown in **Figure 8.4** below.

NOTE: The remote EPO switch must provide dry contact signal, which is normally open or normally closed. The open circuit voltage provided is 12 VDC, <20 mA.

NOTE: The external EPO device is consists of another control system which can disconnect UPS mains supply or bypass input. Pins 1 and 2 of the normally closed EPO port on the integrated control module is linked in factory.

Figure 8.4 EPO Circuit Diagram



Item	Description
1	EPO
2	Integrated control module

NOTE: In Figure 8.4 on the previous page, the upper one is normally open type, and the lower one is normally closed type.

8.3 Operation Procedures for Parallel System

Only one step is required at a time, and the subsequent step may only be completed when this operation step of each UPS module has been completed.

8.3.1 Startup procedures in normal mode

These procedures are applicable to start the UPS under total power down state, which means the UPS or the maintenance bypass switch has not supplied the load before. Make sure UPS has been completely installed and commissioned by the engineer, and external power supply switch has been turned off.



WARNING! These procedures result in mains voltage being applied to the UPS output terminals. If any load equipment is connected to the UPS output terminals, check with that it is safe to apply power. If the load is not ready to receive power, disconnect the downstream load switch, and place a warning label on the connection point of the load.

Procedure to turn ON the UPS from a fully powered down condition:

1. Confirm that the total external maintenance bypass switches are disconnected.
2. Open the front door of each UPS in turn.
3. Ensure that the internal maintenance bypass switch Q3 is disconnected.
4. Check all the input cables, parallel cables and copper bars are connected properly.



WARNING! In parallel UPS configuration, all operations related to disconnection or connection of the maintenance bypass switch must be performed within three seconds to avoid overload situations and damage to the maintenance bypass switch.

5. Close the total bypass input switches.
6. Close the output switch Q5, bypass input switch Q2, rectifier input switch Q1, and all external output isolating switches (if any) of each UPS in turn.

When the above steps are complete, the system is powered on, and the startup screen pops up.

Wait 25 seconds and confirm that the Touchscreen shows that the rectifier power supply and the bypass power supply are normal.

If not, check whether the Q1 and Q2 switches are closed. Then the rectifier starts up, about 30 seconds after the rectifier enters normal operation, the bypass static switch is closed.

7. When the rectifier start process is finished and the rectifier indicator turns solid green, close the external BCB.
8. For each UPS, manually turn on the inverter. The inverter starts up, the whole UPS system will power the load.

8.3.2 Maintenance bypass procedures



WARNING! If the UPS system is composed of more than 2 parallel UPS modules, and the load capacity exceeds the single module capacity, do not use the internal maintenance bypass switch.

Maintenance Bypass will transfer the load from UPS power supply protection state to direct connection with AC input bypass state.



CAUTION: Power supply interruption danger. Before performing this procedure, should check the LED information first and make sure the bypass is normal and inverter synchronized. Otherwise, it may result in the load power interruption for a while.

1. Manually turn off the inverter of each UPS respectively. The power flow diagram shows **Inverter Off**, and the buzzer alarms. The load transfers to the static bypass, and the inverter shuts down. At last, all UPS units are transferred to Bypass Mode.

NOTE: Pressing the Silence Off button silences the alarm; however, the alarm message on the touch screen does not disappear until the alarm status is cleared.

2. Close the UPS all the external maintenance bypass switches but, do not close the internal maintenance bypass switch Q3 of each UPS. While you are closing these switches, all the external maintenance bypass should be parallel connected with static bypass of each of the UPS's. The touch screen of each UPS should display Main Switch Closed.
3. Disconnect the output switch Q5 of each UPS in turn, and the maintenance bypass can supply power to the load.



CAUTION: Load is not secured on the maintenance bypass anymore unless there is power generator running instead of normal grid utility.

4. Pressing the EPO button of each UPS stops the operation of rectifier, inverter, static switch and battery, but this action will not affect the maintenance bypass power the load normally.

NOTE: In maintenance mode, the load is directly fed by the mains power instead of the pure AC power from the inverter.

5. Disconnect the rectifier input switch Q1 and bypass input switch Q2 of each UPS in turn.

After all the internal power supply is disconnected and the touch screen does not display will also be turned off.

NOTE: Wait for 10 minutes before maintenance for the internal DC bus capacitance to get discharged.



WARNING! The parts of UPS circuits also have hazardous voltage, though the rectifier input switch, bypass input switch and battery switch are disconnected. Therefore, the UPS maintenance is applicable to qualified personnel only.

8.3.3 Procedures for isolating one UPS module from parallel system

IMPORTANT! The isolation procedures should be carried out only by Vertiv certified service personnel.

NOTE: After isolating one UPS module, when the parallel system is not overload, then proceed with steps below.

To isolate the UPS module from the parallel system for any major repairing activity, follow the below steps.

1. Turn off the rectifier, inverter, static switch and battery with the EPO button on the GHMI.

NOTE: Turning off the rectifier, inverter, static switch, and battery will not affect all the other UPS in parallel system and the load will remain powered normally.

2. Disconnect the external power mains switch, rectifier input switch Q1, external power bypass switch, bypass input switch Q2, output switch Q5, BCB and single module external output switch.



WARNING! Place a notice at the AC input distribution (generally far away from the UPS) to alert that UPS maintenance is being performed.

NOTE: Wait 10 minutes for the internal DC bus capacitance discharging. Then the UPS is completely shut down.

8.3.4 Procedures for inserting one isolated UPS module in parallel system

IMPORTANT! These procedures shall only be carried out by service personnel of Vertiv or under their guidance.

The following procedures are used to reintegrate a UPS module that has been previously isolated from the parallel system:

1. Confirm that the I/O cable, battery cable and parallel cable of the single module are correctly connected.
2. Confirm that the maintenance bypass switch Q3 or the single module external maintenance switch is disconnected.
3. Close the output switch Q5, external output switch, external power bypass switch, bypass input switch Q2, rectifier input switch Q1, and external power mains switch of each UPS in turn.
4. When the single module starts, close the BCB and then manually turn on the inverter.

Wait for few seconds after starting the inverter the UPS system, it connects with existing systems for parallel operation automatically.

8.3.5 Procedures for completely powering down UPS

Complete UPS shutdown and load power OFF should follow the below procedure. All power switches, isolating switches and breakers are disconnected, and then UPS no longer supplies power to the load.



CAUTION: In the powering down procedure of the UPS, the load power will be cut off.

1. Press the EPO button of each UPS to stop the operation of rectifier, inverter, static switch, and battery.
2. Disconnect the rectifier input switch Q1 and bypass input switch Q2 of each UPS that will close the internal power supply and the touch screen display will stop functioning.
3. Disconnect the output switch Q5 of each UPS.



CAUTION: Place a notice at the AC input distribution (generally far away from the UPS) to alert that the UPS maintenance is being performed.



CAUTION: Wait 10 minutes while the internal DC bus capacitance discharging. Then the UPS is completely shut down.



WARNING! Hazardous battery voltage. The battery terminals will have hazardous voltage even after the UPS complete shutdown.

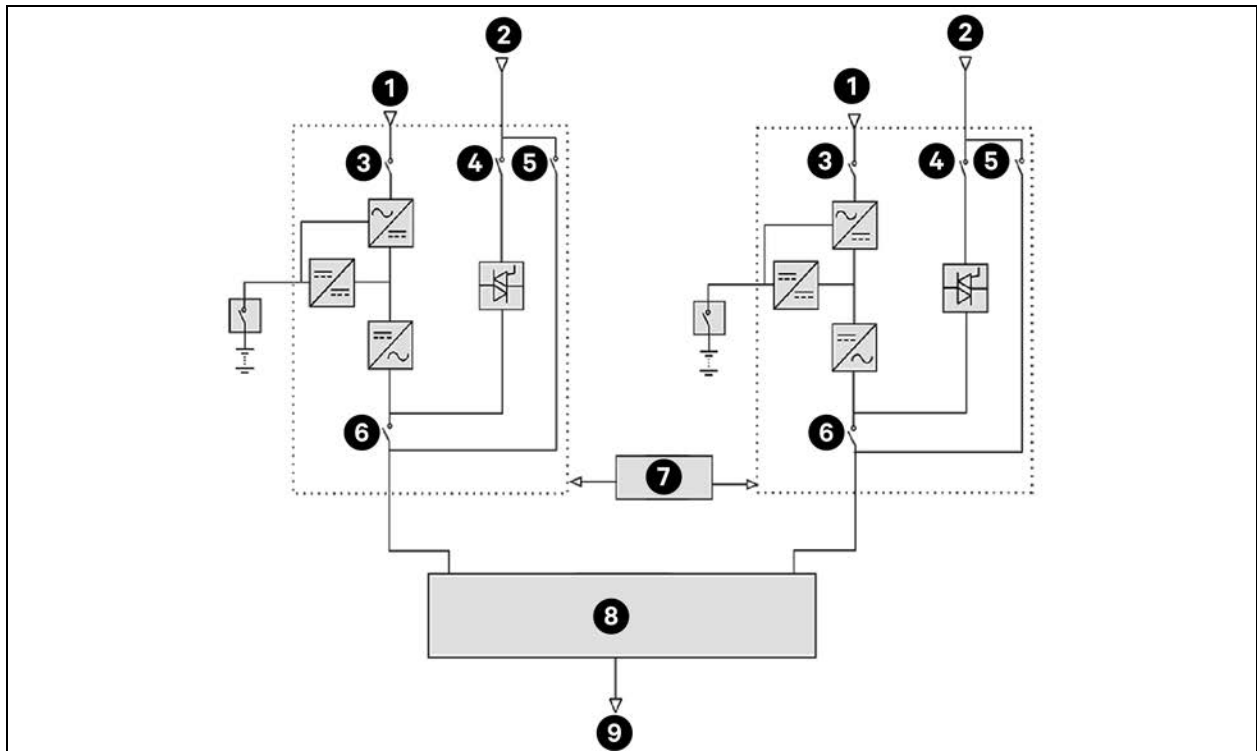
8.4 LBS System

8.4.1 Cabinet installation

An LBS system consists of two independent UPS systems, each containing one or more parallel UPS modules, as shown in **Figure 8.5** below and **Figure 8.6** on the facing page. The LBS system has high reliability and is applicable to the load with multiple inputs. For single input load, a STS can be installed to feed power to the load.

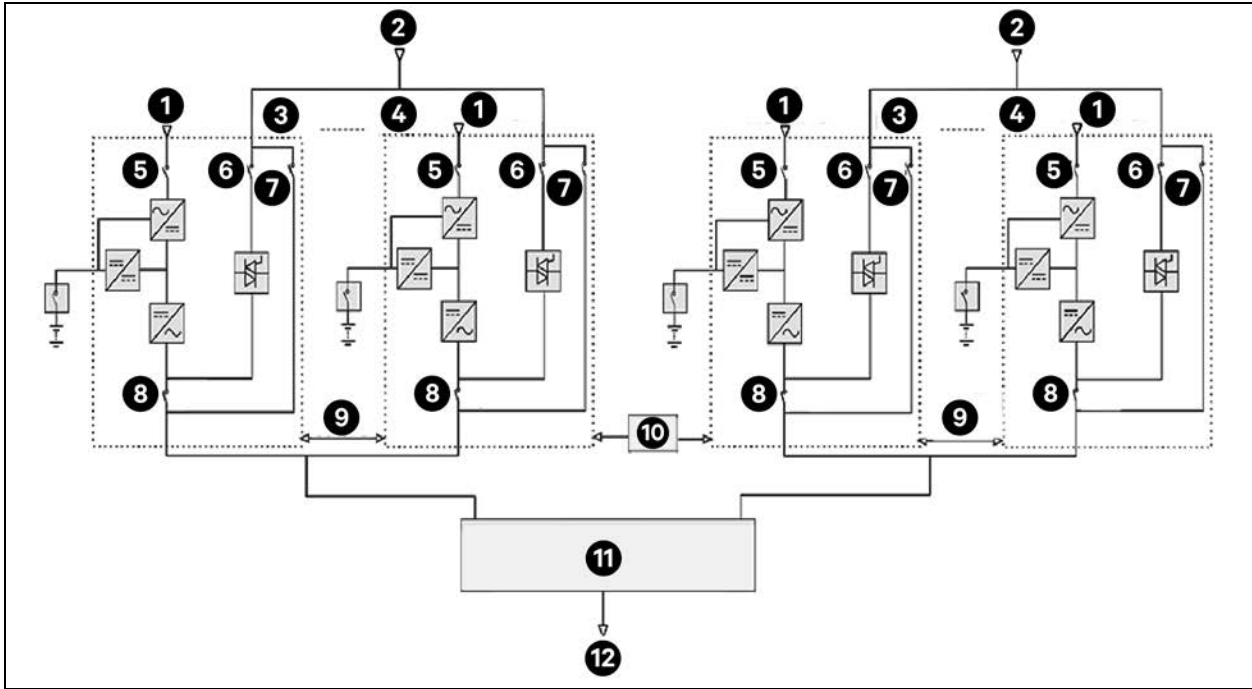
The system uses the LBS cables to keep the output of two independent UPS systems in synchronization. One set of UPS system (single/parallel) is designated as the master, the other set of UPS system (single/parallel) is designated as the slave for the operation in LBS mode.

Figure 8.5 LBS System (UPS Module)



Item	Description	Item	Description
1	Rectifier	6	Q5
2	Bypass	7	LBS
3	Q1	8	STS
4	Q2	9	To load
5	Q3		

Figure 8.6 LBS System (Parallel System)



Item	Description	Item	Description
1	Rectifier	7	Q3
2	Bypass	8	Q5
3	UPS1	9	Parallel cable
4	UPS4	10	LBS
5	Q1	11	STS
6	Q2	12	To load

NOTE: Q1, Q2, and Q5 are optional while Q3 is standard.

NOTE: In a dual bus system, the two UPS systems must have the same voltage and frequency, and the load should not exceed the power rating of a UPS module system.

8.4.2 External protective device

Refer to [External protective devices](#) on page 35.

8.4.3 Power cable

The power cable of dual bus power system is similar to that of single system. See the [Wiring of Power Cable](#) on page 33.

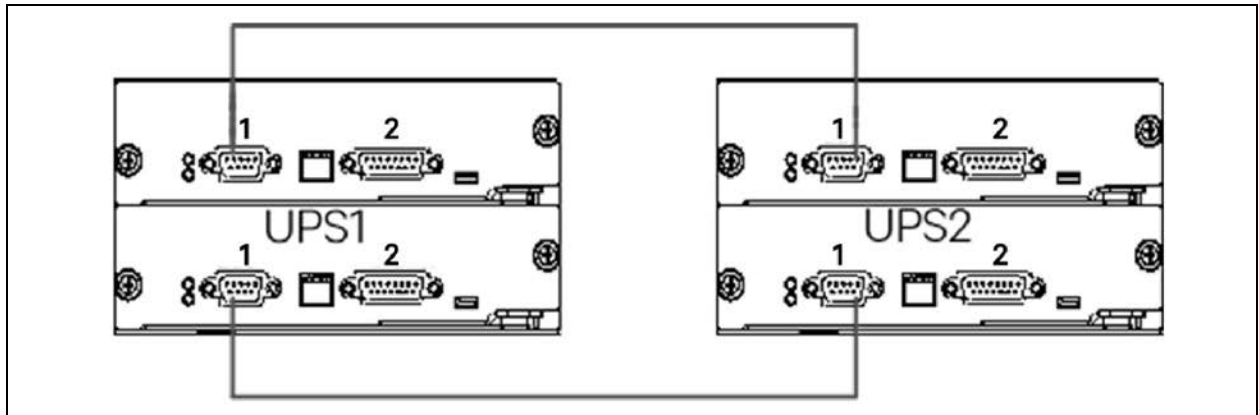
The bypass and rectifier input supplies must use the same neutral line input terminal. If the input has a current leakage protective device, the device should be installed with upstream of the neutral line input terminal.

8.4.4 LBS cable

Connect the optional LBS cables (10 m, 15 m, 20 m) between the LBS ports or PARA2 and LBS port of the two UPS systems, for 300 to 600 kVA dual bus system, shown in [Figure 8.7](#) below and [Figure 8.8](#) on the facing page. The LBS port is shown in [Figure 8.9](#) on the facing page.

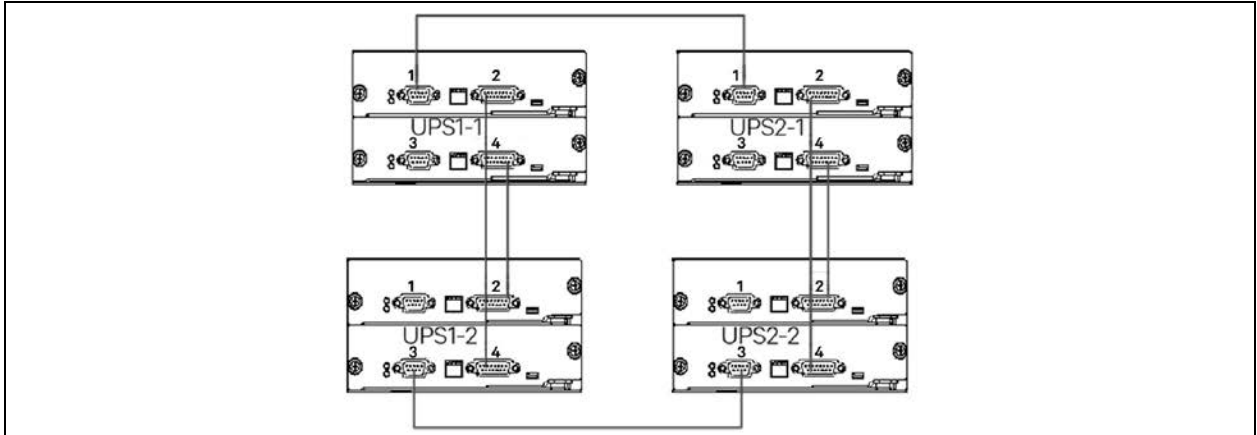
NOTE: You must use the shortest LBS cable suitable for the application and must not coil excess. Meanwhile, separate the LBS cable from the power cables to prevent electrical interferences.

Figure 8.7 Connection of Typical LBS System (Single Module)



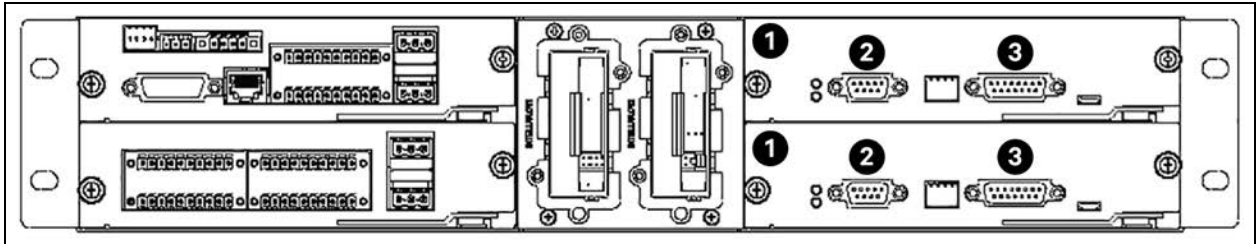
Item	Description
1	UPS
2	Parallel

Figure 8.8 Connection of Typical LBS System (Parallel System)



Item	Description	Item	Description
1	LBS1	3	LBS2
2	Parallel 1	4	Parallel 2

Figure 8.9 LBS Port



Item	Description
1	U4
2	LBS
3	Parallel

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9 Vertiv™ Liebert® APM2 Option Configurations

This chapter provides the information about available options for Liebert® APM2 UPS.

9.1 Options List

Table 9.1 Options List

No.	Option Name	Remark
1	Battery temperature sensor kit	-
2	Battery ground fault kit	-
3	Seismic anchor kit	-
4	IS-UNITY-DP card	Intellislot ports 1 to 2
5	IS-UNITY-LIFE card	Intellislot ports 1 to 2
6	SIC card	Intellislot ports 1 to 2
7	UF-RS-485 card	Intellislot port 1
8	IS-RELAY card	Intellislot ports 1 to 2
9	External remote LBS box	
10	BCB cabinet	
11	Parallel cable	Available in 5 m, 10 m, 15 m
12	LBS cable	Available in 10 m, 15 m, 20 m
13	Common source copper bar	-
14	Top fan kit	
15	IP21 kit	

9.2 Options Introduction

9.2.1 Battery temperature sensor kit

The battery temperature sensor is used to detect the battery temperature. This kit allows for adjustment of the float charging voltage of the battery that makes it inversely proportional to the ambient temperature of the battery. This helps to prevent over charging of the battery during high ambient temperature.

NOTE: Keep one battery temperature sensor and one cross head screwdriver handy before starting the installation.



CAUTION: Install the battery temperature sensor kit following the given steps, to avoid, damages to the UPS and the battery.



WARNING! When installing the battery temperature sensor, turn off the UPS. During installation, be sure not to touch the battery terminals, exposed copper bars and components.

To install the battery temperature sensor, follow the steps below:

1. Power down the UPS completely.
2. Turn OFF the load.
3. Wait for the UPS indicators to turn off.

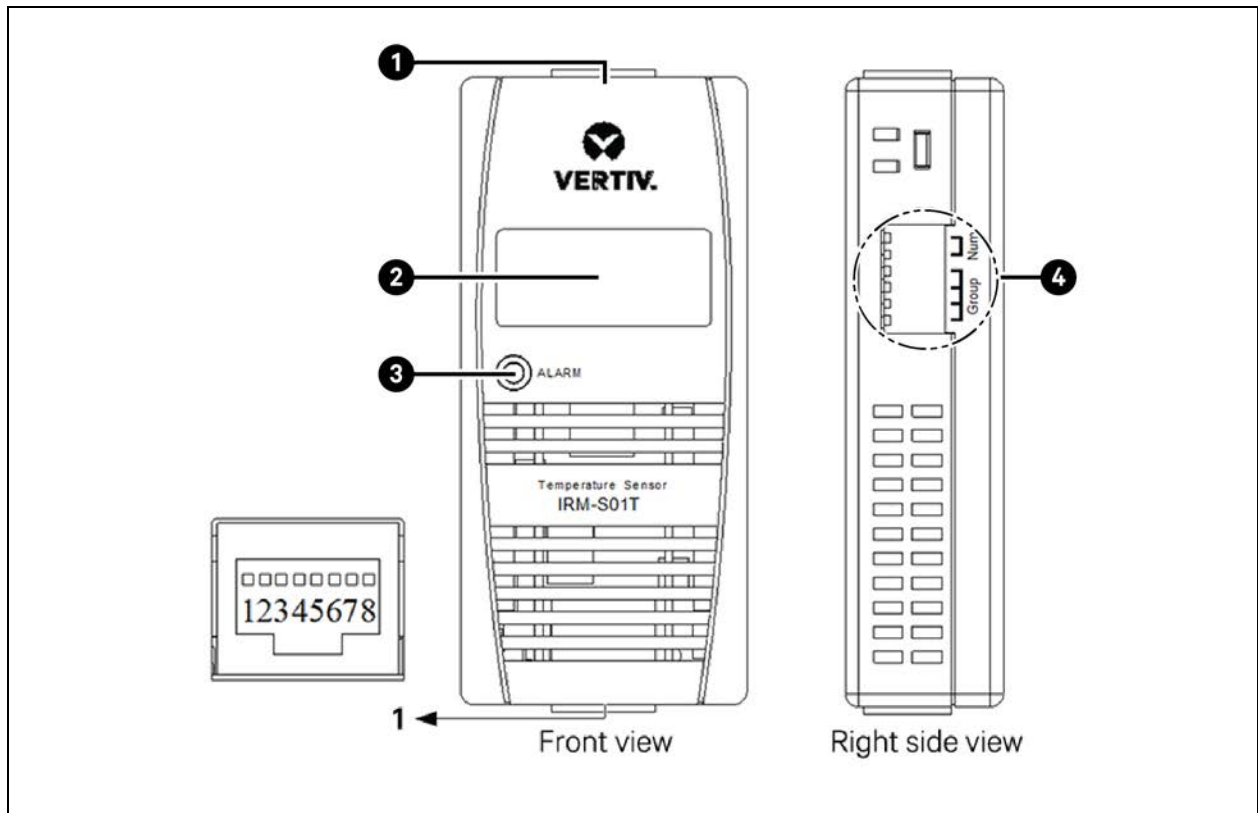
All the UPS indicators turns off.

4. Wait for five minutes to completely discharge the internal DC bus capacitors of the UPS.
5. Connect one end of the network cable with shielded RJ45 port to the battery temperature sensor and plug the other end into the J2 dry contact port on the X6 BATT: Battery temperature or BMS communication port.

NOTE: The temperature sensor can be connected in series with a maximum of 20 sensors and a maximum distance of 50 m.

6. Route the power cables and other cables separately to avoid the EMI generation from the cables.

Figure 9.1 Sensor Appearance



Item	Description
1	RJ45 Port
2	LCD
3	Alarm indicator
4	DIP Switch

Item	Parameter
Dimension (H×W×D)	97 mm × 44 mm × 22 mm
Weight	about 100 g

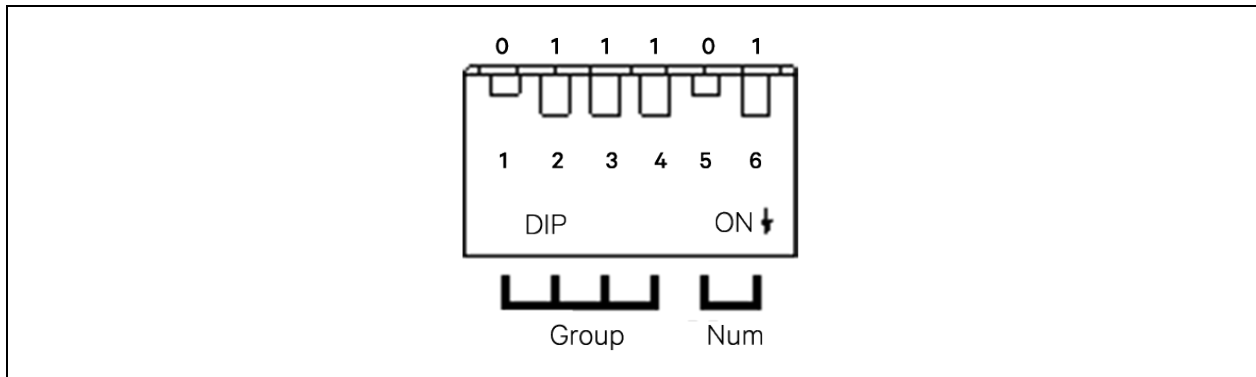
The electrical connection between the sensor and the communication module of UPS is completed through two RJ45 interfaces, used for power supply, communication and equipment cascading. The description of each related pin is given in the **Table 9.2** below.

Table 9.2 Pins Description

Pin	Description
Pin1, Pin2	+12 V / 24 V
Pin3, Pin6	NC
Pin4, Pin5	GND
Pin7	D+
Pin8	D-

DIP switch

The DIP switch is used to set the address of the sensor, that communicates with the upper device through the MODBUS protocol. The sensor address consists of a group number and a sequence number within the group, among which DIP1 to DIP4 are used to set the group number, and DIP5 to DIP6 are used to set the sequence number within the group. See figure below for the example of, the setting up sensor address 71. Here 0111 represents group number 7, and 01 represents sequence number 1 within the group.



NOTE: ON indicates 1, OFF indicates 0 address cannot be to 00 as this is the broadcast address.

The APM2 series UPS supports multiple external battery cabinets to be grouped and numbered to monitor and manage the temperature of the battery cabinets.

The settings of the DIP switches DIP1 to DIP6 of the battery temperature sensor are shown in the **Table 9.3** on the next page:

Table 9.3 DIP Switch Setting

DIP1 ~ DIP4	DIP5 ~ DIP6	Sensor Address	Matched Battery Cabinet Number
0001	00	10	Battery cabinet 1
	01	11	
	10	12	
	11	13	
0010	00	20	Battery cabinet 2
	01	21	
	10	22	
	11	23	
0011	00	30	Battery cabinet 3
	01	31	
	10	32	
	11	33	
0101	00	50	Battery cabinet 5
	01	51	
	10	52	
	11	53	
0110	00	60	Battery cabinet 6
	01	61	
	10	62	
	11	63	
0111	00	70	Battery cabinet 7
	01	71	
	10	72	
	11	73	
1000	00	80	Battery cabinet 8
	01	81	
	10	82	
	11	83	
1011	00	B0	Battery cabinet 1
	01	B1	
	10	B2	
	11	B3	

Table 9.3 DIP Switch Setting (continued)

DIP1 ~ DIP4	DIP5 ~ DIP6	Sensor Address	Matched Battery Cabinet Number
1100	00	C0	Battery cabinet 2
	01	C1	
	10	C2	
	11	C3	
1101	00	D0	Battery cabinet 3
	01	D1	
	10	D2	
	11	D3	
1110	00	E0	Battery cabinet 4
	01	E1	
	10	E2	
	11	E3	

9.2.2 Battery ground fault kit

Vertiv™ Liebert® APM2 UPS has an optional battery ground fault detector kit, it helps to detect and remove battery ground fault to ensure reliable system operation.

When a battery ground fault is detected, the indicator alarms ON the UPS display panel.

The battery ground fault detector kit includes a mutual inductor and a PCB, to be installed in the Battery Circuit Breaker (BCB) box. For the installation and connection of the battery ground fault detector, refer to [Battery Ground Fault Detector \(Optional\)](#) on page 132.

9.2.3 Seismic anchor kit

Liebert® APM2 UPS has an optional seismic anchor kits. It helps to avoid and reduce the damage to UPS caused by earthquake or vibration in the earthquake prone areas.

See [Table 9.4](#) below for dimensions of the seismic anchor kit.

Table 9.4 Dimensions and Content of the Seismic Anchor Kit

Item	Width (mm)	Length (mm)
Seismic anchor	60	585
Without switch	Two seismic anchors	Eight M8 × 25 tapping screws, six M12 expansion bolts
Single switch		
Four switches	Four seismic anchors	Sixteen M8 × 25 tapping screws, 12 M12 expansion bolts

Fix the UPS onto the concrete floor.



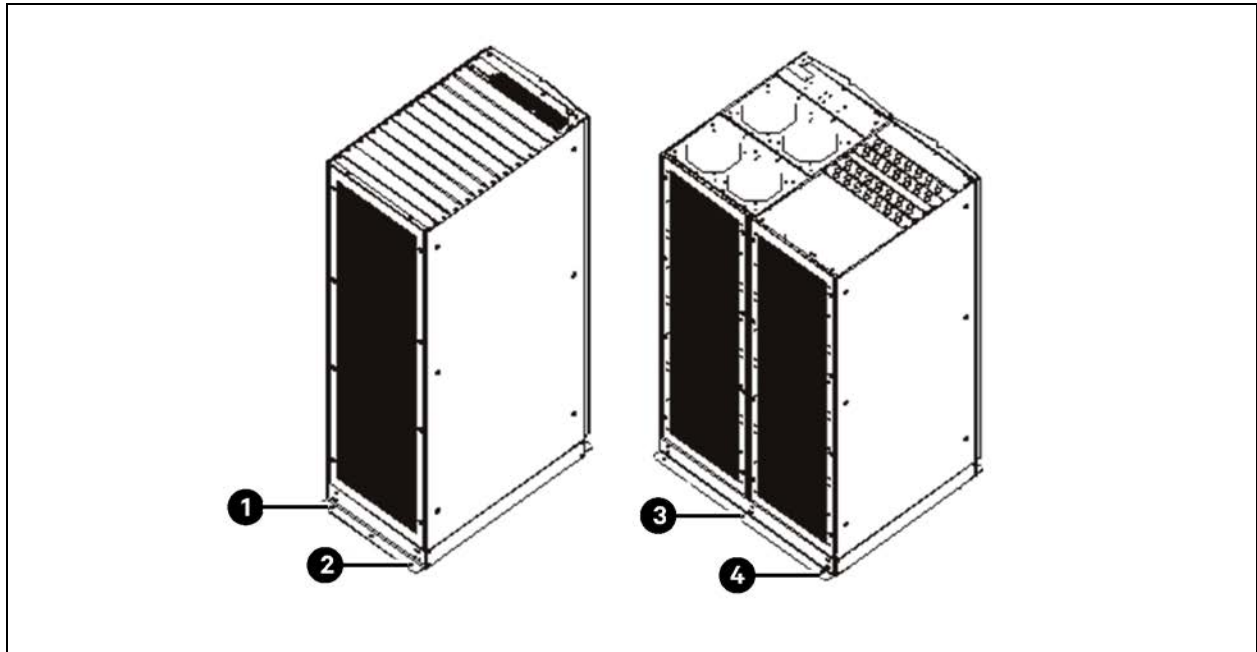
WARNING! Execute the installation according to the instructions. Failure to do so can cause personnel injury or damage to the UPS and seismic anchor kits.

Keep the Seismic Anchor Kit (see **Table 9.4** on the previous page for kit details), and one cross head screwdriver, a torque spanner and an adjustable spanner handy before starting the installation.

Installing the Seismic anchor:

1. Use M8 × 25 tapping screws (4 pieces) to install seismic anchor on the rear bottom side of the UPS cabinet, and use M12 expansion bolts (3 pieces) to install seismic anchor on the ground, as shown in **Figure 9.2** below.

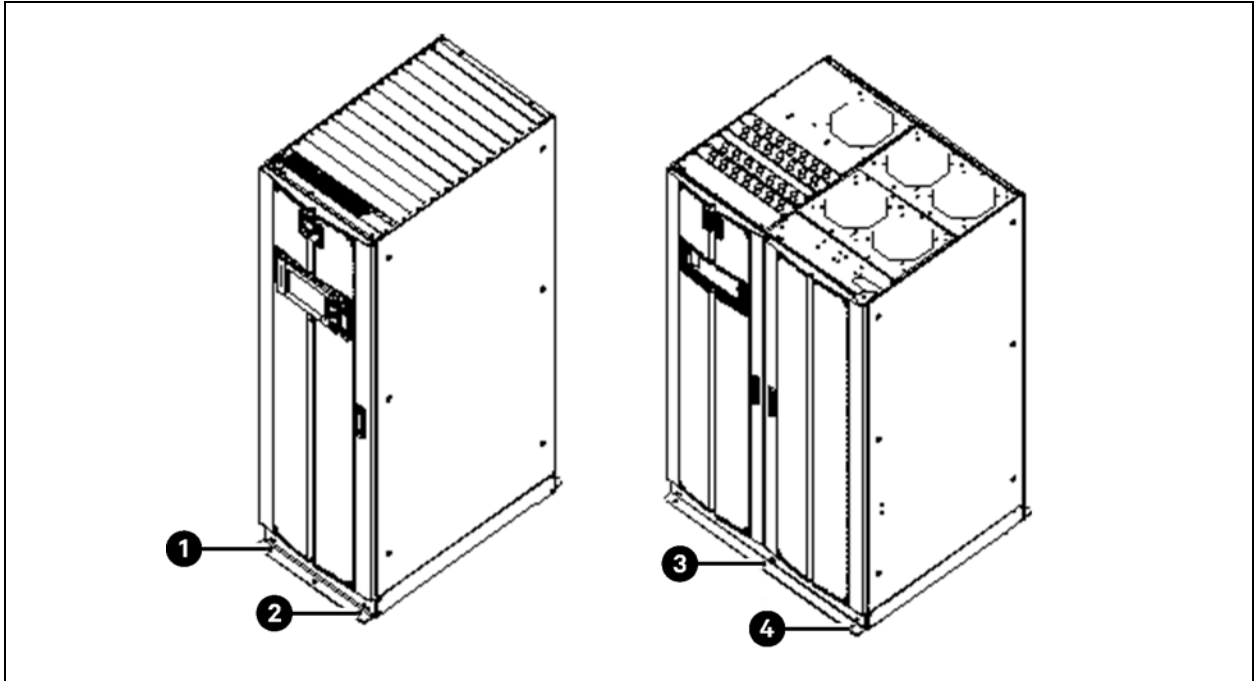
Figure 9.2 Installing Seismic Anchor (Rear Installation)



Item	Description	Quantity
1	M8 x 25 tapping screws	4 PCS
2	M12 expansion bolts	3 PCS
3	M8 x 25 tapping screws	8 PCS
4	M12 expansion bolts	6 PCS

2. Use M8 × 25 tapping screws (4 pieces) to install seismic anchor on the front bottom side of the UPS cabinet, and use M12 expansion bolts (3 pieces) to install seismic anchor on the ground, as shown in **Figure 9.3** below.

Figure 9.3 Installing Seismic Anchor (Front Installation)



Item	Description	Quantity
1	M8 x 25 tapping screws	4 PCS
2	M12 expansion bolts	3 PCS
3	M8 x 25 tapping screws	6 PCS
4	M12 expansion bolts	6 PCS

The bottom installation dimensions of the seismic anchors are shown in **Figure 9.4** on the next page.

Figure 9.4 Seismic Anchor Dimensions for 600 kVA (Without switch) and 600 kVA (Four Switches)

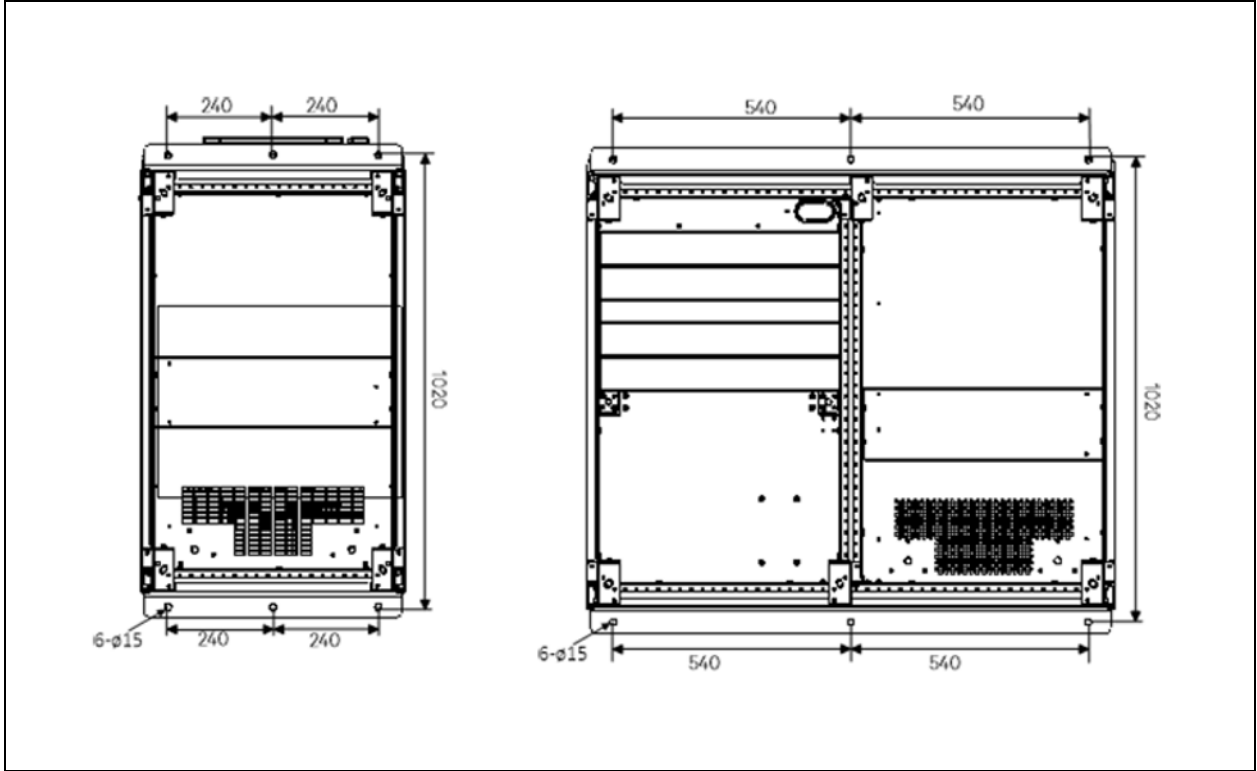
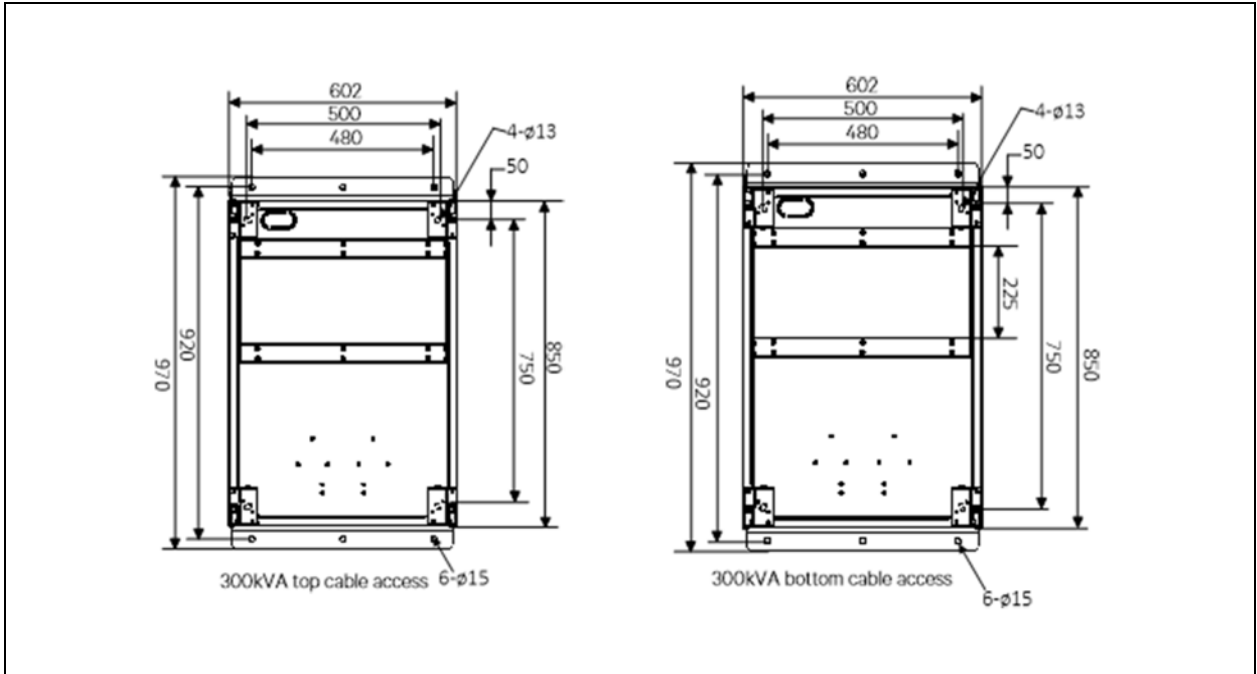


Figure 9.5 Seismic Anchor Dimensions for 300 kVA (Top Cable Access) and 300 kVA (Bottom Cable Access)



9.2.4 Vertiv™ Liebert® IS-UNITY-DP Card

IMPORTANT! It is recommended to use the shielded cables to enhance the electromagnetic compatibility (EMC).

The appearance of the IS-UNITY-DP card is shown in **Figure 9.6** below.

Figure 9.6 IS-UNITY-DP Card



For further description and installation of the IS-UNITY-DP card, refer to Vertiv™ Liebert® IntelliSlot™ Unity Card User Manual Web, SNMP, Modbus, BACnet, YDN23.

The installation method of the IS-UNITY-DP card is the same as that of the SIC card described in [SIC Card](#) on the next page.

9.2.5 Vertiv™ Liebert® IS-UNITY-LIFE Card

IMPORTANT! We recommend using the shielded cables to enhance the Electromagnetic Compatibility (EMC).

The appearance of the IS-UNITY-LIFE card is shown in **Figure 9.7** below.

Figure 9.7 IS-UNITY-LIFE Card



For further description of the IS-UNITY-LIFE card, refer to Vertiv™ Liebert® IntelliSlot™ Unity Card User Manual Web, SNMP, Modbus, BACnet, YDN23.

The installation method of the IS-UNITY-LIFE card is the same as that of the SIC card described in [SIC Card](#) on the next page.

9.2.6 SIC Card

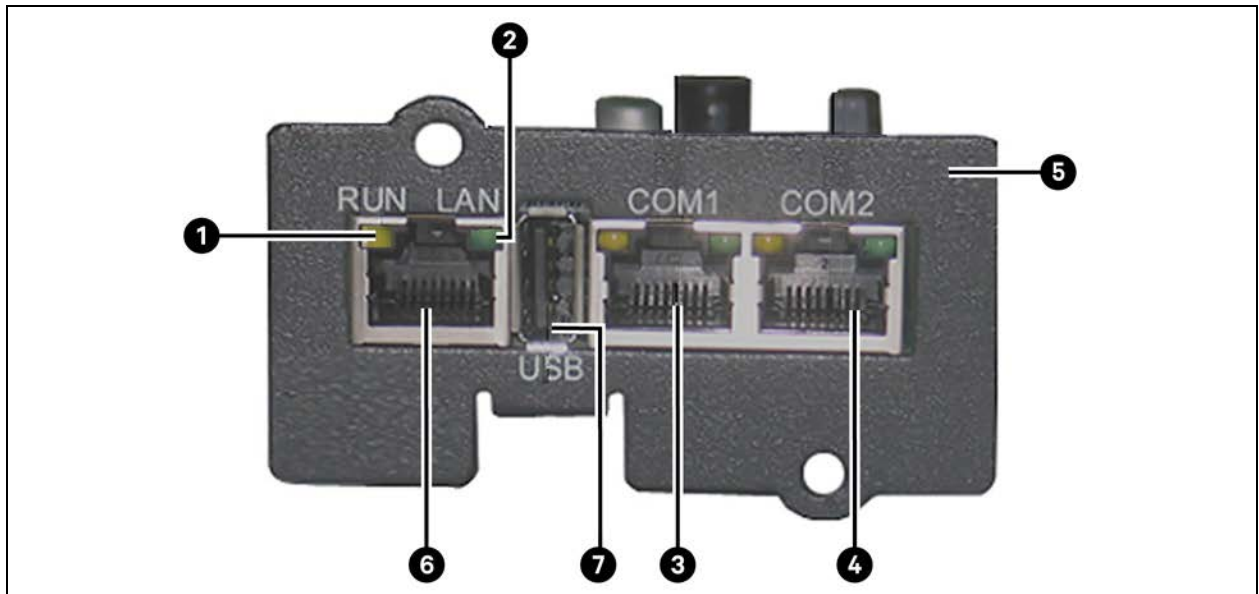
The SIC card shown in **Figure 9.8** below is a network management card. It enables the network communication capability for the Vertiv™ Liebert® APM2 UPS. It can also support IRM series sensor to monitor the environment. When the intelligent equipment generates an alarm, the SIC card can notify the user by recording the log, sending trap information, and sending an email. SIC card also supports Modbus RTU protocol.

NOTE: Keep the installation materials, including SIC card and one cross head screwdriver, handy before starting the installation.

NOTE: There is no need to shut down the UPS during SIC card installation because the SIC card is hot pluggable.

⚠ WARNING! Some electron components in SIC card are sensitive to static, therefore, do not touch the electron components or circuit in SIC card by hand or other conductive materials, to protect the SIC card against static shock. Hold the side edge of the card to remove or install the SIC card.

Figure 9.8 SIC Card



Item	Description	Item	Description
1	RUN indicator	5	Front panel
2	LAN indicator	6	Port
3	COM1 port	7	USB port
4	COM2 port		

The SIC card is installed in the Intellislot port in the UPS. See **Table 4.12** on page 52 for installation positions of optional cards. See **Figure 4.11** on page 45.

Installing the SIC card:

1. Remove the cover of Intellislot port.

NOTE: Preserve the screws and port cover for future use.

2. Insert the SIC card (along two sides of the Intellislot port) into the indicated position recommended in **Table 4.10** on page 51, and then tighten the screws.

For more information of the SIC card, refer to Site Interface Web/SNMP Agent Card User Manual in accessory.

Refer to [Signal cable connection steps](#) on page 53 for the cabling and routing of the signal cables.

9.2.7 IS-Relay Card

Vertiv™ Liebert® APM2 UPS has an optional IS-Relay card to use the dry contact signal to monitor the UPS functionalities . The functions of the IS-Relay card are listed in **Table 9.5** below. See **Figure 9.9** below.

Figure 9.9 IS-Relay Card



Table 9.5 Function of UPS IS-Relay card

Pin	Function	Operation
1	Common-Low Battery	
2	Low Battery	Closed if low battery point occurs
3	Low Battery	Closed if battery is OK
4	Common-UPS Fault	
5	UPS Fault	Closed if UPS fault occurs
6	UPS Fault	Closed if no UPS failure
7	Common-On Battery	
8	On Battery	Closed if On Battery power (Utility failure)
9	On Battery	Closed if not On Battery power (Utility OK)
10	Signal Ground	Future release
11	Signal Ground	Future release

Table 9.5 Function of UPS IS-Relay card (continued)

Pin	Function	Operation
12	UPS Any-Mode Shutdown	Future release
13	Summary Alarm	Closed if no alarm conditions are present
14	Summary Alarm	Closed if summary alarm occurs
15	Common-Summary Alarm	
16	On UPS	Closed if On UPS (inverter) power
17	On Bypass	Closed if On Bypass
18	Common-On Bypass	

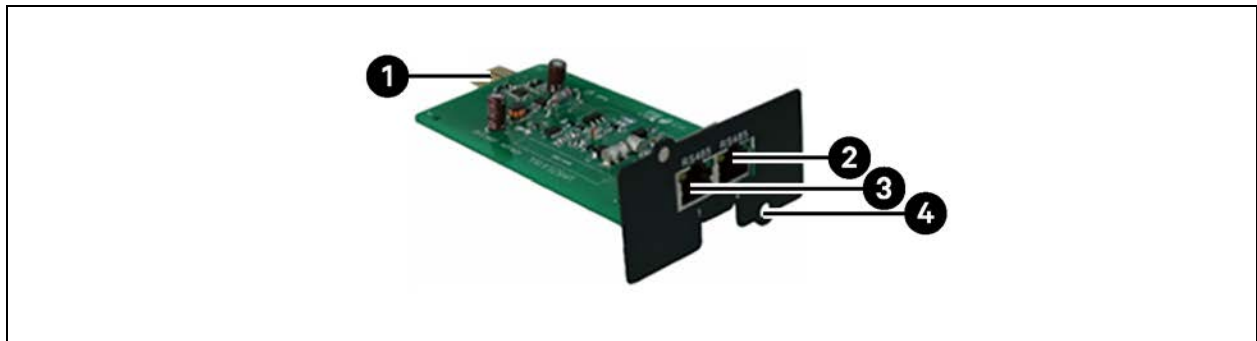
For more information of the IS-Relay card, refer to the Vertiv™ Liebert® IntelliSlot™ IS-Relay Card User Manual in accessory.

The installation method of the IS-Relay card is the same as that of the SIC card described in [SIC Card](#) on page 158. Refer to [Signal cable connection steps](#) on page 53 for the cabling and routing of the signal cables.

9.2.8 UF-RS-485 Card

The UF-RS-485 card converts RS-232 signal to RS-485 signal to ensure UPS networking and communication. It is to be installed in an Intellislot port of the UPS. See [Table 9.1](#) on page 149.

Figure 9.10 UF-RS-485 Card



Item	Description
1	Goldfinger
2	RJ45 port 2
3	RJ45 port 1
4	Installation hole (2 pcs)

The gold finger is used for insertion into the Intellislot port of the UPS. It provides RS232 input signal. The RJ45 port 1 and RJ45 port 2 are in parallel connection. They provide RS-485 output signal.

Installation

NOTE: The UF-RS-485 card is hot pluggable, install it without shutting down the UPS.



CAUTION: Some electronic components on the UF-RS-485 card are quite sensitive to static electricity. To prevent static electricity from damaging the card, do not touch its electronic components or circuits. Please hold the card by side edges of the UF-RS-485 card when moving or installing it.

Installing the UF-RS-485 Card:

1. Remove the Intellislot port cover on the front panel of the bypass module.

NOTE: Preserve the port cover for future use.

2. Align the UF-RS-485 card with the Intellislot port.
3. Insert the card into the port UPS along the grooves on both sides of the port.
4. Fix the UF-RS-485 card through the fixing holes on the UF-RS-485 card panel with the screws provided with the Intellislot port cover.
5. Connect the cable by Inserting one end of the standard network cable into the RJ45 port 1 or RJ45 port 2 of the UF-RS-485 card.

NOTE: Users can select a standard network cable of required length.

6. Insert the other end of the cable to the corresponding port of the user's equipment.



WARNING! The RJ45 ports of the UF-RS-485 card must connect to SELV circuit. Failure to observe this could cause damage to the card and even result in safety accidents.

Troubleshooting

Fault: The UF-RS-485 output signal does not change with the UPS status.

Action to take: Ensure that the UF-RS-485 card is properly inserted into the Intellislot port, and the network cable is properly connected.

9.2.9 BCB cabinet

Refer to [BCB Cabinet \(Optional 1\)](#) on page 128.

9.2.10 Parallel cable

Connect a module parallel cable from its PARA1 port to the PARA2 port of another module. Similarly connect other parallel cables.

Shielded and double insulated parallel cables available in lengths of 5 m, 10 m and 15 m must be interconnected in a ring configuration between the UPS modules, as shown in **Figure 8.2** on page 139.

The ring connection ensures the reliability of the control of the parallel system. Ensure to verify the cable connection before starting up the UPS system.

9.2.11 LBS cable

Shielded and double-insulated parallel control cables (LBS1 and LBS2) available in lengths of 10 m, 15 m and 20 m. The LBS cable must be interconnected in a branch configuration between LBS1 and LBS2 of any UPS modules, as shown in **Figure 8.7** on page 146, **Figure 8.8** on page 147, and **Figure 8.9** on page 147.

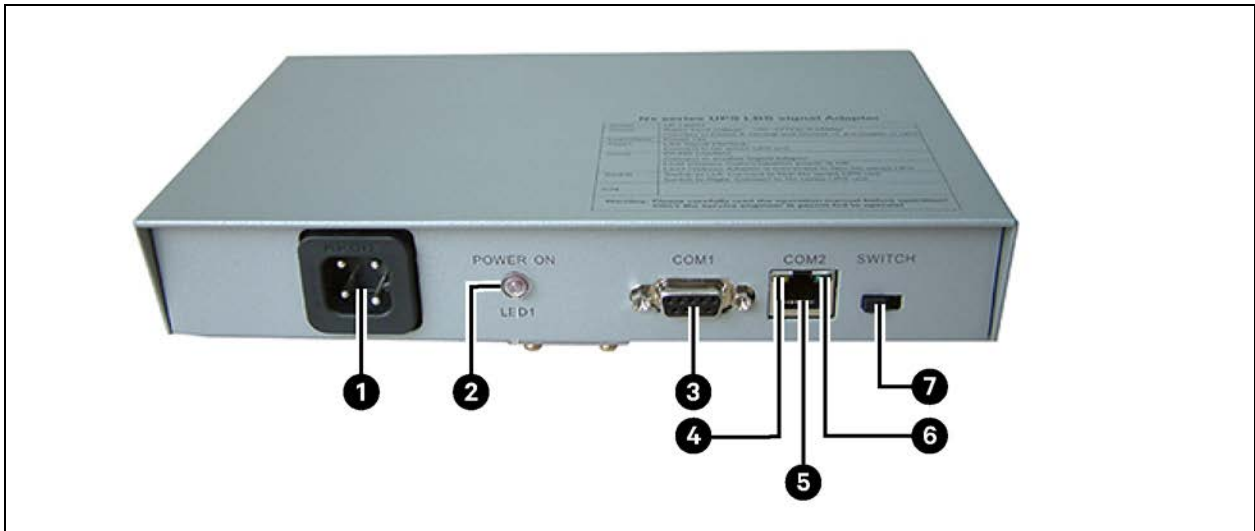
9.2.12 Shorting copper bar kit

For the UPS with shorting copper bar of common input configuration, the user should select the shorting copper bar kit to short the mains input and bypass input.

9.2.13 LBS Adapter

The LBS adapter (see **Figure 9.11** below) is designed to extend the LBS function up to 150 m between the 2 UPS units or systems of a dual bus system, and it also enables an Vertiv™ Liebert® APM2 APM2 to synchronize with other UPS models.

Figure 9.11 LBS Adapter



Item	Description	Item	Description
1	Power Port	5	COM2
2	LED1	6	Green LED
3	COM1	7	Switch
4	Yellow LED		

For details about how to install and connect cables, see Dual Bus UPS LBSTM Expander/Adapter Installation Manual.

10 Communication

This chapter provides information about the compatible communication protocols.

Vertiv™ Liebert® APM2 Supports:

- SNMP Protocol communication
- Modbus protocol communication
- Dry contact communication
- Velocity protocol communication.

10.1 SNMP Protocol Communication

Vertiv's UNITY or SIC network management cards make the UPS an IOT device. These cards support SNMP protocol that helps to monitor the UPS through network.

IRM series sensor can also be connected to these cards to provide environmental monitoring function. When the intelligent equipment generates an alarm, the UNITY card and SIC card can notify the user by recording the log, sending trap information, and trigger mails.

The UNITY card and SIC card provide three approaches for you to monitor your intelligent equipment and equipment room environment:

- Using web browser. Through the Web server function provided by the SIC card or UNITY card.
- Using Network Management System (NMS) through the SNMP function provided by the SIC card or UNITY card.
- Using SiteMonitor, network management software for equipment room power and environment through the TCP/IP interface provided by the SIC card.

The SIC card can also work with the Network Shutdown computer safe shutdown program developed by Vertiv to provide automatic safe shutdown function for your computer installed with Network Shutdown, so as to prevent data loss.

The communication card shall be installed at the Intellislot port. See **Figure 4.11** on page 45.

For the installation and setting information of the SIC card, refer to the Site Interface Web/SNMP Agent Card User Manual in accessory.

10.2 Modbus Protocol Communication

The Modbus (RTU) protocol communication is supported by the SIC card and UNITY card.

10.3 Dry Contact Communication

The UPS provides the following two dry contact communications:

- IS-Relay card (Optional)
- Dry contact port of central control module

10.3.1 Communication through IS-Relay card

The UPS provides an Liebert® IS-Relay card user to use dry contact signals to monitor the UPS. For the installation and use of the IS-Relay card, refer to Vertiv™ Liebert® IntelliSlot™ IS-Relay Card User Manual.

10.3.2 Communication through dry contact port of central control module

For field specific needs, the UPS may need auxiliary connection to have functions like acquiring external equipment status information, providing alarm signals to external devices, and remote EPO. These functions are realized through the following interfaces on the bypass control module:

- Input dry contact port of external device status information
- Output dry contact ports of alarm signal
- EPO input port

For the functions and detailed information of these ports, refer to [Wiring of Signal Cable](#) on page 45.

11 Service and Maintenance

The UPS system (including the battery) requires periodic service and maintenance to ensure long service life. This chapter provides information about the service life, regular inspection, maintenance and replacement of the key UPS components.

NOTE: Effective maintenance of the UPS system can reduce the risk of UPS failure and will increase the UPS service life.

11.1 Safety for Service and Maintenance



WARNING! The replacement of the device, service, and Maintenance should be executed by trained service personnel of Vertiv only. Failure to do so can cause malfunctioning of the device.



WARNING! The neutral line has hazardous voltage when servicing the UPS. pay attention when servicing the UPS.



WARNING! For the UPS without switch or single switch, switch off the disconnect device before maintenance, and check whether the UPS is powered on.



CAUTION: The components that can only be accessed by opening the protective cover with tools cannot be operated by the user. Only qualified service personnel are authorized to remove such covers.

11.2 Service Procedures of Power Module and Bypass Power Module

NOTE: Only Vertiv service engineers must execute the servicing of the power modules and bypass power modules.

1. Remove the power modules and bypass power module from top to bottom, to prevent cabinet toppling due to high gravity center.
2. Do not disassemble the power module, bypass power module and central control module. They may have high voltage inside.
3. Service the power modules and bypass power modules after 5 minutes of unplugging from power source.
4. Put the modules back into the cabinet after 5 minutes after the servicing.
5. Do not pull different types of modules out of the cabinet at the same time.

11.2.1 Service procedures of bypass power module

1. Place the ready switch on the front panel of the power module to unready state, the green indicator beside the ready switch should be off and the red indicator is on.
2. Ensure that the red indicator on the power module is on.
3. Remove the fixing screws on both sides of the front panel of the module, and pull the bypass module out of the cabinet.

NOTE: When the module is pulled out halfway, it will be blocked by the leaf spring on the right side of the module. The leaf spring must be pressed down to pull out the module.

4. After servicing the module, check that the ready switch is in unready state.
5. Put the module into the cabinet and tighten the screws on both sides.

NOTE: Install the another serviced module inside the cabinet after 10 seconds.

6. Place the ready switch of the module to the left position, and the module will get connected to the system automatically.

11.2.2 Replacement procedures of bypass power module

Service procedures in bypass mode:

1. Make sure to enable Normal mode or Maintenance bypass mode, refer to [Procedures for Transfer Between Operation Modes](#) on page 110 or [UPS Battery](#) on page 124.
2. Place the ready switch on the front panel of the power module to unready state, the this will turn the red indicator beside the ready switch ON.
3. Remove the fixing screws on both sides of the front panel of the bypass power module, and pull the module out of the cabinet, to service the module.
4. After servicing the module, put the module back into the cabinet, and tighten the screws on both sides.

NOTE: When pulling the bypass power module out of the cabinet, move it around and pull outward many times.

NOTE: Loose contact of the bypass module can affect the normal operation of the bypass power module and the overall unit.

NOTE: When putting the bypass power module back in the cabinet, push it to ensure it connects correctly with the system. The brackets on both sides of the module are close to the cabinet column.

5. Place the ready switch to ready state. This will turn the red indicator beside the ready switch OFF and the green indicator ON.
6. Ensure to enable to the Bypass mode, refer to [Procedures for Transfer Between Operation Modes](#) on page 110 or [UPS Battery](#) on page 124.

Service procedures for single UPS in normal mode:

1. Place the ready switch on the front panel of the power module to unready state. this will turn the red indicator beside the ready switch ON.
2. Remove the fixing screws on both sides of the front panel of the bypass power module, and pull the module out of the cabinet.
3. After servicing the module, put the module into the cabinet, and tighten the screws on both sides.
4. Place the ready switch to ready state. This will turn the red indicator beside the ready switch OFF and the green indicator ON.

11.3 Key Components and Service Life of UPS

When in use, some components of UPS system will have shorter service life compared to the UPS due to abrasion. For the safety of the UPS supply system, it is necessary to have regular inspection and replacement of these components. This section introduces the key components of UPS and the reference years of service life. For systems under different conditions (environment or load rate) assessment and advice by service engineers on whether to replace the device are required with reference to the information provided in this section.

11.3.1 Life parameters and the proposed replacement time of key components

Key components in **Table 11.1** below are used in the UPS system. To prevent system failures due to some device failure by wear, it execute the regular inspection and replacement during its estimated life.

Table 11.1 Life Parameters and the Proposed Replacement Time of Key Components

Key Components	Estimated Life	Proposed Replacement Time	Proposed Inspection Period
Fan	Not less than 7 years	5 years	1 year
Air filter	1 year to 3 years	1 year to 2 years	2 months
VRLA battery (5-year life)	5 years	3 years to 4 years	6 months
VRLA battery (10-year life)	10 years	6 years to 8 years	6 months

11.3.2 Replacement of air filter

NOTE: The air filters need regular inspection and replacement, which depends on the environmental conditions of the UPS. Under normal environmental conditions, the air filters should be cleaned or replaced once every two months and need more frequent cleaning and replacement in dusty or other unclean environments.

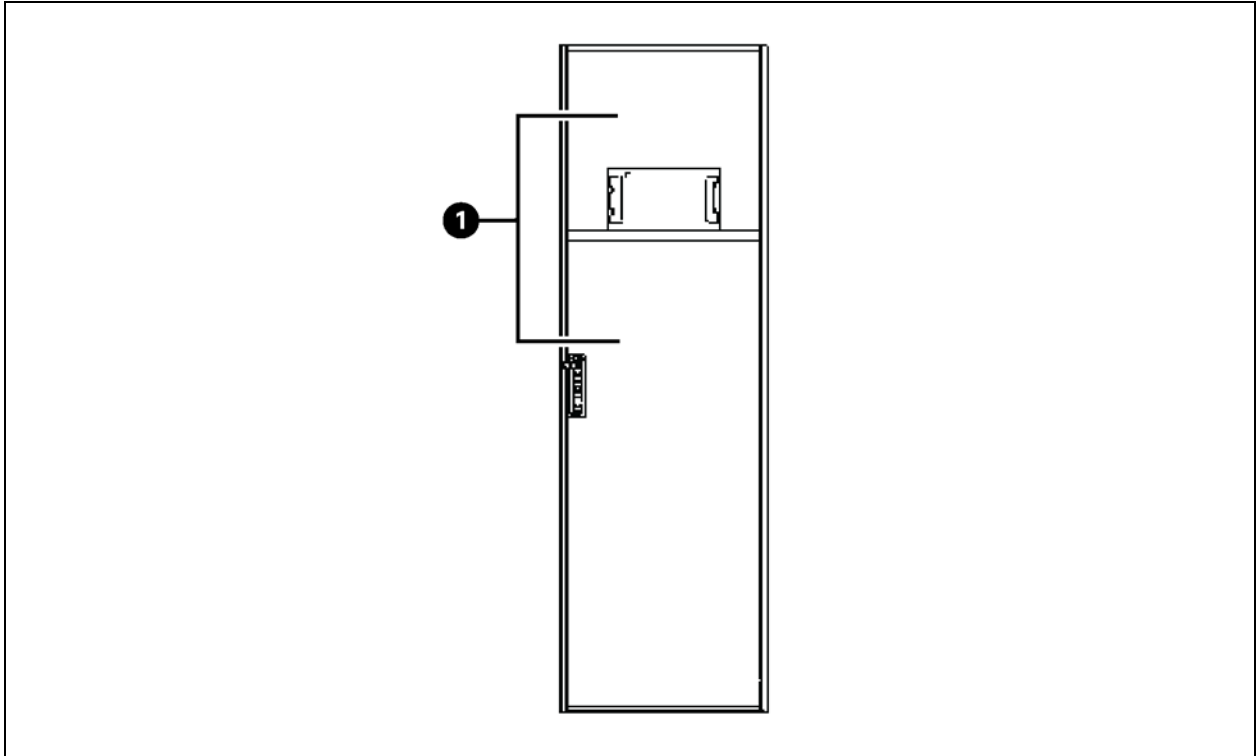
The UPS has air filters mounted on the rear side of the front door of the cabinet. The filters can be replaced while the UPS is operational.

The air filters are fixed by bars on both the sides. See **Figure 11.1** on the next page.

Procedure to replace the air filters:

1. Open the front door of the UPS.
2. Loosen the screws to remove one of the fixing bar while leave the other bar as it is.
3. Replace the clean air filter.
4. Reinstall the fixing bar and tighten all the fixing screws.

Figure 11.1 Replacing Air Filter



Item	Description
1	Air filter

11.4 Maintenance of UPS and Options

UPS and the options need common maintenance:

1. Keep good maintenance record. Keeping good maintenance record facilitates failure treatment.
2. Keep the surrounding clean, to prevent dust and moisture entering the UPS.
3. Maintain appropriate ambient temperature of 20 °C to 25 °C for battery.

NOTE: Very low temperature will reduce the battery capacity and if it is too high the battery life will reduce.

4. Check the wiring regularly for any damage.
5. Check and tighten all the screws, and tighten all the screws periodically, at least once a year.
6. Check regularly for any abnormality in the upstream or downstream switch to ensure cutting off the input or output when the current is too large.
7. Regularly check the status of the LED light on the built in lightning protection board of the UPS. If the indicator light is abnormally off, replace the lightning protection board (see [Power switch](#) on page 103 for the position of the lightning protection board).

Maintenance staff should be aware of the typical ambient conditions where UPS is working to detect the unusual ambient conditions the setting of UPS touch screen should be known as well.

For information of the UPS battery maintenance, refer to [Battery Maintenance](#) on page 134.

12 Specifications

This chapter includes all the required UPS specifications.

12.1 Conformance and Standards

The UPS is designed to comply with the European and international standards listed in **Table 12.1** below.

Table 12.1 European and International Standards

Item	Normative Reference
General safety requirements for UPS	EN62040-1/IEC62040-1/AS62040-1
EMC requirements for UPS	EN62040-2/IEC62040-2/AS62040-2 (Class C3)
Method of specifying the performance and test requirements of UPS	EN62040-3/IEC62040-3/AS62040-3 (VFI SS 111)
UPS: Environmental Factors. Requirements and Reports	EN62040-4/IEC62040-4/AS62040-4 (VFI SS 111)

NOTE: The product standards in this table incorporate relevant compliance clauses with generic IEC and EN standards for safety (IEC/EN/AS60950), electromagnetic emission and immunity (IEC/EN/AS61000 series) and construction (IEC/EN/AS60146 series and 60529).

12.2 Environmental Characteristics

Table 12.2 Environmental Characteristics

Item	Normative Reference	Rated Power (kVA)	
		300	600
Noise within 1 m (in the front)	dB (A)	≤ 70	
Altitude	m	≤ 1500; derate power by 1% per 100 m between 1500 m and 3000 m	
Relative humidity	%RH	0 to 95%, non condensing	
Operating temperature	°C	0 to 50. 0 to 40, at full load; 41 to 45, 90% load; 46 to 50, 80% load	
Storage and transportation temperature for UPS	°C	Storage: -25 °C to +55 °C; transportation: -40 °C to +70 °C	
Over voltage level	Level 3		
Pollution level	Level 2		
Grid system	TN, TT, IT		

12.3 Mechanical Characteristics

Table 12.3 Mechanical Characteristics

Item		Unit	Rated Power (kVA)			
			Power Module	300 kVA	Without Switch (600 kVA)	Four Switches (600 kVA)
Dimensions (W × D × H)	Packing excluded	mm	440 x 600 x 132	600 x 890 x 2000	600 x 990 x 2000	1200 x 990 x 2000
	Packing included	mm	640 x 800 x 290	800 x 1050 x 2200	710 X 1120 X 2200	1310 X 1120 X 2200
Net weight		kg	35	285	510	830
Gross weight		kg	37	300	525	850
Color		RAL7021 black orange pattern				
Protection degree, IEC (60529)		IP20 (front door open or closed)				

12.4 Electrical Characteristics (Input Rectifier)

Table 12.4 Rectifier AC Input (Mains)

Item	Unit	Rated Power (kVA)	
		300	600
Rated AC input voltage ¹	VAC	380/400/415, 3-phase 4-wire (+PE) TN/TT/IT power distribution system	
Input voltage range ²	VAC	176 to 276 (full load) 132 to 176 (75% load)	
Frequency ²	Hz	50/60 (range: 40 to 70)	
Power factor	kW/kVA, full load (half load)	0.99	
Input current	A, rated ³	454	905
Total current harmonic distortion ⁴	%	3	

¹ Rectifiers operate at any of the rated supply voltages and frequencies without further adjustment.

² At 305 V input mains the UPS maintains the specified output voltage at rated load without discharging a battery.

³ IEC62040-3/EN50091-3: at rated load, input voltage is 400 V, battery remains fully charged.

⁴ Measured with an input THDv < 1%.

12.5 Electrical Characteristics (Battery Bus)

Table 12.5 Battery

Item	Unit	Rated Power (kVA)	
		300	600
Max. charging current ¹	A	600	1200
Quantity of lead-acid cells (nominal)	Block	30 to 50 (12 VDC). (40 to 50 full load, 38 derated to 95%, 36 derated to 90%, 34 derated to 85%, 32 derated to 80%, 30 derated to 75%)	
Float voltage	V/cell (VRLA)	2.25 (selectable from 2.20 V/cell to 2.30 V/cell) Constant current and constant voltage charge mode	
Temperature compensation	mV/°C/cl	-3.0 (selectable from 0 to -5.0 around 25 °C or 30 °C, or inhibit)	
Ripple current	% C ₁₀	≤ 5	
Boost voltage	V/cell (VRLA)	2.35 (selectable from 2.30 to 2.35) Constant current and constant voltage charge mode	
Boost control		Float-boost current trigger 0.050C ₁₀ (selectable from 0.001 to 0.070) Boost-float current trigger 0.010C ₁₀ (selectable from 0.001 to 0.025) 8hr safety time timeout (selectable from 8 hr to 30 hr) Boost mode inhibit also selectable	
EOD voltage	V/cell (VRLA)	1.60 to 1.67 (1.67)	
¹ The charging capacity is limited by the system load rate. When the system load rate is not higher than 50%, the maximum charging capacity is 70% of the system capacity.			

12.6 Electrical Characteristics (Inverter Output)

Table 12.6 Inverter Output (to Critical Load)

Item	Unit	Rated Power (kVA)
		300/600
Rated AC voltage ¹	VAC	380/400/415 (3-phase 4-wire, with neutral reference to the bypass neutral)
Frequency ²	Hz	50/60
Power factor		1
Overload	%	<105%, long time; <110%, ≤1 Hr; <125%, ≤10 min; <150, ≤1 min; >150, ≤200 ms
Max. short circuit current of inverter ⁴	A	180% rated output current , 200 ms
Non-linear load capability	kVA	100
Steady state voltage stability	%	±1
Transient voltage response	%	±5
Total voltage harmonic distortion	%	< 1 (linear load), < 3 (non-linear load ³)
Synchronization window	Hz	Upper Limit: 0.5, 1, 2, 3, (+10%); Default: +10%. Lower Limit: -0.5, -1, -2, -3, (-10%); Default: -10%
Slew rate (maximum change rate of synchronization frequency)	Hz/s	0.6; setting range: 0.1 to 3

¹ Factory set to 380 V - 400 V or 415 V can be selected by service engineer at site.

² Factory set to 50 Hz - 60 Hz can be selected by service engineer at site. Note that the system frequency can be changed only when the UPS is on bypass. It is strictly prohibited to change the system frequency when the UPS is on inverter.

³ EN 50091-3 (1.4.58) crest factor 3:1, non-linear load.

⁴ Applicable for three-phase and single-phase current fault.

12.7 Electrical Characteristics (Bypass Input)

Table 12.7 Bypass Input

Item	Unit	Rated Power (kVA)		
		300	600	
Rated AC voltage ¹	VAC	380/400/415, three-phase 4-wire, sharing neutral with the rectifier input and providing neutral reference to the output		
Rated current	380 V	A	455	909
	400 V	A	435	870
	415 V	A	417	833
Frequency ²	Hz	50/60		
Bypass voltage tolerance	%VAC	Upper limit: +10, +15 or +20, Default: +15 Lower limit: -10, -20, -30 or -40, Default: -20		
Bypass frequency tolerance	%	±10		
Bypass SCR I ² T	A ² S	450,000	1445,000	
Bypass KAIC fuse ³ I ² T	A ² S	180,000	1150,000	
¹ Factory set to 380 V - 400 V or 415 V can be selected by service engineer at site. ² Factory set to 50 Hz - 60 Hz can be selected by service engineer at site. ³ The Kilo Ampere Interrupting Capacity (KAIC) fuse is an option.				

12.8 Efficiency and Loss

Table 12.8 Efficiency and Loss

Item	Unit	Rated Power (kVA)	
		300	600
Rated normal mode (full load) loss	kW	11.2	22.5
Rated normal mode (no load) loss	kW	1	2
ECO mode (full load) loss	kW	2.7	5.4
Dual conversion mode efficiency	Up to 97%		
ECO mode efficiency	Up to 99%		

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

1-800-543-2378

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

Europe

Via Leonardo Da Vinci 8 Zona Industriale Tognana

35028 Piove Di Sacco (PD) Italy

Asia

7/F, Dah Sing Financial Centre

3108 Gloucester Road, Wanchai

Hong Kong

Appendix B: Glossary

Term	Definition
AC	Alternating current
BCB	Battery circuit breaker
CSA	Cross sectional area
DC	Direct current
EIB	External interface board
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EOD	End of discharge
EPO	Emergency power off
I/O	Input/output
IGBT	Integrated gate bipolar transistor
LBS	Load bus synchronizer
LCD	Liquid crystal display
LED	Light emitting diode
PC	Personal computer
PE	Protective earth
RCCB	Residual current circuit breaker
RCD	Residual current detector
REPO	Remote emergency power off
SCR	Silicon controlled rectifier
SNMP	Simple network monitoring protocol
STS	Static transfer switch
SVPWM	Space vector pulse width modulation
UPS	Uninterruptible power system
VRLA	Valve regulated lead-acid

Appendix C: Hazardous Substances and Content

Parts	Hazardous Substances					
	Plumbum	Mercury	Cadmium	Chrome ⁶⁺	Polybrominated Biphenyls	Polybrominated Diphenyl Ethers
	(Pb)	(Hg)	(Cd)	Cr (VI)	(PBB)	(PBDE)
Hex copper stud	×	○	○	○	○	○
PCBA	×	○	○	○	○	○
AC Capacitor	×	○	○	○	○	○
DC Capacitor	×	○	○	○	○	○
Fan	×	○	○	○	○	○
Cables	×	○	○	○	○	○
LCD	×	×	○	○	○	○
Sensors	×	○	○	○	○	○
Large-medium power magnetic components	×	○	○	○	○	○
Circuit breaker/rotating switch	×	○	○	○	○	○
Semiconductors	×	○	○	○	○	○
Battery (if applicable)	×	○	○	○	○	○
Insulation monitoring device (if applicable)	×	○	○	○	○	×

NOTE: This table is prepared based on the regulation of SJ/T 11364.

Content of the hazardous substances in all the average quality materials of the parts is within:

○ : The specified limits.

×: Outsides specified the limits.

About battery: Generally follow the environmental protection use period of the battery, otherwise five years.

The Hazardous Substances and Content mentioned are applicable to Vertiv™ Liebert® APM2 300 to 600 kVA UPS.

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