Liebert APM 600kVA Modular UPS

User Manual

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Emerson Network Power provides customers with technical support. Users may contact the nearest Emerson local sales office or service center.

Emerson Network Power Co., Ltd.

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Special Declaration

Personnel Safety

1. This product must be installed and commissioned by professional engineers of the manufacturer or its authorized agent. Failure to observe this could result in product malfunction or personnel safety risk.

2. Take the time to read this product manual and the safety precaution thoroughly before installing and commissioning this product. Failure to observe this could result in product malfunction or personnel safety risk.

3. This product is not intended for life support equipment application.

4. Never dispose of the internal or external battery of this product in a fire, as it may explode and jeopardize personnel safety when exposed to flame.

Product Safety

1. If this product will be stored or remain de-energized for a long period, it must be placed in a dry and clean environment within specified temperature range.

2. This product should be used in an appropriate operating environment. For details, refer to the section on the environmental requirement in this manual.

3. This product is not designed for application in an environment:

- Where the temperature and relative humidity are outside the specifications
- Subject to vibrations or shocks
- Where conductive dusts, corrosive gases, salts, or flammable gases are present
- Near heat sources or strong electromagnetic interferences

Disclaimer

Emerson disclaims any and all responsibility or liability for the defects or malfunction caused by:

- Application range or operating environment outside the specifications
- Unauthorized modification, improper installation or operation
- Force majeure
- Other actions not in compliance with the instructions in this manual

Safety Precaution

Always observe the following safety symbols!

Used to alert the user to the risk of death or severe injury should the unit be used improperly.

Used to alert the user to the risk of injury or equipment damage should the unit be used improperly.

Used to advise the user to carefully read and observe this unit though it may not cause damage.

This manual contains information concerning the installation and operation of the Liebert APM 600kVA UPS single module and parallel system.

Read this manual thoroughly before installing, using and servicing the UPS.

Important

The UPS with standard configuration is a category C3 product for commercial and industrial application in the second environment. Installation restrictions or additional measures may be needed to prevent disturbances.

Conformity and standards

1. This product complies with CE 2006/95/EC (low voltage safety) and 2004/108/EC (EMC), EMC standards of Australia and New Zealand (C-Tick), and the following UPS product standards:
* IEC62040-1 General safety requirements for UPS
* IEC62040-2-EMC
* IEC62040-3 Performance requirements and test methods

For details, refer to *Chapter 11 Specifications.*

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

Warning: high earth leakage current

1. Earth connection is critical before connecting the input supply (including both mains supply and battery).
2. This equipment is installed with an EMC filter.
3. Earth leakage current is less than 3000mA.
4. Transient and steady state earth leakage currents, which may occur when the equipment is started, should be taken into account in the selection of instantaneous RCCBs or RCD devices.
5. RCCB which is sensitive to unidirectional DC pulse (class A) and insensitive to transient state current pulse must be selected.
6. Note also that the earth leakage currents of the load will be carried by the RCCBs or RCDs.
7. The equipment must be earthed in accordance with the local electrical code of practice.

Warning

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

Warning: backfeeding protection

This 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. A label must be added at all external incoming primary supply disconnect device to warn service personnel that the circuit is connected to a UPS. The text of the label has the following meaning: Risk of voltage backfeed! Isolate the UPS, then check for hazardous voltage between all terminals including the protective earth before working on this circuit.

User serviceable components (For service personnel)

All equipment 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 covers requiring a tool/key for removal.

Battery voltage exceeds 400Vdc (For service personnel)

1. All physical battery maintenance and servicing procedures requires the use of a tool/key and should be carried out only by trained personnel.
2. Take special care when working with the batteries associated with this UPS. When connected together, the battery terminal voltage will exceed 400Vdc and is potentially lethal.
3. Battery manufacturers supply details of the necessary precautions to be observed in working on, or in the vicinity of, a large bank of battery cells. These precautions should be followed implicitly at all times. Particular attention should be paid to the recommendations concerning local environmental conditions and the provision of protective clothing, first aid and fire-fighting facilities.

General safety (For users)

1. Like other types of large power equipment, the UPS and battery circuit breaker box/battery cabinet have high voltage inside. Because the components with high voltage can be accessed only when the front door is opened, the risk of contacting high voltage has been minimized. This equipment meets the IP20 standard, and other safety shields are provided inside the equipment.
2. There will not be any risk when operating this equipment according to the general instructions and the steps recommended in this manual.

Multiple power inputs (For users)

1. This UPS system receives power from more than one source. Disconnection of all AC source and the DC source is required before servicing.
2. 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 the 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 electro-static discharge, implement ESD prevention measures when managing any communication board.

Note

1. The specified upstream breakers are required to obtain the conditional short circuit current rating, Icc at 20kA symmetrical rms. It is recommended to select the breakers in compliance with voltage of 415V, current of 1250A and breaking of 85kA. The specified upstream breakers should comply with an EN 60947 series standard.
2. The specified upstream fuses are required to obtain the conditional short circuit current rating, Icc at 65kA symmetrical rms. It is recommended to select the fuses in compliance with voltage of 690V, current of 2000A and breaking of 200kA. The specified upstream breakers should comply with an IEC 60269 series standard.

Warning

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

Warning

1. The UF-RS485 card, IS-UNITY-DP card, IS-UNITY-LIFE card, SIC card and IS-Relay card must be connected to the SELV, otherwise it may damage the cards or cause safety risk.
2. The cables of UF-RS485 card, IS-UNITY-DP card, IS-UNITY-LIFE card, SIC card and IS-Relay card connecting the external device must be the metal wire shielded cables, and the cable connecting the UPS must be reliably connected to the enclosure.

The Manual Describes The Equipment

Product	Model
600kVA	APM 0600kTK16FN01000

Revision Information

V1.0 (May 6, 2016)

Initial release.

V1.1 (June 6, 2016)

Update Figures 2-6, 2-7, 2-8, 2-9 and 6-5; update Tables 3-4 and 4-7; Change optional BCB cabinet to mandatory BCB cabinet.

V1.2 (October 16, 2016)

Update Sections 6.9, 6.10, 6.11; add Section 8.2.11.

V1.3 (December 30, 2016)

Update Sections 7.4.4, 8.1, 10.2; add Sections 1.3, 7.1, 7.2, 7.3, 8.2.2 and 8.2.13. Update Figures 2-1, 4-3 and 4-4, Tables 11-4, 11-6, and Appendix 2.

V1.4 (February 10, 2017)

Update Section 6.10.

Contents

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Chapter 1 Overview

This chapter briefly introduces the features, design concept, parallel system, operation mode, battery management and battery protection of the Liebert APM 600kVA UPS (UPS for short).

1.1 Features

The UPS is connected between a critical load (e.g. a computer) and mains power to provide high quality power for the loads. The UPS has the following advantages:

- Augment power quality

The UPS protects its output against the input power change through the intelligent controller.

- Provide mains failure protection

If the input power fails, the UPS will work in battery mode, and the power supply to the loads will not be interrupted.

- Convenient installation and maintenance

With system modular design, the power module and bypass module are hot swappable. The system supports on-line replacement for convenient maintenance, and the power module and bypass module can be replaced within five minutes.

1.2 Design Concept

1.2.1 System Design

This section introduces the working principle of the UPS single module. The UPS adopts AC-DC-AC converter (as shown in Figure 1-1). The first stage conversion (AC-DC) adopts three-phase high frequency rectifier to convert the three-phase input voltage into stable DC bus voltage.

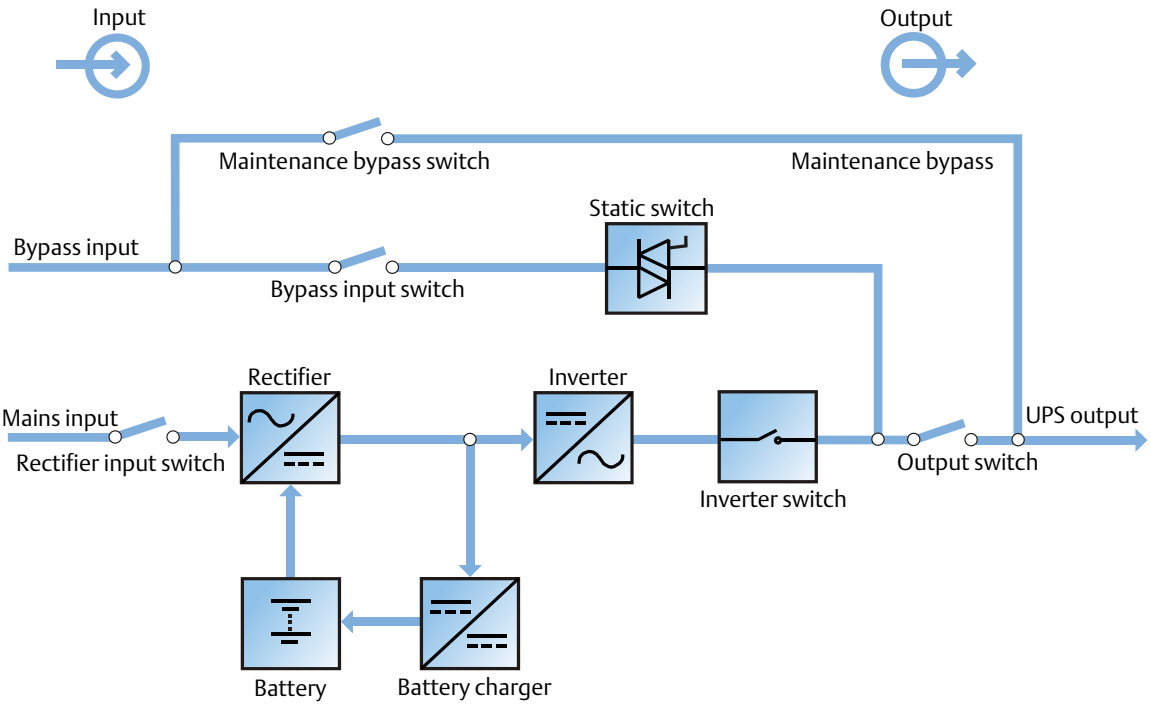


Figure 1-1 Block diagram for working principle of UPS single module

The UPS has its own battery charger and adopts advanced temperature compensation technology to effectively prolong the battery service life. The inverter mainly adopts large power IGBT, and adopts advanced SVPWM technology for control so as to invert the DC bus voltage back to AC voltage.

When the mains is normal, the rectifier and inverter work together to supply the loads 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.

1.2.2 Bypass

Through the intelligent control of the Static Switch module (as shown in Figure 1-1) 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 will automatically transfer the loads to the bypass.

In normal operating state, to realize 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.

Besides, the UPS has a manual maintenance bypass switch for shutdown of the UPS upon maintenance. In this situation, the bypass will directly supply the critical loads through the maintenance bypass.

Note
When the load is supplied by the bypass or maintenance bypass, the quality of the power supply is not guaranteed.

1.2.3 System Control Principle

Normal operation

Normal mode: It means that the UPS has normal input mains, the rectifier and inverter operate normally, the load is supplied by the inverter, the battery circuit breaker is closed, and the battery is in stable floating charge state.

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. During this period, if the battery voltage falls to the EOD voltage and the mains still has not been recovered, the inverter will stop working automatically, and the UPS operator control and display panel will display corresponding alarm messages. If the system uses split bypass configuration and the bypass is normal, the system will transfer to bypass.

Mains recovery

When the mains 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.

Battery disconnection

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 failure, other functions and all the steady state performance of the UPS will not be affected.

UPS module failure

In case of inverter failure, output fuse blowout and bypass STS failure, the load will automatically transfer to the bypass. In this situation, please contact the local customer service center of Emerson Network Power Co., Ltd for technical support.

Overload

If the inverter is overloaded or the inverter current remains outside the specifications (refer to Table 11-6) 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 first of all by the features of the protective device of the system.

In the above two situations, the UPS operator control and display panel will display alarm messages.

Maintenance bypass

The UPS has a second bypass circuit, i.e. maintenance bypass, which 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.

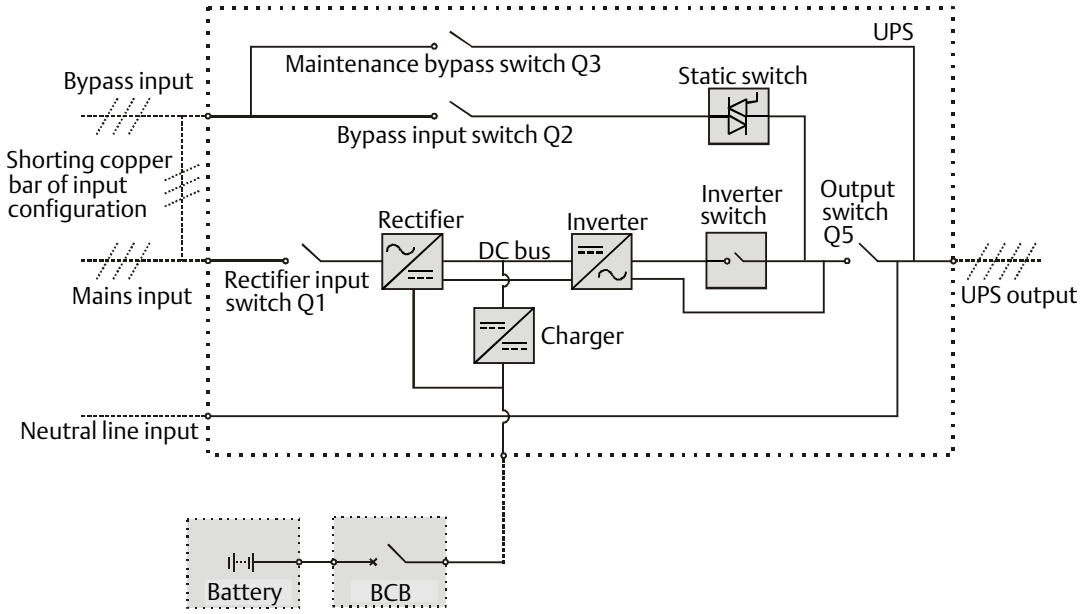
1.2.4 UPS Power Supply Switch Configuration

The UPS has four switches: rectifier input switch Q1, bypass input switch Q2, maintenance bypass switch Q3, and output switch Q5. **Note that switches Q1, Q2, and Q5 are optional**.

If the user configures the switches at upstream and downstream of the UPS, the UPS has no need to configure switch option. The I/O fuse requirement is configured according to the industry standard. Therefore, the switch and I/O fuse get four modes: with switch and fuse, with switch but no fuse, no switch but with fuse, no switch or fuse.

Figure 1-2 describes the block diagram of the UPS module. The UPS has split bypass configuration (that is, 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 (split bypass configuration for delivery) 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.



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

Figure 1-2 UPS power supply switch configuration

Note: The mains input and bypass input share the same neutral line.

The user can achieve maintenance mode through connecting the external maintenance switch of the single module.

1.2.5 Battery Circuit Breaker (BCB)

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

1.3 Parallel System

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

Moreover, two UPS modules 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 device, thus enabling seamless load transfer between the two parallel systems or single modules through the STS device.

1.3.1 Parallel System Features

1. Except for the load sharing inductor assembly and parallel communication cables, 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 can be queried from each UPS module's LCD.

1.3.2 Parallel System Requirements

A group of paralleled modules behave as if it were one large UPS with the advantage of presenting higher reliability. To ensure that all modules are equally utilised and to comply with relevant wiring rules, the following requirements apply:

1. All UPS modules must be the same series, 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. Refer to *Warning: high earth leakage current* before *Contents*.

4. For parallel system consists of two or more UPS modules, the bypass load sharing inductors (optional) should be selected.

1.4 Operation Modes

The UPS has the following operation modes:

- Normal mode
- Battery mode
- Automatic restart mode
- Bypass mode
- Maintenance mode
- ECO mode
- Frequency converter mode
- Dormancy mode
- LBS mode

Normal mode

As shown in Figure 1-3, the mains is rectified by the UPS rectifier and then inverted by the inverter to supply uninterrupted AC power to the loads. At the same time, the charger will charge the battery.

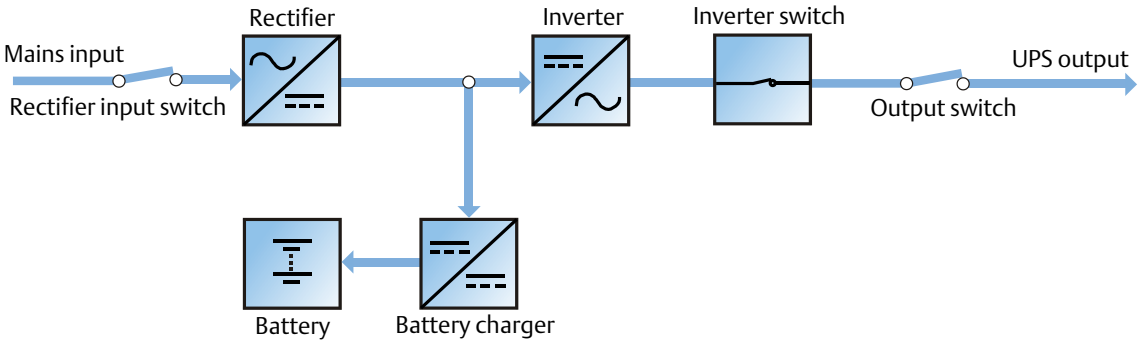


Figure 1-3 Schematic diagram of normal mode

Battery mode

As shown in Figure 1-4, 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.

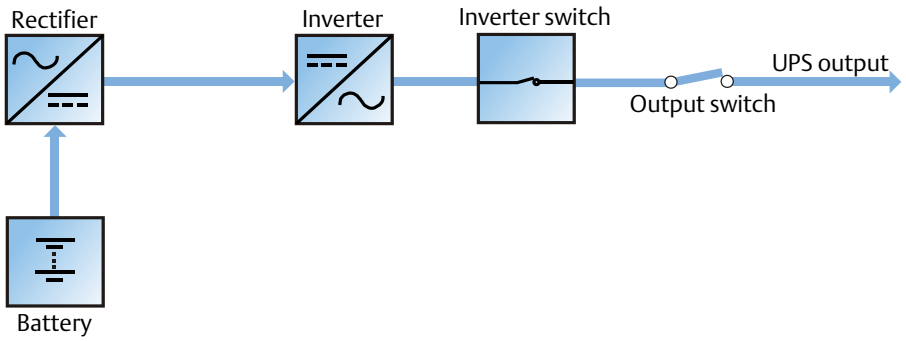


Figure 1-4 Schematic diagram of battery mode

Automatic restart mode

The UPS has automatic restart function. When the inverter shuts down because the mains fails and the battery discharges to EOD voltage, if the mains is recovered, the UPS will restart automatically after a certain time of delay. This function and the automatic restart type can be set by the service engineer authorized by Emerson.

During the process of automatic restart time of delay, the UPS will charge the battery to protect against the power-off risk of the load device caused by mains power failure.

If the automatic restart function has not been set, the user can manually start the UPS through pressing the FAULT CLEAR key first and INVERTER ON key next.

Bypass mode

As shown in Figure 1-5, in normal mode, in case of an inverter failure, an inverter overload or an inverter manual shutdown, the static switch will transfer the load from the inverter side to bypass side, with no interruption in power to the load. At this time, if the inverter and bypass are not synchronized, the power of the load has transitory interruption, with time of less than 20ms.

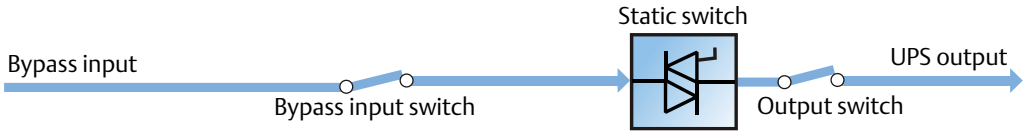


Figure 1-5 Schematic diagram of bypass mode

Maintenance mode

As shown in Figure 1-6, if the UPS maintenance or service is required, you may 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 modules and rated for full load of a single module.

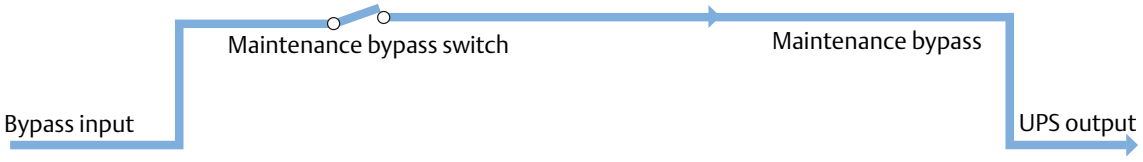


Figure 1-6 Schematic diagram of maintenance mode

ECO mode

If ECO mode is selected, all power switches and the battery switches are closed except for the maintenance bypass switch, and the system prefers to put the load on the bypass, to achieve the aim of 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. In this mode, the system can normally charge the battery.

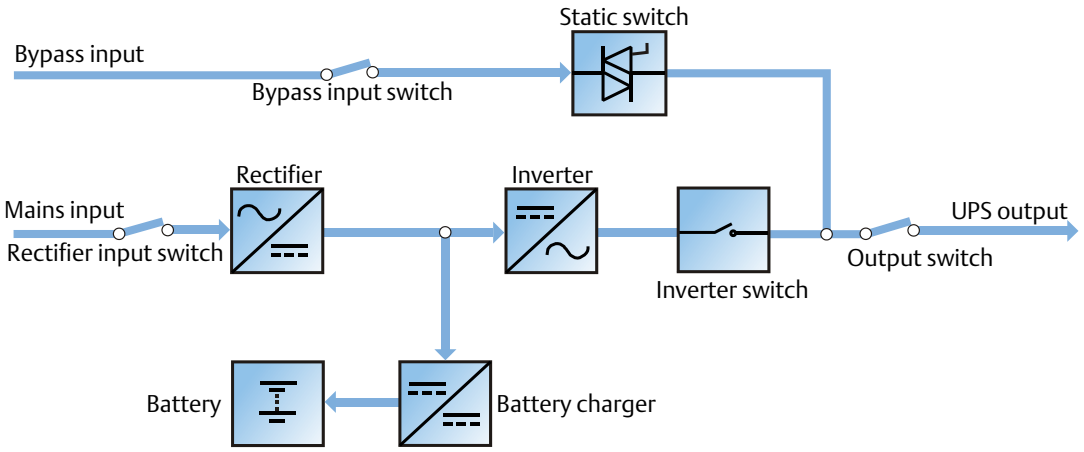


Figure 1-7 Schematic diagram of ECO mode

If ECO mode is required, adjust corresponding parameters through the operator control and display panel.

The operation method of ECO mode is the same as the description in *Chapter 5 UPS Operation Introduction*. However, in normal mode, the load is powered by the bypass, the inverter indicator is flashing, and the LCD displays 'Bypass mode'.

Warning

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

Frequency converter mode

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

Dormancy mode

Dormancy mode is designed to maximize the number of the dormant power modules while ensuring load power, which brings the system efficiency to the greatest extent. The dormancy mode is configured by the commissioning engineer through the background software. This mode has the following restrictions on the power module addresses: When there are 'n' power modules, the power module addresses should be 1, 2, 3, 4 and 'n' in turn; when there are 12 power modules, the power module addresses should be from 1 to 12 in turn.

Note

In dormancy mode, sudden load change should be avoided, which may cause UPS transfer to bypass mode.

LBS mode

A dual bus system consists of two 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 7-5.

1.5 Battery Management

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

1.5.1 Normal Function

1. Constant current boost charge

Adopt the constant current (within battery charging limit) to charge the battery. The function can be used for battery capacity fast recovery. The charge current can be set.

2. Constant voltage boost charge

Adopt the constant voltage to charge battery. The function can be used for battery capacity fast recovery. For VRLA batteries, the maximum boost charge voltage should not exceed 2.4V/cell.

3. Float charge

The charging method is used for keeping battery with a full capacity. The float charge voltage is generally low. The function can balance the capacity loss due to battery self discharging, and can be used for battery capacity recovery.

For VRLA batteries, the float charge voltage should be between 2.2V/cell and 2.3V/cell.

4. Automatic transfer to float charge

When the charge current is less than 'Threshold of Equalize Charge to Float Charge' or 0.5A, 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 be forcibly transferred to float charge for protecting the battery.

5. Float charge temperature compensation (optional)

This function must be used together with the battery temperature detection device. The Emerson battery temperature sensor is a standard option for your selection.

6. 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 1.60V/cell to 1.90V/cell (VRLA).

7. Battery low pre-warning time

The battery low pre-warning time is adjustable between 3min and 60min. The default setting is 5min.

8. 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 shall be configured by service engineer through the Emerson setting software.

9. 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 Emerson setting software.

1.5.2 Advanced Function

The UPS provides battery maintenance test function. At periodic intervals, 20% of the rated capacity of the battery will be discharged automatically, and the actual three-phase load must exceed 20% of the nominal UPS capacity. If the load is less than 20%, the automatic discharge cannot be executed. The periodic interval can be set from 30 to 360 days. The battery maintenance test function can be disabled through the Emerson setting software.

Conditions: Battery at float charge for at least 5h, load equal to 20% ~ 100% of rated UPS capacity.

Trigger: Automatically, or manually through the command of battery maintenance test in LCD.

Interval: 30 ~ 360 days (default setting: 60 days).

The UPS also provides battery capacity self-test function: Periodically test the battery activity, test the battery residual capacity, judge the battery quality, and then provide corresponding measures. The capacity self-test is started by the user through the operator control and display panel. During the capacity self-test, the battery will continuously discharge to the battery undervoltage shutdown threshold. After the self-test is finished, the system will update the battery curve table. The capacity self-test command is valid only one time, without any memory. During the capacity self-test, if the battery maintenance requirement is satisfied, the system will generate audible/visual alarm and give corresponding records.

Conditions: System load rate within 20% ~ 100%, battery float charge at least 5h, and generator not connected; the current system is in float charge state.

Trigger: Start up through the LCD.

Note:

1. The battery will continuously discharge to the battery undervoltage 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.

2. The user can manually stop the capacity self-test operation through the LCD.

1.5.3 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 life time.

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

1.6 Battery Protection

The following battery protection functions are set by the service engineer through the Emerson 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 for three remaining minutes discharging with full load. The time can be configured from 3min to 60min.

EOD protection

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

BCB alarm

The BCB alarm occurs when the external BCB opens, if you select the Emerson BCB (optional).

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

Chapter 2 Mechanical Installation

This chapter briefly introduces the mechanical installation of the UPS, including the precautions, initial inspection before installation, environmental requirement, mechanical requirement and installation diagram.

2.1 Precautions

This chapter describes the environmental and mechanical requirements and mechanical considerations that must be taken into account when planning the positioning and cabling of the UPS equipment.

Because each site has its particular characteristics, this chapter does not provide the detailed installation steps, it only acts as a guide for the general procedures and practices that should be observed by the installing engineer, so that they can properly handle the specific situation of the site.

Warning: professional installation required

1. Do not disassemble the package without permission of authorized service engineer.
2. The UPS should be installed by an authorized engineer in accordance with the information contained in this chapter.

Warning

1. The UPS system can connect to the power system (i.e., IT system) whose neutral point is not earthed.
2. The UPS can be connected to TN and TT AC distribution systems (IEC60364-3) of 3-phase 5-wire (A, B, C, N, PE).

Warning: battery danger

Take special care when installing batteries. When connecting batteries, the battery terminal voltage will reach 320Vdc, which is fatal to human being.

1. Please wear safety glasses to protect the eyes from being damaged by arc.
2. Remove all the metal items, including finger rings, watch, etc.
3. Use tools with insulated handle.
4. Wear rubber gloves.
5. 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.
6. If the skin contacts the electrolyte, flush it with water immediately.

2.2 Transportation

Note

The center of gravity of the UPS cabinet is not centered; avoid falling over during the cabinet movement by forklift.

Railroad transportation and shipping are the recommended means of transportation. If truck transportation is unavoidable, choose roads that are less bumpy in order to protect the equipment.

The UPS cabinet is heavy (see Table 11-3 for the weight). It is recommended to use mechanical equipment such as an electric forklift to unload and move the equipment to the place closest to the installation site. If an electric forklift is used, insert the tines of the forklift below the bottom pallet (as shown in Figure 2-1) to prevent the equipment from falling over.

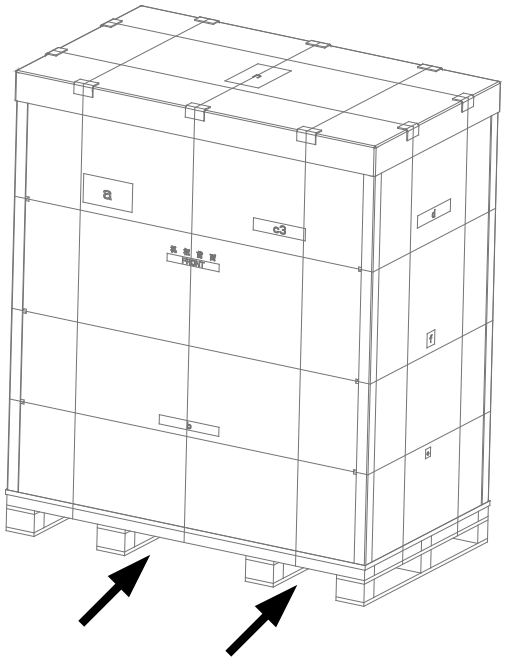


Figure 2-1 Inserting and movement (Cabinet front)

Note

Before removing the packaging, please visually inspect whether the packaging has any transportation damage or anti-dumping label has color changed. If there is any abnormity, contact Emerson local service center.

2.3 Tools

Warning

1. For the sake of safety, the installation tools under live operation must be insulated.
2. Tools in Table 2-1 are for reference only; please follow the actual requirement for on-site installation and connection.

Table 2-1 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	

Name	Drawing	Name	Drawing
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	

2.4 Unpacking

Unpack the UPS and battery packages under the guidance of authorized service engineer. Steps:

1. As shown in Figure 2-2, remove the packing belts and honeycomb boards.

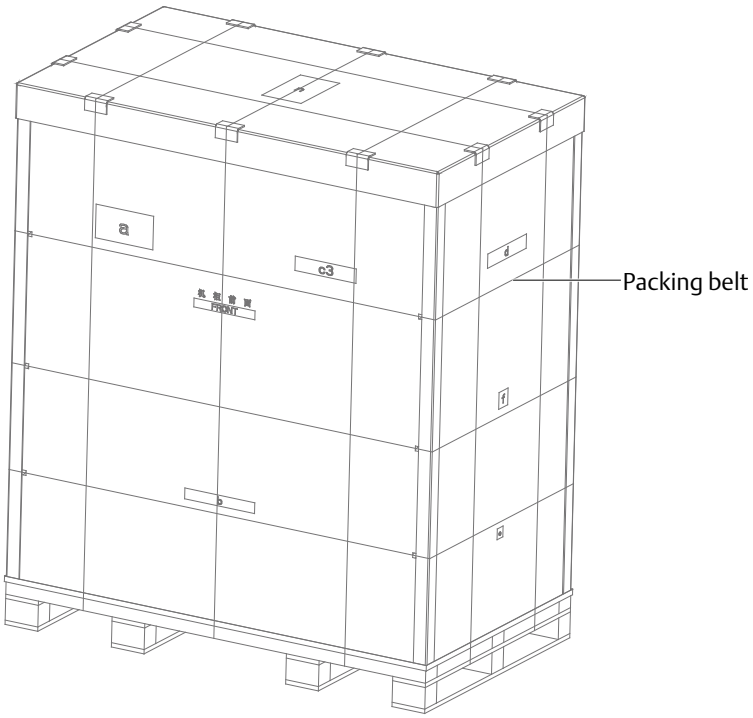


Figure 2-2 Removing the packing belts and honeycomb boards

2. Remove the ratguards both front and rear, see Figure 2-3.

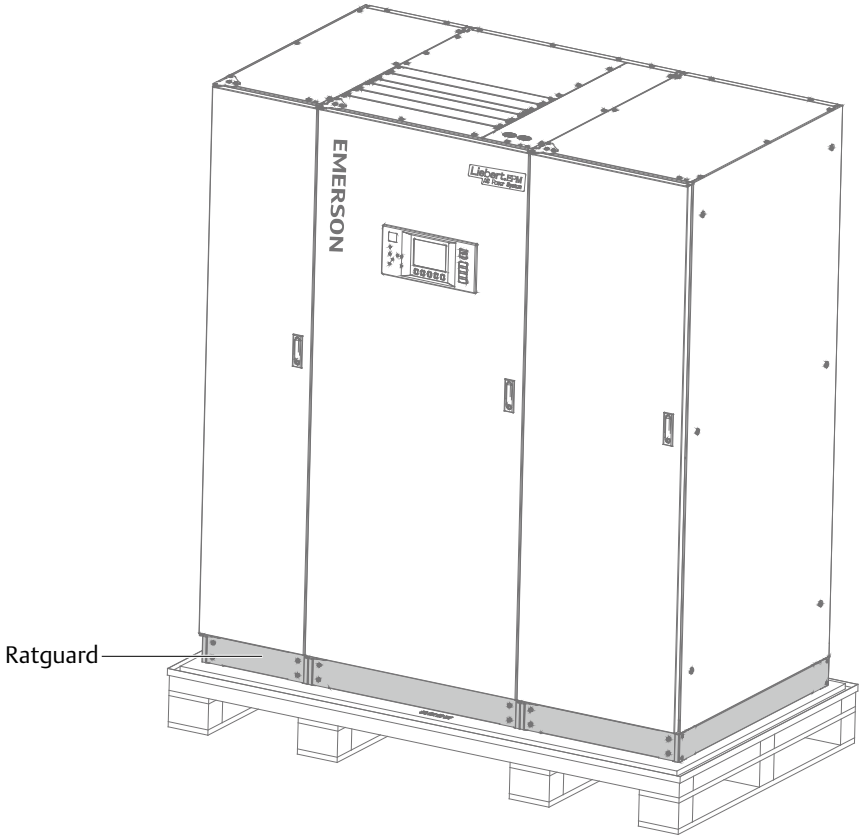


Figure 2-3 Removing ratguards

3. According to Figure 2-4, remove the fixing bolts at bottom of the cabinet.

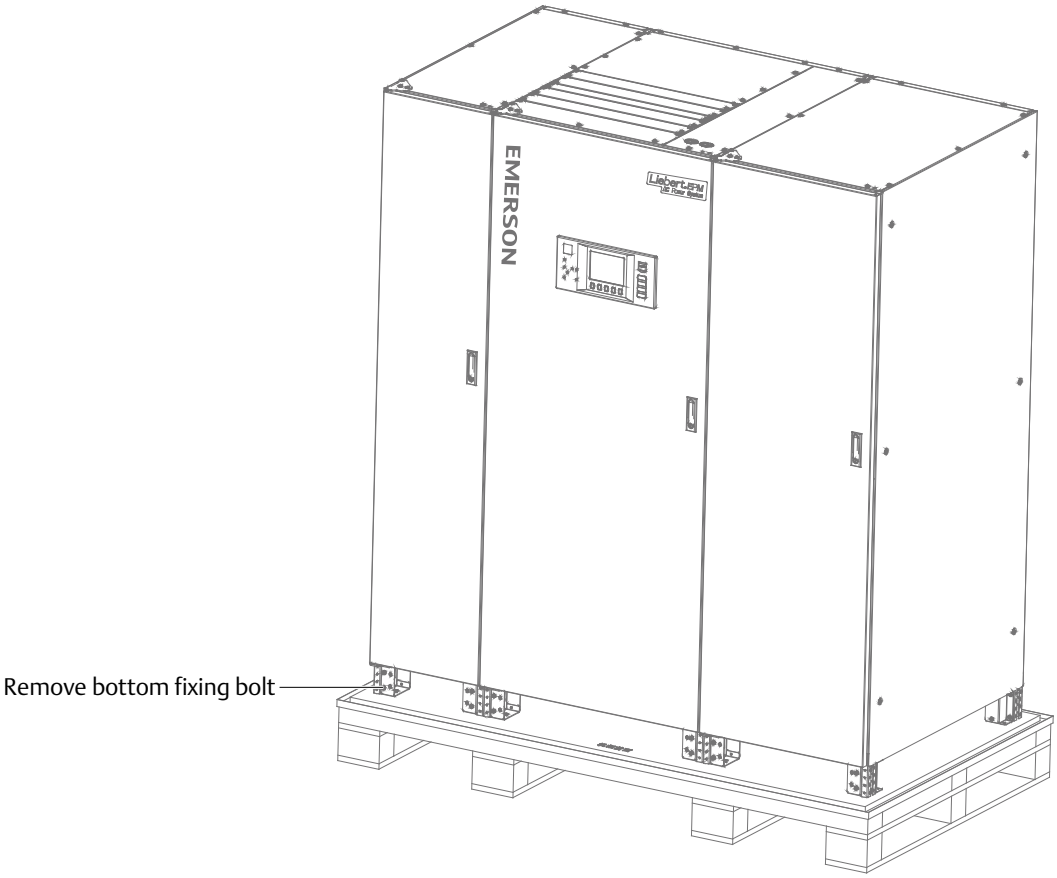


Figure 2-4 Removing bottom bolts

4. If the cabinet is equipped with the seismic anchors, you should remove them (8 pieces at front and rear) according to Figure 2-5, then use the forklift to move the cabinet to its installation position.

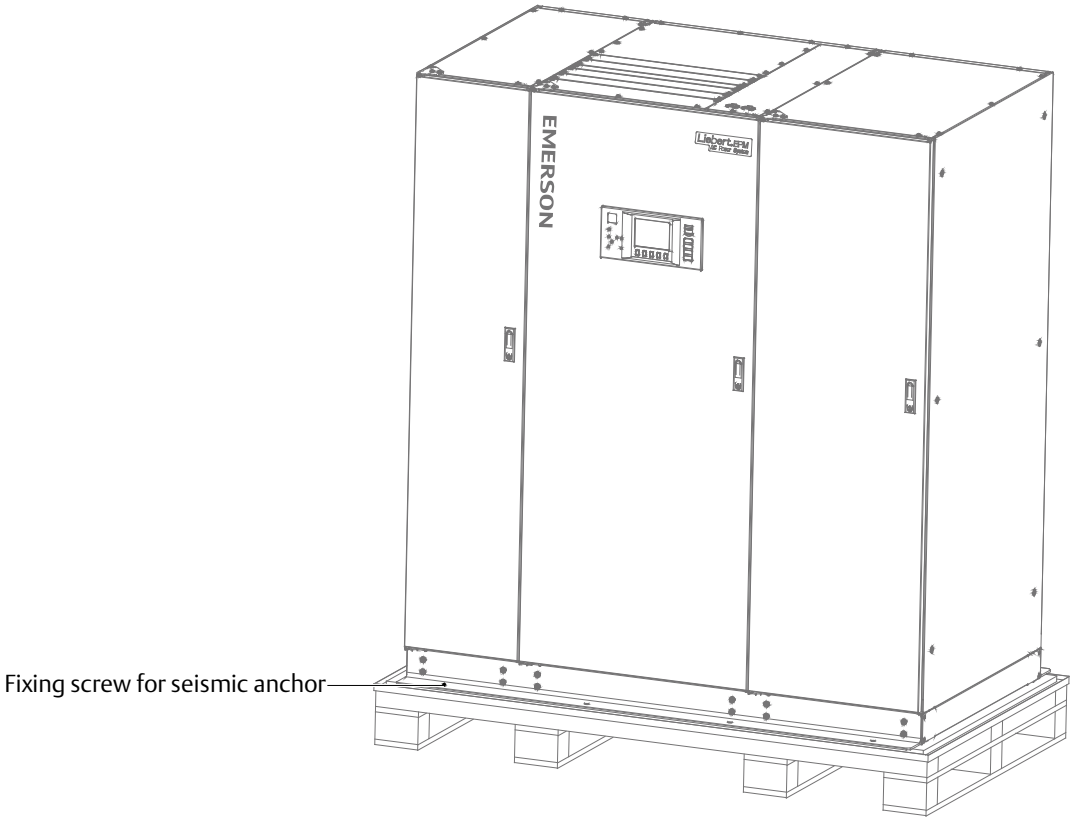


Figure 2-5 Removing seismic anchors

2.5 Initial Inspection

Before installing the UPS, carry out the following inspections:

1. Ensure that the environment of the UPS equipment room meets the environmental requirement specified in the product technical specifications, especially the ambient temperature, ventilation conditions, and the dust situations.

2. Unpack the UPS and battery under the guidance of authorized service engineer. Visually inspect whether the UPS and battery have any transportation damage. If there is any damage, report to the carrier immediately.

3. Verify the UPS label and confirm the correctness of the UPS. The UPS label is attached on the back of the door. The model, capacity and main parameters of the UPS are marked on the label.

2.6 Environmental Requirement

2.6.1 Selection Of UPS Location

The UPS should be located in a cool, dry, clean-air indoor environment with adequate ventilation, and should be located on concrete or other nonflammable and flat surfaces. The ambient environment should be free of conductive powder (such as metallic powder, sulfide, sulfur dioxide, graphite, carbon fiber, conductive fiber, etc.), acid mist or other conductive media (strongly ionized substances). The environment specifications should comply with relevant international standard & specifications and the operating range (see Table 11-2) specified in this manual.

The UPS uses forced cooling by internal fans. Cooling air enters the UPS through the ventilation grills at the front of the cabinet and exhausted through the ventilation grills at the back of the cabinet. Do not obstruct the ventilation holes (ventilation grills). The rear of the UPS should be kept a distance at least 500mm from the wall 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 room temperature buildup. Air filters (optional) should be used when the UPS is to operate in a dirty environment.

Note 1: When the battery cabinet is installed near the UPS, the maximum allowable ambient temperature is dependent on the battery rather than the UPS.

Note 2: 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.

2.6.2 Selection Of Battery Location

Batteries generate some amount of hydrogen and oxygen at the end of 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 20°C. If the ambient temperature is higher than 20°C, the battery life will be reduced. If it is lower than 20°C, the battery capacity will be reduced. In normal situation, the allowable ambient temperature for the battery is 15°C to 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 which shall be close to the UPS. If the battery is placed on the raised floor, 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.

2.6.3 Storage

Should the UPS not be installed immediately, it must be stored with the original packaging in a room for protection against excessive humidity and heat sources (see Table 11-2). The battery needs to be stored in a dry and cool place with good ventilation. The most suitable storage temperature ranges from 20°C to 25°C.

 **Warning**
During battery storage, periodically charge the battery according to the battery manufacturer instructions.

2.7 Mechanical Requirement

2.7.1 Composition

The 600kVA UPS system contains the 400kVA main power cabinet, 200kVA main power cabinet and switch cabinet (including bypass control module and bypass power module), and provides the options such as rectifier input switch, bypass input switch, and output switch.

2.7.2 Moving Cabinet

Warning

1. The lifting equipment for moving the UPS cabinet must have enough lift capacity.
2. When removing the UPS from the shipping pallet, pay attention to keeping the UPS from sliding. Ensure that adequate personnel and lifting equipment are available when removing the shipping pallet.
3. The center of gravity of the UPS cabinet is high; avoid falling over during the cabinet movement.
4. Vertical hanging of cabinet is not allowed.

Ensure that the weight of the UPS does not exceed the capacity of the lifting equipment. For the UPS weight, refer to Table 11-3.

The UPS cabinet can be moved by forklift or other similar lifting equipment.

2.7.3 Clearance

Because the UPS has no grille at the two sides, there is no special clearance requirement on the two sides.

Besides the local regulations, to enable routine tightening of the power terminals within the UPS, it is recommended that clearance around the front of the UPS should be larger than 1200mm and sufficient to enable free passage of personnel with the door fully open. Meanwhile, maintain at the back of the cabinet a clearance at least 500mm to permit adequate circulation of air coming out of the UPS. See Figure 2-6.

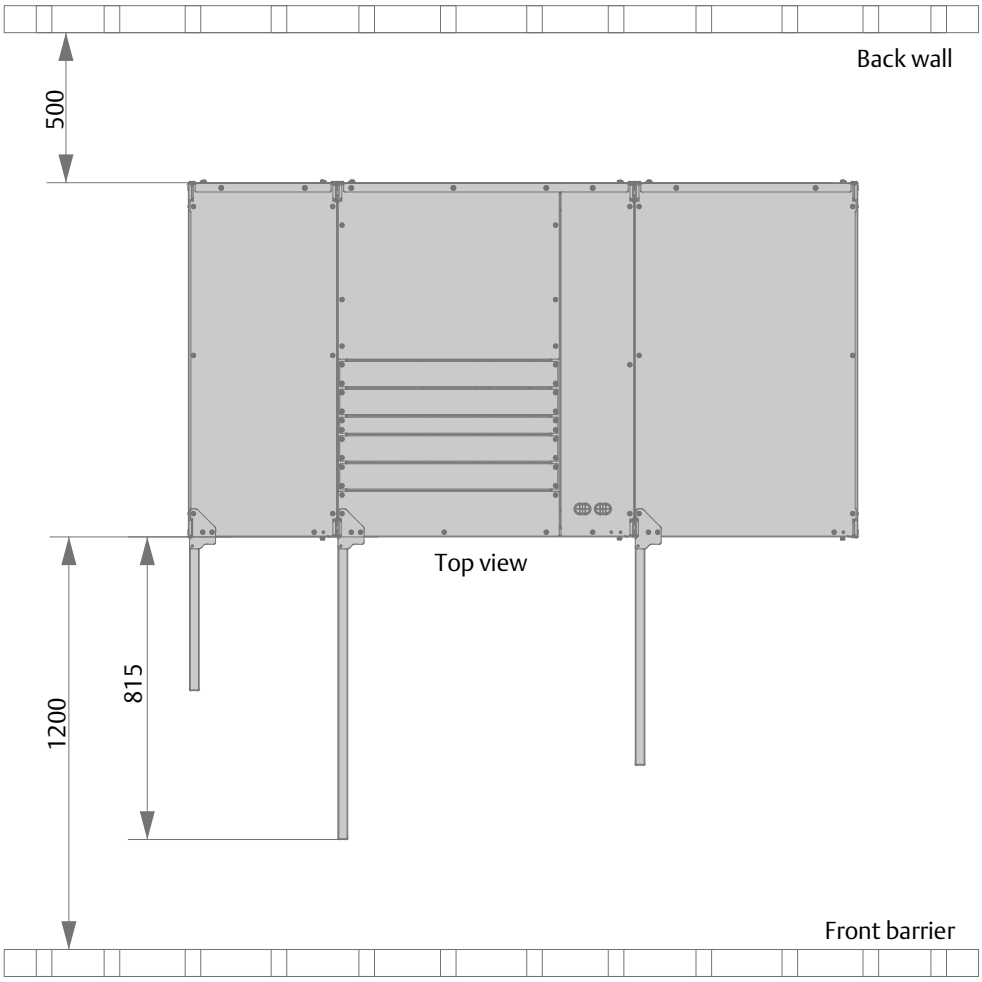


Figure 2-6 Clearance (unit: mm)

2.7.4 Cable Access Mode

The UPS adopts top cable access method and bottom cable access method.

For further description, refer to *3.1.10 Power Cable Connection Steps* and *3.2.10 Signal Cable Connection Steps*.

2.7.5 Installing And Removing Power Modules

Note
Install/Uninstall the power modules and output distribution modules from bottom to top to avoid cabinet toppling due to high gravity center.

See Figure 2-7 for the installation position of the power modules.

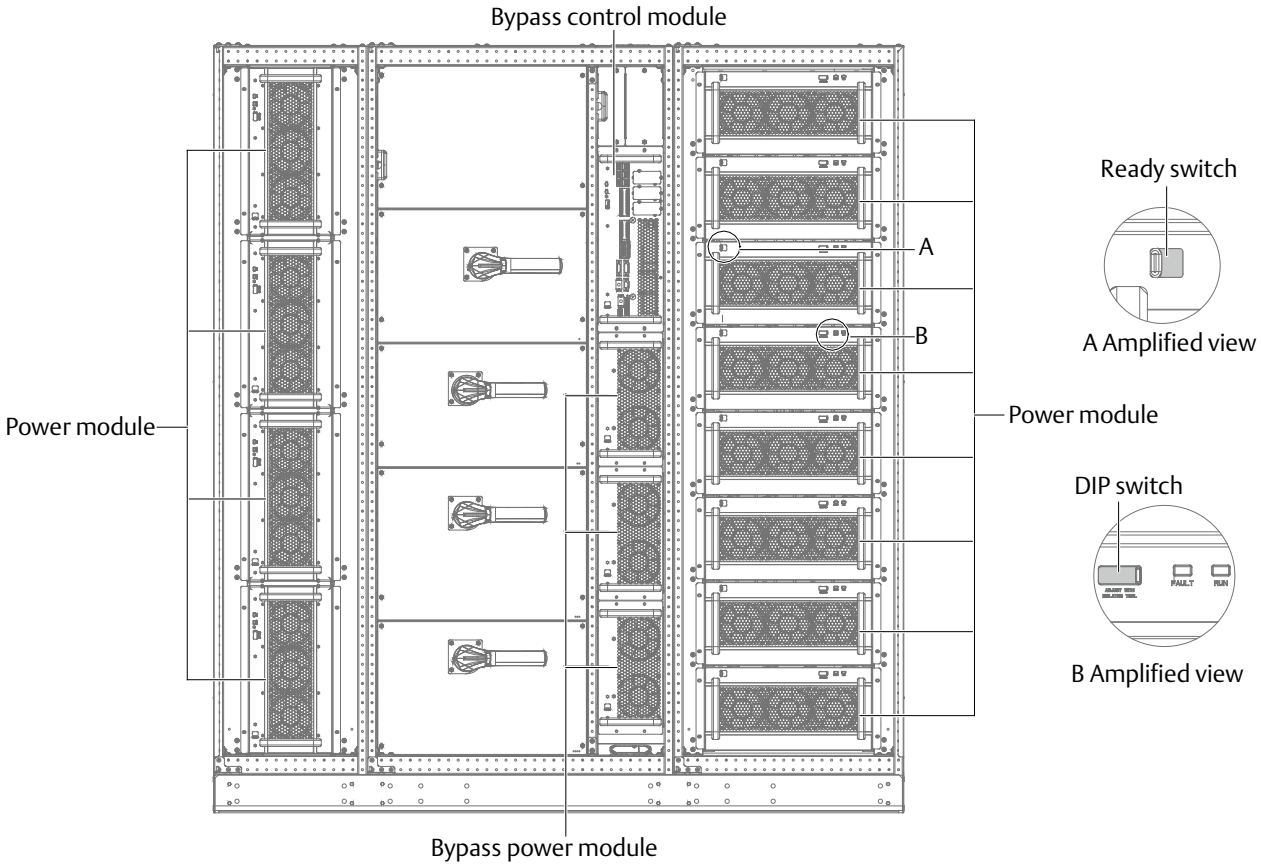
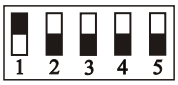
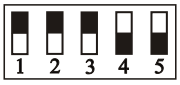
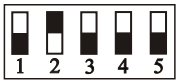
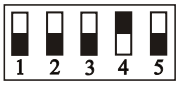
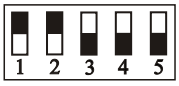
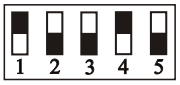
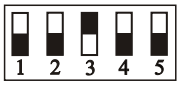
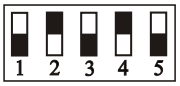
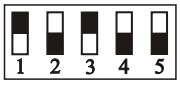
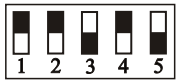
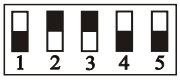
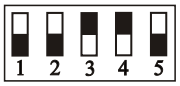


Figure 2-7 Installation of power modules

Use the following procedures to install the power modules:

1. Use the DIP switch on the front panel of the module to set the module address. The setting range is from 1 to 12. The module address should be exclusive. The setting method is shown in Table 2-2.

Table 2-2 DIP switch setting method

DIP switch setting	Module address		DIP switch setting	Module address
	1			7
	2			8
	3			9
	4			10
	5			11
	6			12

2. Place the ready switch on the front panel of the module to unready state (the switch is in red).
3. Remove the dummy plate, insert the module in the installation position, and push it into the cabinet.
4. Secure the module onto the cabinet through the fixing holes on both sides of the front panel of the module.
5. Place the ready switch to ready state.

2.8 Installation Drawings

The mechanical installation dimensions are shown in Figure 2-8 and Figure 2-9 (including seismic anchors).

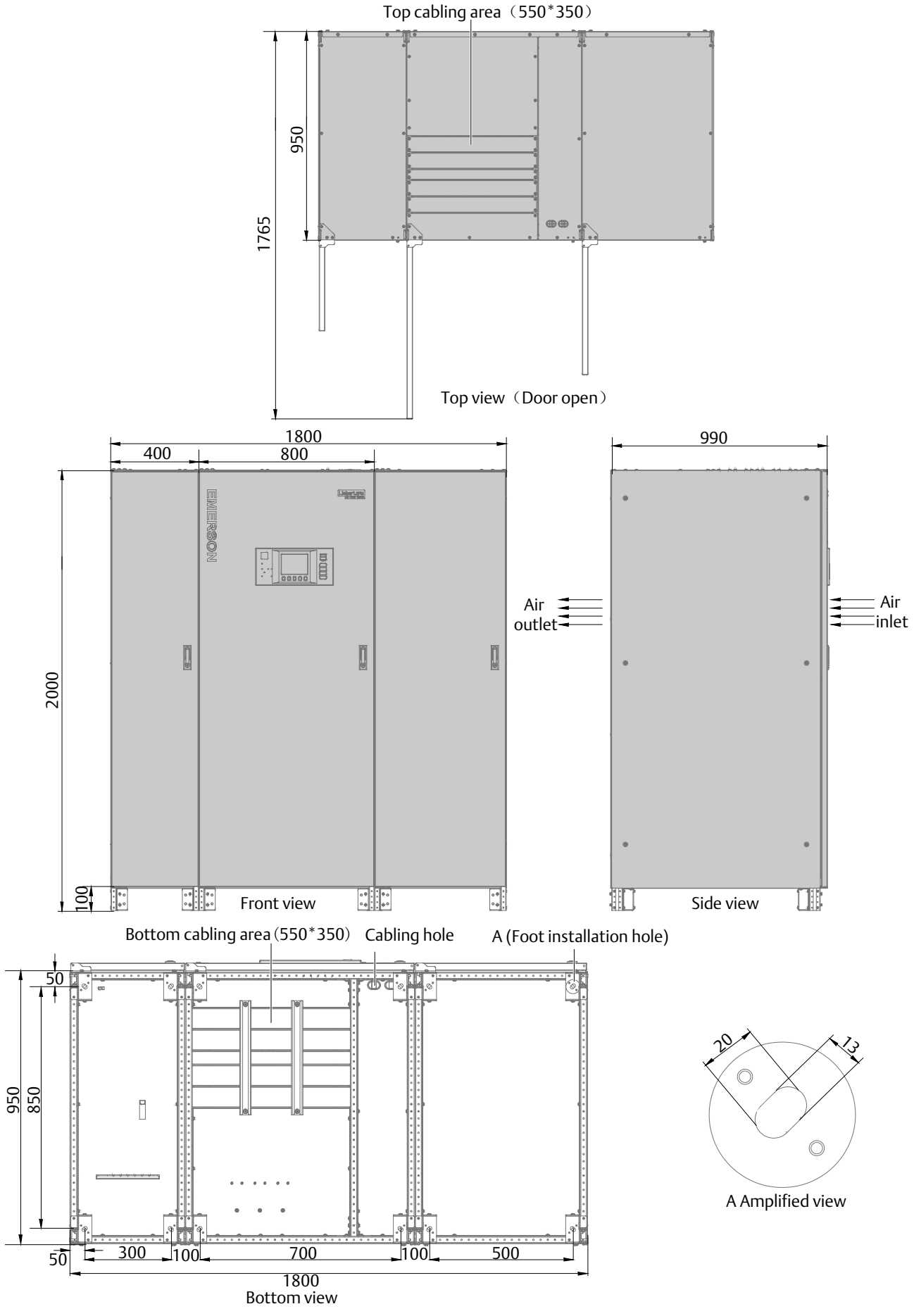


Figure 2-8 Top/front/side/bottom view of the 600kVA UPS (unit: mm)

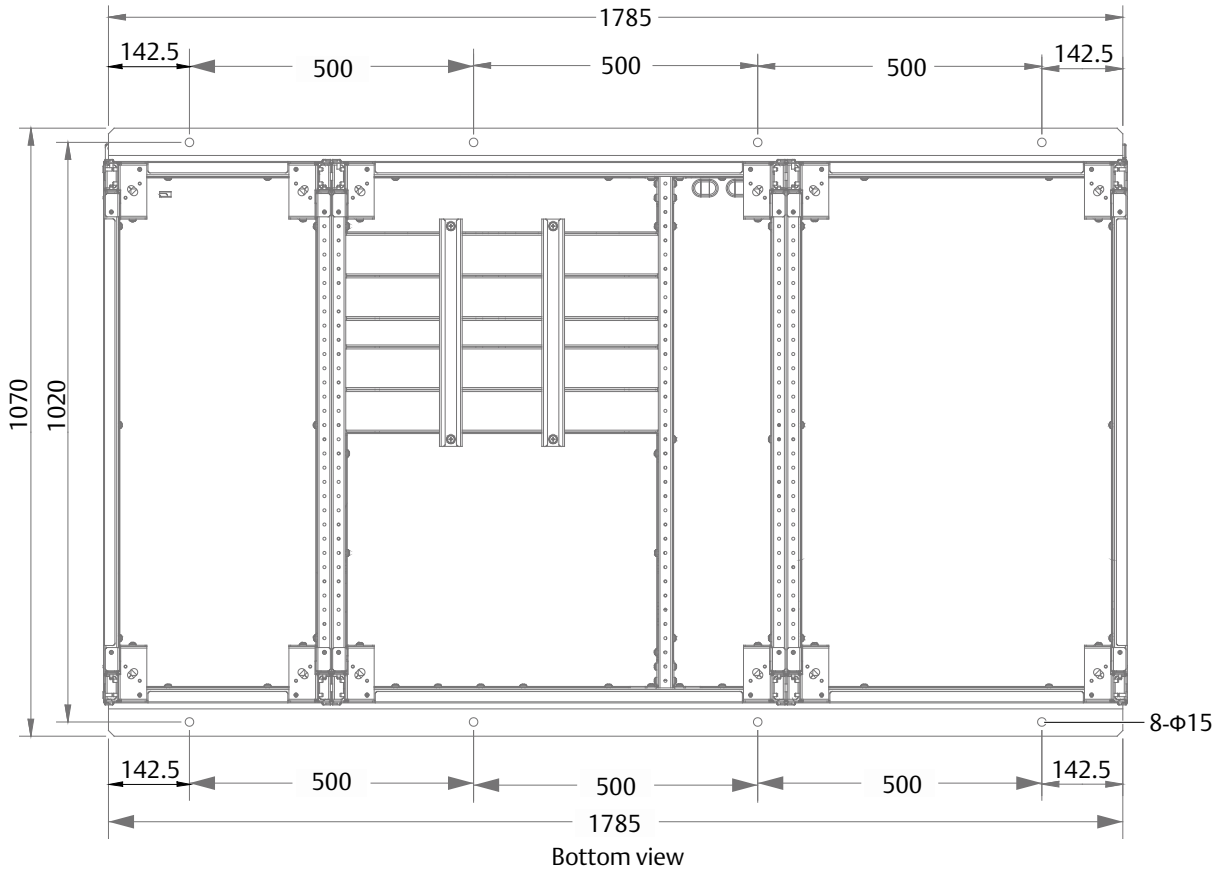


Figure 2-9 Bottom view of the 600kVA UPS with seismic anchors (unit: mm)

Chapter 3 Electrical Installation

This chapter mainly introduces the electrical installation of the UPS, including the power cable and signal cable connecting procedures and methods.

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, shall be kept away from the power cables.

Warning

1. Do not power on the UPS before the arrival of authorized service engineer.
2. The UPS cables should be routed by an authorized engineer in accordance with the information contained in this chapter.

3.1 Wiring Of Power Cable

3.1.1 System Configuration

The cable size of the system power cable shall meet the following requirements:

UPS input cable

The cable size of the UPS input cable differs with the UPS power ratings and input AC voltages, provided that it meets the requirement of maximum input current, including the maximum battery charge current, see Table 3-1.

UPS bypass and output cable

The cable size of the UPS bypass and output cable differs with the UPS power rating and output AC voltages, provided that it meets the requirement of nominal output or bypass current, as shown in Table 3-1.

Battery cable

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 3-1.

3.1.2 Maximum Steady State AC And DC Currents

The power cable must be selected according to the current and voltage values in Table 3-1 as well as the local wiring regulations, and take environmental conditions (temperature and physical media) into consideration, then refer to Table 3B in IEC 60950-1.

Table 3-1 Max. steady state AC and DC currents

UPS power (kVA)	Rated current (A)					Bus stud bolt/nut specification	
	Max. input current[1,2]	Output/bypass current[2] at full load			Battery discharge[3] current (+, -, N) at min. battery voltage	Input, battery, output, bypass/PE cable	Recommended torque (N.m)
		380V	400V	415V			
600kVA	1196	909	866	835	1730	M16/M12	90/40 (PE cable)

Note

1. Max. current of low voltage for rectifier input at full load.
2. Non-linear load (like switch power) affects the design of output and bypass neutral line.
3. The discharge current at EOD point (voltage is 9.6V) calculated by 38-block battery.

3.1.3 Recommended CSA Of Single Module Cable

The recommended CSA of the single module cable is listed in Table 3-2.

Table 3-2 Recommended CSA of the UPS single module cable (unit: mm^2, ambient temperature: 25℃)

Model	Input	Output	Bypass	I/O neutral line	Earth cable	Battery
600kVA	3*185	3*185	3*185	3*185	2*185	See Table 6-4

3.1.4 Selection Of UPS I/O Switch

Table 3-3 is the recommended capacity of the UPS I/O switch; the user can select it according to actual needs.

Table 3-3 Selection of the UPS I/O switch

Model	Input port	Output port
600kVA	1250A	1000A

3.1.5 Distance Between The UPS Connection Point And The Floor

Table 3-4 Min. distance between UPS connection point and floor

UPS connection point	Min. distance（mm）
	600kVA
Rectifier input	510
Bypass input	940
AC Output	1265
Battery supply (+)	915
Battery supply (-)	540
Input and output battery line N	1265
PE terminal	275

3.1.6 Notes

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

1. The cable size of the protective earth cable shall be selected according to the AC power failure level, cable length and protection type. The grounding wire connection must use the shortest connection route.

2. For the cables with large current, parallel connection of small cables can be adopted to facilitate the installation.

3. When selecting the battery cable size, the current value in Table 3-1 shall be referred to, and a maximum voltage drop of 4Vdc is allowed.

4. To minimize the formation of EMI, do not form coils.

3.1.7 Power Cable Connecting Terminal

The rectifier input, bypass input, output and battery power cables are connected to the corresponding terminals shown in Figure 3-2.

3.1.8 Protection Ground

The protective earth cable is reliably connected to the PE input terminal (see Figure 3-2) via the fixing bolt. All the cabinets and cable troughs shall be grounded according to the local regulations. The grounding wires shall be tied up reliably 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.

3.1.9 External Protective Device

To ensure the safety, it is necessary to install external circuit breaker for the input and battery of the UPS. Because of the difference of the specific installations, this section only provides general practical information for the installation engineer. The qualified installation engineer should have the knowledge of the local wiring regulations on the equipment to be installed.

Input power supply of rectifier and bypass

1. Input overcurrent and short circuit protection

Install suitable protective devices in the distribution line of the incoming mains supply. The protective devices should provide functions such as the overcurrent protection, short circuit protection, isolation protection and tripping upon backfeed. When selecting the protective devices, consider the power cable current-carrying capacity, system overload capacity (see Table 11-6 and Table 11-7) and the short circuit capability of the upstream power distribution.

Under the condition of adding external protective devices (use the recommended model or the device with performance better than recommended model), the UPS can satisfy the requirement of KAIC.

2. Split bypass configuration

If the UPS adopts split bypass configuration, independent protective device shall be installed respectively on the rectifier input and bypass input distribution lines.

Note

1. The rectifier input and bypass input must use the same neutral line.
2. 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 an RCD, the transient state and steady state ground leakage current upon the startup of the UPS shall be considered.

The RCCB shall meet the following requirements:

- Be sensitive to the DC unidirectional pulse (class A) of the whole distribution network
- Be insensitive to transient state current pulse
- Have an average sensitivity which is 0.3A ~ 3A adjustable

The RCCB symbols are shown in Figure 3-1.

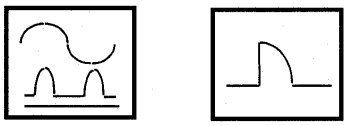


Figure 3-1 RCCB symbols

The UPS has an internal EMC filter, therefore the protective earth cable has leakage current which is less than 3000mA. It is recommended to confirm the RCD sensitivity of the upstream input distribution and the downstream distribution (to the load).

External battery

The BCB must be installed for protecting the external battery. The UPS provides a mandatory BCB cabinet to provide overcurrent protection, short circuit protection and automatic tripping functions for the external battery.

This BCB is important for the battery maintenance, and is generally installed near the battery.

System output

The UPS output distribution shall be configured with a protective device. The protective device shall be different from the input distribution protection switch and able to provide overload protection (refer to Table 11-6 and Table 11-7).

Note

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

3.1.10 Power Cable Connection Steps

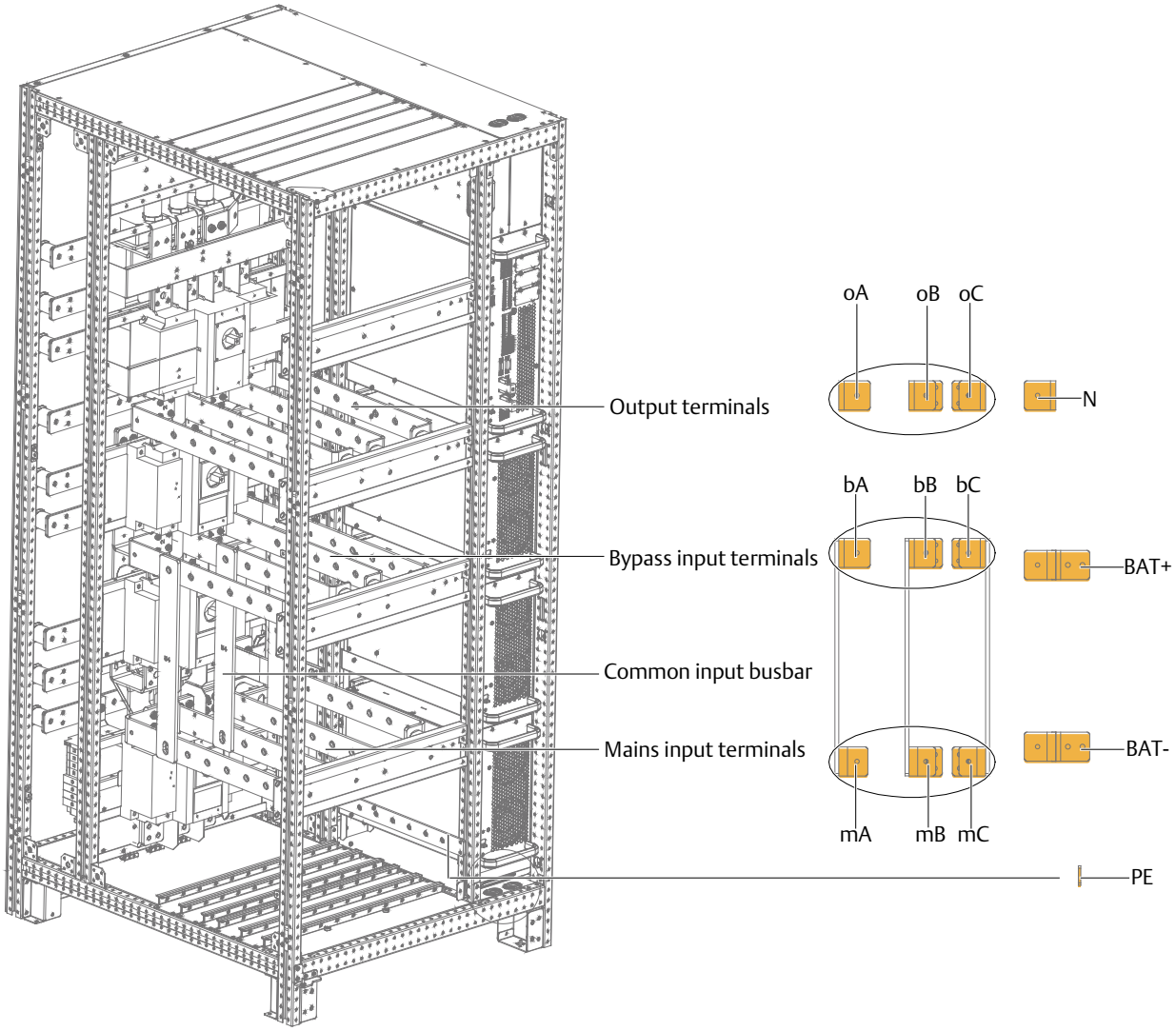
For cable access mode of the UPS, refer to *2.7.4 Cable Access Mode*.

Connection terminal and cable routing method

Figure 3-2 shows the connection terminals of the UPS power cable. Figure 3-3 and Figure 3-4 show the power cable entry and routing methods, please refer to the cabling method to route cables and then connect them to corresponding terminals shown in Figure 3-2.

Note

1. The power cables should be routed through tunnels or cable troughs to avoid cable damage due to mechanical stress and reduce the EMI.
2. When routing the cables inside the cabinets, it is required to bind and fix the cables to avoid cable damage due to mechanical stress.



Note:

1. BAT+, BAT-, N: Battery input terminals.
2. PE: Grounding terminals.
3. mA, mB, mC, N: Mains input terminals.
4. bA, bB, bC, N: Bypass input terminals.
5. oA, oB, oC, N: Output terminals.

Figure 3-2 Power cable connection terminals of 600kVA

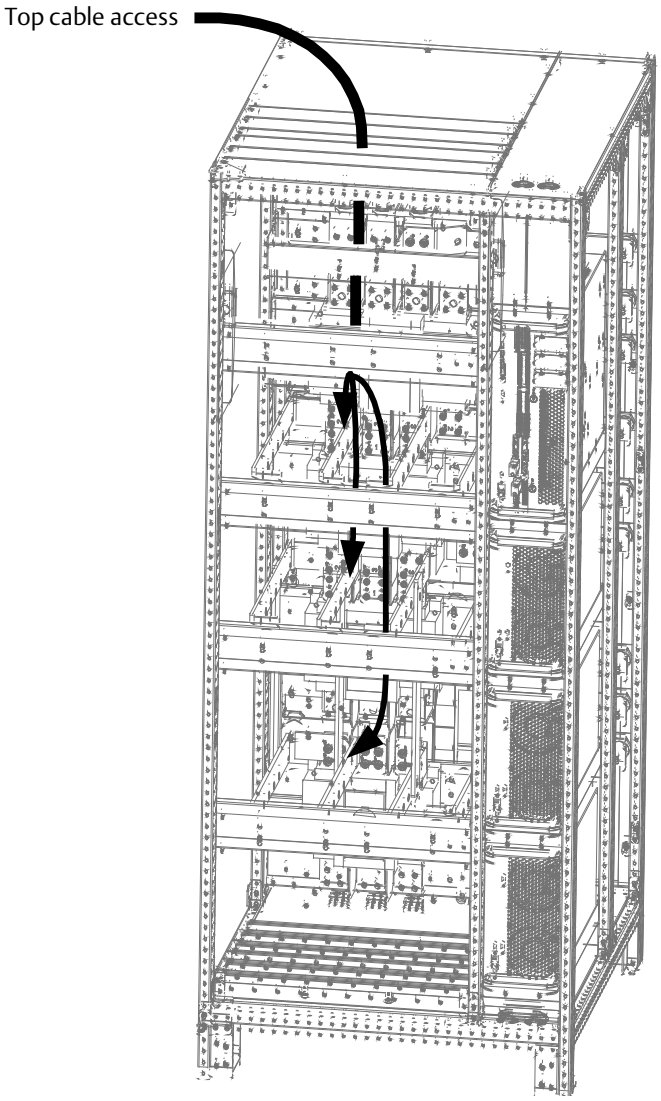


Figure 3-3 Power cables wiring route of 600kVA (top cable access)

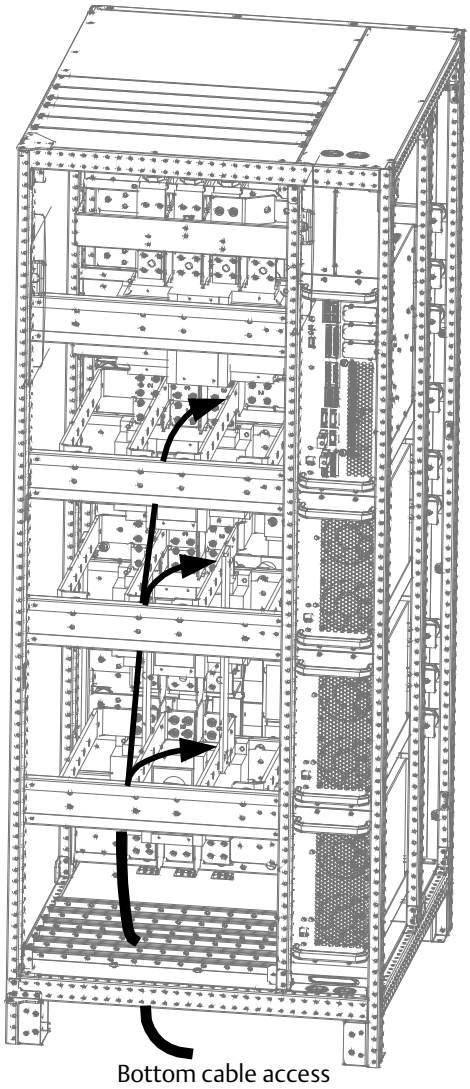


Figure 3-4 Power cables wiring route of 600kVA (bottom cable access)

Warning

Before cables connection, make sure that all external and internal power switches of the UPS are off, and post necessary warning signs to prevent inadvertent operation of the switches. Meanwhile, measure the voltages between the UPS terminals and the voltages between the terminals and the earth.

Refer to Figure 3-2 ~ Figure 3-4, open the front door of the UPS, and remove the protective cover to reveal the power cable connection terminals (see Figure 3-2). Connect the protective earth cable to the PE input terminal in the cabinet.

Warning

1. The earth cables and neutral line must be connected in accordance with local and national codes of practice.
2. Failure to observe this could result in electric shock or fire risk.

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 ensure that the three shorting copper bars between the rectifier input terminals (mA-mB-mC) and the bypass input terminals

are connected correspondingly. Connect the input neutral line to the neutral terminal N in the cabinet. Ensure correct phase rotation.

Note that the shorting copper bar is optional. If the user has ordered it, then the shorting copper bar has been configured before delivery, and on-site installation is not required. If the user needs on-site installation, please follow Figure 3-2 for the detailed installation.

Warning

For cables connection of the common input configuration, if the upstream switch trips, then the UPS mains and bypass input will be off.

2. Split bypass configuration (factory default)

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. Connect the rectifier input neutral line and bypass neutral line to the neutral terminal N in the cabinet. 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. Refer to Table 3-1 for the torque value. Ensure correct phase rotation.

Warning

If there is no requirement of power supply for the load before arrival of the service engineer, ensure that the system output cables are safely isolated at their ends.

Connection of batteries

Ensure correct polarity of the connections from the battery string terminals to the BCB and from the BCB to the battery input terminals (BAT+, BAT N, BAT-) in the UPS cabinet, that is, (BAT+) to (+) and (BAT-) to (-), (BAT N) to (N), but disconnect one or more battery cell links in each tier. Do not reconnect these links and do not close the BCB 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 BCB terminal.

Now the connection is finished. Then replace the protective covers.

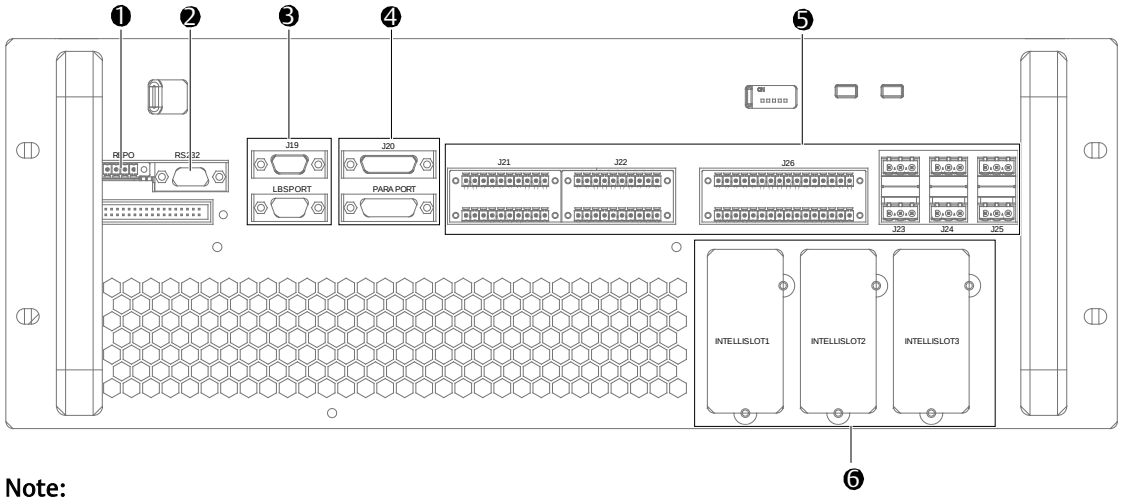
Note

After connection, take appropriate measures to seal the cable entry holes.

3.2 Wiring Of Signal Cable

3.2.1 Overview

For on-site specific needs, the UPS needs auxiliary connection to realize battery system (including the external battery switch) management, communicate with PC, provide alarm signal to external devices, realize remote EPO or provide bypass back feed circuit breaker signal and parallel communication. These functions are realized through the communication box in the UPS cabinet. As shown in Figure 3-5, the communication box provides the following ports.



Note:

❶ REPO port
❷ RS232 communication port
❸ LBS communication port
❹ Parallel communication port
❺ User dry contact port
❻ Intellislot port

Figure 3-5 Illustration drawing of communication ports

3.2.2 Dry Contact Port J21

The dry contact port J21 is shown in Figure 3-6. The port which is only operated by service engineer is used for the configuration of the parallel CAN. Before delivery, the jumper has been connected to the bottom terminal of J21. When the parallel number is less than or equal to two, no need to replace it; when parallel number is larger than two, just change the jumper to the top terminal.

The dry contact voltage is 12Vdc, and the current is 20mA.

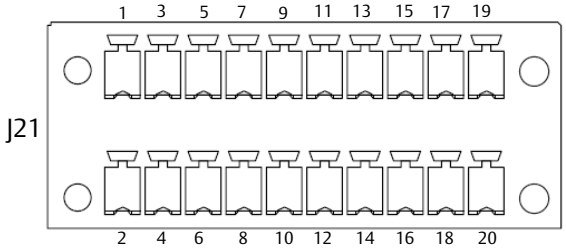


Figure 3-6 Dry contact port J21

3.2.3 Dry Contact Port J22

The dry contact port J22 is shown in Figure 3-7 and described in Table 3-5. The dry contact voltage is 12Vdc, and the current is 20mA.

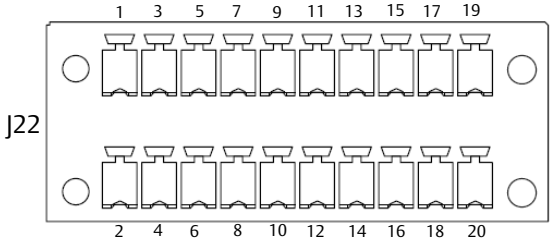


Figure 3-7 Dry contact port J22

Table 3-5 Description of dry contact port J22

Pin	Name	Meanings		Pin	Name	Meanings
1	12V_DRV	BCB driver signal		2	NC	Reserved
3	BCB STATUS	BCB state signal		4	NC	Reserved
5	GND_DRY	Dry ground		6	NC	Reserved
7	BCB_ONLine	BCB on line signal		8	NC	Reserved
9	NC	Reserved		10	NC	Reserved
11	GND_DRY	Dry ground		12	NC	Reserved
13	TMP_BAT	External battery temperature		14	NC	Reserved
15	12V_DRY	Power		16	NC	Reserved
17	GND_DRY	Dry ground		18	NC	Reserved
19	BAT_Ground_FAULT	Battery ground fault		20	NC	Reserved

Note

The BCB drive signal and external battery temperature signal need shielded cables, and the both sides of the shielding coat must be well connected to the enclosure.

3.2.4 Dry Contact Port J26

The dry contact port J26 is shown in Figure 3-8 and described in Table 3-6. The dry contact voltage is 12Vdc, and the current is 10mA.

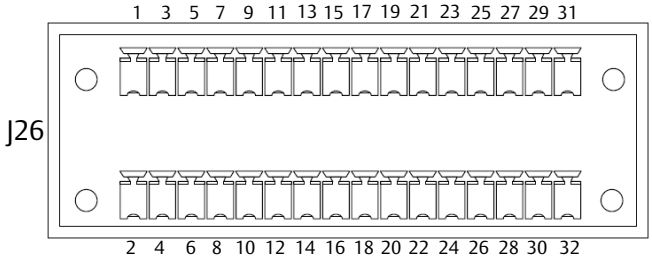


Figure 3-8 Dry contact port J26

Table 3-6 Description of dry contact port J26

Pin	Name	Meanings		Pin	Name	Meanings
1	Q1 STATUS	Status signal of the rectifier input switch		2	GEN MODE	Generator mode input. Generator mode when shorted with Pin2, Pin4
3	GND_DRY			4	GND_DRY	
5	Q2 STATUS	Status signal of the bypass input switch		6	TMP BATT_IN	Reserved
7	GND_DRY			8	+12V_DRY	
9	Q3 STATUS	Status signal of the external maintenance switch		10	Reserved	
11	GND_DRY			12	GND_DRY	
13	Q5 STATUS	Status signal of the external output switch		14	ENV_DET	Battery room temperature abnormal
15	GND_DRY			16	GND_DRY	
17	GND_DRY	Reserved		18	CHG SHUT	Charger off contact
19	RESV2			20	GND_DRY	
21	RESV3	Reserved		22	RESV1	Reserved
23	GND_DRY			24	GND_DRY	
25	NC	Reserved		26	NC	Reserved
27	UT1 485+	Reserved		28	UT2 485+	Reserved

Pin	Name	Meanings		Pin	Name	Meanings
29	UT1 485-	Reserved		30	UT2 485-	Reserved
31	GND_MON	Reserved		32	NC	Reserved

3.2.5 Dry Contact Ports J23 ~ J25

The dry contact ports J23 ~ J25 are shown in Figure 3-9 and described in Table 3-7. The dry contact can bear voltage up to 24Vdc or 250 Vac, and the largest current flowing is 5A.

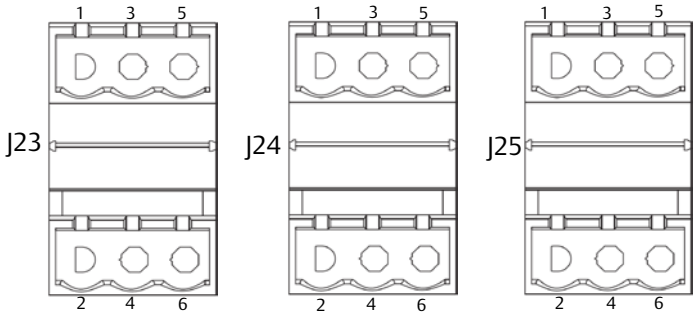


Figure 3-9 Dry contact ports J23 ~ J25

Table 3-7 Description of dry contact ports J23 ~ J25

Port	Pin	Name	Meanings
J23	1	BFP_O	Bypass back-feed normally open contact. Open when there is no back-feed
	3	BFP_S	Bypass back-feed common contact
	5	BFP_C	Bypass back-feed normally closed contact. Closed when there is no back-feed
	2	INV_O	Inverter state normally open contact. Closed when the inverter is on
	4	INV_S	Inverter state common contact
	6	INV_C	Inverter state normally closed contact. Open when the inverter is on
J24	1	MFP_O	Rectifier back-feed normally open contact. Open when there is no back-feed
	3	MFP_S	Rectifier back-feed common contact
	5	MFP_C	Rectifier back-feed normally closed contact. Closed when there is no back-feed
	2	MAIN_O	Rectifier input state normally open contact. Closed when the rectifier is on
	4	MAIN_S	Rectifier input state common contact
	6	MAIN_C	Rectifier input state normally closed contact. Open when the rectifier is off
J25	1	RESV_O	Reserved
	3	RESV_S	Reserved
	5	RESV_C	Reserved
	2	RESV_O	Reserved
	4	RESV_S	Reserved
	6	RESV_C	Reserved

3.2.6 REPO Port

The UPS has an EPO function that operates by an EPO button on the operator control and display panel of the UPS or by a remote contact provided by the user. The EPO button has a protective cover.

J2 is the REPO port. The port is shown in Figure 3-10 and described in Table 3-8.

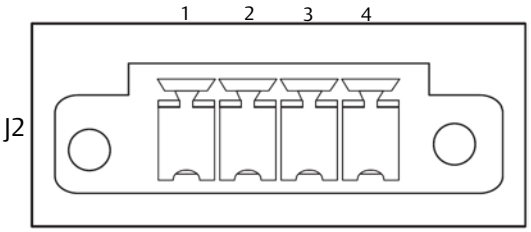


Figure 3-10 REPO port J2

Table 3-8 Description of REPO port J2

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

EPO is triggered when pins 3 and 4 of J3 are shorted or pins 2 and 1 of J2 are opened.

If an external EPO facility is required, pins 1 and 2 or 3 and 4 of J2 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 of J2 must be opened and pins 1 and 2 of J3 must be shorted.

Note

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

3.2.7 RS232 Communication Port

See Figure 3-5 for the position of RS232 communication port. This port monitors and sets parameters through connecting with computer.

The RS232 communication port provides serial data and is intended for use by authorized commissioning and service personnel in UPS commissioning and service.

3.2.8 Parallel And LBS Communication Ports

See Figure 3-5 for their positions.

3.2.9 Intellislot Port

The Intellislot ports are used for installing optional cards on the site, including IS-UNITY-DP card, IS-Relay card, and SIC card. Table 3-9 provides models and installation positions of the optional cards. For the detailed installation of the optional cards, refer to the corresponding contents in *Chapter 8 Options*.

Table 3-9 Models and installation positions of optional cards

Optional card	Model	Installation position
IS-UNITY-DP card	IS-UNITY-DP	Intellislot ports 1 ~ 3 (port 1 or 2 recommended)
SIC card	UF-SNMP810	Intellislot ports 1 ~ 3 (port 1 or 2 recommended)
IS-Relay card	IS-RELAY	Intellislot port 1

Note

1. The Intellislot port 2 shares communication resource with RS485 port. To avoid conflict, when using RS485 port in service and commissioning, it is not recommended to use the Intellislot port 2.
2. The Intellislot port 3 shares communication resource with RS232 port. To avoid conflict, when using RS232 port in service and commissioning, it is not recommended to use the Intellislot port 3.

3.2.10 Signal Cable Connection Steps

Note

Respectively route the power cables and signal cables. The shielding coat of signal cable must be reliably earthed.

Two connection modes are available: top cable access, bottom cable access. Refer to Figure 3-11 and Figure 3-12 for the cabling route and then connect signal cables to corresponding ports shown in Figure 3-5.

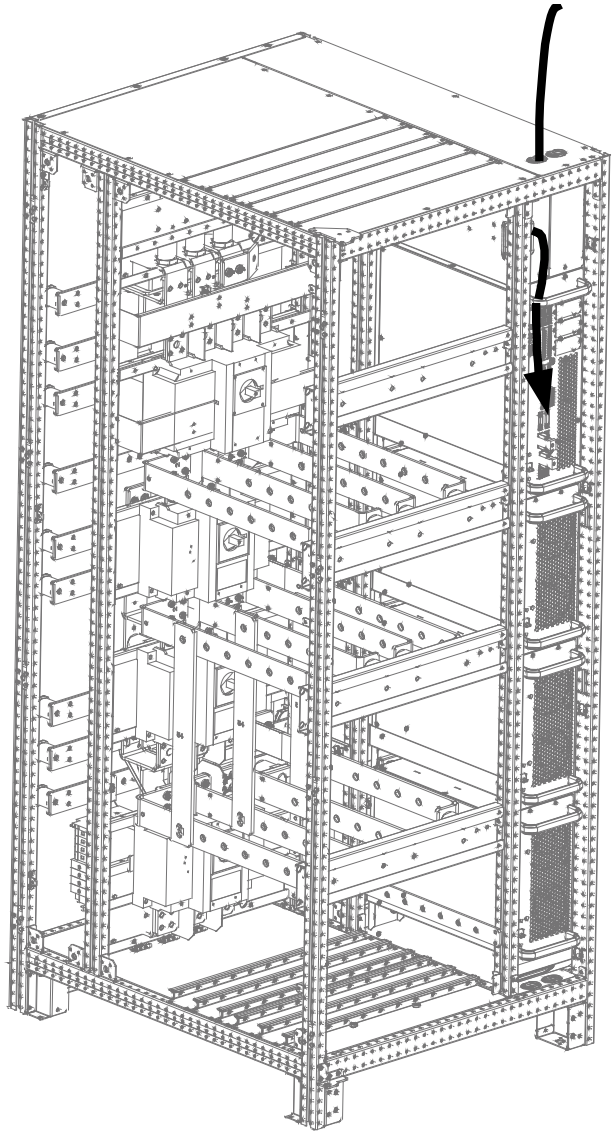


Figure 3-11 Signal cables wiring route of 600kVA (top cable access)

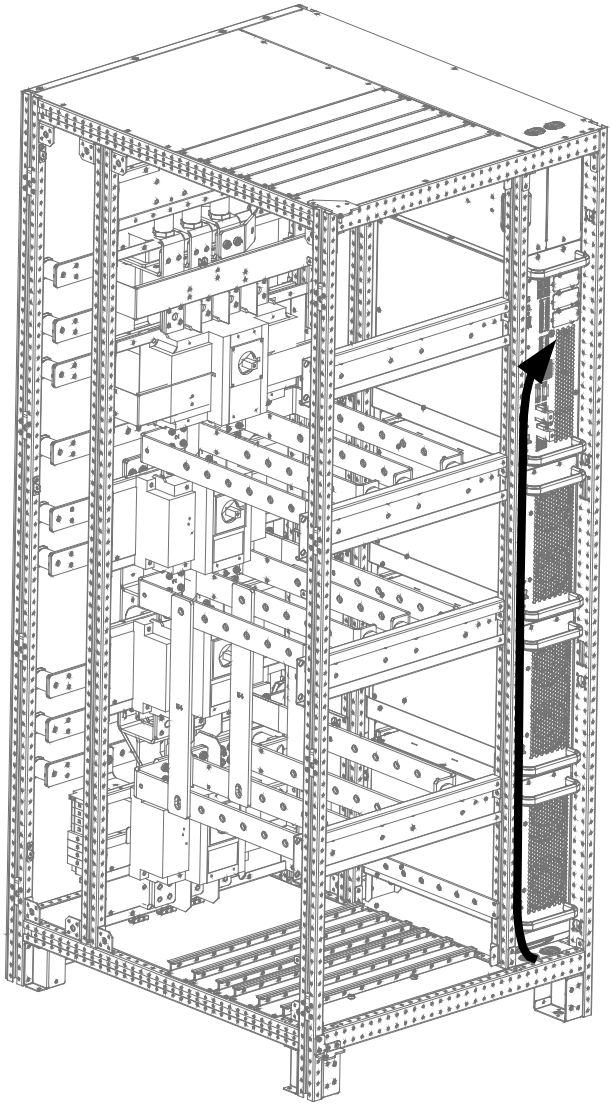


Figure 3-12 Signal cables wiring route of 600kVA (bottom cable access)

Chapter 4 Operator Control And Display Panel

This chapter details the functions and use of the components on the operator control and display panel of the UPS, provides LCD display information including LCD screen types, detailed menu messages, prompt windows and UPS alarm list.

4.1 Introduction

The UPS front provides the operator control and display panel. It is the access point for operator control and query all measured parameters, UPS and battery status and alarms.

The operator control and display panel is divided into three functional areas: mimic power flow chart, LCD display with menu keys, control keys, as shown in Figure 4-1, and as described in Table 4-1.

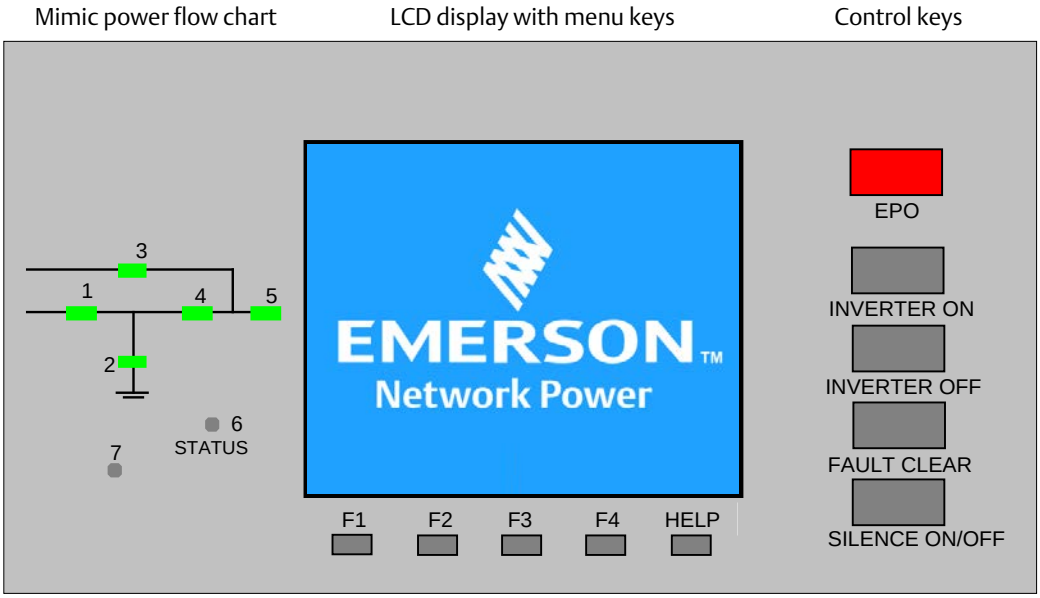


Figure 4-1 Operator control and display panel

Table 4-1 Description of components of the operator control and display panel

No.	Function
1	Rectifier indicator
2	Battery indicator
3	Bypass indicator
4	Inverter indicator
5	Output indicator
6	Status indicator
7	Buzzer

Key	Function
F1 ~ F4, HELP	LCD menu keys
EPO	EPO switch
INVERTER ON	Inverter start switch
INVERTER OFF	Inverter shutdown switch
FAULT CLEAR	Fault reset switch
SILENCE ON/OFF	Alarm silencing switch

4.1.1 LED Indicators

The LED indicators mounted on the mimic power flow chart represent the various power paths and current UPS operational status. The indicators are described in Table 4-2.

Table 4-2 Definition of indicators

Indicator	State	Description
Rectifier indicator	Solid green	Rectifier in normal operation
	Flashing green	Mains input normal, but rectifier not operating
	Solid red	Rectifier fault
	Off	Rectifier not operating, mains input abnormal
Battery indicator	Solid green	Load on battery
	Flashing green	Battery EOD pre-warning
	Solid red	Battery abnormal (failed, absent or polarity reversed) or battery converter abnormal (failed, overcurrent or overtemperature)
	Off	Battery and battery converter normal, battery charging
Bypass indicator	Solid green	Load on bypass
	Solid red	Bypass power abnormal or outside specifications, or static bypass switch fault
	Off	Bypass normal
Inverter indicator	Solid green	Load on inverter
	Flashing green	Inverter turning on, starting up, synchronizing
	Solid red	Inverter fault
	Off	Inverter not operating
Output indicator	Solid green	UPS output on and normal
	Solid red	UPS output on and overloaded
	Off	UP output off
Status indicator	Solid green	Normal operation
	Solid yellow	UPS alarm (for example, no battery)
	Solid red	UPS fault (for example, fuse or hardware fault)

4.1.2 Audible Alarm (Buzzer)

UPS activity is accompanied by the two kinds of sound listed in Table 4-3.

Table 4-3 Description of audible alarm

Alarm sound	Meaning
Beep every other second	Alarm upon a general fault, for example, module overload, battery disconnected, fan failure, parallel load sharing failure and battery discharge pre-alarm, etc.
Continuous beep	Alarm upon a general fault, for example, inverter relay short circuit, bypass STS short circuit, bypass backfeed and inverter fault, etc.

4.1.3 Control Keys

The operator control and display panel provides five control keys, as described in Table 4-4.

Table 4-4 Description of control keys

Control key	Silkscreen	Description
EPO switch	EPO	Cut off the load power and battery, shut down the rectifier, inverter, static bypass
Inverter start switch	INVERTER ON	Start the inverter
Inverter shutdown switch	INVERTER OFF	Shut down the inverter
Fault reset switch	FAULT CLEAR	Clear fault first to restart the UPS
Alarm silencing switch	SILENCE ON/OFF	When an alarm is active, pressing this key silences the audible alarm. Pressing this key again enables the buzzer again

Note

It is required to hold and press the preceding keys for 2s to initiate the key function.

4.1.4 LCD And Menu Keys

The operator control and display panel provides an LCD screen and five menu keys (F1 ~ HELP). The menu keys are described in Table 4-5.

Table 4-5 Description of menu keys

Key	F1	F2	F3	F4	HELP
Function 1	HOME	ESC Escape	Left	Right	Enter
Function 2			Up	Down	FLOW Flow chart

Providing 320 × 240 dot matrix graphic display, the user-friendly and menu-driven LCD allows you to easily browse through the input, output, load and battery parameters of the UPS, get current UPS status and alarm information, and perform functional setting and control operation. The LCD also stores up to 2048 historical records that can retrieve for reference and diagnosis.

4.2 LCD Screen Type

4.2.1 Start Screen

Upon UPS start, the UPS executes self-test, and the start screen appears and remains approximately 25 seconds, as shown in Figure 4-2.

Figure 4-2 Start screen

4.2.2 Primary Screen

After the UPS starts and finishes self-test, the primary screen appears, as shown in Figure 4-3. The primary screen is divided into four windows: system information window, data window, menu window and keypad window.

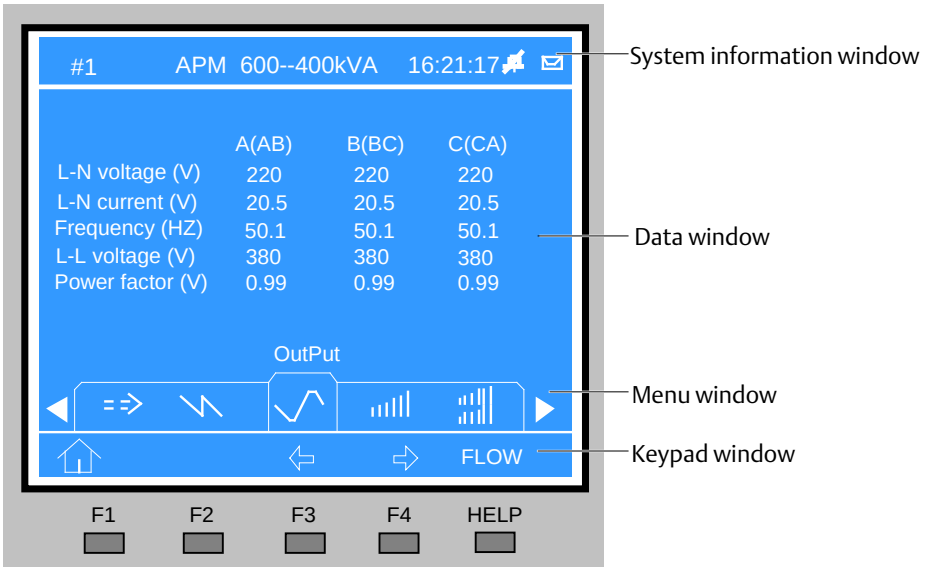


Figure 4-3 Primary screen

The functions of the menu keys F1 ~ HELP for the current screen are shown by self-explanatory icons in the keypad window as appropriate. From any menu on the primary screen, pressing the F1 key returns to the 'OutPut' menu.

4.2.3 Default Screen

During operation of the UPS, if there is no alarm or key action within two minutes, the default screen will appear, as shown in Figure 4-4. After a short delay, the LCD backlight will turn off. Pressing any menu keys (F1 ~ HELP) restores the default screen.

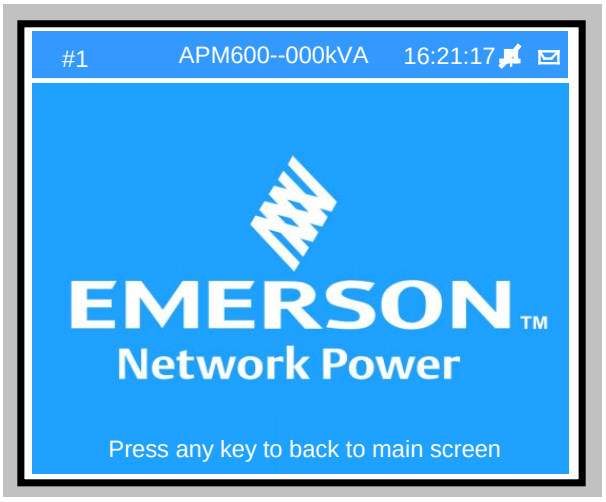


Figure 4-4 Default screen

4.3 Detailed Description Of Menu Items

The description that follows refers to the LCD primary screen shown in Figure 4-3.

System information window

The system information window displays the current time, UPS name, configuration and alarm silencing state. This window requires no user operation. For details, see Table 4-6.

Table 4-6 Item description of system information window

Item	Explanation
APM	Name of the UPS series
Single	Single: UPS module system with dual conversion
APM 600kVA	UPS model is 600kVA, and the mains online capacity is 400kVA
16:21:17	Current time (format: 24 hours, hour: minute: second)
/	Audible alarm enabled or disabled. : disabled, : enabled
	New alarm being shown

Menu window and data window

The menu window provides the menus of the data window. The data window displays the items of the menu selected in the menu window. UPS parameters can be browsed and functions can be set through the menu window and data window. Details are provided in Table 4-7.

Table 4-7 Item description of menu window and data window

Menu	Item	Explanation
Mains	L-N voltage (V)	Phase voltage
	L-N current (A)	Phase current
	Frequency (Hz)	Input frequency
	L-L voltage (V)	Line voltage
	Power factor	Power factor
Bypass	L-N voltage (V)	Phase voltage
	Frequency (Hz)	Bypass frequency
	L-L voltage (V)	Line voltage
OutPut	L-N voltage (V)	Phase voltage
	L-N current (A)	Phase current
	Frequency (Hz)	Output frequency
	L-L voltage (V)	Line voltage
	Power factor	Power factor
Load	S_{out} (kVA)	S_{out}: apparent power
	P_{out} (kW)	P_{out}: active power
	Q_{out} (kVAR)	Q_{out}: reactive power
	Load level (%)	Load (expressed in percentage of the UPS rating load)
	Crest factor	Output current crest factor
System	S_{out} (kVA)	S_{out}: apparent power
	P_{out} (kW)	P_{out}: active power
	Q_{out} (kVAR)	Q_{out}: reactive power
	Single unit, no parallel system data	Displayed on this data window when the UPS is configured as a single unit
Battery	Battery voltage (V)	Battery bus voltage
	Battery current (A)	Battery bus current
	Battery temperature (°C)	Battery temperature
	Battery remain time (Min.)	Remaining battery backup time
	Battery capacity (%)	Percentage of battery life when compared to a new battery
	Battery boost charging	Battery is boost charging
	Battery float charging	Battery is float charging
	Battery is not connected	Battery is not connected
Event	(active alarm)	Display the active alarms
Records	(alarm history)	Display the alarm history
Language	(language option)	Provide 13 optional LCD languages

Menu	Item	Explanation
Settings	Display contrast	Adjust the LCD contrast
	Date format set	Three formats selectable: MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD
	Date & time	Set the date and time
	Comm1 baud rate	Set the communication baud rate of the Intellislot port 1
	Comm2 baud rate	Set the communication baud rate of the Intellislot port 2
	Comm3 baud rate	Set the communication baud rate of the Intellislot port 3
	Communication address	Applicable to RS485 communication
	Equalize Charge Allowed	Battery boost charge is enabled or not
	Command password	The user can modify the command password
	Protocol	Velocity
Command (initiate, stop battery, system test or freshening charge	Battery maintenance test	20% battery capacity is out upon battery maintenance test. Load must be between 20% and 100%
	Battery capacity test	Perform a full discharge of the battery to obtain a precise measure of the battery capacity. Load must be between 20% and 100%
	System test	Self-test of the UPS. When the user activates this function, a window appears about 5s later to show the test result
	Stop testing	Manually stop a battery maintenance test, battery capacity test or system test
	Freshening charge	Manually initiate a battery freshening charge
	Stop freshening charge	Manually stop a battery freshening charge
	Modem automatic response activated	Setting of the modem automatic response activated
Eff.Curve	Eff.Curve	Display the system efficiency at current load
Run Time	UPS Run time	Display UPS accumulated run time
	Byp. Run time	Display UPS accumulated run time on bypass
Version	UPS version	Provide UPS inverter, rectifier and monitoring software versions
	UPS model	Provide UPS model information, for example, 400V-60Hz

Keypad window

The functions of the menu keys (F1 ~ HELP) for the current screen are shown by self-explanatory icons in the keypad window as appropriate.

4.4 Prompt Window

A prompt window is displayed during the operation of the system to alert you to certain conditions or to require your confirmation of a command. The prompts are provided in Table 4-8.

Table 4-8 Prompts and meanings

Prompt	Meaning
Transfer with interrupt, confirm or cancel	The load executes interval transfer between the inverter and bypass
The load is too high to be transferred with interrupt	The total load must be less than the capacity of one UPS to allow a parallel system to perform an interrupted transfer from bypass to inverter
This operation leads to output shutdown, confirm or cancel	The bypass is abnormal, turning off the inverter will cause the load to be de-energized
This operation leads to inverter overload, confirm or cancel	Turning off this inverter will lead to the overload of the remaining inverter(s) in a parallel system
Turn on more UPS to carry current load	The number of inverters already turned on is insufficient to carry the existing load. The user is required to turn on more UPSs

Prompt	Meaning
Battery will be depleted, confirm or cancel	If you select battery capacity test, the battery will discharge until the UPS shuts down. This prompt appears to require your confirmation. Canceling the test will ends the test and transfers the UPS to inverter mode
System self-test finished, everything is OK	No action required
Please check the current warnings	Check the active alarm messages
Enter control password	Required for battery or UPS test (default: 12345)
Battery Self Test aborted, conditions not met	Battery self-test condition is not met. Please check if the battery is in boost charge state and the load is more than 20%
Battery Refresh Charge aborted, conditions not met	This prompt appears when you select the Freshening charge command while the a battery freshening charge condition (such as no battery, charger failure) is not met

4.5 Alarm List

Table 4-9 provides the complete list of UPS alarm messages for display either on the 'Event' menu or on the 'Records' menu described in Table 4-7.

Table 4-9 Alarm list

Alarm	Explanation
Fault Clear	FAULT CLEAR key on the operator control and display panel pressed
Rectifier in Setting	The rectifier starts up and is in synchronization
Inverter in Setting	The inverter starts up and is in synchronization
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
Turn On Fail	The inverter failed to turn on when the INVERTER ON key is pressed. This may be the result of an invalid operation (maintenance bypass switch closed) or DC bus or rectifier not ready
Rec. Soft Start Fail	Owing to low DC bus voltage, the rectifier will report this alarm
Silence Active	SILENCE ON/OFF key on the operator control and display panel pressed
Silence Inactive	SILENCE ON/OFF key on the operator control and display panel pressed in alarm silence state
Bypass Mode	The UPS is in bypass mode
Normal Mode	The UPS is in normal mode
Battery Mode	The UPS is in battery mode
Check UPS Output	UPS shutdown with no output power
Output Disabled	EOD event happened. Check the battery voltage
Other Bypass STS Fail	The adjacent bypass STS open circuit fault or short-circuit fault
Input Voltage Abnormal	The mains voltage is outside specifications and results in rectifier shutdown
Input Undervoltage	At least one phase main input voltage is within 132V ~ 176V, thus the load should be derated
Input Freq. Abnormal	The mains frequency is outside specifications and results in rectifier shutdown
Input Phase Reversed	The AC input phase rotation is reversed
Input Backfeed	Battery voltage fed back to rectifier input
Input Neutral Lost	AC rectifier input neutral line not detected
Input Current Abnormal	Battery load sharing imbalance or rectifier input current abnormal
Input Current Limit	Input current over limit
Bypass Unable to Trace	The bypass frequency is outside specifications. This alarm automatically resets once the bypass voltage goes normal
Bypass Abnormal	The amplitude or frequency of the bypass voltage exceeds the limit. This alarm can be automatically recovered

Alarm	Explanation
Bypass STS Fail	At least one of the STSs at the bypass side is open or shorted. This fault is locked until power-off
Byp. Abnormal Shutdown	Both the bypass and inverter voltages are abnormal, and the output is off
Bypass Phase Reversed	The phase rotation of the bypass voltage is reversed
Bypass overcurrent	The bypass current is outside the rated current
Bypass backfeed	The bypass back-feed 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 Neutral Lost	The bypass lacks of N
Bypass in Setting	The bypass module is initialized and synchronized
Rectifier Fault	Bus voltage abnormal or battery SCR short circuit
DC Bus Overvoltage	The rectifier, inverter and battery converter shut down because the DC bus voltage is too high. The load transfers to bypass
DC Bus Abnor. Shutdown	The DC bus voltage is abnormal and results in inverter shutdown. The load transfers to bypass
Inverter Asynchronous	The output voltage and bypass voltage are misaligned in phase. This alarm resets automatically once the condition is no longer true
Inverter Fault	Inverter output voltage outside specifications. Load transfers to bypass
Inverter Relay Fail	At least one of the inverter relays is opened or shorted. This fault is locked until mains power-off
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 Overload	This alarm appears when the load arises above 105% of the nominal rating. The alarm automatically resets once the overload condition is removed
System Overload	This alarm appears when the total load rises above 105% of the nominal rating of the parallel system. 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
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
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
Load Sharing Abnormal	The UPSs in a parallel system are not sharing the load current correctly
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 LCD of the UPS with passive transfer to bypass
Control Power Fail	The auxiliary power failure or power-off
EPO	EPO button on operator control and display panel pressed or external EPO command received
Fan Abnormal	At least one fan has fault
Operation Invalid	Maintenance bypass switch is closed when the parallel system is on inverter, or output switch and maintenance bypass switch are closed when the inverter is on
LBS Active	The LBS setting is active
LBS Abnormal	LBS is abnormal
Input Switch Open	Input switch is open

Alarm	Explanation
Maint. Switch Open	Maintenance bypass switch is open
Maint. Switch Closed	Maintenance bypass switch is closed
Bypass Switch Open	Bypass switch is open
Output Switch Open	Output switch is open
Charger Fault	Battery charger has failure
Discharger Curr. Limit	Discharge current is over limit, close the discharger
Autostart	After UPS shutdown at EOD, the inverter automatically starts upon mains restoration
Batt. Equalize Charge	The battery is forced to be in boost charge state
Rectifier DSP Update	Rectifier DSP software being updated
Rectifier FPGA Update	Rectifier FPGA software being updated
Inverter DSP Update	Inverter DSP software being updated
Inverter FPGA Update	Inverter FPGA software being updated
Bypass DSP Update	Bypass DSP software being updated
Bypass FPGA Update	Bypass FPGA software being updated
Monitor Update	Monitoring software being updated
Flash Operate Fail	Historical record not saved
Remote Turn On	Turn on the inverter through the service command
Remote Turn On Fail	Caused by invalid operation (maintenance bypass switch closed), DC bus or rectifier not ready
Remote Turn Off	Turn off the inverter through the service command
No Battery	Check the battery and battery connection
Discharger Fault	Bus voltage abnormal
Battery Reversed	Reconnect battery and check battery wiring
Battery Period Testing	The battery is under automatic periodic battery maintenance test (20% capacity discharge)
Batt. Capacity Testing	The user initiated a battery capacity test (100% capacity discharge)
Batt. Maint. Testing	The user initiated a maintenance test (20% capacity discharge)
Batt. End of Discharge	Inverter turned off due to battery EOD
Battery Overtemp.	The battery temperature is over limit
Low Battery Warning	Before the EOD, battery low pre-warning will occur. After this pre-warning, the battery will have the capacity for 3min discharging with full load. The time is user-settable from 3min to 6min
On Generator	Dry contact signal, indicating generator connected
Battery Maintain	Battery test is failed, maintain or replace the battery
Battery Ground Fault	Battery has ground fault
Batt. Room Temp. Abn.	Battery room has overtemperature (option included)
BCB Status Abnormal	Logic conflict between BCB drive signal and feedback signal
BCB Closed	BCB state (closed)
BCB Open	BCB state (open)
Out. Fuse Fail	At least one-route output fuse open, the inverter is disconnected
Equalize Chg. Timeout	The actual float charging time exceeds the time set by the setting software
MonCAN Comm. Abnor.	Communication failure among internal monitoring board and inverter, rectifier and bypass
ParaMonCAN Comm.Abnor.	Communication fault between racks
PowerCAN Comm. Abnor.	Communication failure among inverter, rectifier and bypass
ParaPowerCANComm Abnor.	Communication failure between different UPSs in parallel system. Check if any UPS is not powered on or parallel cables are not well connected, then clear the fault to restart the UPS
Discr.Bus	Communication failure between discrete bus inside the rack. It is recommended to confirm

Alarm	Explanation
Comm.Abnor.	that the rear communication cables connection inside the rack is reliable
ParaDiscrBusCommAbnor.	Communication failure between discrete bus inside the rack. It is recommended to confirm that the rear communication cables connection inside each rack is reliable, and that the bypass module is fixed
Ambient Overtemp.	The overtemperature detection of ambient temperature, which can be set through the setting software
Byp. SCR Fan Abnormal	The internal fan of bypass module is faulty
Top-outlet Fan Abnor.	The fan of top air outlet is faulty
System Interrupt Xfer	Execute the interval transfer under conditions of bypass unable to trace and inverter phase not locked
Para. Cable Abnormal	Parallel cables are not well connected or the cables are damaged
LBS Cable Abnormal	LBS cables are not well connected or the cables are damaged
Capacity Exceeded	System overload
Loss of Redundancy	Loss of redundant capacity
Pwr. Hardware Mismatch	The model information set at the host is inconsistent with the actual situation
Module Overtemp.	The power tubes of rectifier and inverter inside the module have overtemperature
Charger Overtemp.	The power tube of charger inside the module has overtemperature

Note

1. For UPS installed with the optional battery monitor, refer to the user manual of the battery monitor for the alarm messages related to battery cell and charge current.

2. If the alarm is caused through setting the software value by Emerson authorized engineer, and you wish to change the setting values, please contact the Emerson local customer service center.

Chapter 5 UPS Operation Introduction

This chapter introduces the operating precautions and daily operating methods of UPS in detail.

5.1 Brief Introduction

5.1.1 Precautions

Important

The user can conduct relative operation only after the authorized engineer carries out the first power on and test.

Warning: hazardous mains and/or battery voltage

1. No operator-serviceable parts are located behind covers that require a tool for their removal. Only qualified service personnel are authorized to remove such covers.
2. The AC input and output terminals of UPS have dangerous voltage at any time. If the cabinet is equipped with an EMC filter, the filter may have dangerous voltage.

1. For the control keys and LCD related to all the operating steps, refer to *Chapter 4 Operator Control And Display Panel*.

2. During operation, the buzzer alarm may occur at any time. Press SILENCE ON/OFF key to silence the audible alarm.

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.

5.1.2 Power Switch

Opening the front door of the UPS cabinet reveals the power switches, as shown in Figure 5-1, including:

Q1: Rectifier input switch, which connects UPS to the main circuit power.

Q2: Bypass input switch, which connects UPS to the bypass.

Q3: Maintenance bypass switch, which supplies power to the load when UPS is being maintained.

Q5: Output switch, which connects UPS output to the load.

Note

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

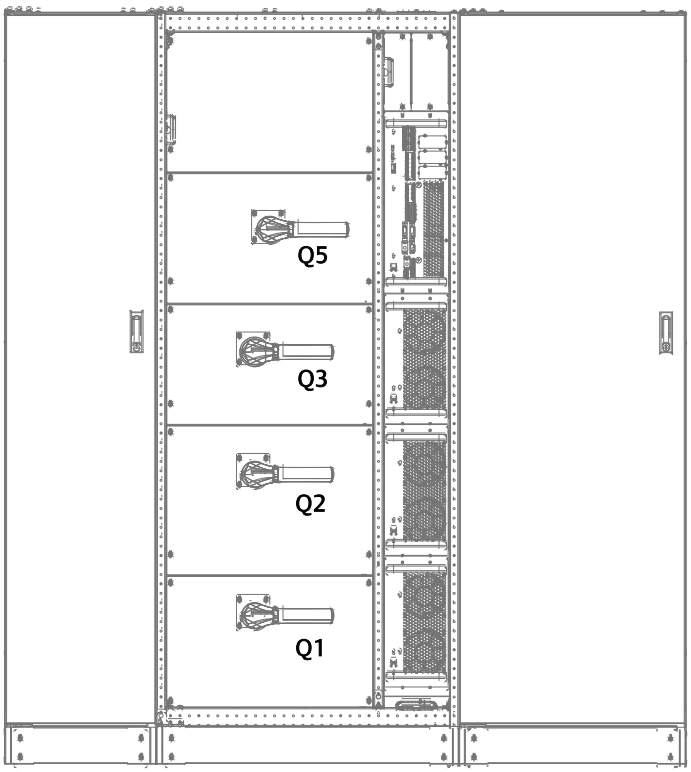


Figure 5-1 600kVA UPS power switch

5.2 UPS Startup Procedures

The UPS must be completely installed and tested by authorized engineer, and external power supply switch is closed, then you can start the UPS.

5.2.1 Startup Procedures In Normal Mode

Warning

1. These procedures result in mains voltage being applied to the UPS output terminals.
2. 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.

Use the following procedures to turn on the UPS from a fully powered down condition.

1. Open the front door of the UPS, ensure that the internal maintenance bypass switch Q3 is disconnected, while the input cables and copper bars are reliably connected.

Warning

To avoid misreporting as faults, all operations relating to disconnection or connection of the maintenance bypass switch shall be finished within three seconds.

2. 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.

At the moment, the system is powered on, and the startup screen pops up. Refer to *4.2.1 Start Screen*.

About 25 seconds later, confirm that the LCD shows the rectifier power supply and the bypass power supply are normal; if not, check whether the switches Q1 and Q2 are closed. Then the rectifier starts up and the

rectifier indicator flashes in green color. About 30 seconds after the rectifier enters normal operation, the rectifier indicator goes solid green. After the system initialization, the bypass static switch is closed. The UPS indicator states are as listed in Table 5-1.

Table 5-1 UPS indicator state

Indicator	State
Rectifier indicator	Green
Battery indicator	Off
Bypass indicator	Green
Inverter indicator	Off
Output indicator	Green
Status indicator	Amber

3. When the rectifier start process is finished and the rectifier indicator goes solid green, close the external battery switch.

4. Press the INVERTER ON key for two seconds.

The inverter starts up, and the inverter indicator flashes in green color. After the inverter runs normally, the UPS transfers from the bypass to inverter, then the inverter indicator goes solid green.

The UPS is in normal mode, and the UPS indicator states are as listed in Table 5-2.

Table 5-2 UPS indicator state

Indicator	State
Rectifier indicator	Green
Battery indicator	Off
Bypass indicator	Off
Inverter indicator	Green
Output indicator	Green
Status indicator	Green

UPS operated in Normal mode

Warning

In parallel system, if the equipment is configured with an external output switch, do not shut down the external output switch of any equipment, otherwise it may cause the system to work in Byapss mode. If you need to shut down one UPS in parallel system, just refer to *5.6 UPS Shutdown Procedures* for details.

5.2.2 Startup Procedures In ECO Mode

1. Open the front door of the UPS, ensure that the internal maintenance bypass switch Q3 is disconnected, and that the input cables and copper bars are reliably connected.

Warning

To avoid misreporting as faults, all operations relating to disconnection or connection of the maintenance bypass switch shall be finished within three seconds.

2. 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.

At the moment, the system is powered on, and the startup screen pops up. Refer to *4.2.1 Start Screen*.

About 25 seconds later, confirm that the LCD shows the rectifier power supply and the bypass power supply are normal; if not, check whether the switches Q1 and Q2 are closed. Then the rectifier starts up and the alarm indicator goes solid red. At the same time, the bypass static switch is closed. About 30 seconds later, the alarm indicator flashes in red color, then the rectifier startup is finished.

3. If ECO mode is required, contact Emerson service engineer to set it through the setting software. If you wish to set it by yourself, you can enable it through the sub-menu under 'Settings' on the LCD screen.

4. When the rectifier start process is finished and the rectifier indicator goes solid green, close the external BCB.

5. Press the INVERTER ON key for two seconds.

The inverter starts up, and the inverter indicator flashes in green color. 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, then the inverter indicator goes solid green. 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.

UPS operated in ECO mode

5.3 Procedures For Transfer Between Operation Modes

5.3.1 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, wait for several seconds, and then close the external power switch to re-connect the mains power to the UPS. 10 seconds later, the rectifier restarts automatically, and the UPS works in normal mode.

5.3.2 Transfer From Normal Mode To Bypass Mode

Press the INVERTER OFF key for two seconds, the inverter indicator is off, and the UPS will be transferred from normal mode to bypass mode.

Note

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

5.3.3 Transfer From Bypass Mode To Normal Mode

When the UPS is in bypass mode, press the INVERTER ON key for two seconds, the inverter starts up, and the inverter indicator flashes in green color till the inverter enters normal operation, then the UPS is transferred from bypass mode to normal mode.

5.3.4 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 making this operation, read the information on the LCD 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. Press the INVERTER OFF key for at least two seconds. At this point, the inverter indicator turns off, bypass indicator turns on, and the status indicator is in yellow accompanied by an audible alarm. The load transfers to the static bypass, and the inverter shuts down.

Note

Pressing the SILENCE ON/OFF key cancels the audible alarm but leaves the alarm message displayed until the alarm condition is rectified.

2. Close the maintenance bypass switch Q3.

3. At the moment, the maintenance bypass parallels with the UPS static bypass.

4. The LCD 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.

At the moment, all the internal power supply is off and the LCD does not display any more.

Warning

1. If the maintenance is required, wait 10 minutes for the internal DC bus capacitance discharging.
2. 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.

5.3.5 Transfer From Maintenance Mode To Normal Mode

The following procedures will transfer the maintenance bypass supply mode of the UPS to the 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.

Confirm that the bypass indicator goes solid green. At this moment, the rectifier starts and the UPS runs in Bypass mode.

2. Disconnect the maintenance bypass switch Q3.

3. When the rectifier start process is finished and the rectifier indicator goes solid green, close the external BCB. Then press the INVERTER ON key to start the inverter.

The inverter indicator goes solid green, and now the UPS runs in Normal mode.

Warning

You must start the bypass first, and then disconnect the maintenance bypass switch; or it may cause output load power failure.

At the moment, the load has transferred to UPS normal mode.

5.4 Battery Test Procedures

The battery test function is disabled by default. If you need this function, please contact the customer service engineer of Emerson.

The battery self-test includes periodical self-test and manual maintenance self-test. The battery discharge outputs 20% energy of the 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 Emerson setting software. During the periodical self-test, if the battery maintenance requirement is met, the system will generate 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 be automatically start up the self-test once you exits. During the maintenance self-test, if the battery maintenance requirement is satisfied, 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 5h, and generator not connected, while the manual maintenance self-test just satisfies the conditions of battery fully charged.

Achievement

1. Manual maintenance self-test: via the LCD.

2. Periodical self-test: self-test period can be configured via the Emerson setting software. The range of battery self-test period is 30 days ~ 360 days (default: 60 days).

Self-test startup conditions

1. System load rate is within 20% ~ 100%, stable output.

2. Battery in fully charged state, battery float charge at least 5h, 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 at least 10 seconds, and satisfies the following conditions: in battery mode or rectifier is closed, and then the system will shift 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 LCD.

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 manual maintenance self-test

1. Select the **Command** menu on the LCD screen.

Use the F3 (left) key or F4 (right) key to display the **Command** menu. Press the Enter key (HELP) to confirm it.

2. Select the desired test.

Use the F3 (up) key or F4 (down) key to highlight the desired test item. Press the Enter key (HELP) to confirm it.

After the prompt, use the F3 (up) and F4 (right) keys to input the password, and then press the Enter key (HELP) to confirm it.

3. Wait until the battery test completes.

After the test, the system will automatically update the battery data which used to calculate the backup time (displayed upon mains failure), and battery actual capacity (battery capacity percentage when compared to a new battery, displayed in inverter mode).

4. Stop the battery test.

If required, the test may be stopped before completion by selecting **Stop Test** on the **Command** menu.

Refer to *Chapter 4 Operator Control And Display Panel* for more information.

5.5 UPS Self-test Procedures

During the self-test, the UPS can check the UPS control functions, LED indicators and audible alarm states. This self-test is password controlled and menu driven. It can be carried out from the UPS operator control and display panel by the operator and takes five minutes.

Procedures for UPS self-test

1. Select the **Command** menu on the LCD screen on the operator control and display panel of the UPS.

Use the left key (F3) or right key (F4) to display the **Command** menu. Press the Enter key (HELP) to confirm it.

2. Select the desired test.

Use the up key (F3) or down key (F4) to highlight the desired test item. Press the Enter key (HELP) to confirm it.

After the prompt, use the up and right keys (F3, F4) to input the password, and then press the Enter key (HELP) to confirm it.

3. Wait until the test completes.

After five seconds, a pop window will appear to show the result of this diagnosis: rectifier, inverter, monitor OK or fault.

4. Stop the test.

If required, the test may be stopped before completion by selecting **Stop Test** on the **Command** menu.

Refer to *Chapter 4 Operator Control And Display Panel* for more information.

5.6 UPS Shutdown Procedures

5.6.1 Procedures For Completely Powering Down UPS

Complete UPS shutdown and load power-off should follow this procedure. 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. Press the INVERTER OFF button to stop the operation of the inverter, 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. At the moment, all the internal power supply is off and the LCD does not display any more.

Warning

1. Post a label at the AC input distribution (generally far away from the UPS) to alert that the UPS maintenance is being operated.
2. Wait 10 minutes for the internal DC bus capacitance discharging. Then the UPS is completely shut down.

Warning: hazardous battery voltage

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

5.6.2 Procedures For Completely Powering Down UPS While Maintaining Power To Load

The following procedures are suitable for completely powering down the UPS and still keeping the power supply to the load. Refer to the procedures in *5.3.4 Transfer From Normal Mode To Maintenance Mode*.

5.7 EPO Procedures

The EPO is designed to switch off the UPS in emergency conditions (that is, fire, flood, etc.). 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's 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.

5.8 UPS Reset Procedures After EPO

After shutting down the UPS through EPO or reasons of UPS fault, clear the fault according to the alarm message displaying on LCD 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. Press the FAULT CLEAR key over two seconds, the system will exit the EPO state, and the alarm indicator flashes in red color.

2. After the rectifier starts, the rectifier indicator will goes solid green. Press and hold the INVERTER ON key over two seconds, the inverter starts up, and the inverter indicator flashes in green color. After the inverter runs normally, the UPS will be transferred from the bypass to inverter, and then the inverter indicator goes solid green.

Note

1. The rectifier will restart and the bypass will begin to power the load. The rectifier indicator flashes while the rectifier is starting up. When the rectifier enters normal operation (about 30 seconds later), the alarm indicator flashes or is off (when connected with battery).
2. The rectifier will start automatically when the overtemperature fault disappears five minutes after the disappearance of overtemperature signal.

3. After pressing the EPO button, if the mains input is switched off, the UPS will shut down completely. When the mains input returns, the UPS will start up on bypass. There will be power at the output terminals of the UPS.

Warning

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

5.9 Automatic Restart

In the case of a mains failure, the UPS draws power from the battery system to supply the load until the batteries are depleted. 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.

3. If the Auto Recovery after EOD Enabling feature is disabled, the user may restart the UPS manually by pressing the FAULT CLEAR key first for two seconds and then INVERTER ON key for two seconds.

Note

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

5.10 Selecting Language

The LCD menu and data display is available in 13 languages: simplified Chinese, traditional Chinese, English, French, German, Italian, Japanese, Polish, Portuguese, Spanish, Swedish, Czech and Turkish.

Use the following procedures to select the language:

1. On the 'OutPut' menu screen, press the F3 (left) or F4 (right) key to select the 'Language' menu.

2. Press the HELP (enter) key to move the cursor to the data window of the screen.

3. Press the F3 (up) or F4 (down) key to select the desired language.

4. Press the HELP (enter) key to confirm.

5. Press the F2 (ESC) key repeatedly to return to the 'OutPut' menu.

At this point, the LCD displays all characters in the selected language.

5.11 Changing Current Date And Time

Use the following procedures to change the system date and time:

1. On the 'OutPut' menu screen, press the F3 (left) or F4 (right) key to select the 'Settings' menu.

2. Press the HELP (enter) key to move the cursor to the data window of the screen.

3. Press the F3 (up) or F4 (down) key to select the 'Date & time' item, and then press the HELP (enter) key to confirm.

4. Press the F3 (up) or F4 (down) key to the row displaying the date and time, and press the HELP (enter) key to confirm.

5. Use the F3 (up) or F4 (down) key to input the current date and time.

6. Press the F5 (enter) key to confirm, and press the F2 (ESC) key to return to the 'OutPut' menu.

5.12 Control Password

The system provides password protection for UPS operation and control. The default password is '12345'. Only enters the correct password can you execute the UPS self-test and battery test operation.

To change password, carry out the following procedures:

1. On the 'OutPut' menu screen, press the F3 (left) or F4 (right) key to select the 'Settings' menu.

2. Press the HELP (enter) key to move the cursor to the data window of the screen.

3. Press the F3 (up) or F4 (down) key to select the 'Command password' item, and press the HELP (enter) key to confirm, then 'Command password' is changed to 'Enter old password'.

4. Press the F4 key to move the cursor to corresponding password position, and press the F3 key to select the number from '0' ~ '9' for this position. After the five digits input, press the HELP (enter) key to confirm, at this moment, 'Command password' is changed to 'Enter new password'.

5. Similar to step 4, press the F3 and F4 to input new password and press the HELP (enter) key to confirm, at this moment, 'Command password' is changed to 'Enter new password again'.

6. Similar to step 4, press the F3 and F4 to input new password again, and press the HELP (enter) key to confirm, then press the F2 (ESC) key to return to the 'OutPut' menu.

Chapter 6 Battery

This chapter introduces the battery, including the battery safety, installation and maintenance information, battery protection function, as well as the connection of BCB cabinet (option), battery temperature sensor (option), and battery ground fault detector (option).

6.1 Introduction

The UPS battery string is composed of several batteries in series connection and provides rated DC input voltage for the UPS inverter. The required battery backup time (i.e. 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 strings of battery 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 may be realized by the battery circuit breaker of proper capacity. This circuit breaker shall be located as close as possible to the battery connecting terminal, and the wiring distance of the power and signal cables connected to the UPS shall be minimized.

When several strings of battery are paralleled 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.

6.2 Safety

Take special care when working with the batteries associated with the UPS. When all the blocks are connected together, the battery string voltage can be up to 540Vdc. This is potentially lethal. Please follow the precautions for high voltage operation. Only qualified personnel are allowed to 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.

Confirm that the battery switch has been disconnected before battery maintenance.

Warning: 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.

Proper connection mode	Improper connection mode	
Tighten the terminal bolt of the battery with specified torque	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 shall 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.

Battery damaged during handling or transportation	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

Warning: hazardous battery voltage present behind covers

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.

6.3 UPS Battery

The UPS generally adopts valve-regulated battery. At present, 'valve-regulated' means the 'sealed type' or 'maintenance free' mentioned in the past.

The valve-regulated battery is not completely sealed, especially when it is over-charged, there will be gas escape. The volume of the gas escape is less than the water injection battery. However, during the installation design of the battery, temperature rise shall be taken into account, and enough room shall be reserved to ensure good ventilation.

Besides, the valve-regulated battery is not maintenance free. The valve-regulated battery must be kept clean, and it shall be inspected regularly to check if the connection is reliable, and if it is corroded. For details, please refer to *6.13 Battery Maintenance.*

It is suggested 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.

The battery must be stored in fully charged state. The battery will lose certain capacity because of self discharge during the transportation or storage. Charge the battery before use. During the storage, ensure that the ambient temperature shall not exceed the range of -15°C ~ +45°C, and the optimal temperature is 20°C ~ 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 before carrying out onsite test on the battery backup time. The test may take several days. Therefore, it should be conducted after the battery has been subject to uninterrupted float charging for at least one week.

When the battery has been running for several weeks or subject to two to three charge and discharge cycles, the battery performance will be increased.

To avoid the battery over-charge or under-charge, please 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.

6.4 Precautions For Installation Design

Note

Precautions for installation, 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 matters that must be considered during the installation design. The design results may be changed according to the local situations.

6.5 Battery Installation Environment And Number Of Batteries

6.5.1 Installation Environment

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:

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

Where:

Q—The fresh air ventilation volume per hour, the unit is m^3/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 2.27V/cell

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

C_{rt}—20hr battery rated capacity

Temperature

Table 6-1 Range of ambient temperature

Type	Temperature value	Remark
Recommended optimal temperature	20°C ~ 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 ~ 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 significantly 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 sunshine.

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 very important to maintain balanced temperature in the battery string, and the temperature difference between batteries of different layers shall be kept within 3°C. Valve-regulated battery is very sensitive to the temperature, therefore the valve-regulated battery shall be used in 15°C ~ 25°C. If the battery cabinet is installed near the UPS, the maximum design ambient temperature shall 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 ~ 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.

6.5.2 Number Of Batteries

Set the nominal DC bus voltage and battery floating voltage to 518Vdc according to the rated I/O voltage of the UPS, so as to ensure the expected cell battery float voltage is 2.27V. The number of batteries, EOD voltage, and float charging voltage under the 380V/400V/415V voltage system are consistent, as shown in Table 6-2.

Table 6-2 Number of batteries

Parameter	380V/400V/415V
Number of cells (standard)	228 ~ 264
EOD voltage	1.60Vdc/Cell ~ 1.90Vdc/Cell, 1.63V/cell recommended
Float charging voltage	2.2Vdc/Cell ~ 2.3Vdc/Cell, 2.27V/cell recommended

6.6 Battery Protection

Important

It is recommended to use the Emerson BCB to protect against the risk. If the user's switch does not satisfy the needs, then risk may occur.

The battery is connected to the UPS through the BCB. The BCB can be 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:

- Isolated with the battery; safe and reliable
- Short circuit protection
- In case the inverter is locked because of battery under-voltage, the circuit breaker will be disconnected automatically to avoid battery over-discharge
- If remote EPO button is installed, the EPO button can be used to disconnect the circuit breaker
- Mis-operation protection

To obtain the required backup time, the batteries may be connected in parallel. In this situation, the BCB shall be installed in the after-stage of all the paralleled batteries.

Note

Only trained personnel shall operate and maintain the battery circuit breaker.

6.7 Battery Installation And Connection

Warning

Only qualified engineer shall install and connect the batteries. The battery has hazardous high voltage, and ruqires reliable insulated tools for safety protection.

6.7.1 Battery Installation

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. There shall be at least 10mm gap between the batteries in vertical direction, to ensure the free circulation of the ambient air of the batteries.

3. Certain clearance shall be maintained between the battery top and the upper layer to facilitate the monitoring and maintenance of the battery.

4. The batteries shall be installed from the bottom layer to top layer, so as to avoid a too high gravity center. The battery shall be properly installed and protected from vibration or shock.

6.7.2 Battery Connection

1. All the battery cabinets or battery racks must be connected together and properly grounded.

2. When multiple batteries are used, they shall be connected in series and then in parallel. Before loading and power-up, it must be detected that the total voltage of the batteries is as specified. The negative and positive poles of the batteries must be connected to the negative and positive battery terminals of the UPS according to the labels on the battery and UPS. If the battery is reversely connected, explosion and fire may be caused, it may result in battery and UPS damage or even human injury.

3. When the battery cable connection is finished, install insulating shield for the terminals.

4. When connecting the cable between the battery terminal and the BCB, the BCB terminal shall be connected first.

5. The bending radius of the cable shall be larger than 10D, wherein D is the outer diameter of the cable.

6. When the battery cable is connected, it is prohibited to pull the battery cable or the cable terminal.

7. Do not cross the battery cables during the connection, and do not tie the battery cables together.

8. See Figure 6-1 for battery connection.

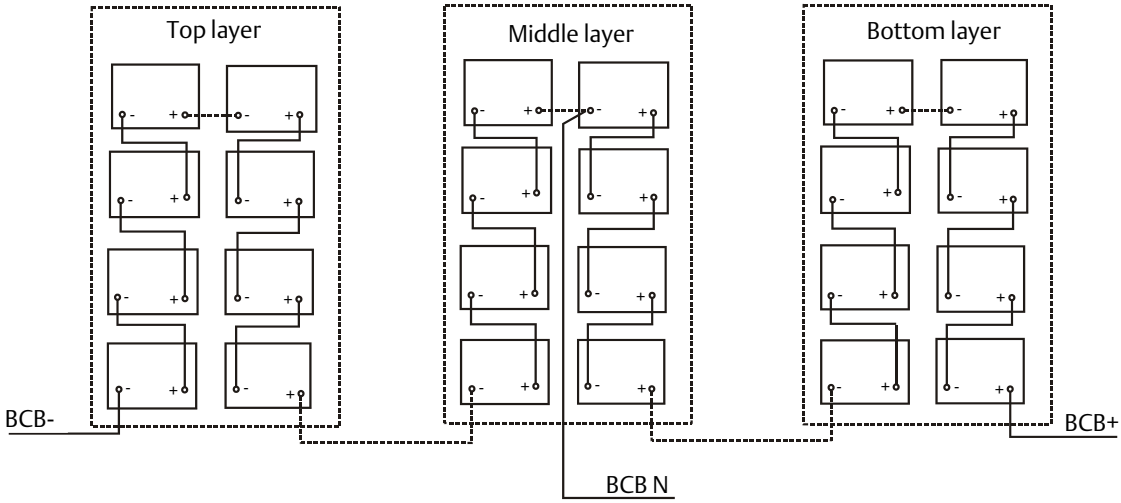


Figure 6-1 Connection of batteries

6.8 Design Of Battery Room

No matter which type of installation system is adopted, the following items shall be paid special attention to (refer to Figure 6-2):

❶Layout of cells

No matter which battery installation system is used, the battery shall be located in a matter that it will not contact two naked live parts with the potential difference over 150V at the same time. If it is unavoidable, insulated terminal shield and insulated cable shall be used for the connection.

❷Workbench

The workbench (or pedal) must be skid-proof and insulated, and at least 1m wide.

❸Wiring

All the wiring distances shall be minimized.

❹BCB

The BCB is generally installed in the wall-mounted box near the battery.

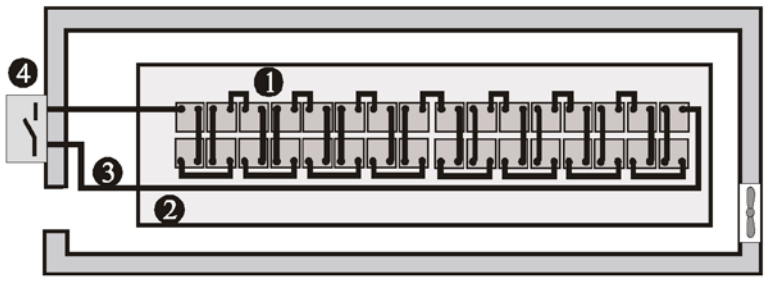


Figure 6-2 Design of battery room

6.9 BCB Cabinet (Mandatory)

The UPS requires a mandatory BCB cabinet. The mandatory BCB cabinet has three kinds of BCB matching cabinets, and the user can choose the cabinet you need according to actual requirement. The BCB cabinet can also electrically isolate the UPS from the battery to minimize the danger of the service personnel at work.

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 operator control and display panel of the UPS is pressed

Three kinds of BCB cabinets:

Overall BCB cabinet

One 1600A switch included for single battery string use or bus switch of several battery strings.

Divided BCB cabinet (three independent switches included)

Three 800A switches included for three groups of battey string use, and each switch can independently control the connection of each battery string.

Divided BCB cabinet (four independent switches included)

Four 630A switches included for the four groups of battey string use, and each switch can independently control the connection of each battery string.

Table 6-3 provides the mechanical specifications of the BCB cabinet.

Table 6-3 Parameters of BCB cabinet

Dimensions (H × W × D) (mm)	Weight (kg)	Recommended screw
2000 × 600 × 987	250	M16

The BCB cabinet should be installed as close as possible 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 around the front of the UPS should be larger than 1200mm and sufficient to enable free passage of personnel with the door fully open. Meanwhile, maintain at the back of the cabinet a clearance at least 500mm to permit adequate circulation of air coming out of the UPS.

Refer to Figure 6-3 ~ Figure 6-7 to install and connect the BCB cabinet. There are connection terminals in the BCB cabinet for connecting the power cables from the UPS and battery. Before powering on the UPS, lead out the internal signal cables from the BCB cabinet to connect the left port of J22 on the bypass control module.

Note

1. The BCB cabinet can use top cable entry and bottom cable entry. It provides two big and one small cable entry holes on both the top plate and bottom plate. The big ones are for power cable entry, and the small one is for signal cable entry. After connection, take appropriate measures to seal the cable entry holes.
2. The signal cable W812 must be run separate from the battery power cables. W812 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.
3. Make sure that the UPS rectifier has started before closing the BCB.
4. Mark the battery string when configuring the divided BCB cabinet, and note that the marked number must be correspond to the battery ter minals in the BCB cabinet when connecting the power cbales.

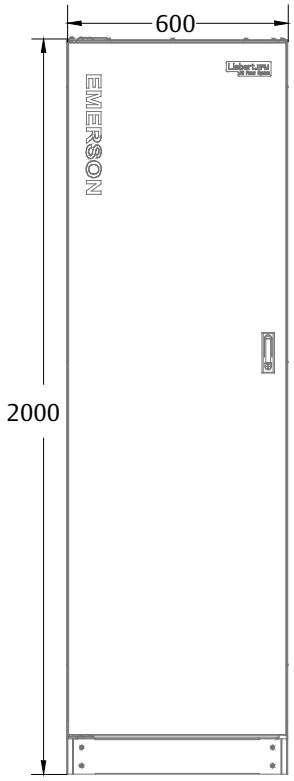


Figure 6-3 Front dimension of BCB cabinet (unit: mm)

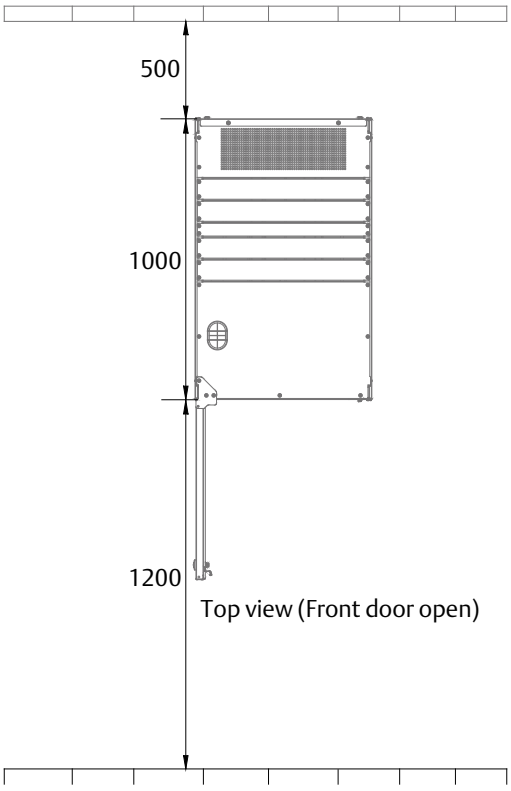


Figure 6-4 Dimensions of BCB cabinet

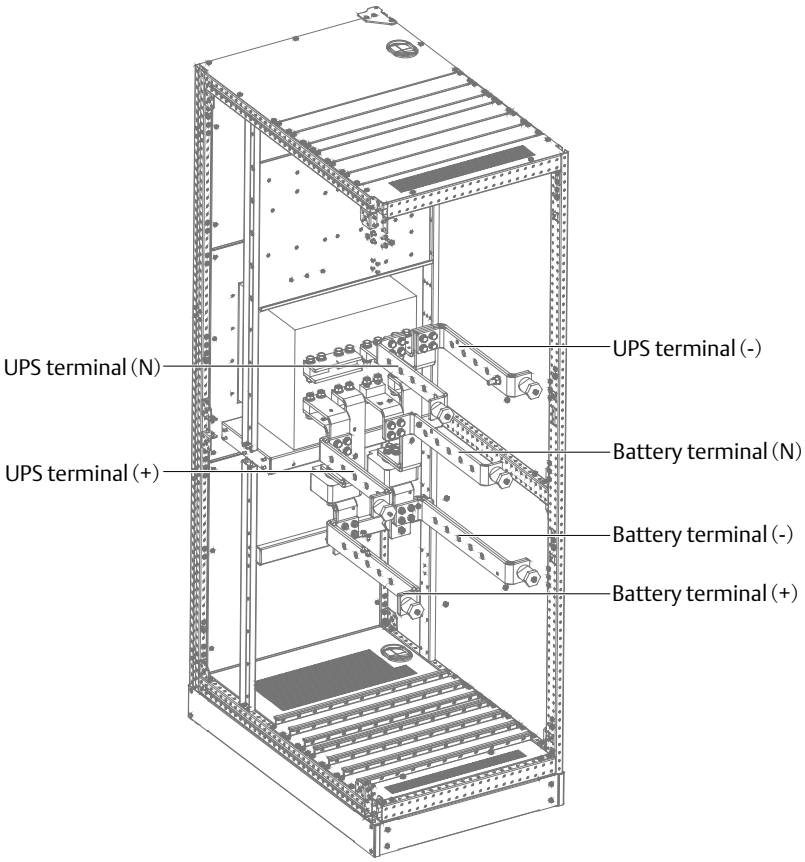


Figure 6-5 Connection diagram of overall BCB cabinet

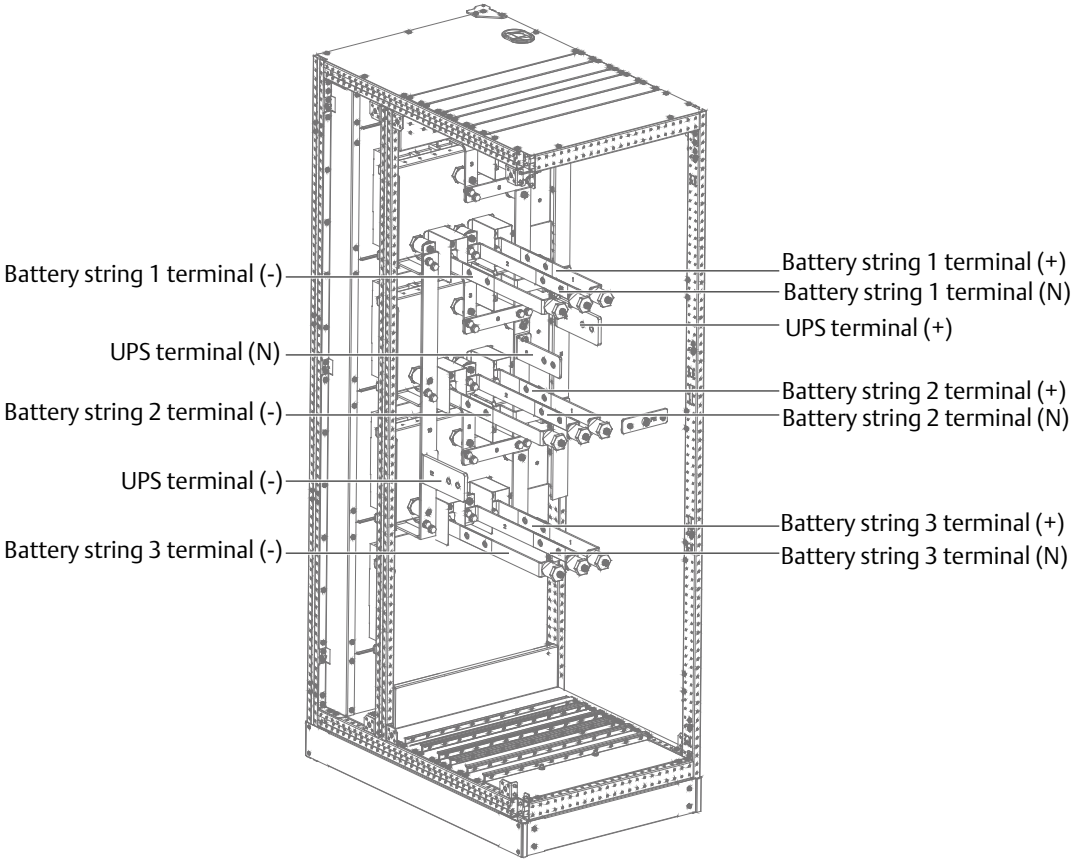


Figure 6-6 Connection diagram of three groups of divided BCB cabinet

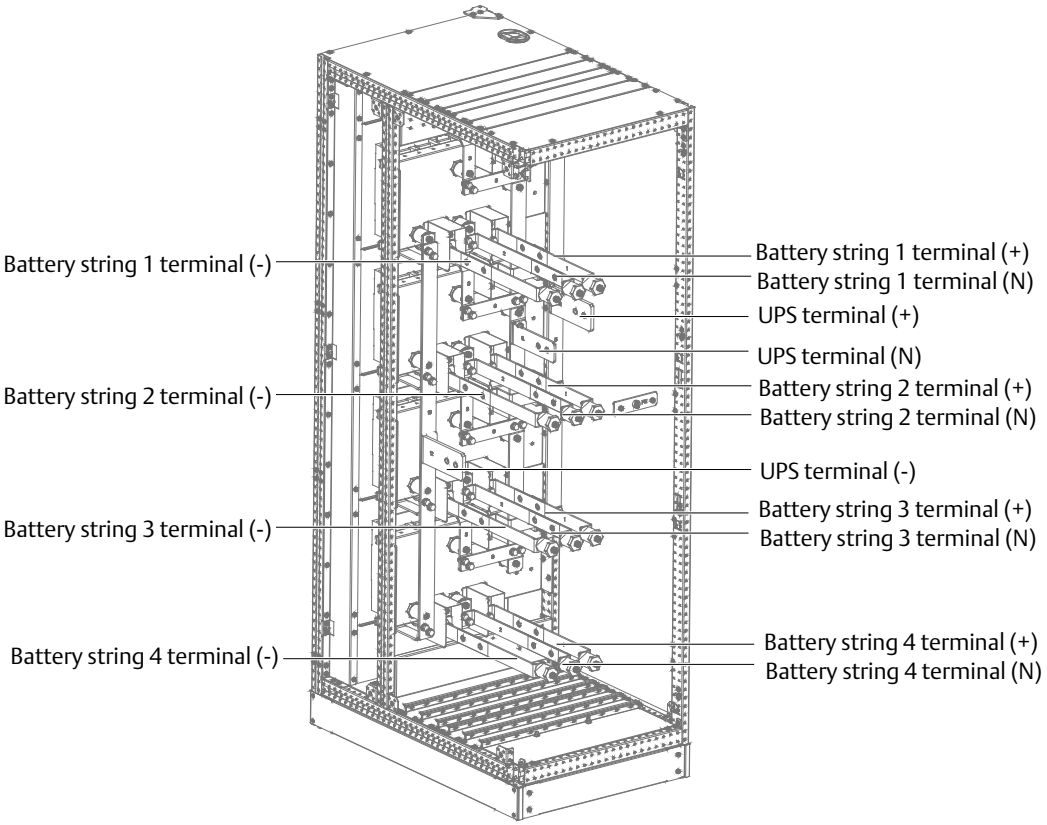


Figure 6-7 Connection diagram of four groups of divided BCB cabinet

6.10 Battery Temperature Sensor (Option)

Emerson provides an optional battery temperature sensor which can measure the temperature about four positions. If using several battery temperature sensors, the monitor will display the highest temperature. When using the battery temperature sensor, just connect the probe to the X103 ~ X106 ports of UHW241C2 board inside the BCB cabinet via the adapter box, and then connect the X108 port to the PIN number corresponding to J22 port on bypass control module. As shown in Figure 6-8.

If divided BCB cabinet is configured and several battery temperature sensors are used, you should choose the UHW241C2 board beside the uppermost switch for connection based on Figure 6-8 due to multiple UHW241C2 boards inside the cabinet.

Note:

1. Connect each sensor to the X103 ~ X106 ports of UHW241C2 board.

2. Only one cable for connection between the PCB board and UPS bypass control module, and the cable must be connected to the X108 port of UHW241C2 board.

Overall BCB cabinet diagram

Contents inside the dashed box are options

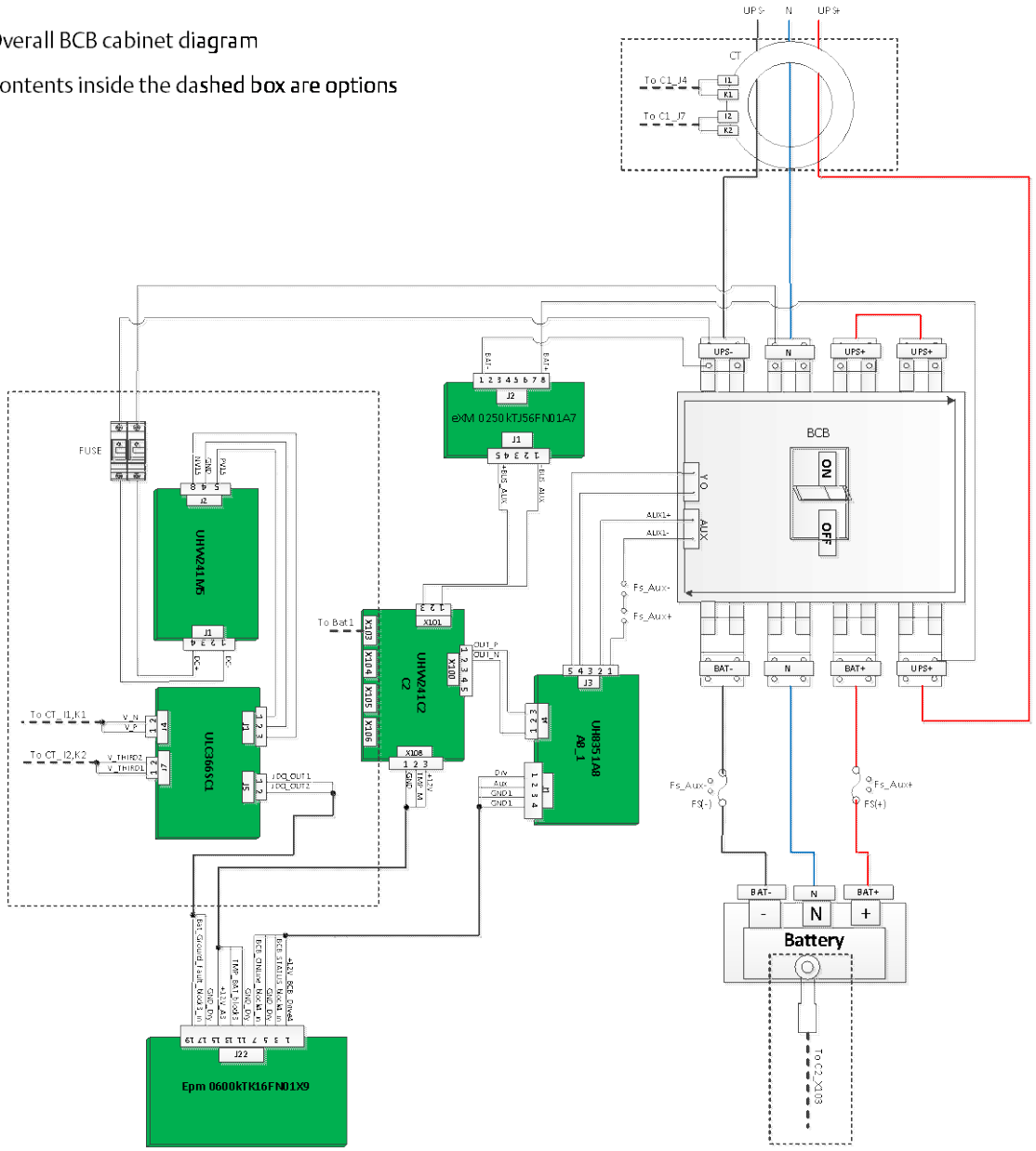


Figure 6-8 Internal and optional diagram of overall BCB cabinet

6.11 Battery Ground Fault Detector (Option)

Emerson provides an optional battery ground fault detector. It includes a mutual inductor and a PCB, which should be 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 6-8 (Contents inside the dashed box are options).

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.

6.12 BCB Reference Current And Connection

Table 6-4 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 regulations.

Table 6-4 BCB rated current and battery max. discharge current at full load (recommended)

Items		Unit	UPS rated power (kVA)
			600
38-block battery	Rated battery discharge current at full load	A	1390
	Reference rated current of BCB	A	1600
	CSA of connection cable	mm^2	4*240
40-block battery	Rated battery discharge current at full load	A	1320
	Reference rated current of BCB	A	1600
	CSA of connection cable	mm^2	4*240
42-block battery	Rated battery discharge current at full load	A	1250
	Reference rated current of BCB	A	1600
	CSA of connection cable	mm^2	4*185
44-block battery	Rated battery discharge current at full load	A	1200
	Reference rated current of BCB	A	1600
	CSA of connection cable	mm^2	4*185

6.13 Battery Maintenance

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

Note

1. Periodically check the screws of the battery connection parts and confirm that they are firmly tightened. If there is any loosened screw, tighten it immediately.
2. Ensure that all safety devices operate normally, and that the battery management parameters are set properly.
3. Measure and record the air temperature inside the battery room.
4. Check to ensure that the battery terminals have no damage or heat generating trace, and the battery enclosure and terminal shields are intact.

6.14 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 waste, and it is a key item for used battery pollution control. The storage, transportation, use and disposal of the battery shall 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 must be recycled and shall not be disposed of with 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.

Chapter 7 Parallel System And LBS System

This chapter gives details on the installation of the parallel system and LBS system.

7.1 General

The parallel system can comprise of up to four UPS modules 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.

From a 'power' viewpoint, 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 multi-way ribbon cables connected between the units of the system to form a ring.

When two or more modules are to be connected in parallel, it is recommended that inductor should be inserted in the static bypass line. This can be installed internal to the UPS as an option.

7.2 System Installation Procedures

The basic installation procedure of a parallel system is the same as that of single module system. This section only introduces the installation procedures specific to the parallel 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.

7.2.1 Preliminary Checks

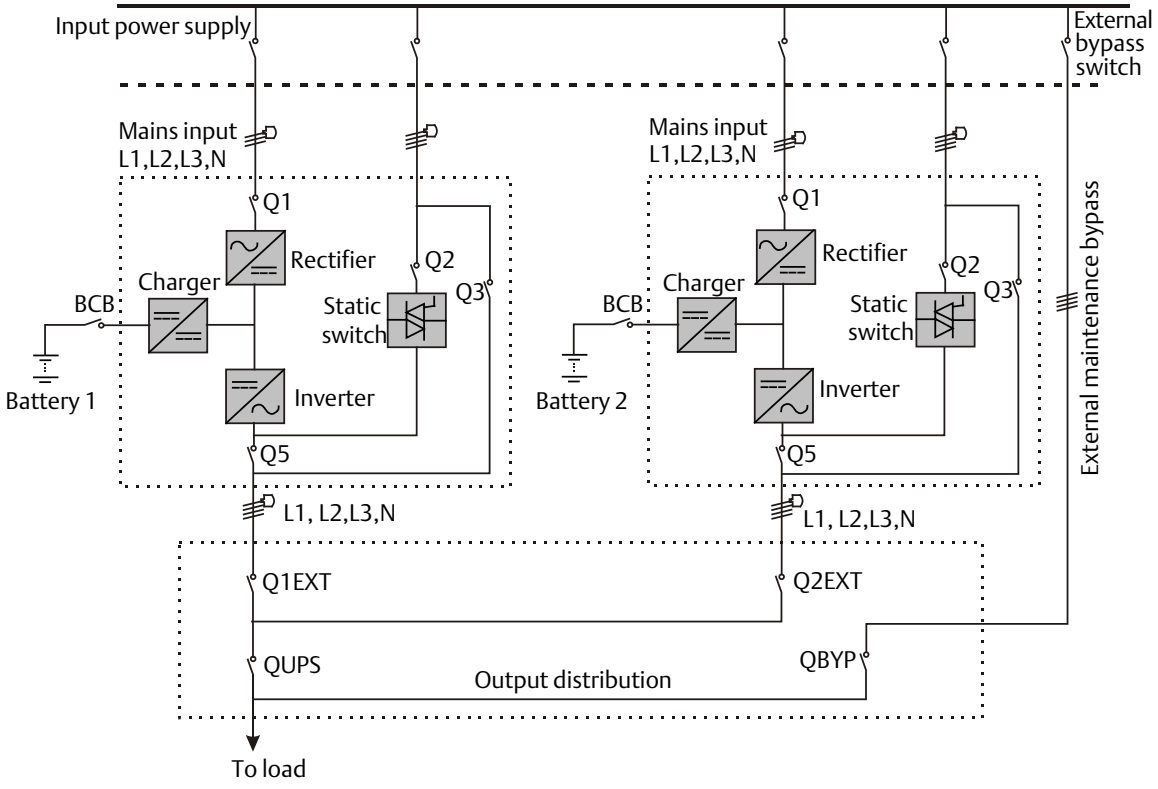
Be sure that the options of the parallel cables are correct, and that the modules are of the same rating, model, and with the same software and hardware release.

Warning

To achieve coordinated operation of the modules in the parallel system, it is required to configure each module separately using Emerson setting software. This must be done by Emerson service personnel.

7.2.2 Cabinet Installation

Place the UPS modules side by side and interconnect as shown in Figure 7-1. The output distribution mode (Q1EXT, Q2EXT must be configured) shown in Figure 7-1 is recommended to facilitate maintenance and system testing.



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

Figure 7-1 Schematic of typical parallel system (with common input, separate batteries and output)

7.2.3 External Protective Device

Warning

1. High earth leakage current: Earth connection is critical before connecting the input supply (including both mains supply and battery).
2. The equipment must be earthed in accordance with the local electrical code of practice.

Refer to *3.1.9 External Protective Device*.

7.2.4 Power Cable

The power cable wiring is similar to that of the UPS module. Refer to *3.1 Wiring Of Power Cable*.

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

Note

1. The power cables (including the bypass input cables and UPS output cables) of each UPS module should be of the same length and specifications to facilitate load sharing.
2. The UPS adopts common input configuration and split bypass configuration. If the mains input and bypass input come from two different transformers, then these two transformers should share one grounding grid.

7.2.5 Parallel Cable

Shielded and double-insulated parallel cables available in lengths 5m, 10m and 15m must be interconnected in a ring configuration between the UPS modules, as shown in Figure 7-2. Method: connect a module parallel cable from its PARA1 port to the PARA2 port of another module. Follow this method to connect other parallel cables.

The parallel port J20 is provided on the front panel of the bypass module, as shown in Figure 7-3.

The ring connection ensures the reliability of the control of the parallel system. Be sure to verify the reliable cable connection before starting up the system!

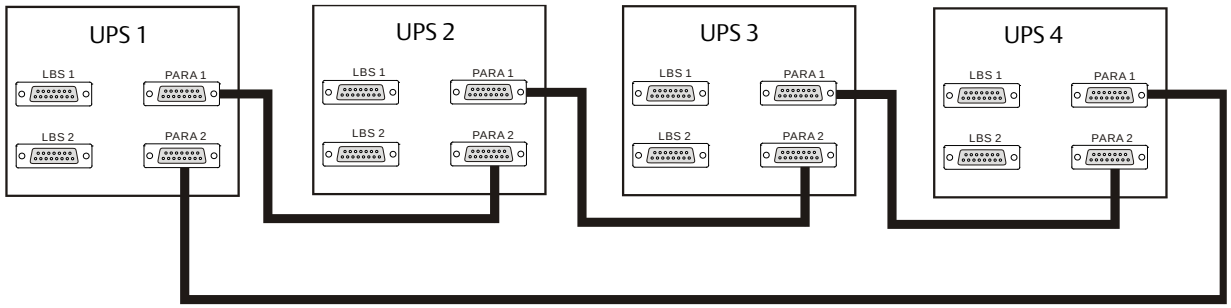


Figure 7-2 Parallel signal cables connection (Parallel system)

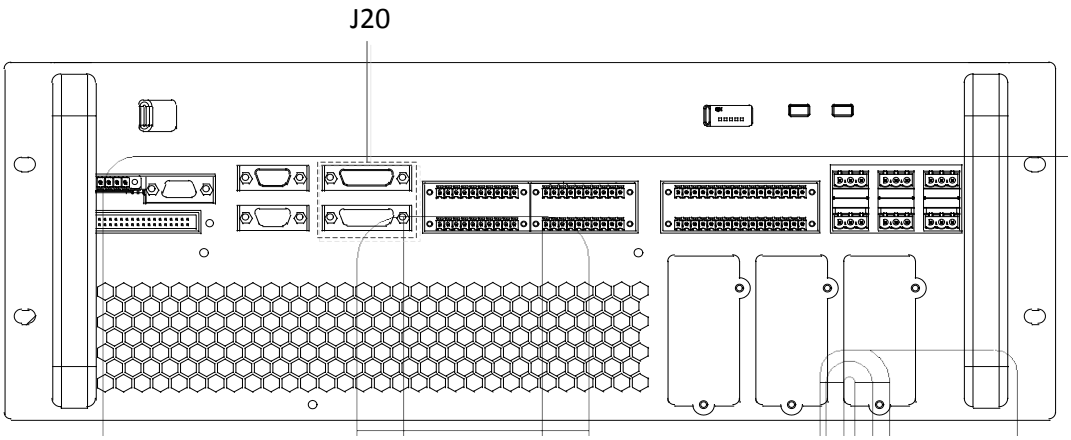


Figure 7-3 Location of parallel port J20 on bypass module

7.2.6 Remote 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 7-4.

Note

1. The remote EPO switch must provide dry contact signal, which is normally open or normally closed.
2. The open circuit voltage provided is 12Vdc, < 20mA.
3. The external EPO device can be composed of another control system which can disconnect UPS mains supply or bypass input.
4. Pins 1 and 2 of the normally closed EPO-J2 port on the bypass module have been linked in factory.

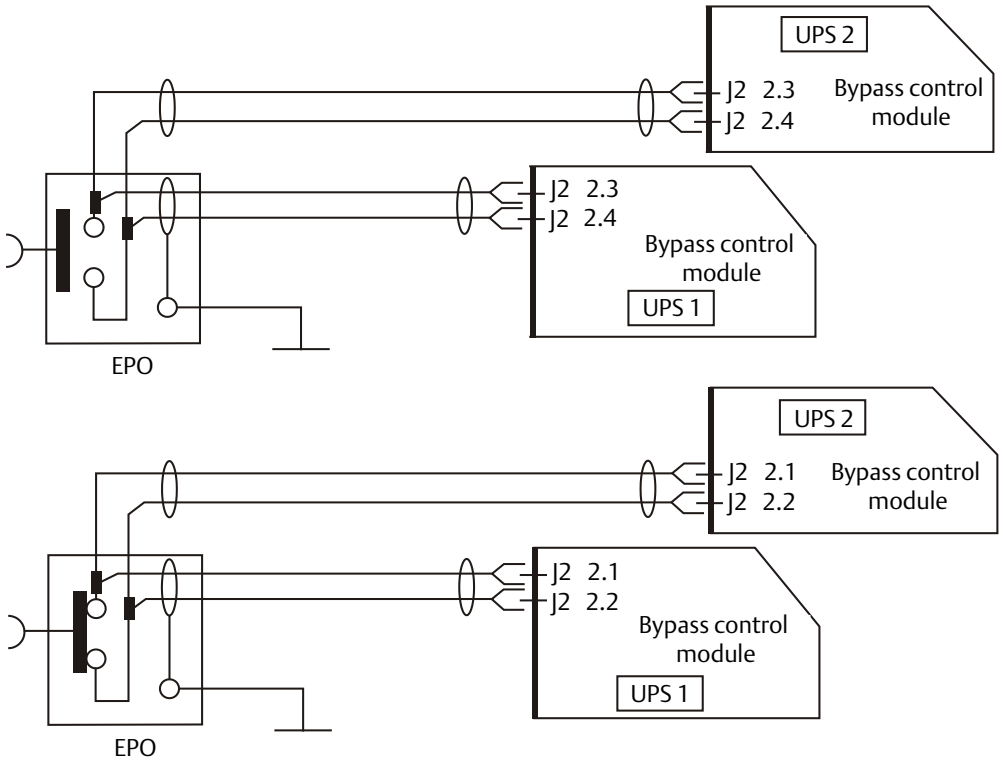


Figure 7-4 EPO circuit diagram

Note: In Figure 7-4, the upper one is Normally Open type, and the lower one is Normally Closed type.

7.3 Operation Procedures For Parallel System

Warning

If UPS input uses RCD, differential switch is only used in the system's bypass mains supply. At the moment of electrical connection, current may not be immediately separated, which may result in the tripping of RCCB respectively.

Only one step is needed for once, and only after finishing this operation step of each UPS module, the next step can be carried on.

7.3.1 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

1. These procedures result in mains voltage being applied to the UPS output terminals.
2. 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, disconnect the downstream load switch, and stick a warning label on the connection point of the load.

Use the following procedures to turn on the UPS from a fully powered down condition.

1. Confirm that the total external maintenance bypass switches are disconnected. Open the front door of each UPS in turn, ensure that the internal maintenance bypass switch Q3 is disconnected, while the input cables and copper bars are reliably connected, and the parallel cables are firmly connected.

Warning

To avoid misreporting as faults, all operations relating to disconnection or connection of the maintenance bypass switch shall be finished within three seconds.

2. Close the total bypass input switches.

3. 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.

At the moment, the system is powered on, and the startup screen pops up. Refer to *4.2.1 Start Screen*.

About 25 seconds later, confirm that the LCD shows the rectifier power supply and the bypass power supply are normal; if not, check whether the switches Q1 and Q2 are closed. Then the rectifier starts up and the rectifier indicator flashes in green color. About 30 seconds after the rectifier enters normal operation, the rectifier indicator goes solid green. After the system initialization, the bypass static switch is closed. The UPS indicator states are as listed in Table 5-1.

4. When the rectifier start process is finished and the rectifier indicator goes solid green, close the external BCB.

5. For each UPS, press the INVERTER ON key for two seconds. The inverter starts up, and the inverter indicator of each UPS flashes in green color. After all the UPS inverter indicators turn solid green, the whole UPS system will power the load.

7.3.2 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.

This operation will make the load transfer from UPS power supply protection state to direct connection with AC input bypass state.

Caution: power supply interruption danger of the load

Before performing this procedure, you 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. Press the INVERTER OFF key of each UPS in turn for at least two seconds. The inverter indicators are off and the buzzer alarms. The load transfers to the static bypass, and the inverter shuts down. At last, all UPSs are transferred to Bypass mode.

Note

Press the SILENCE ON/OFF button can silence the alarm, but the alarm message of the the LCD does not disappear until the alarm status is cleared.

2. Close the UPS external total maintenance bypass switches, and do not close the internal maintenance bypass switch Q3 of each UPS.

3. At this moment, the external total maintenance bypass should be parallel connected with each UPS's static switch.

4. At this moment, the LCD of each UPS displays ' Maint. Switch Closed'.

5. Disconnect the output switch Q5 of each UPS in turn, and the maintenance bypass can supply power to the load.

Caution

When the UPS is in maintenance mode, the load does not have the mains abnormal protection.

6. 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.

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

At the moment, all the internal power supply is off and the LCD does not display any more.

Warning

1. If the maintenance is required, wait 10 minutes for the internal DC bus capacitance discharging.
2. 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.

7.3.3 Procedures For Isolating One UPS Module From Parallel System

Important

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

Warning

Before operation, confirm that the system capacity has redundancy to avoid system shutdown due to overload.

The following procedures apply when one UPS module must be isolated from the parallel system for repair due to serious fault:

1. Pressing the EPO button stops the operation of rectifier, inverter, static switch and battery, but this action will not affect other UPSs in parallel system to power the load 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.

3. Correctly connect the remaining parallel cables in other single modules, refer to *7.2.5 Parallel Cables*.

Warning

1. Post a label at the AC input distribution (generally far away from the UPS) to alert that the UPS maintenance is being operated.
2. Wait 10 minutes for the internal DC bus capacitance discharging. Then the UPS is completely shut down.

7.3.4 Procedures For Inserting One Isolated UPS Module In Parallel System

Important

These procedures shall only be carried out by service personnel of Emerson 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. 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.

3. When the single module rectifier indicator goes solid green, close the BCB and then press the INVERTER ON key.

At this point, the single module inverter indicator flashes in green color. Few seconds later, the single modules form the parallel system for operation.

7.3.5 Procedures For Completely Powering Down UPS

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

Caution

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

1. Pressing the EPO button of each UPS stops the operation of rectifier, inverter, static switch and battery.

2. Disconnect the rectifier input switch Q1 and bypass input switch Q2 of each UPS. At the moment, all the internal power supply is closed and the LCD does not display any more.

3. Disconnect the output switch Q5 of each UPS.

Warning

1. Post a label at the AC input distribution (generally far away from the UPS) to alert that the UPS maintenance is being operated.
2. Wait 10 minutes for the internal DC bus capacitance discharging. Then the UPS is completely shut down.

Warning: hazardous battery voltage

The battery terminals still have hazardous voltage after the UPS complete shutdown.

7.3.6 Procedures For Complete UPS Shutdown While Maintaining Power To Load

The following procedures are applicable for completely powering down the UPS and still keeping the power supply to the load. Refer to the procedures in *7.3.2 Maintenance Bypass Procedures*.

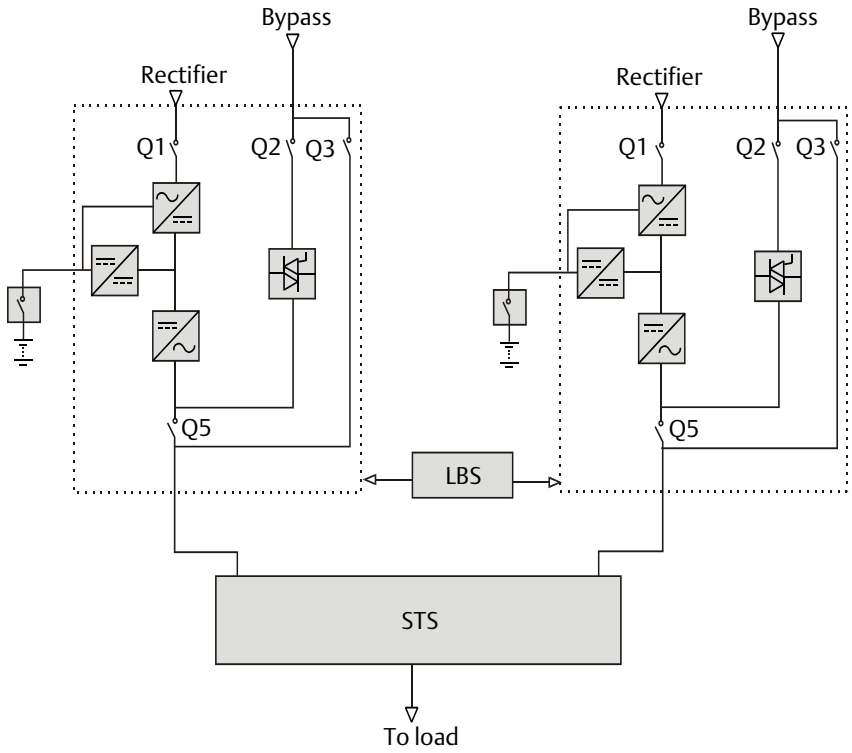
7.4 LBS System

7.4.1 Cabinet Installation

An LBS system consists of two independent UPS systems, each containing one or more parallel UPS modules, as shown in Figure 7-5. The LBS system has high reliability and is applicable to the load with multiple inputs. For single-input load, an STS can be installed to feed power to the load.

The system uses the LBS cables to keep the output of the two independent (or parallel) UPS systems in synchronization. One system is designated as the master, the other is designated as the slave. The operation modes of the parallel system comprise master and slave operation in normal or bypass mode.

Place the UPS modules side by side and interconnect the UPS modules according to the following instructions.



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

Figure 7-5 LBS system (UPS module)

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.

7.4.2 External Protective Device

Refer to *3.1.9 External Protective Device*.

7.4.3 Power Cable

The power cable of dual-bus power system is similar to that of single system. Refer to *3.1 Wiring Of Power Cable*.

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

7.4.4 LBS Cable

For 600kVA dual bus system, connect the optional LBS cables (10m, 15m, 20m) between the LBS ports (J19) of the two UPS systems shown in Figure 7-6. The J19 ports are provided on the front panel of the bypass module, as shown in Figure 7-7.

Note

You must use the shortest LBS cable to suit the application and must not coil excess. Meanwhile, separate the LBS cable from the power cables to prevent electrical inteferences.

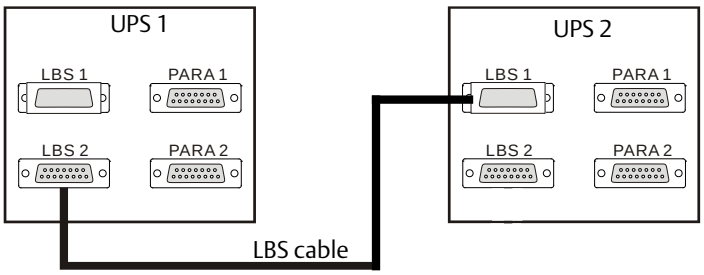


Figure 7-6 Connection of typical LBS system (UPS module)

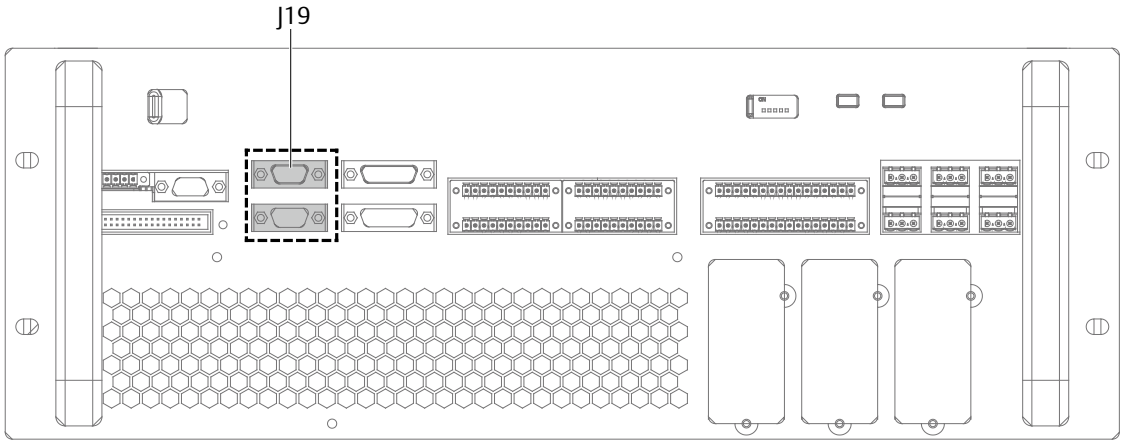


Figure 7-7 LBS port (J19) on bypass module

7.5 LBS Adapter

The LBS box is designed to extend the LBS function up to 150m between the two UPS modules or systems of a dual bus system, and it also enables an APM UPS to synchronize with other UPS models. See *8.2.6 LBS Adapter* for details.

Chapter 8 Options

This chapter provides the UPS option list, and introduces the functions, installation and configuration of each option.

8.1 Option List

Table 8-1 Option list

No.	Option name	Remark	Model
1	Battery temperature sensor kit	/	023500U7
2	Bypass load sharing inductor kit	/	02010002
3	Battery ground fault kit	Different battery ground fault kit for overall BCB and divided BCB	02312144, 02312149
4	Seismic anchor kit	/	023500LG
5	IS-UNITY-DP card	Intellislot prots 1 ~ 3 (Port 1 or 2 recommended)	03020728
6	IS-UNITY-LIFE card	Intellislot prots 1 ~ 3 (Port 1 or 2 recommended)	03020753
7	SIC card	Intellislot prots 1 ~ 3 (Port 1 or 2 recommended)	02351817
8	IS-RELAY card	Intellislot port 1	02359487
9	Lightning proof kit	Lightning proof kit (Class C)	023500LC
		Lightning proof kit (Class D)	0235014S
10	LBS cable	Available in 10m, 15m, 20m	04112069 (10m), 04112070 (15m), 04112071 (20m)
11	LBS adapter	/	02350554
12	Shorting copper bar	/	0235013M
13	Parallel cable	Available in 5m, 10m, 15m	04112066 (5m), 04112067 (10m), 04112068 (15m)

8.2 Option Introduction

8.2.1 Battery Temperature Sensor Kit

A battery temperature sensor is used to measure the battery temperature. At this moment, the temperature sensor is connected with the UPS internal logic circuit.

With this feature fitted, the nominal float voltage supplied to the battery is adjusted so as to be inversely proportional to the ambient temperature of the battery cabinet or battery room. This prevents the battery being over charged at high ambient temperatures.

Preparation

1. Prepare the installation tools, including a cross head screwdriver.
2. Check that all installation materials are present and complete, including a battery temperature sensor.

Procedures

Warning

1. Connect the cables strictly following the instructions. Failure to observe this may cause damage to the UPS and the battery.
2. Shut down the UPS when installing the battery temperature sensor. During installation, do not touch the battery terminals, bared copper bars and components.

1. Shut down the UPS completely.

a) Close the load.

b) All the LCDS are off, wait five minutes for the internal DC bus capacitors of the UPS complete discharging.

2. Connect one end of the specified cable to either port of the battery temperature sensor, and the other end to corresponding port of IS-Relay card. Refer to Figure 6-5 for details.

3. Route and pack the cables in order. Note that the cables should be routed separately from the power cables, to avoid EMI.

8.2.2 Bypass Load Sharing Inductor Kit

Install the bypass load sharing inductors for the parallel system comprised of two or more UPS modules, to ensure the bypass output load sharing for the parallel system. The bypass load sharing inductor is used to compensate the impedance differentia between SCR and cable. See Table 8-2 for the specifications.

Table 8-2 Specifications of bypass load sharing inductor

Dimensions (H × W × D) (mm)	Inductor value (uH)
305 × 190 × 145	7±10%

Each UPS cabinet has three bypass load sharing inductors, with no extra clearance occupied. The load sharing rate is generally 10% of the system rated current with the difference of external cable configuration. Try to make the cable length be the same from bypass to each UPS and from UPS module output to parallel system connection point.

Preparation

1. Prepare the installation tools, including an electric screwdriver, a screw driver, a torque sleeve and a red marker.

2. Check that all installation materials, types and cables are present and complete, and that auxiliary materials (such as fastener, heat shrinkable tube and wire clasp) are present and in good condition.

Procedures

Warning

1. Only authorized personnel shall install and replace the inductors.
2. Connect the cables strictly following the instructions. Failure to observe this may cause damage to the UPS and the inductors.

1. Disconnect all the switches, such as battery and load.

2. All the LCDS are off, wait five minutes for the internal DC bus capacitors of the UPS complete discharging.

3. Remove all the screws connecting between 400kVA power side cabinet and power distribution cabinet. Then remove the 400kVA power cabinet and its rear panel, reserve the removed screws.

4. Plull out the bypass control module and bypass power module.

5. Remove the cables W01, W02 and W03 from the bypass power module input terminals.

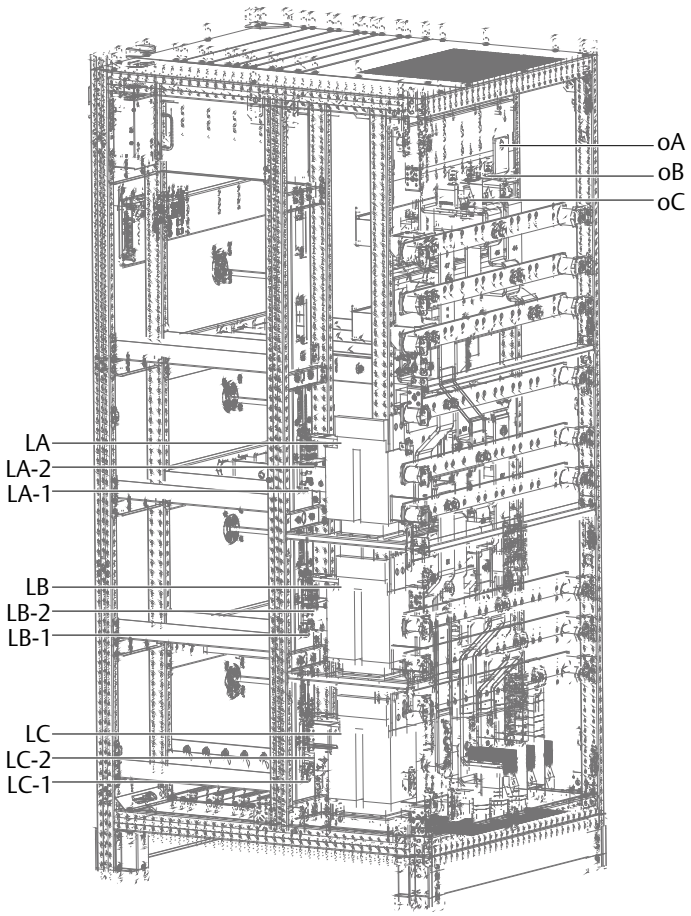


Figure 8-1 Installing bypass load sharing inductors

6. Place the three inductors to the installation positions LA, LB and LC, and use three hexagon sems screw M12 × 30 to connect the power cables between LA-1, LB-1, LC-1 and one end of the bA/L1-B (A), bA/L1-B (B), bA/L1-B (C), as shown in Figure 8-1.

7. Use the six hexagon sems screw M12 × 30 and w07 (bA), W08 (bB), W09 (bC) to connect the terminals between LA-2, LB-2, LC-2 and bypass power module, as shown in Figure 8-1.

8. Keep the cables connection between bypass power module output terminal and terminals (oA, oB, oC) unchanged.

9. After finishing the above procedures, you should check that cables are connected correctly.

Now, the installation and connection of the bypass load sharing inductor assembly is complete.

8.2.3 Battery Ground Fault Kit

The UPS provides a battery ground fault detector to detect and remove battery ground fault so as to ensure reliable system operation. Residual current range monitored: 30mA ~ 5000mA; power supply: UHW241M5 auxiliary power supply board.

When a battery ground fault is detected, an alarm will appear on the UPS display panel.

The battery ground fault detector includes a mutual inductor and a PCB, which should be installed in the BCB cabinet. For the installation and connection of the battery ground fault detector, refer to *6.10 Battery Ground Fault Detector (Option)*.

8.2.4 Seismic Anchor Kit

UPS provides seismic anchor kits to avoid and reduce the damage to UPS caused by earthquake or vibration.

After fixing the UPS onto the concrete floor, the seismic anchor kits should achieve Class 2 requirement of Table 2 in IEC60068.3.3 and satisfy the UBC 1994 standard (earthquake area 4 from strong to very strong).

Warning

1. Only Emerson authorized engineers shall carry out the installation.
2. Carry out the installation strictly following the instructions. Failure to observe this could cause personnel injury or damage to the UPS and seismic anchor kits.

Preparation

1. Prepare installation tools, including a cross head screwdriver, a torque spanner and an adjustable spanner.

2. Check that all installation materials are present and complete, including two seismic anchors, 12 M8 × 30 tapping screws, four M12 expansion bolts.

Procedures

Use M8 × 30 hex sems screws (12 pcs) to fix the two seismic anchors located at bottom of both the cabinet front and rear. Then use four M12 expansion bolts to fix the two seismic anchors on the ground, as shown in Figure 8-2.

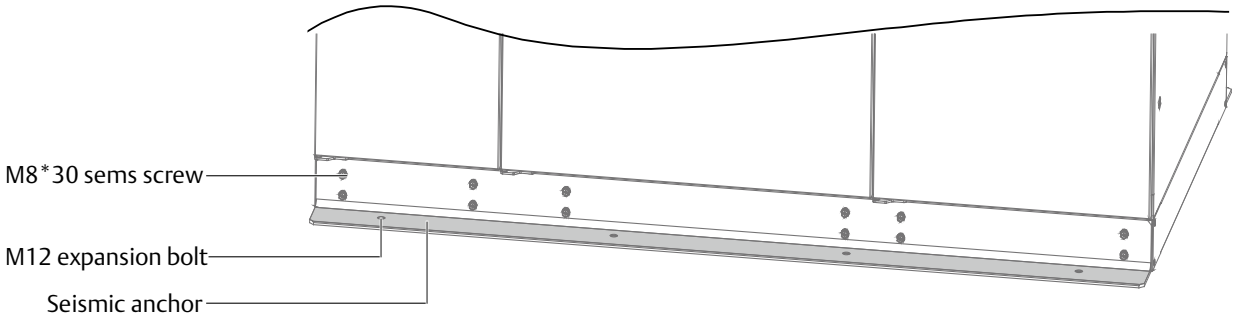


Figure 8-2 Installing seismic anchors

8.2.5 IS-UNITY-DP Card

Important

It is recommended to use the shielded cables to enhance the EMC.

The appearance of the IS-UNITY-DP card is shown in Figure 8-3.

Figure 8-3 Appearance of IS-UNITY-DP card

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

8.2.6 IS-UNITY-LIFE Card

Important

It is recommended to use the shielded cables to enhance the EMC.

The appearance of the IS-UNITY-LIFE card is shown in Figure 8-4.

Figure 8-4 Appearance of IS-UNITY-LIFE card

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

8.2.7 SIC Card

The SIC card is a network management card. It can make the UPS developed by Emerson Network Power Co., Ltd have network communication capability. It can also be connected to the IRM series sensor to provide environment monitoring function. When the intelligent equipment generates an alarm, the SIC card can notify the user by recording the log, sending trap information, and sending a mail. The SIC card supports Modbus RTU protocol.

Preparation

1. Prepare the installation tools, including a cross head screwdriver.
2. Check that all installation materials are present and complete, including an SIC card.

Procedures

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, so as to protect the SIC card against static shock. When removing or installing the SIC card, hold the card side edge to operate it.

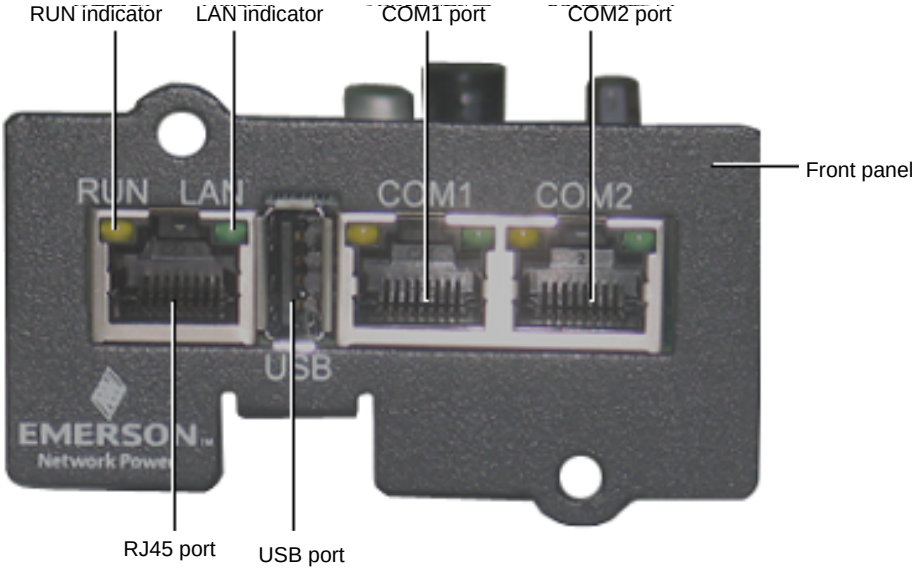


Figure 8-5 Appearance of SIC card

The SIC card (see Figure 8-5) should be installed in the Intellislot port (see Figure 3-5) in the UPS. See Table 3-9 for installation positions of optional cards.

Method for installation:

1. Remove the cover of Intellislot port. Note to reserve the removed screws and take care of the cover for future use.

2. Insert the SIC card (along two sides of the Intellislot port) into the port position recommended in Table 3-9, and then fasten the screws.

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

Refer to *3.2.10 Signal Cable Connection Steps* for the cabling and routing of the signal cables.

8.2.8 IS-Relay Card

The appearance of the IS-Relay card is shown in Figure 8-6.

Figure 8-6 Appearance of IS-Relay card

The UPS provides IS-Relay card for the user to use the dry contact signal to monitor the UPS.

The functions of the IS-Relay card are listed in Table 8-3.

Table 8-3 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
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 *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 *8.2.7 SIC card*. Refer to *3.2.10 Signal Cable Connection Steps* for the cabling and routing of the signal cables.

8.2.9 LBS Adapter

The LBS adapter is designed to extend the LBS function up to 150m between the two UPS modules or systems of a dual bus system, and it also enables an APM UPS to synchronize with other UPS models

Appearance

The appearance of the LBS adapter is shown in Figure 8-7.

Figure 8-7 Appearance of LBS adapter

The LBS adapter provides ports, LED indicators and a switch on the front panel, which are described in Table 8-4.

Table 8-4 Description of ports, LED indicators and switch of LBS adapter

Item	Description
Power port	Connect to phase A, neutral and ground of output of UPS
LED1 (red)	Power LED. It illuminates when the power is on, turns off when the power fails
COM1	LBS signal port. Connect to APM UPS
COM2	RS485 port. Connect to the other LBS adapter. Green LED. On: The communication power is OK; off: The communication power fails. Yellow LED. On: The LBS adapter is connected to a non-APM UPS; off: The LBS adapter is connected to an APM UPS
SWITCH	The switch should be placed to right if the LBS adapter is connected to an APM UPS; it should be placed to left if the LBS adapter is connected to a non-APM UPS

Electrical parameters

The electrical parameters of the LBS adapter are listed in Table 8-5.

Table 8-5 Electrical parameters of LBS adapter

Parameter	Specification
Voltage	120Vac ~ 277Vac
Frequency	45Hz ~ 65Hz
Current	1.5A max.

Installation

Warning

Only qualified electrical personnel shall install the LBS adapter, as hazardous voltage may be present at the UPS output terminals.

1. Fix the LBS adapter.

The dimensions of the LBS adapter are shown in Figure 8-8. The LBS adapter can use horizontal installation (see Figure 8-9) or vertical installation (see Figure 8-10).

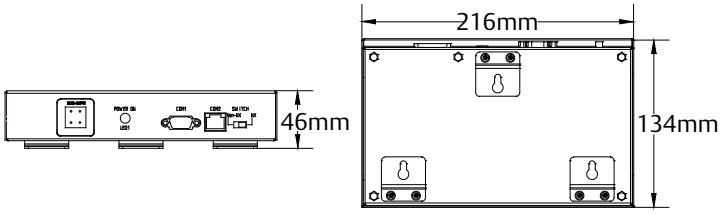


Figure 8-8 Dimensions of LBS adapter

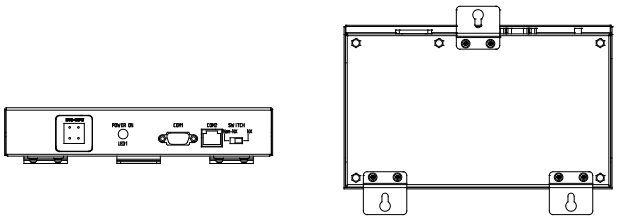


Figure 8-9 Horizontal installation

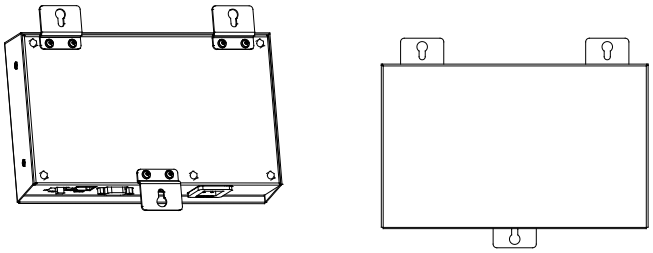


Figure 8-10 Vertical installation

2. Make cable connection.

- APM UPS to APM UPS

See Figure 8-11, the connection procedures are as follows:

a) Connect the power cables of the LBS adapter to the phase A, neutral and ground output of each UPS.

b) Connect the end of the LBS cable with a DB9 port to COM1 port of the LBS adapter, and connect the other end of the LBS cable with an RJ45 port to the J19 port of the bypass module of the UPS.

c) Connect the communication cable (up to 150m) to the COM2 port of each LBS adapter.

d) Place the switch of both LBS adapters in the right position.

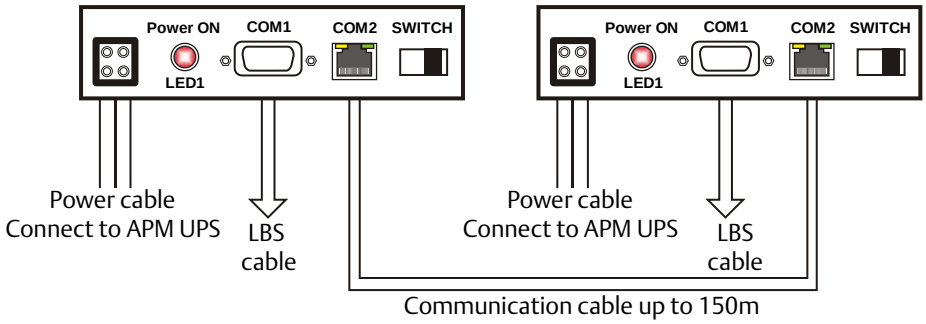


Figure 8-11 Connection between two LBS adapters (APM UPS to APM UPS)

- APM UPS to non-APM UPS

See Figure 8-12, the connection procedures are as follows:

1) Connect the power cables of the LBS adapter to the phase A, neutral and ground output of each UPS.

2) Connect the end of the LBS cable with a DB9 port to COM1 port of the LBS adapter, and connect the other end of the LBS cable with an RJ45 port to the J19 port of the bypass module of the APM UPS. Make no connection to the COM1 port of the LBS adapter connected to the non-APM UPS.

3) Connect the communication cable (up to 150m) to the COM2 port of each LBS adapter.

4) Place the switch of the LBS adapter connected to the APM UPS in the right position, and place the switch of the LBS adapter connected to the non-APM UPS in the left position.

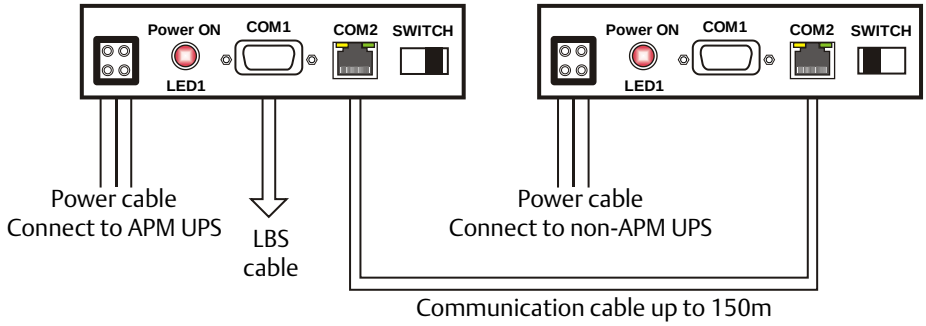


Figure 8-12 Connection between two LBS adapters (APM UPS to non-APM UPS)

8.2.10 LBS Cable

Shielded and double-insulated parallel control cables available in lengths of 10m, 15m and 20m. The LBS cable must be interconnected in a branch configuration between LBS1 and LBS2 of any UPS modules, as shown in Figure 7-6. When there is a dual bus for parallel system, one parallel system needs one LBS cable.

8.2.11 Shorting Copper Bar Kit

For the UPS with shorting cooper bar of common input configuration, the use should select the shoeting copper bar kit to short the mains input and bypass input. This option is installed before delivery. If on-site installation is required, please follow Figure 3-2 for its installation.

8.2.12 Lightning Proof Kit

The lightning proof kit has two modes: Class-C and Class-D, you can choose the desired mode according to actual requirement. If the application environment demand of SPD is not high, no need to install the lightning proof kit. Note that either Class-C or Class-D. The protection level of Class-C SPD is higher than Class-D. The SPD is connected to the mains input copper bar.

8.2.13 Parallel Cable

Shielded and double-insulated parallel cables available in lengths of 5m, 10m and 15m must be interconnected in a ring configuration between the UPS modules, as shown in Figure 7-2. Method: connect a module parallel cable from its PARA1 port to the PARA2 port of another module. Follow this method to connect other parallel cables.

The ring connection ensures the reliability of the control of the parallel system. Be sure to verify the reliable cable connection before starting up the system!

Chapter 9 Communication

The UPS supports SNMP communication, Modbus protocol communication, dry contact communication and Velocity protocol communication. This chapter provides information relevant to these types of communication.

Refer to corresponding settings in Table 4-7 for communication protocol. Selecting 'Velocity' means the system supports the Velocity protocol communication.

9.1 SNMP Protocol Communication

If you need to monitor the UPS through network, you may select the SIC card provided by Emerson Network Power Co., Ltd. This card supports SNMP protocol.

The SIC card is a network management card. It can make the UPS developed by Emerson Network Power Co., Ltd have real network communication capability. It can also be connected to the IRM series sensor to provide environment monitoring function. When the intelligent equipment generates an alarm, the SIC card can notify the user by recording the log, sending trap information, and sending a mail.

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

- Web browser. You can use Web browser to monitor your intelligent equipment and equipment room environment through the Web server function provided by the SIC card
- Network management system (NMS). You can use NMS to monitor your intelligent equipment and equipment room environment through the SNMP function provided by the SIC card
- SiteMonitor, network management software for equipment room power and environment. You can use SiteMonitor to monitor your intelligent equipment and equipment room 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 Emerson Network Power Co., Ltd. to provide automatic safe shutdown function for your computer installed with Network Shutdown, so as to prevent data loss.

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

9.2 Modbus Protocol Communication

The Modbus protocol communication is supported by the SIC card.

9.3 Dry Contact Communication

The UPS provides the following two dry contact communication approaches:

- IS-Relay card
- Dry contact port

9.3.1 Communication Through IS-Relay Card

The UPS provides an IS-Relay card for the user to use dry contact signals to monitor the UPS. The IS-Relay card should be installed in an Intellislot port (see Figure 3-5) of the communication box in the cabinet. For the installation and use of the IS-Relay card, refer to *Liebert IntelliSlot IS-Relay Card User Manual*.

9.3.2 Communication Through Dry Contact Port

For on-site specific needs, the UPS may need auxiliary connection to achieve 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 external interface board (EIB):

- Input dry contact port
- Output dry contact port
- EPO input port

For the functions and detailed information of these ports, refer to *3.2 Wiring Of Signal Cable*.

Chapter 10 Service And Maintenance

The UPS system (including battery) needs regular service and maintenance in long-term operation. This chapter elaborates on the advice on the service life, regular inspection, maintenance and replacement of the UPS key components. Effective maintenance of the UPS system can reduce the risk in UPS failure and prolong the UPS service life.

10.1 Safety

Warning

1. Inspection of UPS systems can only be executed by people who have received relevant training, and the inspection and replacement of devices should only be undertaken by authorized professionals.
2. 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.
3. Note that the neutral line has hazardous voltage when servicing the UPS.

10.2 Service Procedures Of Power Module And Bypass Module

10.2.1 Notes

1. Only customer service engineers shall service the power modules and bypass module.

2. Remove the power modules and bypass module from top to bottom, so as to prevent cabinet toppling due to high gravity center.

3. To ensure safety, before servicing the power modules and bypass module, be sure to use a multimeter to verify that the DC bus capacitor voltage is lower than 60Vdc, and that the voltages between the earth and the components you are going to work on are under dangerous voltage values, that is, lower than 60Vdc or 42.4Vac peak value.

4. The power modules and bypass modules should be serviced 5 minutes after they are removed, and replug them into the cabinet after 5 minutes.

10.2.2 Service Procedures Of Power Module

1. Place the ready switch on the front panel of the power module to unready state, at this time, the green indicator beside the ready switch is off and the red indicator is on.

3. Ensure that the red indicator on the power module is solid on, remove the fixing screws on both sides of the front panel of the module, and pull the module out of the cabinet.

Note

The module will be blocked by a spring piece on the left side of the module when the module is pulled out of the cabinet halfway. At this point, you must press the spring piece before you continue to pull the module out.

4. After servicing the module, check that the address of this module is different from those of other modules and that the address ranges from 1 to 12. Check that the ready switch is in unready state.

5. Push the module (at least 10s after another) into the cabinet, and tighten the screws on both sides.

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

10.2.3 Service Procedures Of Bypass Control Module

Service procedures in bypass mode

1. Close the maintenance bypass switch, the UPS transfers to the maintenance mode, then press the EPO button.

2. Place the ready switch on the front panel of the power module to unready state, at this time, the red indicator beside the ready switch is on.

3. Wait for two minutes, confirm that the red indicator beside the ready switch is always on, and then remove the fixing screws on both sides of the front panel of the bypass module, unplug the signal cables and pull the module out of the cabinet, then maintain the module.

4. After servicing the module, push the module into the cabinet, and tighten the screws on both sides, then connect the signal cables removed in step 3. Use the multimeter to measure and verify that the remote EPO terminal J2 described in *3.2.6 REPO Port* and cable are well connected.

Note

When pulling the bypass module out of the cabinet, move it around and pull outward many times. When inserting the bypass module, you should insert it forcibly, otherwise the bypass module poor may have poor contact with the system, thus affect the normal operation of the bypass module and the overall unit. The standard for the bypass module normal insertion position is that the brackets on both sides of the bypass module can be close to the cabinet column.

5. After getting the software version from the LCD menu, place the ready switch to the down position (that is, in ready state), at this time, the red indicator beside the ready switch is off while the green indicator is on. Press the FAULT CLEAR key, and then the module will automatically connect to the system. After the bypass indicator goes solid green, the UPS is in Bypass mode, then disconnect the maintenance bypass switch.

Service procedures of single UPS in normal mode

1. Place the ready switch on the front panel of the power module to unready state, at this time, the red indicator beside the ready switch is on.

2. Wait for two minutes, confirm that the red indicator beside the ready switch is always on, and then remove the fixing screws on both sides of the front panel of the bypass module, unplug the signal cables and pull the module out of the cabinet, then maintain the module.

3. After servicing the module, push the module into the cabinet, and tighten the screws on both sides, then connect the signal cables removed in step 2. Use the multimeter to measure and verify that the remote EPO terminal J2 described in *3.2.6 REPO Port* and cable are well connected.

4. After getting the software version from the LCD menu, place the ready switch to ready state, at this time, the red indicator beside the ready switch is off while the green indicator is on. Then the module will automatically connect to the system.

Service procedures of parallel system in normal mode

1. Press the EPO button for the UPS to be serviced, and open the mains input switch, bypass input switch and output switch.

2. Place the ready switch on the front panel of the power module to unready state.

3. Wait for two minutes, remove the fixing screws on both sides of the front panel of the bypass module, unplug the signal cables and pull the module out of the cabinet, then maintain the module.

4. After servicing the module, push the module into the cabinet, and tighten the screws on both sides, then connect the signal cables removed in step 3. Use the multimeter to measure and verify that the remote EPO terminal J2 described in *3.2.6 REPO Port* and cable are well connected.

5. Close the mains input switch, bypass input switch, output switch and BCB.

6. After getting the software version from the LCD menu, place the ready switch to ready state. Then start the system following the procedures in Section 7.3.4.

10.2.4 Service Procedures Of Bypass Power Module

Service procedures in bypass mode

1. Close the maintenance bypass switch, the UPS transfers to the maintenance mode, then press the EPO button.

2. Place the ready switch on the front panel of the power module to unready state, at this time, the red indicator beside the ready switch is on.

3. Wait for two minutes, confirm that the red indicator beside the ready switch is always on, and then remove the fixing screws on both sides of the front panel of the bypass module, and pull the module out of the cabinet, then maintain the module.

4. After servicing the module, push the module into the cabinet, and tighten the screws on both sides.

Note

When pulling the bypass module out of the cabinet, move it around and pull outward many times. When inserting the bypass module, you should insert it forcibly, otherwise the bypass module poor may have poor contact with the system, thus affect the normal operation of the bypass module and the overall unit. The standard for the bypass module normal insertion position is that the brackets on both sides of the bypass module can be close to the cabinet column.

5. Place the ready switch to ready state, at this time, the red indicator beside the ready switch is off while the green indicator is on. Press the FAULT CLEAR key, and then the module will automatically connect to the system. After the bypass indicator goes solid green, the UPS is in Bypass mode, then disconnect the maintenance bypass switch.

Service procedures of single UPS in normal mode

1. Place the ready switch on the front panel of the power module to unready state, at this time, the red indicator beside the ready switch is on.

2. Remove the fixing screws on both sides of the front panel of the bypass module, and pull the module out of the cabinet.

3. After servicing the module, push the module into the cabinet, and tighten the screws on both sides.

4. Place the ready switch to ready state, at this time, the red indicator beside the ready switch is off while the green indicator is on and red indicator is off.

Service procedures of parallel system in normal mode

1. Press the EPO button for the UPS to be serviced, and open the mains input switch, bypass input switch and output switch.

2. Place the ready switch on the front panel of the power module to unready state.

3. Wait for two minutes, remove the fixing screws on both sides of the front panel of the bypass module, unplug the signal cables and pull the module out of the cabinet, then maintain the module.

4. After servicing the module, push the module into the cabinet, and tighten the screws on both sides.

5. Close the mains input switch, bypass input switch, output switch and BCB. Place the ready switch to ready state. Then start the system following the procedures in Section 7.3.4.

10.3 Key Components And Service Life Of UPS

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

10.3.1 Life Parameters And The Proposed Replacement Time Of Key Components

Key components in Table 10-1 are used in the UPS system. To prevent system failures due to some of the devices' failure by wear, it is proposed to carry out regular inspection and replacement during its estimated life.

Table 10-1 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	Five years to six years	One year
Bus capacitor	Not less than 7 years	Five years to six years	One year
Air filter	One year to three years	One year to two years	Two months
VRLA battery (5-year life)	Five years	Three year to four years	Six months
VRLA battery (10-year life)	10 years	Six years to eight years	Six months

10.3.2 Replacement Of Air Filter

Note: The replacement of air filters of 200kVA power cabinet and 400kVA power cabinet are the same of those in the following procedures.

The air filters need regular inspection and replacement. The inspection and replacement intervals are related to 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 harsh environments. Frequent inspection or replacement should also be made in new buildings.

The UPS provides air filters on the back of the front door of the cabinet, and the user can replace the air filter during the UPS operation.

Each air filter is fixed by a fixing bar on both sides. Refer to Figure 10-1, the following is the air filter replacement procedures:

1. Open the front door of the UPS to reveal the air filter on the back of the front door.

2. Remove a fixing bar on one side and loosen the fixing screws of the fixing bar on the other side, with no need to remove this fixing bar.

3. Remove the air filter to be replaced, and insert a clean one.

4. Re-install the removed fixing bar in the original place and tighten the fixing screws.

5. Tighten the fixing screws of the fixing bar on the other side.

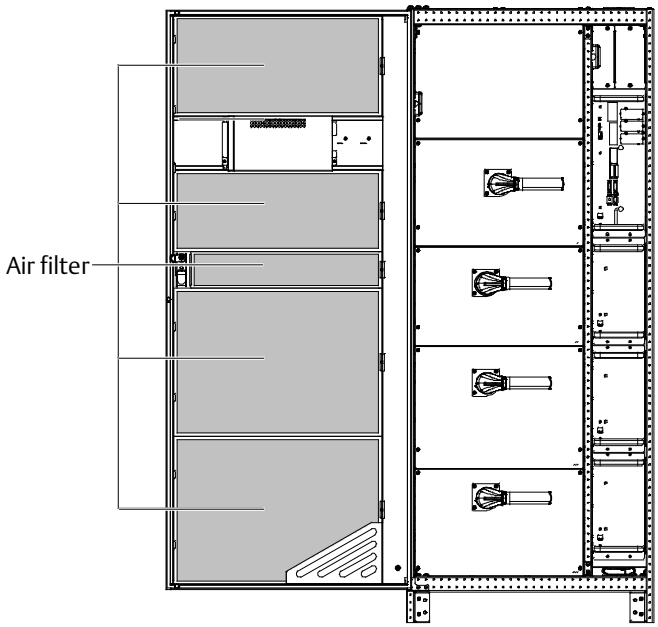


Figure 10-1 Replacing air filter

10.4 Maintenance Of UPS And Options

UPS and the options need common maintenance:

1. Keep good history record. Keeping good history record facilitates failure treatment.

2. Keep clean, so as to prevent UPS from the invasion of dust and moisture.

3. Maintain appropriate ambient temperature. The most appropriate temperature for battery is 20°C to 25°C. Too low temperature will reduce the battery capacity and too high temperature will reduce the battery life.

4. Check the wiring. Check the tightening of all connected screws, and there should be routine tightening at least once a year.

5. Check regularly if there is any abnormity in the superior or subordinate switch to ensure cutting off the import or export when the current is too large. Maintenance staff should be familiar with the typical ambient conditions where UPS is working in order to rapidly position which ambient conditions are unusual; the setting of UPS operation control panel should be known as well.

For information of the UPS battery maintenance, refer to *6.13 Battery Maintenance.*

Chapter 11 Specifications

This chapter lists the UPS specifications.

11.1 Conformance And Standards

The UPS has been designed to comply with the European and international standards listed in Table 11-1.

Table 11-1 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)

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).

11.2 Environmental Characteristics

Table 11-2 Environmental characteristics

Item	Unit	Rated power (kVA)
		600
Noise within 1m (in the front)	dB (A)	70
Altitude	m	≤ 1500; derate power by 1% per 100m between 1500m and 3000m
Relative humidity	%RH	0 ~ 95%, non condensing
Operating temperature	°C	0 ~ 40°C
Storage and transportation temperature for UPS	°C	Storage: -25°C ~ +55°C; transportation: -40°C ~ +70°C
Over-voltage level		Level 2
Pollution level		Level 2
Grid system		TN, TT, IT

11.3 Mechanical Characteristics

Table 11-3 Mechanical characteristics

Item		Unit	Rated power (kVA)
			600
Dimensions (D × W × H)	Packing excluded	mm	1000 × 1800 × 2000
	Packing included	mm	1135 × 1930 × 2260
Net weight		kg	1100
Gross weight		Kg	1200
Color			Black ZP7021
Protection degree, IEC (60529)			IP20 (front door open or closed)

11.4 Electrical Characteristics (Input Rectifier)

Table 11-4 Rectifier AC input (mains)

Item	Unit	Rated power (kVA)
		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	228 ~ 478
Frequency[2]	Hz	50/60 (range: 40 ~ 70)
Power factor	kW/kVA, full load (half load)	0.99 (0.98)
Input current	A, rated[3]	1048A
Total current harmonic distortion	%	3

Note

1. Rectifiers operate at any of the rated supply voltages and frequencies without further adjustment.
2. At 305V 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 400V, battery remains fully charged.

11.5 Electrical Characteristics (Intermediate DC Circuit)

Table 11-5 Battery

Item	Unit	Rated power (kVA)
		600
Max. charging current	A	151
Rated battery bus voltage	Vdc	456 ~ 528
Quantity of lead-acid cells (nominal)	Block	30 ~ 44 (12Vdc)
Float voltage	V/cell (VRLA)	2.25 (selectable from 2.2V/cell to 2.3V/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 2.3 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 8hr to 30hr) Boost mode inhibit also selectable
EOD voltage	V/cell (VRLA)	1.67 (selectable from 1.60 to 1.90)

11.6 Electrical Characteristics (Inverter Output)

Table 11-6 Inverter output (to critical load)

Item	Unit	Rated power (kVA)
		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

Item	Unit	Rated power (kVA)
		600
Output power		Rated 600kVA (module is full configuration)
Overload	%	<105%, long time; <110%, ≤1hr; <125, ≤10min; <150, ≤1min
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])
Synchronisation window	Hz	Rated frequency ±2Hz (Range: 50/60Hz ± 10%)
Slew rate (max. change rate of synchronisation frequency)	Hz/s	0.6; setting range: 0.1 ~ 3

Note

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

2. Factory set to 50Hz. 60Hz 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.

11.7 Electrical Characteristics (Bypass Input)

Table 11-7 Bypass input

Item		Unit	Rated power (kVA)
			600
Rated AC voltage[1]		Vac	380/400/415, 3-phase 4-wire, sharing neutral with the rectifier input and providing neutral reference to the output
Rated current	380V	A	909
	400V	A	866
	415V	A	835
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 (delay time to accept steady bypass voltage: 10s)
Bypass frequency tolerance		%	±10 or ±20, default: ±10

Note

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

2. Factory set to 50Hz. 60Hz can be selected by service engineer at site.

11.8 Efficiency And Loss

Table 11-8 Efficiency and loss

Item	Unit	Rated power (kVA)
		600
Rated normal mode	kW	24
ECO mode	kW	6

Appendix 1 Glossary

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 2 Hazardous Substances And Content

Parts	Hazardous substances and content					
	Plumbum	Hydrargyru	Cadmium	Chrome^{6+}	PBB	PBDE
	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 (when applicable)	×	○	○	○	○	○
Insulation monitoring device (when applicable)	×	○	○	○	○	×

This table is made following the regulation of SJ/T 11364.

○: Means the content of the hazardous substances in all the average quality materials of the parts is within the limits specified in GB/T 26572

×: Means the content of the hazardous sustances in at least one of the average quality materilals of the parts is outsides the limits specified in GB/T 26572

Emerson Network Power Co., Ltd. has been committed to the design and manufacturing of environment-friendly products. It will reduce and eventually eliminate the hazardous substances in the products through unremitting efforts in research. However, limited by the current technical level, the following parts still contain hazardous sustances due to lack of reliable substitute or mature solution:

1. All solders in the products contain plumbum
2. Copper alloy contains plumbum
3. Backlight bulb contains plumbum
4. The ceramic materials of the ceramic capacitor, the copper terminals and copper leads of metallic film capacity contain plumbum.
5. The glass of resistor contains plumbum.
6. The glass of LCD contains plumbum, and the backlight lamp contains hydrargyru.
7. The lead in the battery is determined by the battery feature and technical levels.
8. The insulation monitoring device contains plumbum and PBDE.

About environment protection period: The environment protection period of the product is marked on the product. Under normal working conditions and normal use of the products observing relevant safety precautions, the hazardous substances in the product will not seriously affect the environment, personnel safety or property in the environment protection period starting from the manufacturing date.

About battery: The battery life is dependent on the ambient temperatire and charging/discharging times. The battery life will be shorted if the battery is used under high temperature or in deep discharging status. Refer to product manual for details.

Applicable scope: Liebert APM 600kVA UPS